Section V

Preferred Alternative and Its Consequences

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V. PREFERRED ALTERNATIVE AND ITS CONSEQUENCES

Preview of this Section

This section examines how authorized activities under the Preferred Alternative, including oil and gas exploration and development, may impact the environment in and surrounding the Northwest NPR-A Planning Area. The effects of non-oil and gas activities are also considered. A range of reasonably expected oil and gas exploration and development activities has been projected for this alternative (Section IV.A.1). The analyses in this section discuss the potential environmental consequences of the projected activities. The analyses focus first on the potential direct and indirect impacts that may result from the first oil and gas lease sale under the Preferred Alternative, then on the potential impacts of multiple lease sales that may be authorized based on this IAP/EIS.

After reading this section, you will understand the potential environmental consequences of activities projected to occur under the BLM's Preferred Alternative.

A. Overview Of the Preferred Alternative

Under the Preferred Alternative (Map 18), all BLM-administered lands within the Northwest NPR-A Planning Area would be made available for oil and gas leasing, although leasing would be deferred for 10 years on approximately 1,570,000 acres (about 17%) of the Planning Area in the vicinity of Wainwright. Within the deferral area, Kasegaluk Lagoon would be subject to a no-surface-occupancy stipulation. Outside the deferral area, additional no-surface-occupancy stipulations would be imposed along coastal areas, key rivers and deep water lakes. In total, these restrictions would apply to approximately 1,515,000 acres, which is about 16 percent of the total Planning Area. Stipulations and required operating procedures (ROP's) (Section II.C.6 and Table II-03) provide clearly defined setbacks, restrictions (including seasonal restrictions), and guidance for all aspects of oil and gas and related operations. How the Preferred Alternative was developed is discussed in Section VI.D .

The Preferred Alternative stipulations and ROP's would impose restrictions on the establishment of permanent or temporary facilities on all deep waterlakes (lakes with depths greater than 7 ft) and prohibit permanent facilities within ¼ mi of such lakes. No permanent facilities would be permitted in the streambeds of rivers. A no-permanent-surface-occupancy setback of ½ mi would be imposed on all major rivers (measured from the centerline of the river as determined by current hydrology at the time of application). Along rivers or river segments where subsistence concerns have been raised, setbacks for no surface occupancy increase to ¾ mi. Along the Colville and the upper Ikpikpuk rivers, a 1-mi setback for no surface occupancy would be imposed to protect important raptor habitat.

Along the entire coastal area of the Planning Area, permanent support facilities would be located at least ¾ mi inland from the coastline to the extent practicable. When technological limitations, economics, logistics or other factors require that a facility be located within ¾ mi inland of the coast, the practicality of locating the facility at previously occupied sites such as the former Cape Simpson, Peard Bay, or Wainwright DEW-line sites would be considered. Use of existing sites within ¾ mi of the coastline would also be acceptable where it is demonstrated that use of such sites would reduce impacts to shorelines or otherwise be environmentally preferable. All lessees/permittees involved in activities in the immediate area would be required to coordinate the use of sites with other prospective users.

On Dease Inlet, Admiralty Bay, Elson Lagoon, and associated barrier islands, the Preferred Alternative would allow oil and gas exploration activities to take place only between October 15 and May 15 of each year. Special stipulations would be imposed for exploration and development, including a setback ¾ mi from shoreline seaward and around natural islands (excluding the barrier islands) within which no development could occur on or under the water. Standards that would have to be met before authorization would be granted for permanent facilities within the setback area would be intentionally set high, with the burden of proof resting with the lessee to demonstrate that approval by BLM is warranted. These standards address specific concerns raised by the North Slope Borough, local communities and residents about conflicts between oil and gas activities and seasonal concentrations of fish, wildlife, and waterfowl that frequent the area; associated subsistence uses and access on these important water bodies; navigation hazards; spill response capabilities; and special consultation procedures.

Multi-year surveys would also be required on a Planning Area-wide basis to prevent the taking of spectacled and Steller's eiders, which are listed as a threatened species under the Endangered Species Act, and yellow-billed loons,a BLM-designated sensitive species (Appendix 16). The Preferred Alternative identifies special study areas for brant and caribou where multi-year studies would be required before the authorization of development activities. Within the brant study area, studies would be directed at preventing the loss or alteration of habitat or disturbance of nesting and brood-rearing areas as a result of oil and gas activities. Within the caribou study area, the focus would be on avoiding conflicts with caribou movement through insect-relief habitat.

Under the Preferred Alternative, the 102,000-acre area of Kasegaluk Lagoon would be recommended for designation as a Special Area and no-surface-occupancy stipulations would be imposed. Geophysical exploration within the Special Area would be allowed subject to applicable ROP's.

Overland travel and associated activities for permitted uses would be guided by specific ROP's. The Preferred Alternative would designate the Planning Area as Limited, confining recreational off-highway vehicle (OHV) use to winter use of snow machines and other low-ground-pressure vehicles. Within NPR-A, no summer recreational use of OHV's would be permitted. The summer use of OHV's--including all-terrain vehicles (ATV's) and airboats--to support traditional subsistence activities and access would be allowed. The use of airboats during the summer would be limited to streams, lakes, and estuaries that are seasonably accessible by motorboat. To prevent impacts to soils, water quality, vegetation, and wildlife (in particular nesting waterfowl), airboat use in areas of seasonal flooding of tundra and temporary shallow waters adjacent to streams, lakes, and estuaries would be prohibited. Under the Preferred Alternative, the lands along the Colville River area would be designated Visual Resource Management (VRM) Class I.

Identifed estuarine areas and lands along the 21 rivers eligible for designation as wild and scenic rivers would be designated VRM Class III (Map 23). These VRM classes apply to all lands within 3 mi of the banks of all identified water bodies. The remainder of the Planning Area would be designated VRM Class IV.

B. Environmental Consequences Of the Preferred Alternative

This section examines how authorized activities under the Preferred Alternative may impact other resources on BLM-managed lands in the Northwest NPR-A Planning Area. A range of reasonably expected oil and gas exploration and development activities has been projected for this alternative (Section IV.A.1). Activities associated with oil and gas exploration and development are described in Section IV.A.1.b. Activities other than oil and gas exploration and development are described in Section IV.A.1.a. The analyses in this section discuss the potential environmental consequences of the projected activities. The analyses focus first on the potential direct and indirect impacts that may result from the first oil and gas lease sale under the Preferred Alternative, then on the potential impacts of multiple lease sales that may be authorized based on this IAP/EIS.

This section on environmental consequences should be read together with Section II, which explains the alternatives, and Section III, which describes the important resources and their occurrence and status within the Planning Area. The analyses of environmental consequences in this section build upon and relate to information presented in these earlier sections to identify which resources may be impacted and how and where impacts might occur under the Preferred Alternative. The maps of the different land forms, species, and other resources of the Planning Area and the tables and figures presenting the activities projected in the scenarios are contained in Volume 3 of the Final IAP/EIS.

The stipulations and required operating procedures (ROP's) for the Preferred Alternative can be found in Section II.C.6 and Table II-03. The effectiveness of stipulations and ROP's is evaluated for each resource in the analysis section. A summary of the effectiveness of the stipulations and ROP's is provided in Appendix 12.

The conclusions on the impacts of the various alternatives are compared in Appendix 2. The overall impacts under each alternative are summarized in Section II.D.

1. Soils

a. Effects of Non-Oil and Gas Activities

The types of activities and associated impacts that may affect soils under the Preferred Alternative include ground-impacting aircraft use (landing and take-off), OHV use, and other surface activities. If during any land use the vegetative cover remains unaltered, 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 snow machine crossing of a drainage channel at the same site), damage to the soils could result. If the insulating vegetative cover is disturbed or the surface organic mat is removed or worn, soil erosion is likely to occur.

Generally, disturbance of vegetation alters the thermal balance, and those soils containing large amounts of ice may lose volume when there is thawing. Subsidence, thermokarsting, and gullying may follow. Removal of the surface organic mat exposes the mineral portion of the soils to erosive forces. Wind and water would transport sediment from these soils, and this sediment may be deposited in sensitive areas. Soil excavation and removal activities are estimated at no more than one acre annually under the Preferred Alternative. In these instances, such as archeological excavations, the impacts are local and probably not widely distributed. When warmed, dominantly ice-rich permafrost soils may slump and release melt water, which would pond. The ponded water may 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.

Effects would be similar to those evaluated under Vegetation (Section V.B.7).

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

Snow trails, ice roads, snow roads, ice pads and runways, and other similar transportation and storage structures have little effect on soils.

Seismic operations affect soils primarily through the action of on-the-ground travel. Fundamental to the protection of frozen soil is prevention of disturbance to the insulating vegetative layer. Any activity using heavy vehicles has the ability to depress the vegetative layer and reduce insulation. All vehicle use has the risk of removing the vegetative mat. During the summer months, when seasonal thaw occurs, soils may be more susceptible to disturbance, as the active layer may contain large amounts of melt water and the saturated soils may not be capable of resisting the forces of vehicle traffic. In areas such as the foothills--where soils are thin or soils are well drained, or vegetation is otherwise underlain by materials containing less water--vehicle travel has occurred in summer months with little disturbance. Generally, winter months--when soils are frozen (especially the seasonal thaw layer)--compose the only time period when when soils are capable of supporting the weight of heavy vehicles.

Holes that are dug in the earth for construction of well cellars affect soils for 16 ft^2 of ground (0.006 acres). Small amounts of soil disturbance and thermokarsting would likely occur. For the projected 7 to 30 exploration and delineation wells from the first lease sale (Table IV-05), this could result in the disturbance of up to 1 acre of soil.

Development requires a long-term commitment of resources. Disturbance of soils through burial or truncation usually is part of this commitment. 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 may 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 using design approaches to minimize the effect to the surrounding area. The amount of soil loss, based on the estimated areal extent of vegetation destruction, should be similar to that discussed under Vegetation (Section V.B.7).

Aspects of development that could impact soils (just as they might impact vegetation) include construction of gravel pads, roads, and airstrips; potential construction of a 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 footprint for the average, mid-sized oil field development in the Planning Area would cover a total of 100 acres of a combination of pads, roads, and airstrips. Under the Preferred Alternative, up to 4 fields would be developed following the first lease sale (Table IV-04), resulting in an impact of up to 400 acres of soils.

(b) Material Sites

Excavations of material sites for gravel fill would destroy soils over the area of the excavation and probably affect soils near stockpiled overburden. Following the assumptions made for vegetation, it is assumed that there would be one material site within the NPR-A for each oil/gas development, each with a surface disturbance of 20 to 50 acres (average 35 acres). Under the Preferred Alternative, soil disturbance of up to 140 acres is projected.

(c) Pipelines

Areas of disturbance for soils would be similar to the areas of disturbance described under Vegetation (Section V.B.7). The area disturbed by the drilling of holes for vertical support members (VSM's) for pipelines and the deposition of the resulting spoil would amount to 0.03 acre per pipeline mile, or up to 6.2 acres within the Planning Area under the Preferred Alternative. Impacts from the remainder of the transport pipeline as it extends east of the Planning Area are evaluated under the cumulative case.

Additional pipelines that could be placed on the original VSM assembly would not increase the amount of soil disturbance. Buried pipelines, a common construction method for gas pipelines, would cause a dramatic shift for disturbed soils. The result would be an impact area of up to 45 acres along the assumed 25-mi route within the Planning Area, as described under Vegetation (Section V.B.7). Soils thus disturbed in the northern part of the Planning Area are more likely to experience thermal degradation as a result. In this case, the soils might not be lost completely, but soil horizons as well as the thermal regime would be completely confused. Melting of ice in the soils would result and the filled area, normally mounded immediately after fill, would level over time as melt water migrates. Ponding could occur.

(2) Effects of Spills

Oil spills may impact soils 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 is more likely to damage soils. Cleanups are not always well controlled; heavy traffic and digging are common, resulting in damaged soils. Oil-spill cleanup mitigates impacts of the oil on soils only if cleanup methods and operations are very carefully controlled and minimize surface disturbance. The area affected is limited to that area immediately adjacent to and covered by the spill and the cleanup activities.

c. Effectiveness of Stipulations and Required Operating Procedures

ROP C-2, by limiting vehicle use to winter months, would protect soils in the Planning Area. Limiting vehicle use to winter months has proven valuable as a technique for the protection of soils.

The E series ROP's (primarily ROP's E-1, E-5, E-6, and E-8) involve the design and construction of facilities that can be important to soil management as they provide the opportunity for design elements that may reduce erosion. For example, techniques can be implemented to allow for maintaining natural drainages.

d. Conclusion--First Sale

Soil stability depends closely on vegetative cover; where vegetation is disturbed, impacts on soils follow. Impacts to vegetation from activities other than oil exploration and development under the Preferred Alternative would be minor to negligible (see Section V.B.7) and unlikely to cause loss of soils. Any impacts to soils would be expected to be negligible.

Winter exploration operations resulting from the first sale would be unlikely to cause loss of soils. Well drilling would result in up to 1 acre of soils lost or disturbed from well cellars. Any impacts to soils would be expected to be minor to negligible.

Development resulting from the first sale would cause loss or disturbance to soils through the construction of gravel pads, roads and airstrips for each oil/gas development, excavation of material sites, and construction of pipelines. The combined effect of these activities would cause the loss or disturbance of up to 600 acres of soils. The duration of these impacts would be permanent. Oil spills would affect soils over an area similar to the area of vegetation affected (Section V.B.7), up to 5 acres within the Planning Area. Spills would be cleaned up immediately, causing minimal disturbance to soils.

Under the Preferred Alternative, the impacts to soils would be minor to low.

e. Multiple Sales

It is assumed that multiple sales under the Preferred Alternative would result in additional exploration activities. The annual level of seismic operations is assumed to stay the same. The number of exploratory and delineation wells is projected to be 21 to 72 wells (Table IV-07) drilled from ice pads, resulting in up to 1 acre of soils lost or disturbed from well cellars.

The multiple sales scenario assumes that up to 8 fields would be developed (Table IV-06). Because lost or disturbed soil follows direct impacts to vegetation, soil loss or disturbance would also be up to 1,530 acres (Section V.B.7). Soil loss or disturbance from material sites would increase to up to 350 acres. A projected 295 mi of VSM-supported pipelines would result in up to 9 acres of lost or disturbed soils. A buried pipeline might result in 90 acres of lost or disturbed soils. The incidences of spills would remain the same with the total acreage affected being up to 5 acres.

f. Conclusion--Multiple Sales

Soil stability depends closely on vegetative cover; where vegetation is disturbed, impacts on soils follow. Under

the Preferred Alternative, a range of area activities based on the price of oil and the probabilities of exploration and development is assumed. Although little impact to soils is expected from exploration activities, the impacts to soils from development activity under the Preferred Alternative would involve either disturbance or loss of relatively small- to moderate-sized areas. The duration of these impacts may range from several years, if the vegetation is disturbed, up to several decades if the soils are disrupted. The overall impact to soils of the Northwest NPR-A Planning Area would be negligible (with seismic) to moderate (with development).

2. Paleontological Resources

a. Effects of Non-Oil and Gas Activities

Under the Preferred Alternative, some paleontological research and excavation would be conducted annually by permit within the Northwest NPR-A Planning Area. While excavation is a destructive activity, it is necessary for the recovery of scientific data. Excavation and collection normally occur during the summer. Excavation may also be done for geological and archaeological research. Geological and archaeological researchers are trained to recognize and properly deal with 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 remains 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 belonging to the regional paleontological record.

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

b. Effects of Oil and Gas Activities

Because seismic data gathering activity is permitted only during the winter using low-ground-pressure vehicles such as Rolligons (ROP C-2 a, c, and d), there is little chance that significant impacts to paleontological deposits could occur. Although a remote possibility, some impact to paleontological resources could occur along stream-bank exposures from the passage of vehicles. In such cases, impact would be isolated and minimal.

It is worth noting that paleontological resources are not ubiquitous in the Planning Area as are habitat and wildlife. As a result, it is quite possible that oil and gas exploration or development activities would have no impact on paleontological resources simply because oil and gas operations would occur where paleontological resources are not present.

(1) Effects of Disturbances

As previously mentioned, because most of the activity would occur during the winter months, the potential for impact to buried paleontological resources remains relatively low. The likelihood of impacting surface paleontological materials is also low because of their isolated and rare occurrence and because of stipulations governing oil and gas exploration activity.

Although the drilling of between 5 and 12 exploration wells and 2 to 18 delineation wells could occur under the Preferred Alternative (Table IV-05), because of the limited availability of drill rigs, no more than a few wells are expected to be drilled at one time. If 7 to 30 wells were to be drilled, drilling would certainly 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 for exploratory drilling and, therefore, no gravel or rock needed, no significant disturbance of the ground would occur and buried paleontological resources would not be in jeopardy. The only significant subsurface disturbance that would occur as a result of exploratory drilling would be the creation of the drill hole itself. It is possible that drilling the hole could impact important accessible paleontological material, but the likelihood of that occurrence is minuscule.

The effects of disturbance from development; i.e. the construction of up to 6 production pads (connected by roads), an airstrip, a pump station, a staging base, and up to 205 mi of pipeline could occur under the Preferred Alternative. Surface disturbance resulting from this work would impact approximately 150 acres, but there would be little subsurface impact associated with these activities. The primary source of potential impacts to paleontological resources would result from the excavation of material for construction of the permanent facilities. If the pads/roads/airstrip material source is terrestrial, then extraction of material could impact paleontological resources. The extent of the impact would be dependent on the amount of gravel extracted, the areal characteristics of the material source and the identified presence of paleontological remains. For this analysis it is assumed that pipelines would not have associated all-weather roads or pads and would be constructed during the winter months from an ice road and/or 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 buried paleontological resources would be impacted. If buried pipelines were to be used, disturbance and impacts to paleontological resources could occur during excavation, construction and burial, depending on the depth, size, and location of the pipeline. The potential for impacts to surface paleontological resources under this alternative has been previously discussed.

(2) Effects of Spills

An estimated 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. In the exploration stage, 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 subsequent spill cleanup. The effects of spills and spill cleanup associated with development would be similar to those associated with exploration activities except that they could occur during the snow-free months. Although cleanup from these spills might be more invasive because of the non-frozen surface environment, there is little chance that subsurface paleontological resources would be impacted. If present, surface paleontological remains could be impacted in the same manner as surface cultural material. However, since the occurrence of significant surface paleontological remains are far less common than cultural remains, the probability of any impact is remote.

c. Effectiveness of Stipulations and Required Operating Procedures

Under the Preferred Alternative, ROP C-2a, c, and e bear on paleontological resources. This ROP provides protection from seismic and overland move activities that could potentially disturb the vegetative mat and impact paleontological resources that are near the surface. In addition, ROP's A-3 and A-4 b, c, d and f help to prevent large fuel or crude-oil spills, and consequently reduce the small potential for impacts to paleontological resources from spill cleanup. Stipulations K-1 and K-6 provide ½-, ¾-, and 1-mi setbacks along the major rivers and streams and a ¾-mi setback along the coast providing additional protection for paleontological resources. The

NHPA requires that an archaeological resource survey be completed before any undertaking occurs on Federal lands. Ground disturbing activities such as the construction of buried pipelines are considered undertakings. If paleontological resources are identified during such a survey, BLM guidelines and policy require that all impacts to these resources be mitigated to the satisfaction of the land manager and the State Historic Preservation Office.

Additionally, it should be noted that any post-leasing ground-disturbing activity engaged in by a lessee would require another NEPA review tiered off this or other EIS's. In that event, the protection of paleontological resources in the Planning Area would follow the established and proven permitting procedures developed by the BLM as the result of past NPR-A activities.

d. Conclusion--First Sale

Under the Preferred Alternative, impacts to paleontological resources from management activities other than oil and gas exploration and development would be as previously stated. Impacts would include displacement and/or destruction of resources and are anticipated to be minimal regardless of the level of seismic activity. Under the Preferred Alternative, the potential impacts to paleontological resources from first sale oil and gas exploration and development would probably be minor because of the environmental constraints that would be in effect. These constraints would benefit paleontological resources because of the high probability of paleontological resources being located near lakes, streams, and rivers, which are afforded more protection from oil and gas exploration under Stipulation E-1.

e. Multiple Sales

Under the Preferred Alternative multiple-sales scenario, the potential for impacts to paleontological resources would continue to be relatively low. Although the scattered nature and deeply buried context of most 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, the environmental protection measures under the the Preferred Alternative are expected to significantly reduce the probability of any potential impacts.

f. Conclusion--Multiple Sales

Under the Preferred Alternative multiple-sales scenario, potential impacts to paleontological resources from management activities other than oil and gas exploration and development would be as previously described for the single-sale scenario. Overall, the probability of the occurrence of impacts would increase somewhat, simply because multiple sales would increase the amount of land that could potentially be impacted.

3. Water Resources

a. Effects of Non-Oil and Gas Activities

Non-oil and gas management actions within the Planning Area that may affect water resources include ground activities such as resource inventories, paleontological and cultural excavations, and research and recreational camps—all of which might occur during summer or early fall. The other principal activity is overland equipment

movement, which occurs during the winter on snow-covered, frozen tundra. Negligible impacts to water resources would occur, as discussed in Section IV.B.3.a.

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

Under the Preferred Alternative, seismic survey activities probably would double (Sec. IV.A.1.b(3)(b)) compared to that expected under the No Action Alternative, but these activities still would occur seasonally at transitory locations when the tundra is snow covered and lakes and rivers are frozen. As noted under the No Action Alternative (Section IV.B.3.b), modern seismic lines, with newer, low-ground-pressure equipment, have much lower impacts to the tundra than the older, outdated types, but impacts still could occur during the camp-move (WesternGeco, 2003). While extensive thermokarst erosion along recent winter seismic trails is seldom observed, impacts to vegetation and surficial compaction (precursors to thermokarst and water diversions) can still be found (Jorgenson et al., 2003). Adequate protection of the tundra requires a uniformly distributed snow pack with a hard surface crust. Often, the less than ideal snow conditions on the north slope, particularly where the snow pack is influenced by wind scour and drift, could expose tussock tundra to surface disturbance (Walker et al., 1987). Varying levels of disturbance have been documented even where the snow depth exceeded 2 ft (Felix and Raynolds, 1989).

While observations by the BLM and others (NRC, 2003) indicate that short-term, transitory impacts such as surficial compaction, diversions of shallow water tracks and limited ponding, can be estimated at about 1 percent of the proposed seismic lines per season (see seismic scenario in Sec. IV.A.1.b(3)(b)), newer, low-ground-pressure equipment could reduce this to about 8 acres under the Preferred Alternative. Since the tundra vegetative mat has been shown to recover in from 7 to 10 years where damage is not severe (Abele et al., 1984; Jorgenson et al., 2003), long-term impacts due to thermokarst erosion--such as permanent diversions of shallow-water tracks and extensive ponding--are estimated at only about 1 percent of the short-term impacts, or less than a tenth of an acre affected by seismic operations. These impacts are strongly influenced by snow depth and distribution, as noted above, and may only happen when seismic activities occur under less than ideal snow conditions (NRC, 2003). Where subsidence and thermokarst erosion do occur, it could take from several years to several decades for the effects to be ameliorated (Walker et al., 1987).

Because the projected exploratory drilling occurs during the winter (Section IV.A.1.b), 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 2 million gallons per pad. Water supply for drilling as well as for camp use also would be significant--up to 1.6 million gallons per site (Section IV.A.1.b). The estimated total winter water pumpage for the levels of activities (Section IV.A.1.b) under the Preferred Alternative could be up to 295 million gallons, or the equivalent of 905 acre/ft. While there are a multitude of lakes on the coastal plain of the Planning Area, many of these lakes are shallow and most either freeze solid or have very limited free water during the winter when exploration takes place (Sloan, 1987). Based on remote sensing (Mellor, 1987) and other surveys, a typical large tundra lake (about a mile or more in length and 8 to 10 ft deep) used as a winter water source could have from less than 10 acre/ft to more than 100 acre/ft of water available for pumping. ROP B-2 under the Preferred Alternative would limit water withdrawal to 15 percent of the under-ice water volume on fish-bearing lakes and would prohibit water withdrawal from riverine pools during winter (Section II.C.6). Depending on the areas leased and number of exploratory wells drilled, annual water usage for exploration under the Preferred Alternative could require pumping water from as few as 9 to as many as 90 or more lakes during a winter's exploration season. If more than 15 percent of the under-ice water volume is removed, then fewer lakes would be required, but less of the critical over-wintering habitat would remain in the pumped lakes.

Removal or compaction of snow cover can increase the depth of freezing, often a foot or more, greatly reducing the water quantity within a lake or river pool. Since the ice thickness may approach 7 ft on undisturbed lakes, significant amounts of additional water would be lost as the ice thickness increases from snow compaction or clearing. Altering travel to avoid crossing or clearing deep lakes and augmenting snow cover by using snow fences would reduce ice buildup on lakes and rivers, and melted snow could be used in camps and for drilling. 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 lakes and ponds that normally would freeze to the bottom are the best source for this ice aggregate. Taking aggregate from the frozen areas of deep lakes could increase the ice thickness of the unfrozen area, reducing marginal aquatic habitat.

After each season of use, ice roads are abandoned and allowed to melt when spring snowmelt begins. Ice ramps or bridges that cross streams or lakes should be removed or breached before spring breakup. While some ponding might occur during a rapid onset of snowmelt, melt-water channels, similar to the spring breakup channels that cut through naturally occurring river aufeis (overflow icing), would develop in the ice-road surface and rapidly drain the impounded water (Sloan et al., 1975). If the location of ice roads is offset from year to year, the effects of these short-term impoundments should be negligible. Ice roads and pads 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 subsidence and subsequent drainage alteration, multiple-year ice roads should be avoided. Multiple-year ice pads show fewer impacts, since their limited size results in less disruption of flow and subsequent ponding, so effects are usually limited to some vegetative impacts around the margins. These effects are discussed further in the vegetation section.

Overland ice-road construction becomes impractical over 50 mi. Due to the relatively short length of the winter season for construction and drilling, overland moves using low-ground-pressure vehicles and trailers (Rolligons) can be used to haul drilling rigs to ice pads without an ice road. In some cases, where distances are too great for drilling to be completed in one season, the ice pad is insulated and the drill rig stored over the summer. In these cases, the amount of water required is greatly reduced. However, hauling heavy loads on snow roads may adversely impact the tundra and stream and lake crossings.

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 mud pits may be allowed by the AO. If mud and cuttings are stored on the surface, sediments and other contaminants could be flushed into the watershed. Requiring that wastes be stored in lined and bermed areas and disposed of before spring breakup, however, would reduce the potential for this.

The projected oil and gas development activities would involve constructing ice roads to haul equipment and gravel for the construction of production pads, connecting roads, and landing strips. 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.

(a) Thermokarst

Thermokarst refers to ground subsidence that occurs when the removal or compaction of surface cover exposes ice-rich permafrost to a higher temperature regime and subsequent melting. The depth of subsidence is a function of the relative amount of ice present, the sub-surface materials, and topography (Lawson, 1986). Since fine-grained sediments are easily erodable, as well as the most likely to contain ice-rich permafrost, stream banks and lakeshores are often particularly vulnerable to thermokarst. With the exception of the Colville River, most of the streams and lakes in the Planning Area have banks or shorelines that consist largely of fine-grained sediments.

While a large number of activities have been linked to disturbances that result in thermokarst, limiting surface-disturbing activities to the winter greatly reduces the amount of thermokarst (Walker, 1987).

(b) 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, especially culverts blocked by snow and ice, can result in seasonal or permanent impoundments (NRC, 2003). The resulting inundation often negatively impacts the vegetation and, combined with dust blown from gravel roads and pads, can alter the thermal regime and lead to thermokarst (Walker, 1987). 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, surface pipelines, and other structures, as well as keeping culverts free of snow and ice dams, would greatly minimize drainage problems.

(c) Erosion and Sedimentation

In addition to thermokarst and drainage alteration, erosion and sedimentation can be caused by construction or other activities that disturb the streambed and stream banks, or remove protective shoreline vegetation. Channelized meltwater can erode gullies--even in areas with limited slope--and deposit alluvial fans into streams and lakes (Lawson, 1986). 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. Blockages or diversions due to insufficient flow capacity, especially culverts blocked by snow and ice, can lead to road washouts, a common occurrence on the Dalton Highway during breakup flooding. Winter or low-water construction and transport activities, adequate armoring of fill, and keeping culverts free of snow and ice dams would minimize erosion and sedimentation (Walker, 1987).

(d) 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 development wells drilled, annual water usage for development activities under the Preferred Alternative would vary considerably. Because of the continued need for ice roads, annual water use during development could be similar to that for exploration, requiring water from at least 9 to as many as 90 or more lakes, assuming the drawdown limit of 15 percent of the under-ice water depth that would be required by ROP B-2. If more than 15 percent is removed, then fewer lakes would be required, but less of the critical over-wintering habitat would remain in the pumped lakes. Removal or compaction of snow cover 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 for camps and drilling (Sloan, 1987).

(e) Gravel Removal

While some of the gravel used for the construction of permanent facilities may be obtained from permitted sites outside of the Planning Area, some material sites would 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 channel braiding and erosion from breakup or storm flooding would greatly minimize impacts (NRC, 2003). Deep pits can be flooded after abandonment to create aquatic habitat. While gravel sources are scarce in the Planning Area, sand and silt are abundant. Composite or "all season" pad designs, using a mixture of gravel, sand, and silt layered with insulation and geotextiles can reduce gravel requirements significantly (Section IV.A.1.b).

Gravel construction of pads, roads, and an airstrip would cover about a 100-acre footprint per field, or a total of 400 acres for the four fields proposed under the Preferred Alternative. In the coastal plain of the North Slope where low surface gradients limit flow and permafrost is ubiquitous, gravel pad and road construction can create significant water impoundments and thermokarst erosion equivalent to twice the area directly covered by the gravel (Walker, 1987), or up to 800 acres. It is possible that a dock and staging areas would also be built under the Preferred Alternative. This could substantially increase the gravel requirement--depending on the size and number of pads and type of structures required--up to 100 acres per site. Borrow pits created by gravel mining could impound or divert water from an area of 20 to 50 acres per site, or from 80 to 400 acres total under the Preferred Alternative. Unlike the ice roads and pads, gravel structures and pits would create long-term impacts over the life of the field(s).

(f) Pipelines

If oil pipelines result from development under the Preferred Alternative, they could range up to 205 mi in total length and affect up to 500 acres of water resources, primarily through temporary impoundments, diversions, and sedimentation during the construction phase. After construction is complete, impacts from elevated pipelines are expected to be minimal. If gas pipelines are also constructed, potential impacts during construction could double--up to 1,000 acres--again primarily through temporary impoundments, diversions, and sedimentation during construction. Buried gas lines also have potential thermokarst, subsidence, and erosion problems that could persist beyond the construction phase. If all work on the pipelines is done during winter, these impacts would be greatly reduced.

(2) Effects of Spills

For the projected 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 the Preferred 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 would help ensure that the size of any area affected by a spill is small and cleanup efforts kept to a minimum. A large crude-oil spill is possible with production operations and pipelines and could adversely affect streams and lakes. While the petroleum residue from a spill could be flushed from streams within a few years, impacts to lakes and ponds could persist for decades. Spill cleanup in a 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. While this methodology is effective during the summer, when open water is present, or during the winter when lakes and rivers are frozen, streamflow conditions during spring breakup or fall freezeup--when ice floes and ice dams can alter normal flow patterns--could greatly complicate cleanup operations. 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, the impacts would be greater, with waters remaining toxic to sensitive species for several years. These spills could be pumped out of the water body, if confined, or neutralized and then diluted

with uncontaminated freshwater.

c. Effectiveness of Stipulations and Required Operating Procedures

Several stipulations and ROP's would protect water resources under the Preferred Alternative. ROP's A-1 through A-7 would regulate garbage, wastewater, drilling wastes, fuel, and chemical storage; fuel handling; and spill prevention and cleanup plans. ROP B-1 prohibits water withdrawal from rivers during winter and ROP B-2 regulates amounts of winter water withdrawals from lakes. ROP's C-2 through C-4 would regulate overland moves, seismic work, ice-road construction, and other heavy equipment travel during the winter to limit impacts to water resources. ROP D-1 would limit exploratory drilling in shallow lakes, streams, and floodplains, but does allow exceptions if there is no feasible or prudent alternative. ROP's E-2, E-3, E-6, and E-8 would limit certain facility, structure, and gravel mine site design and construction impacts near lakes and rivers, but does allow exceptions if there is no feasible or prudent alternative. Stipulation G-1 may require removal and reclamation of the developed site(s) upon field abandonment, which would eventually result in restoration of the natural drainage. Stipulation K-1 would protect aquatic, floodplain and riparian areas adjacent to rivers identified as having critical aquatic and riparian habitat, except in certain situations. Where the floodplain width exceeds the setback limit as measured from the centerline of the river (primarily in the lower reaches of the Meade and Ikpikpuk rivers), development could occur in the active floodplain. Stipulation K-2 should protect aquatic and riparian areas adjacent to deep-water lakes, but does allow exceptions if there is no feasible or prudent alternative.

d. 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 the No Action Alternative, i.e., little, if any, impacts would occur. The most significant impacts of oil and gas development activities on the water resources in the Planning Area are from gravel roads, pads, and structures. These include disturbance of stream banks or shorelines and subsequent melting of permafrost (thermokarst) and blockages of natural channels and floodways that disrupt drainage patterns. While no long-term studies are available on the areas adjacent to NPR-A, a study of the impacts of oil-field activities in the Prudhoe Bay area (Walker, 1987) found that after 15 years, those areas adjacent to the road system still showed an increase in thermokarst growth and that flooding from impoundments and diversions was more than double that of the primary impact of gravel placement. Bridges are the preferred mode of stream crossings where water depths and flows during spring breakup are sufficient to cause ice floes and dams that alter normal flow patterns and block culverts. Since roads pose the single most significant impact (from thermokarst, impoundments, and increased sediment runoff), limiting the length of the roads would bring about the greatest single reduction in impacts to the water resources.

The potential short-term impacts from exploration and delineation would be water removal from up to 90 lakes, and during construction, increased water impoundments, diversions, thermokarst erosion and sedimentation of up to 2,000 acres. Long-term impacts from development of gravel roads, pads and pits could impact up to 1,000 acres. Pipelines--both above-ground oil pipelines (not including infield lines) and buried gas pipelines--could add up to an additional 1,000 acres of short term-impacts. After construction is complete, impacts from elevated pipelines should be minimal. Buried gas lines also have potential thermokarst, subsidence, and erosion problems that could persist beyond the construction phase, or about 500 acres of long-term impacts. If all work on gravel roads, pads, and pipelines were to be done during winter, impacts could be reduced. While any surface-disturbing activity could affect water resources, the stipulations and ROP's under the Preferred Alternative would protect most areas identified as critical aquatic habitat adjacent to streams and lakes, regulate under-ice water withdrawals, and prohibit unnecessary snow and ice removal from lakes and riverine pools.

The overall impact to water resources under the Preferred Alternative would be about 3,000 acres of short-term impacts and 1,500 acres of long-term impacts.

e. Multiple Sales

While oil and gas exploration and development activities from multiple lease sales may be up to several times greater than a single sale, impacts would not necessarily go up proportionally, since some facilities, such as roads, airstrips, and pipelines can be shared. Indirect impacts, such as thermokarst and erosion and sedimentation due to channel alteration or gravel removal, may continue for many years after the original development (Walker, 1987). While difficult to quantify, effects from multiple sales under the Preferred Alternative are assumed to be double those from a single sale. This could result in short-term impacts from winter water withdrawals of up to 1,800 acre/ft from 180 lakes during exploration and delineation drilling and from increased water impoundments, diversions, thermokarst erosion and sedimentation of up to 4,000 acres during construction activities. Long-term effects from development of gravel roads, pads, and pits could impact up to 2,000 acres from water impoundments, diversions, and thermokarst erosion.

Shared use of infrastructure such as airfields, roads, camps, and pipelines would significantly reduce the size of the impacted areas and adverse effects to the water resources. Since roads pose the single most significant impact (from diversions, impoundments, and increased sediments runoff), limiting the length of the roads would bring about the greatest reduction in impacts to the water resources. Bridges are the preferred mode of stream crossings where water depths and flows during spring breakup are sufficient to cause ice floes and dams that alter normal flow patterns and block culverts. If all work on gravel roads, pads, and pipelines were to be done during winter, impacts could be reduced. Where infrastructure is not shared, both long- and short-term impacts as noted above, and recovery times would increase.

f. Conclusion--Multiple Sales

Adverse impacts from multiple lease sales may be up to several times greater than impacts from a single sale, while indirect impacts may take years to develop. While shared infrastructure could reduce the adverse effects to water resources from multiple sales, short-term impacts include water removal of up to 1,800 acre/ft from 180 lakes in support of exploration and delineation drilling, and increased water impoundments, diversions, thermokarst erosion, and sedimentation of up to 4,000 acres in support of construction activities. Long-term impacts from development of gravel roads, pads, and pits could impact up to 2,000 acres of water resources from water impoundments, diversions, and thermokarst erosion. The area affected would depend on the number of leases issued, the amount of exploratory and development activity, and the locations of this activity.

4. Freshwater Quality

a. Effects of Non-Oil and Gas Activities

The only types of non-oil and gas activities in the Northwest NPR-A Planning Area that might affect freshwater quality are ongoing subsistence and recreational activities, primarily along rivers and lakes in the Arctic Coastal Plain (ACP). Although these activities have involved unregulated long-term campsites and cabins (all without adequate sewage disposal), adverse effects on freshwater quality appear to have been negligible.

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

Exploration activities within the Planning Area that may affect water quality under the Preferred Alternative are seismic survey activities, ice-road construction, ice-pad construction, and drilling-fluid storage and disposal. Spillage of crude oil or produced waters is attributed predominantly to development activities.

Under the Preferred Alternative, the estimated level of seismic survey activities probably would double (Section IV.A.1.b) relative to that expected under the No Action Alternative. Seismic operations would start in late fall or early winter after the top foot of the active layer freezes, at least 6 in of snow cover builds up, and lakes and rivers freeze.

As discussed under the No Action Alternative (Section IV.B.4.b), damage to the vegetative mat would most likely occur in tussock tundra and moist sedge-shrub tundra, especially in areas with limited snow cover, but probably not in lower, moist sedge vegetation. While extensive thermokarst erosion along recent winter seismic trails is seldom observed, impacts to vegetation and surficial compaction (precursors to thermokarst erosion) are still in evidence (Jorgenson et al. 2003). Where surface disturbance does occur, recovery of damaged seismic tracks takes many years (Walker et al., 1987). Thermokarst erosion and effects on water quality could occur in high impact areas if damage to the vegetative mat is persistent. Recovery of vegetative mat damaged during seismic activities, which is necessary to improve water quality impacts, could take from a few years to decades (Walker et al., 1987).

While the National Research Council (NRC, 2003) and others have indicated that short-term impacts such as compaction of the vegetative mat, diversions of shallow water tracks, and limited ponding can be estimated at about 1 percent of the proposed seismic lines per season (Section IV.A.1.b), newer low-ground-pressure equipment could reduce this significantly, to a total of about 8 acres under the Preferred Alternative. If it is assumed that 1 percent of the persistent high damage area results in thermokarst erosion, then less than about 0.1 acre would be affected. Persistent thaw settlement and thermokarst erosion can also result in the State turbidity standard being exceeded. This would be confined to rare cases over small areas, likely on the order of no more than a fraction of an acre. Total long-term impacts, including downstream water quality, would perhaps include up to twice this area, with the total area affected still being less than an acre.

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 ways would be short term, lasting generally one season in any area.

First, the winter extraction of water or ice from Northwest NPR-A waters could change the chemistry of those waters. Ice roads would require 1.0 to 1.5 million gallons per mile of road and 50 mi or more of ice roads are projected funder the Preferred Alternative. 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, therefore water would have to come from deeper lakes. Lakes less than 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 most of the extraction being the water that still remains unfrozen by December in a 6-ft deep lake. Water could be extracted from deeper lakes, but these lakes are likely to contain fish that would be put at risk from water removal. Under the Preferred Alternative, the amount of water that could be removed from fish-bearing lakes is limited by Stipulation K-2.

As surface waters freeze, salts are extruded 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, less saline, less alkaline runoff water would replace the removed waters. In lakes less than 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 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. Based on observed lake pH, these lakes are weakly--but still apparently adequately--buffered against acid snowmelt (Section III.A.2.b).

In lakes greater than 6 ft deep, the salts and alkalinity extruded during ice formation normally would remain in the unfrozen 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 less than 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 just 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 (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 before 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 in. Snowdrifts against the low-relief roadbed would extend a few feet beyond the roadbed with average water content of a fraction of an inch. However, the 6-in 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 and despite drainage culverts, the area affected by impoundments (ponding) and thermokarst along gravel roads and pads was equal to twice the area covered by the pads and roads. Ice roads can persist through a considerable portion of the snowmelt period, for as much as a month. However, their ability to impound upslope waters is negligible and any impoundments only last a few days. Because the 6-in thickness of ice roads is 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 up to 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, 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.

Annual ice-road and ice-pad construction could cover from 160 up to 320 acres during each year of exploration. This ice-road construction would require winter extraction of water up to 225 million gallons, or the equivalent of 690 acre/ft pumped from nearby lakes. Drilling and camp needs together would require up to an additional 70 million gallons, or the equivalent of 215 acre/ft. 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 with little 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 would be prohibited. This analysis assumes direct reinjection of drilling fluids. Under this scenario, there likely would 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 the A.O. 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 in bioassays to be toxic to a sensitive zooplankton species. Spread of contaminants from these reserve pits was due 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 before spring breakup.

Development activities within the Planning Area that may affect water quality under Preferred Alternative for the high-resource scenario are ice-road and pad construction and spills. There would 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 would be either disposed of downhole or removed from public lands to ADEC-approved waste-disposal facilities. Produced waters would be reinjected. Some washed cuttings could be used in gravel-road or pad construction. Pipelines carrying crude oil or waterflood would be above ground, and their construction and physical presence would have a negligible affect on water quality.

Because of the annual rebuilding of ice roads, annual water use during development would be similar to that for

exploration, needing water to construct up to 320 acres of ice road. Winter water withdrawals could be up to 905 acre/ft from nearby lakes. During the seasonal construction phase, annual field-water demand would be on the order of 37 acre/ft. After major construction is finished, annual field-water demand would decrease to about 15 acre/ft/year. Some of this water likely would come from lakes less than 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.

Construction of gravel pads and within-field roads with an airstrip would cover about a 100-acre footprint for a single field and require a million cubic yards of gravel. A total of up to 400 acres could be impacted for the four fields proposed under the Preferred Alternative. It is possible that a dock and staging areas would also be built under Preferred Alternative. This could substantially increase the gravel requirement--depending on the size and number of pads and type of structures required--up to 100 acres per site. 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 too many years to refill. Dredging increased upriver bottom erosion by increasing the steepness of river slopes in the Colville River, but the primary environmental effect attributed to NSB dredging has been expansion of fish overwintering areas. Water quality, as evidenced by the healthy fish populations, does not appear to be adversely affected by this dredging activity (Walker, 1994). Borrow pits created by gravel mining could impound or divert water from an area of 20 to 50 acres per site, or from 80 to 400 acres total under the Preferred Alternative. Because gravel is a scarce commodity, alternate construction technology could be refined to lessen gravel use and associated impacts, but such alternatives are not assumed.

The primary effect on water quality 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 the No Action Alternative. 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 1,000 acres for the development assumptions made in this alternative. 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 from upslope impoundment is possible, spring snowmelt generally is expected to be in excess of watershed dead storage in coastal tundra and would limit the effect of downslope drying on water quality. Snowdrifts develop on the sides of elevated roads, which also limits 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 practice 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. Where water depths and flows are sufficient to create significant ice jams upstream of the stream crossing, bridges would be preferable to culverts. In flatter tundra, single culverts are spaced at intervals to limit ponding of sheet flow during breakup.

If oil pipelines result from the development under the Preferred Alternative, they could range up to 205 mi in length and affect from up to 500 acres of water resources, primarily through temporary impoundments, diversions, and sedimentation during the construction phase. After construction is complete, impacts from elevated pipelines should be minimal. If gas pipelines are also constructed, potential impacts during construction could double--up to 1,000 acres--again primarily through temporary impoundments, diversions, and sedimentation during construction. Buried gas lines also have potential thermokarst, subsidence, and erosion problems that could persist beyond the construction phase. If all work on the pipelines is done during winter, these impacts would be greatly reduced.

(2) Effects of Spills

Spills are another impacting agent on water quality. A number of small crude spills (0 to 130) averaging 3 bbl and smaller fuel spills (0 to 323) averaging 0.7 bbl are projected to occur onshore (See Table IV-17). Roughly 65 to 80 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 before 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 could be reasonably anticipated to reach tundra waters. This calculation results in an estimate of up to 10 spills, averaging 3 bbl, reaching tundra waters.

Dissolved-oxygen concentrations in tundra waters could be affected by spilled oil in summer. In one NPR-A experiment (*Northeast NPR-A Final IAP/EIS*, USDOI, BLM and MMS, 1998: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 the 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 the 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) was 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 because sediment (and water column) respiration rates are negligible. In addition, sediment respiration has even less 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 (*Northeast NRP-A Final IAP/ EIS*, USDOI, BLM and MMS, 1998: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 in 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 an actual spill event, 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.

As discussed in the *Northeast NPR-A IAP/EIS* (USDOI, BLM and MMS, 1998), the effects of a 325-bbl spill reaching the Colville River and Teshekpuk Lake in summer were analyzed and that discussion is hereby incorporated by reference. In the Colville River, 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. Similar effects would be expected in the unlikely event that an oil spill were to reach any of the rivers in the Northwest NPR-A.

As noted in the *Northeast NPR-A IAP/EIS* (USDOI, BLM and MMS, 1998), a similar oil 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. Similar effects would be expected to any of the lakes in the Planning Area, if an oil spill were to occur.

Applicable ambient-water-quality standards for surface and ground 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 surface 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 locally and marginally at toxic levels. Effects of spills less than 1,000 bbl can be considered negligible. A spill greater than or equal to 1,000 bbl could temporarily (for about a month) contaminate water above the chronic criterion of 0.015 ppm in an area of a few hundreds of square miles. Concentrations above the 1.5-ppm acute criterion could occur over a few tens of square miles during the first several days of such a spill.

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

- total dissolved solids or salinity from exceeding 1,500 mg/l (1.5 % salinity), including natural conditions; and
- 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 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 less than 6 ft deep freeze solid (Hobbie, 1984). In the event of a saltwater spill into such waters, the remaining salt from the spill water would be extruded 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 greater than 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. 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 (*Northeast NPR-A Final IAP/ EIS*, USDOI, BLM and MMS, 1998:Sec. IV.A.1.b and Table IV.A.1.b-3). If a spill were to result 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 gallons. 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 gallons/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.

(3) Summary

Primary affecting factors on water quality under the Preferred Alternative are water extraction, water impoundment, thermokarst around structures and roads, and spillage of oil and salt water.

During exploration, annual ice-pad and -road construction (320-acre footprint each year), drilling, and domestic needs for water could require winter extraction of unfrozen water from up to 905 acre/ft of nearby lakes. Most of this water use is for ice roads. If exploration continues more than 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 320 acres of ice road, requiring water withdrawals from up to 905 acre/ft of nearby lakes. During the seasonal construction phase, annual field-water demand would be on the order of 37 acre/ft. After major construction is finished, annual field-water demand would decrease to about 15 acre/ft/yr. 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 up to 1,000 acres for development. Unlike the situation for ice structures, the same 1,000 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 nearby rivers, such as the Colville or Ikpikpuk rivers. The spreading of a similar-sized (325 bbl) spill over about 60 acres of nearby lakes for a few weeks could be considered an effect on water quality.

c. Effectiveness of Stipulations and Required Operating Procedures

Several stipulations and ROP's would protect water quality under the Preferred Alternative. ROP's A-1 through A-7 would regulate garbage, wastewater, drilling wastes, fuel and chemical storage, fuel handling, and spill prevention and cleanup plans. ROP B-1 would prohibit water withdrawal from rivers during winter and ROP B-2 would regulate amounts of winter water withdrawals from lakes. ROP's C-2 through C-4 would regulate overland moves, seismic work, ice-road construction, and other heavy equipment travel during the winter to limit impacts to water resources. ROP D-1 would limit exploratory drilling in shallow lakes, streams, and floodplains, but would allow exceptions if there were no feasible or prudent alternative. ROP's E-2, E-3, E-6, and E-8 would limit certain facility, structure, and gravel mine site design and construction impacts near lakes and rivers, but would allow exceptions if there were no feasible or prudent alternative. Stipulation G-1 may require removal and reclamation of the developed site(s) upon field abandonment, which would eventually result in restoration of the natural drainage. Stipulation K-1 should protect aquatic, floodplain and riparian areas adjacent to rivers identified as having critical aquatic and riparian habitat, except in certain large rivers. Where the floodplain width exceeds the setback limit as measured from the centerline of the river, (primarily in the lower Meade and Ikpikpuk rivers), this stipulation could allow development in the active floodplain. Stipulation K-2 would protect aquatic and riparian areas adjacent to deep-water lakes, but would allow exceptions if there is no feasible or prudent alternative.

d. Conclusion--First Sale

Short-term (year-or-more) effects on water quality could occur from annual ice-pad and ice-road construction (320-acre footprint each year), drilling, and domestic needs for water, which could require winter extraction of unfrozen water from over 900 acre/ft of nearby lakes. Gravel construction of pads, in-field roads, and a field airstrip would cover about a 100-acre footprint per field, or 400 acres total for the four fields projected for a single sale under the Preferred Alternative. A dock or staging areas could also be built--depending on the size and number of pads and type of structures required--up to 100 acres per site. 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. Long-term (decade-or-more) effects from development of gravel roads, pads and pits could occur on nearly a thousand acres. Unlike the situation for ice structures, the same locations would be affected by gravel structures each year over the life of a field. 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 from an oil spill over the course of a few weeks along a short stretch of nearby rivers and lakes.

e. Multiple Sales

Effects of seismic trails would be similar to those described for one sale, over about an acre. During peak exploration, annual ice pad and ice road construction, drilling, and crew usage could require water withdrawals of about 1,800 acre/ft. This ice road construction would require winter extraction of water from up to 180 nearby lakes.

Because of the continued need for ice roads during peak development, annual water use for ice-road construction, drilling, and crew usage would be similar to that for exploration, requiring water withdrawals of about 1,800 acre/ft. After major construction is finished, annual water demand would decrease to about 15 acre/ft/year for each field.

The primary water-quality effect from construction and placement of gravel structures is related to upslope impoundment and thermokarst erosion. Gravel construction of pads, roads, staging areas, and an airstrip are assumed to double, from that of a single sale, for the Preferred Alternative. 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 2,000 acres. Unlike the situation for ice structures, the same locations would be affected by gravel structures each year over the life of the fields.

f. Conclusion--Multiple Sales

Short-term (year-or-more) effects of multiple sales would be similar to those for a single sale. Long-term (decade-or-more) effects of multiple sales are assumed to be double those of a single sale, while indirect impacts may take years to develop. Water quality could be affected on up to 2,000 acres from water impoundments, diversions, and thermokarst erosion, depending on the number of leases issued, the number of proposals for exploratory and development activity, and the locations of roads, pipelines, and infrastructure. Oil spills could result in waters of about eight ponds or small lakes remaining toxic to sensitive species for about 7 years.

5. Estuarine Water Quality

The Preferred Alternative would defer leasing in NPR-A estuarine waters within Peard Bay and Kasegaluk Lagoon for 10 years, but would allow leasing within Admiralty Bay, Dease Inlet, Elson Lagoon, and Walakpa Bay. This section assesses the effects of that leasing on estuarine water quality. The assessment is followed by an analysis of the effect of special mitigation measures (stipulations and required operating procedures). Leasing is proposed also on the Beaufort Sea Outer Continental Shelf (USDOI, MMS, Alaska OCS Region, 2003) and also might occur on the inner shelf in State lands and on Native in-holdings. These offshore leasing programs could influence water quality in NPR-A estuaries, as discussed in the cumulative effects section (Section IV.F.8.e).

a. Effects of Non-Oil and Gas Activities

Non-oil and gas activities that would affect estuarine water quality include ongoing subsistence and recreational activities in the Northwest NPR-A. In contrast to the Northeast NPR-A, the Northwest NPR-A Planning Area includes coastal villages near large estuaries, e.g., Barrow near Elson Lagoon and Wainwright near the Kuk River. Wastewater handling near these coastal villages could affect local estuarine water quality, although to date, adverse effects appear to have been negligible.

b. Effects of Oil and Gas Activities

Estuarine water quality would be affected primarily by three aspects of offshore oil and gas activities: discharges, construction, and accidental oil spills. This assessment is focused on the effects of drilling a few exploration wells from temporary ice islands, the construction of a gravel dock for staging onshore equipment, the barging of equipment and diesel fuel through estuaries, and the construction of a few gravel pads for drilling many production and service wells from onshore to offshore prospects. The assessment is focused also on the possible effects on Admiralty Bay because of its proximity to the tracts that were leased in the Northeast NPR-A. Map 9 shows that tracts were leased along a NW/SE-oriented trend of high geological potential; this geological trend extends into the Northwest NPR-A near Admiralty Bay.

In general, the Preferred Alternative would lead to slightly less offshore activity than Alternative A, as described

in "Differences in Activity Levels for Leasing Alternatives" (Sec.IV.A.1.b.7.b). Ice islands would probably be used for exploration in the shallow estuaries while development of any discoveries might require a gravel island or extensive drilling from shore, as explained in Section IV.C.5.b . Coastal staging facilities might be constructed also to support onshore operations (Map 18 and Map 107). The maps show possible staging sites (probably with short gravel docks and storage tanks for diesel fuel) at Cape Simpson and/or near Peard Bay. Although these particular staging sites are identified as part of a scenario, staging sites might be located elsewhere--including Dease Inlet or Admiralty Bay--so the effects on these estuarine waters are discussed. To summarize, the assessment is focused on Admiralty Bay, the possible drilling of a few exploration wells from temporary ice islands, the probable construction of a few permanent gravel structures for transportation and/or production, and the possible drilling from onshore to offshore of many production and service wells. The assessment is separated into an analysis of effects from disturbances, including discharges, and the effects of spills.

(1) Effects of Disturbances

Discharges of drilling and human waste would be prohibited or regulated by Preferred Alternative ROP's A-2c and A-7. With these ROP's, there could be only regulated discharges of domestic wastes, and drilling wastes (e.g., drilling muds, cuttings, and produced waters) could be discharged only in waters more than 10 m deep. The 10-m isobath is outside Admiralty Bay, Dease Inlet, Elson Lagoon, and Walakpa Bay, so there would be no unregulated discharges of produced water within the Northwest NPR-A estuarine waters.

The effects of other types of disturbances and discharges related to ice islands, ice roads, gravel islands, buried pipelines, and docks are assessed below.

(a) Ice Roads and Ice Islands

Exploration of prospects under narrow estuaries, such as Walakpa Bay, could be conducted from onshore using extended reach drilling techniques. In contrast, exploration of prospects under broad estuaries, such as Dease Inlet and Admiralty Bay, probably would be conducted from temporary ice islands and ice roads. Many ice roads and several ice islands have been constructed in the Beaufort Sea. For example, ice roads have been constructed each year to the Northstar Development Project and along the coast to the east and west from Prudhoe Bay. The roads are usually constructed by pumping seawater from below the ice cover up onto the cold ice surface. Ice islands are usually constructed by spraying seawater onto the ice surface until the thickened ice mound rests on the sea floor. Ice islands were constructed by this method at the Mars Prospect near Cape Halkett at the northeast corner of NPR-A (USDOI, MMS, 1985) and at the Karluk Prospect in inner Stefansson Sound (USDOI, MMS, 1988). The environmental assessments for these proposals focused mainly on the possible effect of thickened ice roads and ice islands on seafloor communities. The proposed ice road to Karluk was rerouted slightly to avoid shading the dense parts of the Boulder Patch kelp community. Kelp grows in only one NPR-A coastal bay--Peard Bay (Truett, 1984). Under the Preferred Alternative, leasing would be deferred for 10 years in Peard Bay, so there would be no immediate adverse effects on kelp from construction of ice islands or ice roads.

(b) Gravel Islands and Buried Pipelines

The sea floor across the inner shelf and in NPR-A estuaries is scraped and gouged frequently by sea ice, so there are only simple benthic communities. As noted above, a depression in the center of Peard Bay is the only place in the Northwest NPR-A in which a diverse kelp community has been found. Leasing in Peard Bay would be deferred for 10 years under the Preferred Alternative. Construction of gravel islands or the burial of pipelines in the remaining lease area would have no effects on this special benthic community.

Gravel island construction and pipeline burial would cause the release of suspended sediments, affecting water turbidity. Many gravel islands have been constructed in shallow bays near Deadhorse, including Sag 3, Niakuk 3 and 4, Resolution, Duck 3, Goose, Endicott, and NW Milne. Construction and abandonment of some of these islands has had a temporary affect on water turbidity; and concerns about long-term effects have been stated (NRC, 2003:p. 15). The effects on water quality from the construction of gravel islands and buried pipelines were assessed also in the Northstar and Liberty EIS's (U.S. Army Corps of Engineers, 1999; USDOI, MMS, Alaska OCS Region, 2002b). The latter concluded that "the greatest effect on water quality from gravel island and pipeline construction would be additional turbidity caused by increases in suspended particles in the water column" and that "turbidity increases from construction activities generally are temporary and expected to occur during the winter and end within a few days after construction stops." There were no reports from Northstar construction that the water-quality effects exceeded the minor expected effects. In summary, the water-quality effects of gravel-island construction and buried-pipeline construction in the Northwest NPR-A would probably be minor and temporary.

(c) Docks

Leasing would probably lead to the construction of a short dock at a staging site for the barging of heavy equipment to nearby onshore operations. The site would likely be located at Cape Simpson or near Peard Bay, but it might be located within an estuary such as Admiralty Bay (Map 17). A dock at any staging site probably would be short (i.e., a few thousand feet long), extending into about 10 ft (3 m) of water. An example of such a dock or jetty is East Dock in Prudhoe Bay; it is about 1,300 ft (400 m) long, extending into 4 ft (1.2 m) of water. Since its construction over 30 years ago, there have been no reports of adverse water-quality effects (e.g., circulation changes or temperature and salinity discontinuities). Most likely, a dock or short jetty in an NPR-A bay would not have measurable adverse effects on water quality. In contrast to docks or short jetties in bays, long docks and causeways have had measurable effects on water quality. The West Dock and Endicott Causeway near Prudhoe Bay extend more than 2 mi (3 km) into offshore water. These long offshore causeways had relatively short breeches and have affected the local water quality, creating cross-causeway differences in hydrologic conditions (e.g., water temperature and salinity) (USDOI, MMS, 1990). Enlarged breeches in West Dock have alleviated most of the cross-causeway differences, but enlarged breeches in the Endicott causeway have not alleviated the differences (Fechhelm et al., 2001). The hydrologic conditions have affected the near-shore distribution of anadromous fish, as discussed in Section IV.C.8.b on marine fish and in USDOI, MMS (1990). In summary, a short dock or jetty in NPR-A estuarine water probably would not affect hydrologic conditions, but a long causeway with inadequate breeches would probably have measurable, long-term impacts on hydrologic conditions.

(2) Effects of Spills

The present quality of the NPR-A coastal waters is pristine--like most of the arctic coast (Arctic Monitoring and Assessment Program, 1997)--in spite of natural oil seeps, such as the seeps at Cape Simpson in the Northeast NPR-A (Sec. III.A.2.b(5)) (Becker and Manen, 1988), and existing regulations would probably keep it that way. For example, before there could be any drilling or transportation of fuel, the ROP A-3 would require that hazardous-materials emergency-contingency plans be prepared and approved. The requirement might not reduce the likelihood of accidental oil spills but it would improve the responses to them. Several types of contingency responses would help to reduce the effect of a large offshore oil spill on estuarine water quality As noted above, the tactics of spill response organizations such as Alaska Clean Seas (ACS) for on-ice spills are relatively effective. The ACS maintains equipment also for spills in open water and broken ice, including booms, skimmers, igniters, pumps, ditch witches, storage tanks, etc. (USDOI, MMS, 2003:Sec. IV.A.6; Alaska Clean Seas, 1999a, b, and c). Some proposed tactics probably would (while removing much oil from the water) have indirect adverse effects on water quality. For example, in situ burning might leave a tarry residue in the water column.

The risk of spills that would affect Northwest NPR-A estuaries would be related partly to proposed oil leasing on the outer continental shelf (OCS), as noted in the cumulative analysis. The EIS for three proposed Beaufort Sea oil and gas lease sales (USDOI, MMS, Alaska OCS Region, 2002c) explains that "a large spill is unlikely to occur based on a mean spill number ranging from 0.08 to 0.11 for Alternative I for MMS Proposed OCS Lease Sales 186, 195, and 202." However, that EIS analyzed a 1,500 bbl spill from a production facility and a 4,600 bbl spill from an offshore pipeline.

This IAP/EIS analysis assumes a large spill of 500 or 900 bbl and a very large blowout of 120,000 bbl (Section IV.A.2, Table IV-19, and Tables App 9-10 to App 9-12). If a spill were to occur during the winter in a Northwest NPR-A estuary, the oil would probably be deposited on or under the ice cover. If a spill were under the ice, the relatively warm oil would probably rise to the ice cover, melt into the bottom of it, and become immobilized (USDOI, MMS, 2003:App. A, Sec. B.1). Water circulation under the ice cover is very slow (Weingartner and Okkonen, 2001) and so slow in shallow estuaries that brine accumulates as the ice cover freezes (Newbury, 1983;Sec. III.A.2.c) so dissolved hydrocarbons would probably accumulate also. In any case, on#ice tactics of spill response organizations (Alaska Clean Seas, 1999a, b, and c) are generally effective, so almost all of a winter spill could probably be recovered. In contrast to winter spills, the effects and responses to a 500- or 900-bbl spill in broken ice or open water would have long-term consequences, as discussed below and in Section IV.J.3.

If the spill were to occur during the open-water season, it might form a slick or become dissolved in the water column. If it were to form a slick, the slick from a 500- to 900-bbl spill would probably sweep an estimated 40 to 55 mi^2 (100 to 140 km^2 ; Tables App 9-10 and App 9-11). If the spill occurred during the melt-out or broken-ice seasons, the slick might cover 50 to 70 mi^2 (35 to 180 km^2) and deposit oil on 22 mi of coastline (Table App 9-11). The largest estimated area (70 mi^2) would be slightly smaller than the area of a typical estuary like Admiralty Bay, and the 22 mi (35 km) of coastline would equal about half of the total Admiralty Bay coastline. Such an oil slick could measurably degrade NPR-A estuarine water quality and shorelines. Spilled oil would persist on some types of shoreline for many years, and possibly for more than a decade (Michel and Holton, 2002), as described in Section III.A.2.c above.

If a summer oil spill became dissolved in the water column, the effect can be estimated with calculations in the Liberty EIS (USDOI, MMS, Alaska OCS Region, 2002b). That EIS calculated the effect of similar sized spills in Foggy Island Bay--a bay that is about the same depth as Dease Inlet. It concluded that hydrocarbons dispersed in the water column from a large (greater than or equal to 500 bbl) crude oil spill could exceed the 1.5 parts per million (ppm) acute (toxic) criteria during the first day in the immediate vicinity of the spill (USDOI, MMS, Alaska OCS Region, 2002b:Sec. III-16.l). Further, the hydrocarbon concentration could exceed the 0.015-ppm chronic criteria for up to 30 days in an area that ranges up to 70 mi^2 (180 km^2) in size. Again, the 70 mi^2 is slightly smaller than a typical estuary like Admiralty Bay.

So, oil spills are very unlikely, but they would have definite effects on estuarine water quality, especially if they occur during summer or the broken ice seasons. Responses to large estuarine spills probably would be effective during the winter when a solid ice cover would restrict the spread of oil. However, during summer or in broken ice, even a moderate-sized spill would be difficult to clean up. A 900-bbl spill in broken ice is estimated to spread across an area slightly smaller than a typical estuary, such as Admiralty Bay, and could contaminate about two-thirds of its shoreline. Such a spill also could measurably degrade the water quality; for example, hydrocarbons dispersed in the shallow water column below a spill probably would exceed the 1.5-ppm acute (toxic) criterion during the first day in the immediate vicinity of an estuarine spill.

If such a spill occurred within an NPR-A estuary, the water-quality effects would probably not extend into deeper water outside the estuaries. However, if a large fuel spill occurred at a coastal staging site, such as Cape Simpson or Peard Bay, the effects could extend offshore slightly. For example, the chance of contact with offshore waters can be estimated with data from the oil spill model for a recent Beaufort Sea EIS (USDOI, MMS, 2003). The model includes data for a hypothetical pipeline on the inner shelf near Cape Simpson (USDOI, MMS, 2003:Map A-4a; Pipeline Segment 8). The model data includes estimates of the chance that a summer oil spill starting at that location would contact surrounding areas within 3 days (USDOI, MMS, 2003:Table A2-19). The chances of

contact indicate that such a spill would drift westward toward the Plover Islands (Environmental Resource Area #2), posing a risk to either the island shoreline or the adjacent offshore area (Environmental Resource Area #29).

c. Effectiveness of Stipulations and Required Operating Procedures

Three stipulations under the Preferred Alternative could influence the level of effects on estuarine water quality: Stipulation D-2 would limit exploratory drilling to temporary facilities such as ice pads; Stipulation G-1 would require the removal of all oil and gas related facilities during abandonment; and Stipulation K-3 would restrict exploration operations in Dease Inlet, Admiralty Bay, and Elson Lagoon to the solid-ice season when spill-response is most effective.

Stipulation D-2, which would limit exploratory drilling to temporary facilities, would mean the use of ice islands for exploratory drilling in NPR-A estuaries. Because they have been a relatively inexpensive and common type of facility for exploration in the nearshore Beaufort Sea (e.g., Mars and Karluk Prospects), ice islands might be the main type of exploration facility that would be used in NPR-A estuaries, even without the stipulation. In other words, the stipulation might have only a minor effect on the types of exploration facilities that are used--and minor beneficial effect on estuarine water quality.

Stipulation G-1, which would require the removal of all oil and gas facilities upon abandonment of the operations, would require the removal of, for example, offshore gravel islands even though--as described above in Section Section V.B.1.b--gravel islands specifically would not have long-term effects. In contrast, long docks and causeways with inadequate breeches would probably have measurable, long-term impacts on hydrologic conditions, as concluded in Section V.B.1.c. The removal of docks might be complicated by their connection to a road system and by their possible future use for non-oil activities. For example, West Dock has been used by subsistence hunters and could be used for general public shipping. So, there might be public objections to the removal of some facilities, moderating the stipulation's beneficial effects on water quality.

Stipulation K-3 could have the biggest effect on estuarine water quality, potentially moderating the effect of exploration spills in estuarine waters. As noted above, a 500- or 900-bbl spill during the open water season would form a slick and would partially dissolve in the water column. The hydrocarbon concentration might exceed the 0.015-ppm chronic criteria for up to 30 days in an area that ranges up to 70 mi^2 (180 km^2) in size. The stipulation could potentially moderate this effect because exploration operations might be limited to the solid-ice season--a period during which spill response tactics could recover most of the oil (USDOI, MMS, 2003:Sec. IV.A.6). However, the stipulation explains also (Sec. b) that the solid-ice restriction would end with, in part, demonstration of "adequate spill response capability to effectively respond during periods of broken ice and/or open water. . . ." The MMS, which has approval authority on oil spill contingency plans for offshore facilities, describes the existing response capabilities in the document above, noting that "offshore operators in the Beaufort Sea currently maintain spill response, containment, and collection equipment to respond to releases the entire year" (USDOI, MMS, 2003:Sec. IV.A.6.a). So, approval of spill-response capability during open-water and broken-ice season might occur upon initiation of Northwest NPR-A exploration operations. Because open-water spill responses generally recover about a third of the spilled oil, leaving some in the water column, approval of open-water responses could inadvertentl increase spill effects on water quality. If open-water and broken-ice spill plans were not approved, the chance of estuarine spills would still not be eliminated because a few operations could be conducted anyway. For example, the stipulation would restrict operations that are permitted, but would not apply to non-permitted operations, including the barging of fuel always conducted during the open-water season under U.S. Coast Guard-approved spill#contingency plans.

In summary, Stipulations D-2 and G-1 and would probably moderate the effects of exploration facilities and long causeways on estuarine water quality, but would not eliminate the effects. The effectiveness of Stipulation K-3 is hard to assess without a more specific performance-based requirement of what would demonstrate "adequate spill response capability to effectively respond."

d. Conclusion--First Sale

This estuarine water-quality assessment concludes: 1) that disturbances from discharges of drilling and human waste would be prohibited within NPR-A estuaries; 2) that there would be no unregulated discharges of produced water; 3) that there would be no adverse effects on kelp or special benthic communities from construction of ice islands or ice roads; 4) that the water-quality effects of gravel-island construction and buried-pipeline construction in the Northwest NPR-A would probably be minor and temporary; and 5) that a short dock or jetty in NPR-A estuarine water probably would not affect hydrologic conditions but that a long causeway with inadequate breeches would probably have measurable, long-term impacts on hydrologic conditions. Further, if a 500- or 900-bbl spill were to occur during the open water season, it might form a slick or become dissolved in the water column. Such a spill could contaminate approximately two-thirds of the coastline in an estuary like Admiralty Bay, or the hydrocarbon concentration might exceed the 0.015-ppm chronic criteria for up to 30 days in an area that ranges up to 70 mi^2 (180 km^2) in size. The effects probably would not extend outside the estuaries unless the spill involved fuel at a coastal staging site, such as Cape Simpson. In summary, Stipulations G-1 and K-3 might be effective at moderating the effects of long causeways and estuarine spills.

e. Multiple Sales

Oil and gas activities are projected to increase with multiple sales under the Preferred Alternative (Table IV-07). Although it is not expected that a large amount of new information would become available after the first sale that would alter or refine the assessments, technology continues to improve. By such means, future spill response could become more effective. Also, the technology for extended-reach drilling is improving, making it easier to drill into nearshore prospects from safer, onshore locations. Therefore, the effects of each subsequent sale would probably be slightly lower than for the first sale.

f. Conclusion--Multiple Sales

The effects of each subsequent sale on estuarine water quality would probably be slightly lower than for the first sale because of technological developments in extended-reach drilling. The overall effects of multiple sales on estuarine water quality would probably be slightly less than twice that for the first sale.

6. Air Quality

a. Effects of Non-Oil and Gas Activities

Impacts to air quality would result from emissions. Emissions from non-oil and gas activities are extremely limited and generally related to the activities of the small resident population and their habitation and transportation activities. Supporting materials and discussions are presented in Section III.A.3.b (description of existing air quality on the North Slope of Alaska).

b. Effects of Oil and Gas Activities

Air pollutants discussed include nitrogen oxides (NO_x), carbon monoxide (CO), sulfur dioxide (SO_2), particulate matter (PM), and volatile organic compounds (VOC). Ozone (O_3) is not emitted directly by any source but is formed in a series of complex photochemical reactions in the atmosphere involving VOC and NO_x.

Nitrogen oxides consist of both nitric oxide (NO) and nitrogen dioxide (NO_2). The NO_x is formed from the oxygen and nitrogen in the air during combustion processes, and the rate of the formation increases with combustion temperature. Nitric oxide, the major component of the combustion process, slowly oxidizes in the atmosphere to form NO_2. The 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 photochemical smog.

Carbon monoxide is formed by incomplete combustion. It is a problem mainly in areas having a high concentration of vehicular 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. 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 acid rain precipitation.

Emissions of particulate matter associated with combustion consist of particles in the size range less than 10 microns (μ) in diameter (PM_{10}). Emissions of particulate matter associated with combustion, especially particles in the size range of 1 to 3 μ, can cause adverse health effects. Particulates in the atmosphere also tend to reduce visibility.

The type and relative amounts of air pollutants generated by oil and gas operations vary according to the phase of activity. There are three principal phases: exploration, development, and production. For a more detailed discussion of emission sources associated with each phase, refer to *Air Quality Impact of Proposed OCS Lease Sale No. 95* (Jacobs Engineering Group, Inc., 1989). Information from that report is relevant to operations that would occur within the Northwest NPR-A Planning Area. Although certain emission sources discussed obviously do not apply to operations occurring on land, the report does include a fairly comprehensive analysis of activities and emission sources that occur during oil and gas exploration, development, and production, regardless of the specific locations in which they may occur. Significant emission sources are summarized below.

Federal and State statutes and regulations define air-quality standards in terms of maximum allowable concentrations of specific pollutants for various averaging periods (see Table III-04). 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_2, 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 PSD classes. Class I allows the least degradation and also restricts degradation of visibility. The entire NPR-A is Class II, which allows a moderate 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 EPA and the State of Alaska before 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.

Under the State Implementation Plan, the Alaska Department of Environmental Conservation (ADEC) has

jurisdiction for regulating and permitting air-quality emissions within the Northwest NPR-A Planning Area. Operators would be required to meet ADEC's requirements for air emissions, including the need to obtain construction and operating permits. Construction air-quality permits include prevention of significant deterioration requirements.

(1) Effects of Disturbances

During the exploration phase, emissions would be produced by: 1) vehicles used in gathering seismic and other geological and geophysical data; 2) diesel power-generating equipment needed for drilling exploratory and delineation wells; 3) vehicles in support of drilling activities; and 4) intermittent operations such as mud degassing and well testing. Pollutants generated would primarily consist of NO_x (these would consist of NO and NO_2; ambient air standards are set only for NO_2), CO, and SO_2. It is assumed that exploration activity would begin in the year following a sale. Emissions from exploration for the first sale would be from seismic surveys and from drilling 5 to 12 exploration wells and 2 to 18 delineation wells from 1 to 3 rigs.

During the development phase, including temporary construction operations and drilling, the main sources of emission would be the following:

- gas turbines used to provide power for drilling;
- reciprocating engines for electrical power, including rig generator (during construction phase only; standby only during commissioning);
- heavy construction equipment used to install facility and pipelines (including gravel-hauling dump trucks);
- construction and commissioning support equipment, including cranes, pumps, generators, compressors, pile drivers, welders, heaters, and flare;
- support vehicles; and
- drill-rig-support equipment, including boilers and heaters.

For all these operations, the best available control technology would be applied under the EPA air-quality regulations. The main emissions would be NO_x, with lesser amounts of SO_2, CO, and PM_{10}. Once in the atmosphere, nitric oxide gradually converts to nitrogen dioxide.

For the production phase, the main source of emissions would be from turbines for power generation and gas compression, and from power generation for oil pumping and water injection. The emissions would consist mainly of NO_x, with smaller amounts of CO and PM_{10}. Another source of emissions would be evaporative losses (VOC's) from oil/water separators, from pump and compressor seals and valve packing. Using seal systems designed to reduce emissions would minimize these sources. Produced water and slop-oil tanks would be equipped with a vapor-recovery system, which would recover emissions of VOC's from these tanks and return them to the process. Operators would probably have a flare available 24 hours a day, 365 days a year. If there were venting (unexpected), it would emit VOC's. However, flaring would burn up any emissions of VOC's, and they should not create a pollution problem. Flaring would produce some NO_x, SO_2, PM_{10}, and CO. Venting or flaring would probably produce only a very small amount of SO_2 (sulfur dioxide), because sulfur in the produced gas should be very low (but never completely absent).

Abandonment of facilities developed after the proposed sales would cause much higher vehicular traffic, and also more heavy equipment operations than during the production phase of operations, but effects probably would be quite similar to the construction portion of the development phase of operations. Because abandonment operations would last perhaps a maximum of 10 to 15 percent of total operations time and would include no activities that should affect air quality more significantly than previously discussed, these operations would cause insignificant effects on air quality.

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

Emissions from development for the first sale under the Preferred Alternative proposal would be from the development of 4 fields and the installation of up to 135 mi of pipeline, and the drilling of a maximum of 232 production and service wells. Peak-year production emissions would result from operations producing about 50 million barrels of oil and from transportation of that oil.

Additional information and discussion from the EIS for Sale 144 provides some details relevant to the current analysis. Table IV.B.12-1 of the *Beaufort Sea Planning Area Oil and Gas Lease Sale 144 Final Environmental Impact Statement* lists estimated uncontrolled pollutant emissions for the peak-exploration, peak-development, and peak-production years from that sale proposal. That EIS also has additional relevant discussion, especially in the last paragraph of Section IV.B.12.(1). Information from the Beaufort Sea Sale 144 Final EIS is relevant for the Northwest NPR-A because the Sale 144 EIS analysis included the area immediately offshore of the Northwest and Northeast NPR-A. The Sale 144 EIS analyzed effects from a scenario that included greater projected oil development than is projected in this IAP/EIS for the Northwest NPR-A. Emissions analyzed for the Beaufort Sea also included some emission sources not applicable to operations on land in the NPR-A. Emissions from expected NPR-A operations would include no significant emission sources not analyzed for the Beaufort Sea. Therefore, effects analyzed and pollutants modeled are for the Beaufort Sea Sale 144 EIS are greater than those that would be expected for the Northwest NPR-A Planning Area. Modeling discussed in the Sale 144 EIS showed that NO_2 had the highest concentration of the modeled pollutants, but that all pollutant contributions would be well within the Prevention of Significant Deterioration increments and Federal ambient air quality standards.

Air-quality analyses were performed for the Northstar and Liberty projects. For those projects (which are probably somewhat smaller than a "typical" field that might be developed in NPR-A), the highest predicted concentrations for NO_2, SO_2, and PM_{10} occurred just outside the facility boundary and were close to the PSD Class II maximum allowable increments. The highest onshore concentrations would be considerably less because of the dispersion over distance. The combined facility concentrations plus background were well within the ambient air-quality standards (between 2 and 30 percent of the standards).

Because the Preferred Alternative should have air emissions that are similar to those predicted for Northstar or Liberty, it can be inferred that the expected pollutant contributions would also be well within PSD increments and Federal ambient air-quality standards.

(2) Effects of Spills

(a) Effects of an Oil Spill on Air Quality

Based upon modeling work by Hanna and Drivas (1993), the VOC's from offshore facility or pipeline oil spills likely would evaporate almost completely within a few hours after the spill occurred. The article cited discusses the rate of evaporation and ambient concentrations of 15 different VOC compounds. The EPA classifies several of these compounds--such as benzene, ethylbenzene, toluene, and n-xylenes--as hazardous air pollutants. The study results showed that these compounds evaporate almost completely within a few hours after the spill occurs. Ambient concentrations peak within the first several hours after the spill starts and are reduced by 2 orders of magnitude after about 12 hours. The heavier compounds take longer to evaporate and may not peak until about 24 hours after spill occurrence. Total ambient VOC concentrations are significant in the immediate vicinity of an oil spill, but concentrations are much reduced after the first day. In the event of an oil spill on land in the NPR-A, the

air-quality effects would be less severe than offshore (because some of the oil could be absorbed by vegetation or into the ground), but some effects might last longer before the VOC compounds were completely dissipated.

Diesel fuel oil could be spilled either while being transported or from accidents involving vehicles or equipment. A diesel spill would evaporate faster than a crude-oil spill. Ambient hydrocarbon concentrations would be higher than with a crude-oil spill, but would persist for a shorter time. Also, since a diesel spill would probably be smaller than some potential crude-oil spills, any air-quality effects likely would be even lower than for other spills.

Oil or gas blowouts may catch fire. In addition, in situburning is a preferred technique for cleanup and disposal of oil spilled into water (see the next paragraph). This type of burning would be less likely in case of oil spilled on land, but the effects on air quality if some of the oil should be burned would be similar. Burning could affect air quality in two important ways. For a gas blowout, burning would reduce emissions of gaseous hydrocarbons by 99.98 percent and very slightly increase emissions of other pollutants. If an oil spill were ignited immediately after spillage, the burn could combust 33 to 67 percent of crude oil or higher amounts of fuel oil (diesel) that otherwise would evaporate. On the other hand, incomplete combustion of oil would emit about 10 percent of the burned crude oil as oily soot (and minor quantities of other pollutants) into the air.

(b) Effects of Oil-Spill Cleanup Activities on Air Quality

In situ burning as part of a cleanup of spilled crude oil or diesel fuel would temporarily adversely affect air quality, but the effects would be low. For much greater detail, please see the article by Fingas et al. (1995). Extensive ambient measurements were performed during two experiments involving the in situ burning of approximately 300 bbl of crude oil at sea. During the burn, carbon monoxide, sulfur dioxide, and nitrogen dioxide were measured only at background levels and were frequently below detection levels. Ambient levels of VOC were high within about 100 m of the fire, but were significantly lower than those associated with a non-burning spill. Measured concentrations of polyaromatic hydrocarbons (PAH's) were found to be low, as it appeared that a major portion of these compounds were consumed in the burn. Effects of in situ burning for spilled diesel fuel would be similar to those associated with a crude-oil spill.

An oil spill could be set on fire accidentally or deliberately. Air pollution would be limited because of atmospheric dispersion. Also, large fires create their own local circulating winds--toward the fire at ground level--that affect plume motion. Accidental emissions likely would have a minimal effect on air quality.

If an oil spill were ignited immediately after spillage, the burn could combust 33 to 67 percent of the crude oil or higher amounts of fuel oil that otherwise would evaporate. On the other hand, incomplete combustion of oil would emit about 10 percent of the burned crude oil as oily soot, and minor quantities of other pollutants, into the air (USDOI, MMS, 1996:Table IV.B.12-4).

Additional work published in an article by McGrattan et al. (1995) reported that smoke plume models have shown that the surface concentration of particulate matter does not exceed the health criterion of 150 $\mu g/m^3$ beyond about 5 km downwind of an in situ burn. This is quite conservative, as this health standard is based on a 24-hour average concentration rather than a 1-hour average concentration. This appears to be supported by field experiments conducted off Newfoundland and in Alaska (McGrattan et al., 1995).

Other air-quality effects from cleanup activities would include emissions from vehicles and equipment used in the cleanup effort; these are expected to be very low.

(3) Effects of Accidental Emissions

Sources of air pollutants related to oil and gas operations include accidental emissions resulting from gas or oil blowouts. The number of blowouts on the U.S. outer continental shelf (OCS)--almost entirely gas and/or water--averaged 3.3 per 1,000 wells drilled from 1956 through 1982 (Fleury, 1983). Danenberger (1993) determined a frequency of 4.1 blowouts per 1,000 wells drilled from 1971 through 1991. Statistical information from outer continental shelf blowouts is relevant for Northwest NPR-A IAP/EIS because of possible activity in offshore coastal waters from leasing in the NPR-A. The statistical information for the OCS is recent enough that it may assist readers in becoming aware of how relatively infrequent such blowouts are in recent years. Please see also Section IV.A.2 , Section IV.A.3 and Section IV.A.4 of this IAP/EIS for a detailed discussion of oil spills. Table 4-19 and Table 4-20 referred to in that discussion show the estimates for large ($\geq$ 500 bbl) and small (<500 bbl) oil spills for the life of Northwest NPR-A oil and gas activities. Typical emissions from such accidents consist of hydrocarbons (volatile organic compounds); only fires associated with blowouts produce other pollutants, such as nitrogen oxides, carbon monoxide, sulfur dioxide, and particulate matter. Accidental emissions likely would have little effect on air quality.

A gas blowout could release 20 tons per day of gaseous hydrocarbons, of which about 2 tons per day would be nonmethane hydrocarbons classified as volatile organic compounds. The probability of experiencing one or more blowouts in drilling the wells projected for the Preferred Alternative multiple-sale proposal is estimated to be low. If a gas blowout did occur, it would be unlikely to persist more than 1 day, and it would very likely release less than 2 tons of volatile organic compounds. Since 1974, 60 percent of the blowouts have lasted less than 1 day; and only 10 percent have lasted more than 7 days.

Gas or oil blowouts may catch fire. In addition, in situ burning is a preferred technique for cleanup and disposal of spilled oil in oil-spill-contingency plans. For catastrophic oil blowouts, in situ burning may be the only effective technique for spill control. For a discussion of in situ burning, see Section V.B.6.b.2.b above.

Burning could affect air quality in two important ways. For a gas blowout, burning would reduce emissions of gaseous hydrocarbons by 99.98 percent and very slightly increase emissions--relative to quantities in other oil and gas industrial operations--of other pollutants (see Table IV.B.12-3 in *Beaufort Sea Planning Area Oil and Gas Lease Sale 144 Final Environmental Impact Statement*). For a major oil blowout, setting fire to the wellhead could burn 85 percent of the oil, with 5 percent remaining as residue or droplets in the smoke plume in addition to the 10-percent soot injection (Evans et al., 1987). Clouds of black smoke from a burning 360,000-bbl oil spill 75 km off the coast of Africa locally deposited oily residue in a rainfall 50 to 80 km inland. Later the same day, clean rain washed away most of the residue and allayed fears of permanent damage.

Based on qualitative information, burns that are 2 or 3 orders of magnitude smaller do not appear to cause noticeable fallout problems. Along the Trans-Alaska Pipeline, 500 bbl of a spill were burned over a 2-hour period, apparently without long-lasting effects (Schulze et al., 1982). The smaller volume Tier II burns at Prudhoe Bay had no visible fallout downwind of the burn pit (Industry Task Group, 1983).

Soot is the major contributor to pollution from a fire. This soot, which would cling to plants near the fire, would tend to slump and wash off vegetation in subsequent rains, limiting any health effects. Coating portions of the ecosystem in oily residue is the major--though not the only--potential air-quality risk. Recent examination of polycyclic aromatic hydrocarbons (PAH's) in crude oil and smoke from burning crude oil indicates that the overall amounts of PAH change little during combustion, but the kinds of PAH compounds present do change. Benzo(a)pyrene, which often is used as an indicator of the presence of carcinogenic varieties of PAH, is present in crude-oil smoke in quantities approximately 3 times greater than in the unburned oil. However, the amount of PAH is very small (Evans, 1988). Investigators have found that, overall, the oily residue in smoke plumes from crude oil is mutagenic but not highly so (Sheppard and Georghiou, 1981; Evans et al., 1987). The Expert Committee of the World Health Organization considers daily average smoke concentrations of greater than 250 $\mu g/m^3$ to be a health hazard for bronchitis.

Because of the dispersal of airborne pollutants by winds, accidental emissions likely would have a minimal effect on air quality.

(4) Other Effects on Air Quality

Other effects on the environment of air pollution from oil and gas activities and other sources not specifically addressed by air-quality standards include the possibility of damage to vegetation, acidification of nearby areas, and atmospheric visibility impacts. Effects may be short term (hours, days, or weeks), long term (seasons or years), regional (Arctic Slope), or local (near the activity only). Visibility may be defined in terms of visual range and contrast between plume and background (which determines perceptibility of the plume). For their proposed Liberty Project, BPXA had run the VISCREEN model and found noticeable effects on only a very limited number of days, ones that had the most restrictive meteorological conditions. No effects at all were simulated during average conditions. Those results would be expected to be typical of other development projects that could occur after any discoveries following the currently proposed lease sales.

A significant increase in ozone concentrations is not likely to result from exploration, development, or production scenarios associated with the Preferred Alternative. Photochemical pollutants such as ozone are not emitted directly; they form in the air from the interaction of other pollutants in the presence of sunshine and heat. Although sunshine is present in the NPR-A, temperatures remain relatively low for much of each day during the summer (Brower et al., 1988). Also, activities occurring as a result of field development are separated from each other, diminishing the combined effects from these activities and greatly increasing atmospheric dispersion of pollutants. At a number of air-monitoring sites in the Prudhoe Bay and Kuparuk areas, ozone measurements show that the highest 1-hour-maximum ozone concentrations generally are in the range of 0.05-0.07 parts per million (ppm), which is well within the existing maximum 1-hour-average ozone standard of 0.12 ppm. The highest 8-hour average ozone concentration is always somewhat lower than the maximum 1-hour average. Therefore, ozone levels are expected to be within the revised 8-hour average ozone standard of 0.08 ppm. (Note: The 8-hour Federal ozone standard currently is under litigation. The Environmental Protection Agency cannot enforce the standard until the legal issues are resolved.) Because the projected ozone precursor emissions from the Preferred Alternative multiple sale proposal are considerably lower than the existing emissions from the Prudhoe Bay and Kuparuk oil fields, the proposal should not cause any ozone concentrations to exceed the 8-hour Federal standard.

Olson (1982) reviewed susceptibility of fruticose lichen, an important component of the coastal tundra ecosystem, to sulfurous pollutants. There is evidence that sulfur dioxide 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 $\mu g/m^3$. In addition, the sensitivity of lichen to sulfate 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 atmospheric dispersion and low existing levels of pollutant concentrations, the effect on vegetation under the Preferred Alternative multiple-sale proposal is expected to be minimal. For their proposed Liberty development project, BPXA had found that maximum modeled pollutant concentrations were well below levels that can damage lichens, according to laboratory studies. This likely would also apply to other development projects that could follow the currently proposed lease sales. Research at Prudhoe Bay from 1989 through 1994 showed no effects of pollutants there on vascular plants or lichens (Kohut et al., 1994). That research was conducted in areas typical of much of the Alaska North Slope area. Monitoring the vascular and lichen plant communities over the 6 years revealed no changes in species composition that could be related to differences in exposures to pollutants.

(5) Native Views on Air Emissions

Elder Bessie Ericklook from Nuiqsut maintained (Ericklook, 1979, as cited in USDOI, MMS, 1979a) that since the oil fields have been established at Prudhoe Bay, the foxes have been dirty and discolored in the area of Oliktok Point. Leonard Lampe, then Mayor of Nuiqsut, more recently reported 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..." (Lavrakas, 1996:1, 5). Because of the distances from the most likely developments to Nuiqsut and the relatively small sizes of these projects in comparison with the Prudhoe Bay complex, the Preferred Alternative would be expected to have no significant effect with respect to these observations.

(6) Summary

The unlikely large oil spill from a facility or pipeline could cause a small, local increase in the concentrations of gaseous hydrocarbons (volatile organic compounds as a result of evaporation from the spill. The VOC concentrations would be very low and normally limited to only 1 or 2 km^2 (0.4 to 0.8 mi^2). Moderate or greater winds would further reduce the VOC concentrations in the air.

Effects on air quality from emissions likely would be only a very small percent of 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, there likely would be only a minimal effect on air quality with respect to standards. Because of the atmospheric dispersion of emissions, the other effects of air-pollutant concentrations caused by exploration and development and production activities or accidental emissions would not be sufficient to harm vegetation. A light, short-term coating of soot over a localized area could result from oil fires.

c. Effectiveness of Stipulations and Required Operating Procedures

None of the stipulations or ROP's is particularly applicable to air-quality impacts. Mitigation of adverse air-quality impacts would result from operators' use of the best available technology to control discharges.

d. Conclusion--First Sale

The air-quality analysis is based on the specific emission controls and emission limitations that facility operators would apply to meet the appropriate EPA regulations and permit requirements for development and production activities. The effects of all these activities would cause only small, local, temporary increases in the concentrations of criteria pollutants. Concentrations would be within the PSD Class II limits and National Ambient Air Quality Standards. Effects on air quality under the Preferred Alternative would be low.

e. Multiple Sales

Air-quality impacts are determined by atmospheric transport and dispersion patterns and the relative locations of the emission sources and receptors (points where impacts are evaluated). These characteristics vary to some extent in different locations within the NPR-A. Wind patterns are determined by large-scale circulation systems as well as by local topography and heat exchange between the atmosphere, ocean, and ice. Atmospheric dispersion

patterns are very complex as well. The air-quality modeling for the Outer Continental Shelf Lease Sale 144 and for the Northstar and Liberty projects used meteorological data from just a few stations, which are generally not representative of the whole Beaufort Sea area. Results for similar projects such as those that would result from the Preferred Alternative in the Northwest NPR-A are likely to vary from one area to another, depending on local meteorological and topographical conditions. The air-quality modeling for the projects mentioned is based on the best available information for the Beaufort Sea; they can be thought of as providing a best "first guess" of conditions anywhere in the Beaufort Sea and in the NPR-A. Since the predicted impacts are small, it can be reasonably assumed that the effects from facilities anywhere in the region would fall within the regulatory standards.

Because individual air masses move constantly with atmospheric circulation, the major differences in effects of the different alternatives upon air quality would be expected to be determined by which specific geographic areas could be affected by air emissions.

f. Conclusion--Multiple Sales

None of the sales would result in effects substantially different from or other than those discussed in Section V.B.6.b . The effects of all activities under all sales would cause only small increases in the concentrations of criteria pollutants. Concentrations would be within the PSD Class II limits and NAAQS. Therefore, effects on air quality from the multiple sale proposals under the Preferred Alternative would be low.

7. Vegetation

Ground-impacting management actions within the Northwest NPR-A Planning Area that may affect vegetation under the Preferred Alternative include those from non-oil and gas related activities and those related to the exploration and development of oil and gas resources.

a. Effects of Non-Oil and Gas Activities

These actions include point-to-point air traffic, aerial surveys, paleontological and archaeological excavations, camps for research and recreation, overland moves, and off-highway vehicle (OHV) (e.g. four-wheelers, snowmachines, and airboats) use. Most of these activities, except for overland moves, snowmachines, and some aerial surveys, occur from June to September.

Most off-runway landings during aerial surveys would be by fixed-wing aircraft using skis or floats; fewer would be by wheeled, fixed-wing aircraft. Only wheeled, fixed-wing 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 the potential to cause minor, short-term damage to the scattered vegetation present on the bars or ridges. The specific locations, season, number of landings, weight of aircraft, etc. associated with these activities would affect the extent of the minor impacts expected.

Archaeological digs are most likely to occur on drier soils, where a sod layer has formed. In some archaeological digs, 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 combined extent of such activities is not expected to exceed 4 acres per year, the same level as in

Alternative B.

Camps can result in vegetation trampling from foot traffic and tent placement, and in small spills of stove or generator fuel. This can result in temporary (one 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 (the same level as for all other alternatives) and would be scattered over several sites, with most containing little or no vegetation.

Most overland moves through the Planning Area--other than for oil and gas related activities--involve traffic between Deadhorse and Barrow, Barrow and Atqasuk, or Barrow and Wainwright. 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 steel-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.20, Visual Resources). 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 crushed or 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. Trails within the Planning Area on the three routes mentioned above total about 225 mi in length. If a trail is 12 ft wide, the impact potentially could affect about 330 acres (the same acreage as for all other alternatives). See the discussion below for the effects of spills.

Use of OHV's would be primarily, or entirely, in support of subsistence activities. Snowmachines used in the winter when the ground is frozen and covered by snow would have no--or negligible--impact on vegetation. Use of four-wheel-drive vehicles, if the vehicle is heavy enough, can kill vegetation and result in thermokarst. However, most or all such use is likely to be in the immediate vicinity of villages on private lands and not on lands managed by the BLM. The impacts of airboats on vegetation would depend on how they are used. If they are kept in the river channels, airboats would have no impact on vegetation. If airboats are driven across very shallow marshes, they might disturb the sediments in which water sedge grows and damage these plants.

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

If it is assumed that impacts to vegetation from any of the disturbance factors below would occur to different land-cover classes in proportion to their occurrence in the Planning Area (with the exception of the three water classes, Table III-06), the percent chance of occurrence of these impacts to the various vegetation types is presented in Table IV-23. However, this assumption would be invalid under either of the two following potential scenarios.

As discussed in Section III, Description of the Affected Environment, more than 95 percent of the Planning Area may be classified as "wetland" by some definitions. There are, however, some general differences between the northern and southern portions of the Planning Area. The northern area lies in the coastal plain and has a higher frequency of "marsh wetlands" (aquatic, flooded tundra, and wet tundra land-cover classes on Table IV-23), whereas the southern area lies in the foothills and has a higher frequency of "tussock wetlands" (tussock tundra and dwarf shrub land-cover classes on Table IV-23). If it is assumed that exploration or development activity is more likely to be concentrated in the northerly portion of the Planning Area, then the "marsh wetland" would be

affected in greater proportion than suggested in Table IV-23 and the "tussock wetland" would be affected less. The comparative value of these two generalized wetland types depends on the context in which they are being evaluated. For instance, the "marsh wetlands" are generally of greater importance to waterbirds, whereas the "tussock wetlands" are generally of greater importance to some shorebirds and songbirds, and to caribou.

Development may be proposed for a location addressed by Stipulations E-2, K-1 through K-3 or K-6, or ROP K-7 (see below). If this were to occur, the location of the development may be shifted to some extent to avoid as much as possible the vegetation types considered of greater importance in that local area for the protection of specific resources. In this case, the vegetation would most likely be of either the "marsh wetland" type, or riparian shrubs (low or tall shrub on Table IV-23).

(a) Exploration

1) Construction of Ice Pads, Ice Roads, and Well Cellars

Activities with the potential to impact vegetation during exploration would be limited to the construction of ice pads for drilling exploratory or delineation wells, ice roads to access some ice pads, and well cellars. Because vegetation is dormant when frozen and the ice pads/roads melt during the spring thaw shortly after melt of snow and natural ice, this construction technique is more benign than building gravel roads. Observations by the BLM of ice roads and pads built in the Northeast NPR-A between 2000 and 2002 have shown that one common impact to vegetation is a green trail, where standing dead vegetation has been flattened. This occurs primarily in wetter areas. Another common impact is caused by the death of some plants, presumably from compression, resulting in a brownish hue in the first summer, followed by a gray hue in later summers. This occurs primarily in areas of tussocks or dwarf shrubs. Both green trails and brown/gray trails are apparent from the air at some angles, but sometimes difficult to observe from the ground. Additional damage observed to occur (though to a lesser extent) was the partial crushing of sedge tussocks and accidental scraping of the tundra surface. No studies have been carried on for long enough to know the duration of such impacts, but based on studies of impacts from seismic surveys (above) the effects could be visible for at least a few years. It is assumed here that 0 to 2 ice roads, 25 to 50 mi long, would be built per year for a total $\leq$ 100 mi of ice road per year. If ice roads were 35 ft wide, the acres affected would be less than 420 per year. These acreage figures are the same as those for Alternative B and up to one-third less than those for Alternative A. Ice road construction could continue for up to 10 years following the first lease sale; ice roads that are rebuilt in multiple years are likely to be built along the same route.

Under the Preferred Alternative, it is assumed that 5 to 12 exploration wells and 2 to 18 delineation wells would be drilled in the Planning Area as a result of the first lease sale, for a total of 7 to 30 wells on ice pads (same as Alternative B and up to one-fourth less than for Alternative A). Assuming that the average ice pad is 500 ft by 500 ft (5.7 acres), these pads would add another 40 to 170 acres of impacts similar to those of ice roads. Some pads may be rebuilt in subsequent winters. This may increase vegetation recovery time, but not the areal extent of impacts.

A different impact from ice construction would occur if an ice pad were insulated so it could be used for a second winter. The vegetation would thaw underneath the timbers placed around the pad's perimeter to hold the insulating cover down. Because that thawed vegetation, about 1 ft in width, would receive no sunlight, it would die (Hazen, 1997; McKendrick, 2000). 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. If it is assumed that 1 in 5 ice pads would be maintained over the summer, this scenario could result in the death of 0.05 to 0.3 acres of vegetation spread among 1 to 6 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 cellars, causing the destruction of vegetation on the 16 ft^2 of ground involved and causing thermokarsting around them, which could change some vegetation cover to a wetter

type. For 7 to 30 wells, this could result in the destruction of less than 0.02 acres of vegetation.

2) Seismic Activities

Seismic exploration causes impacts to vegetation similar to those described for overland moves. Under the Preferred Alternative, it is assumed that two seismic surveys--in some combination of 2-D and 3-D format--would occur in the Planning Area during each winter season. This assumption and the resulting impact estimates below are the same as those for Alternative B and one-third less than those in Alternative A. The exterior dimensions of a typical 2-D survey area vary from about 960 to 1,920 mi^2 (614,400 to 1,228,800 acres) and the maximum area impacted by seismic lines is up to 19,400 acres (400 to 800 mi x 200 ft wide). This figure is presented as a maximum, not only because 800 mi is the higher end of the assumed range, but also because not all of the area within the 200-ft-wide path would actually be overrun by a vehicle. Trails also are made by camp-move vehicles, which traverse about the same distance as line-miles surveyed (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 could cause more severe, longer lasting damage than the use of 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, so that camp-move trails effectively would impact a path 30 ft wide. With 800 or fewer mi of trail within the survey area and an additional 25 mi entering and leaving the Planning Area, this would impact a total of 3,100 acres or less. Thus, total area impacted by 2-D seismic surveys with up to two crews involved would be less than 45,000 acres. This acreage would be less if areas surveyed were to be smaller than maximum size, or if 3-D surveys were to conducted instead of 2D surveys. Impacts on lands east of the Planning Area from travel between there and Kuparuk are discussed in the cumulative analysis.

A study of tundra disturbance by winter seismic surveys on the eastern portion of Alaska's North Slope (Jorgenson et al., 1996) 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 85 percent, with low on 10 percent, medium on 4 percent, and high on 1 percent.

The above study looked at the effects of seismic exploration that took place about 20 years ago and used some vehicle types that were developed 30 to 40 years ago. Presumably, newer equipment types have less impact on tundra vegetation. However, the above study represents nearly all of the available knowledge about long-term recovery from seismic exploration (NRC, 2003). For that reason, the results from the above study are used as assumptions in this document for further analyses of impact to vegetation. For comparison, results of a study of seismic exploration impacts near the Colville River delta in 2001 (Jorgenson et al., 2003) are presented here with several caveats. Besides comparing modern to older equipment, these two studies occurred in different winters when the snow cover probably differed, they occurred on two different areas of the North Slope with different terrain types, and the data (visual estimates) were collected by different observers. In the 2001 study, conducted in the summer following the seismic work, the disturbance level to affected tundra under seismic lines was little to none on 30 percent of plots, low on 66 percent and medium on four percent. No plots on seismic lines were estimated to show high disturbance. The disturbance level to the affected tundra under camp-move trails was little to none on 18 percent of plots, low on 54 percent and medium on 29 percent. No plots in the random sample displayed a high level of disturbance, but at least one occurrence of high disturbance was observed elsewhere in the study area. If the difference in results between the two studies was due entirely to advances in equipment design, this suggests that future seismic lines would see reduced levels of disturbance (primarily more area in the little to none class and less in the medium class) and camp-move trails would see levels of disturbance similar to those found in the earlier study.

Applying the data from the older study to the above scenario for 2-D seismic surveys in the Planning Area suggests that less than 11,300 acres per year would experience medium to high disturbance (if 2-D rather than 3-D surveys were done) and, after 9 years of recovery for any single year's activity, that level of disturbance would remain evident on less than 320 acres.

It is assumed that a 3-D seismic operation would cover a total area of 300 to 600 mi^2 (192,000 to 384,000 acres), or 31 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, varying from 3,750 to 7,500. Thus, the tundra area impacted by seismic lines would be equal to or less than 182,000 acres (7,500 mi by 200 ft wide) for one survey. As for 2-D surveys, this figure is a maximum because it uses the higher end of the range of line-miles and not all of 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 31 percent ($\leq$ 250 mi) of those for 2-D surveys, because the total area involved in a 3-D survey is 31 percent of that covered by 2-D. There still would be an average of an additional 25 mi traveled each way when entering and leaving the Planning Area. Thus, camp-move trails would impact up to 1,110 acres of tundra for one survey. Using the figures from Jorgenson et al., 1996, suggests there would be up to 45,800 acres of medium to high disturbance following a survey and up to 60 acres remaining after 9 years.

Under the Preferred Alternative, with up to two 3-D seismic surveys occurring in the Planning Area during each winter season, the total tundra area affected by 3-D seismic surveys would be less than 366,000 acres per year. Each year this would result in less than 92,000 acres of medium to high disturbance, with less than 120 acres remaining after 9 years. Overall for the Preferred Alternative, depending on the combination of 2-D and 3-D survey types implemented and the number of line-miles actually accomplished per survey, the range of areas impacted per year by all seismic operations would be 22,500 to 366,000 acres. The total area of tundra within the Planning Area that would be impacted by seismic surveys as a result of the first lease sale might be less than the product of these numbers times the number of years since the sale, because individual surveys may overlap one another among years. However, the decrease in acreage impacted might be countered by the higher level of disturbance possible in those areas of overlap.

(b) Development

There are four different aspects of development that could impact vegetation: 1) construction of gravel pads, roads and airstrips; 2) potential construction of a pump station within the Planning Area; 3) excavation of material sites; and 4) construction of pipelines.

1) Gravel Pads, Roads, and Airstrips

It is assumed that the gravel footprint for the average, mid-sized oil field development in the Planning Area would cover a total of 100 acres and that under the Preferred Alternative, 0 to 4 fields would be developed (Table IV-04). This assumption and the subsequent estimates are the same as those for Alternative B and up to one-fifth less than those of Alternative A, and would result in the destruction of $\leq$ 400 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, 1983). Within 30 ft of pads, the dust and gravel may smother the original vegetation, altering the plant communities and at an extreme level eliminating all vascular plants (Jorgenson, 1997, personal communication; McKendrick, 2000). The buildup of dust and gravel could also cause thermokarsting, leading to the development of high-centered polygons with deep moats (Jorgenson, 1997, pers. comm.). For this analysis, it is assumed that the average oil/gas field development 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 development, corresponding to ≤ 144 acres under the Preferred Alternative.

The type of material used for gravel fill also can impact vegetation if the material 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 may 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 a 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 flow of surface water in summer. The latter can cause a wetter soil regime on one side of a pad or road and drier soil on the other. Wetter regimes 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 (50 m) of the pad (Woodward-Clyde Consultants, 1983). 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 oil/gas development, or ≤800 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 area (Walker et al., 1986, 1987). Flooding resulted when roads and pads intercepted the natural flow of water and caused ponding. If lessees are not required to identify natural drainage patterns before construction--and maintain them during and after construction--then the land impacted would be the same land that was affected by dust and snow drifting, as described above. However, the change in vegetation type could be different than that caused by dust or snow drifting, resulting in more aquatic grasses and sedges.

2) Pump Stations

Depending on the number of fields produced, their location, and the diameter of pipe used to transport oil, pump stations 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 that 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 for each pump station.

3) Material Sites

Any need for gravel fill in support of development would likely be met by existing borrow sites east of the NPR-A. However, if excavation of fill material were to occur 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 oil/gas development, each with a surface disturbance of 20 to 50 acres (average 35 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 about 5 acres per material site. Under the Preferred Alternative, this would result in the destruction of ≤ 140 acres of vegetation and the alteration of the vegetation community on an amount ≤ 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.

4) Pipelines

For this analysis, it is assumed that aboveground pipelines would involve a single VSM per pipe-supporting rack. The VSM's would have a diameter of 12 inches and would be placed 55 to 70 ft apart. Each VSM would have an approximately 20-inch-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 < 2.1 acres within the Planning Area under the Preferred Alternative (up to 70 mi of field gathering and trunk pipelines; see Table IV-29). In addition, another 100 mi of trunk lines would be built on Federal lands outside the Planning Area and 35 mi of trunk lines on State lands to get produced oil from the Northwest NPR-A to existing oil transportation infrastructure. This 135 mi of pipeline outside the Planning Area would disturb about 4.1 ac of tundra vegetation.

Pipelines would be constructed in the winter, either from ice roads or vehicles driving on the snow-covered tundra. Assuming that this traffic would cover an area up to 30 ft wide over 70 mi within the Planning Area and 135 mi outside the Planning Area, about 255 acres and 490 acres, respectively, of tundra would receive impacts similar to those mentioned above for ice roads or seismic surveys.

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. commun.) 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 shallower active layer in the soil and reduced photosynthesis by the plants. No data exist to address this possibility. Many currently existing pipelines are associated with a parallel road, and any effects of snow drifting, gravel spray, or dust would mask an effect of shading.

Assumptions made for this analysis of impacts by pipelines would be invalidated by a decision to bury any portion of a pipeline under the tundra. Although not the preferred method for heated oil pipelines, burial is preferred for gas transport pipelines. Gas (field gathering) pipelines would be supported above ground by the same VSM's as the oil pipelines, and would represent no additional impact to tundra vegetation other than the possible effects of increased area shaded or affected by snow drifting. Gas trunk pipelines would likely be buried, and 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 would be up to 15 ft wide, then the total impacts to vegetation would affect $\leq$ 1.8 acres per pipeline mile, or an amount $\leq$ 45 acres along the assumed 25 mi route within the Planning Area and about 310 acres along the 170-mi route beyond the Planning Area. With disturbed areas of this width, colonizing species would not be able to quickly reinvade the disturbed soil, suggesting a recovery time of several years or longer, though wetter areas would generally revegetate before drier areas (McKendrick, 2000).

(2) Effects of Spills

Most oil spills occur on gravel or ice pads. Consequently, their effects do not reach the vegetation. About 20 to 35 percent of past crude oil spills, both large and small, 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 on or reach the tundra vegetation. However, during 60 percent of the year there is sufficient snow cover that cleanup efforts would occur before spilled oil could reach the vegetation. So for this analysis, it is assumed that 11 percent of all oil spills (except blowouts; see below) would affect

vegetation.

Most oil spills would 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). Based on these assumptions, the total area of vegetation that would be impacted by spilled oil over the lifetime of oil/gas developments would be < 4.3 acres (390 spills x 11% chance of reaching tundra x 0.1 acre per spill). Overall, past spills on Alaska's North Slope have caused minor ecological damage, and ecosystems have shown a good potential for recovery with wetter areas recovering more quickly (Jorgenson, 1997; McKendrick, 2000).

The only reported blowout of crude oil on Alaska's North Slope occurred in 1950, 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 low (estimated at 1.5×10^{-5} per well drilled, or one in 67,000). See Section IV.J.5.g for the analysis of the potential effects of a large spill related to a blowout.

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 land cover at the spill site and would be proportional to the amount of seawater spilled. If such a spill were to occur within a community of halophytic plant species, there could be little effect. Otherwise, depending on the specific situation under which the spill occurred, the result could vary from little impact to total plant death in the area affected with eventual replacement of the vegetation community by halophytic species.

(3) 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, ice-road and pad construction, and the construction of well cellars during exploratory drilling. The duration and recovery for seismic work and ice roads/pads would be similar to those for overland moves. The effects of well-cellar construction would be permanent. The effects of development include the impacts of ice roads or off-road vehicles used for pipeline construction; 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, snowdrifts, and blockage of normal surface water flow. The impacts of gravel pads are considered permanent, while those of oil spills--which are cleaned up immediately--allow recovery within a few years to two decades.

c. Effectiveness of Stipulations and Required Operating Procedures

The Stipulations and Required Operating Procedures (ROP's) that would reduce the acreage of impacts to vegetation under the Preferred Alternative are those that would reduce the areal extent of gravel cover or alterations to tundra during exploration or development (ROP's E-5 and I-1) and those that would reduce the probability of oil spills reaching the tundra or spreading further once they reach the tundra (ROP's A-2c, A-3, A-4a-e, A-6, A-7a, E-4, and I-1). Stipulations E-2, K-1, K-2, K-6, and ROP K-7 would not reduce the acreage of vegetation impacted by an action, but might shift the impacts from more valuable wetland or riparian vegetation types to habitats perceived as lesser in value. Impacts to habitat farther from waterbodies rather than adjacent to them may affect fewer wetland, riparian or cliff habitat acres, or they may affect wetland or riparian habitats that contain fewer wildlife and fish species or individuals.

ROP's that would reduce the level of impacts to vegetation--but not the areal extent of impacts--are ROP's A-3 and A-4a (by providing better cleanup of spills), and ROP's C-2a-e and I-1 (by reducing impacts of off-road vehicles).

Stipulation G-1 and ROP E-8 may increase the probability that altered vegetation would eventually be returned to a natural (or at least more productive) state.

d. 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 destructive impacts would involve a small fraction of the 8.8-million-acre Planning Area, the overall impact to vegetation communities from these activities other than oil and gas exploration and development may be minor to negligible.

The impacts of oil exploration would include vegetation disturbance on 22,500 to 366,000 acres per year from 2-D and 3-D seismic surveys over the entire exploration period (10 years). About 25 percent of the disturbance would be at a medium to high level, and after 9 years recovery would be about 90 percent.

Exploration would also include construction of ice roads, with impacts on < 420 acres per year, and ice pads with impacts on < 170 acres. Exploration activities also would result in permanent, minor vegetation destruction and alteration from the construction of exploration well cellars.

The activities of development that would impact vegetation include construction of gravel pads, roads, and airstrips for each oil/gas development; 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 ≤ 650 acres and the alteration in plant species composition of ≤ 1,915 acres, for a total of effects over ≤ 2,565 acres. The duration of most of these impacts would be permanent, assuming that the gravel pads would remain after oil production ends, but some plant species would be able to grow on the pads (McKendrick, 2000).

Since these impacts from development would affect less than 0.03 percent of the total area of the Planning Area, they would not be likely to adversely affect any plant species or communities. If a development facility were to be placed over a population of one of the rare plant species (see Sec. III.B.2.), the effects on that particular taxon could be severe, however it is expected that rare plants colonies would be avoided through careful siting at the facilities-approval stage. Oil spills are inevitable during exploration and development and would affect < 4.3 acres of vegetation within the Planning Area. Spills would be cleaned up immediately, causing minor ecological damage, and ecosystems would be likely to recover in a few years to 2 decades.

e. Multiple Sales

It is assumed that additional lease sales under the Preferred Alternative would result in additional exploration activities and another 0 to 4 oil/gas fields (total of 0 to 8 fields) being developed (Table IV-06). This assumption and those below are the same as those in Alternative B and somewhat less that those in Alternative A. The annual level of seismic operations is assumed to stay the same, and 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 from 5-12 to 15-36, and delineation wells from 2-18 to 6-36, for a total for all lease sales of 21 to 72 wells drilled from ice pads.

Vegetation destruction from well cellars would then increase to affect < 0.03 acres, and vegetation death around ice pad perimeters would increase to 0.2 to 0.7 acres. Tundra would recover from the latter in one to a few years. Since the number of exploratory and delineation wells is assumed to be greater after the second and subsequent sales than after the first sale, it may follow that the area affected per year by ice roads and pads would increase proportionally to < 1,940 acres.

With the assumption of another 0 to 4 oil/gas fields developed (total of 0-8 fields; Table IV-06), the total vegetation that might be destroyed by burial under gravel fill would double to < 800 acres. The area of vegetation around gravel pads that would undergo change from dust- or moisture-regime impacts would double to < 1,600 acres. The impacts of developing material sites would increase correspondingly to the number of oil/gas fields. This would mean the destruction of vegetation on a total of < 280 acres and effects of moisture regime changes on a total of < 40 acres. If additional pump stations would be needed, the area of vegetation affected would increase accordingly. The number of VSM-supported-pipeline miles within the Planning Area would more than triple under multiple sales, from 70 mi to 240 mi, and those outside the Planning Area would increase from 135 mi to 245 mi. The number of miles of buried gas trunk lines would increase from 25 mi to 125 mi within the Planning Area and from 170 mi to 270 mi outside of the Planning Area. Buried gas trunk lines would increase from 25 to 125 mi within the Planning Area and from 170 to 270 mi outside of the Planning Area. The resulting total for all sales, both inside and outside the Planning Area, would be 1,780 acres of vegetation destruction or alteration by off-road vehicle or ice road use and 720 acres by trenched gas transport lines. The incidence of oil spills also would double, raising the total acres affected to < 8.6. The probability of a blowout would remain low.

f. Conclusion--Multiple Sales

The impacts of oil exploration would include about double the vegetation disturbance from seismic work as those under a single-sale scenario. However, 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 < 0.03 acres of permanent vegetation destruction around well cellars and alteration of < 1,940 acres per year around and under ice pads and roads.

The activities of development that would impact vegetation include construction of gravel pads, roads, and airstrips for each oil/gas field developed; potential construction of one pump station within the Planning Area; excavation of material sites; and construction of pipelines both within and outside the Planning Area.

The combined effect of these exploration and development activities over all lease sales would cause the destruction of vegetation on ≤ 1,260 acres and the alteration in plant species composition of ≤ 4,050 acres, for a total of effects on ≤ 5,310 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. These impacted areas within the Planning Area (3,920 acres) represent about 0.04 percent of the total land cover. As such, they would not be likely to adversely affect any plant species or communities. If a development were placed over a population of one of the rare plant species, the effects on that particular taxon could be severe, however careful siting of facilities after site-specific environmental analysis is expected to result in avoidance and protection of rare plant species. Oil spills would affect < 8.6 acres of vegetation within the Planning Area. Recovery from spills would take a few years to 2 decades.

8. Fish Resources

a. Freshwater and Anadromous/Amphidromous Fish

Activities within the Planning Area that may affect fish under the Preferred Alternative include non-oil and gas actions, activity related to seismic operations, and those activities related to exploratory drilling and development of oil and gas resources.

Fish found in the Planning Area that may be impacted by these activities include freshwater species such as lake trout, arctic grayling, Alaska blackfish, northern pike, longnose sucker, round whitefish, burbot, ninespine stickleback, slimy sculpin, and Arctic char and anadromous/amphidromous species including arctic cisco, least cisco, Bering cisco, rainbow smelt, humpback whitefish, broad whitefish, Dolly Varden, inconnu, and chum and pink salmon (Morrow, 1980). Many of these species are depicted in Figure III-25 . The discussion of fish species in Section III.B.3.d provides details on their distribution and habits. Since the activities listed above frequently have similar impacts on all of these species, the following analysis often discusses effects on arctic fish as a group.

(1) Effects of Non-Oil and Gas Activities

Actions associated with the Preferred Alternative that could cause disturbance to fish include camps for research and recreation and overland moves. Most of these activities, except for overland moves, occur during June to September.

Ground activities related to research include data collection activities and camp set-up. Camps vary in size from small mobile parties that remain at a site for a few days or move daily to larger camps that may be set up in one location for portions of the summer field season. Regardless of size, potential impacts to fish at these sites are related to fuel spills that would enter the water. Mobile camps are likely to have only small quantities of stove fuel needed for cooking or gas necessary for boat motors. Impacts from spills at these sites pose little risk to fish. Stationary camps often have fuel caches used for helicopters. Fuel is either stored in bladders, tanks, or drums with quantities of up to 5,000 gallons on site. Given this scenario, a fuel spill at a storage site could occur and potentially impact fish. Possible impacts are presented below in "Effects of Spills."

Recreation activities are similar to mobile research camps in that they are likely to be short term in nature with daily or frequent movements between sites. Impacts from this activity include potential fuel spills and sport fish harvest. Fuels in these camps are likely to be limited to stove fuel and possibly gas used in boat motors. The risk of water contamination by a spill is negligible given the types of containment used and the small amounts of fuel involved. Fishing activity is widely dispersed for float trip parties. Eight parties (Table IV-28) with four persons per party are expected to float or use boats in the Planning Area in any given year. Based on past BLM permitting experience, it is expected that almost all fish caught would be released. Similarly, fishing activities at research camps involve mostly catch and release. Therefore, impacts to fish from hook-and-line fishing are not expected.

Overland moves are permitted during the winter after the ground is frozen and there is sufficient snow cover. Common routes of travel include Prudhoe Bay or Oliktok to Barrow, Barrow to Wainwright, or Barrow to Atqasuk. Typical routes are over the sea ice between Prudhoe Bay and Barrow, and over upland terrain from Barrow to Wainwright and Atqasuk. An estimated 20 to 60 trips per year are anticipated. The most likely source of concern to fish and their habitat during this activity is a fuel spill. Most spills are expected to be small (< 5 gallons) and would occur during fuel transfer. A larger spill from a fuel tank is less likely, though possible. Impacts related to spills are discussed in this section under "Effects of Spills."

Non-oil and gas actions associated with the Preferred Alternative that could cause disturbance to fish are similar to those described under the other alternatives. Measurable effects on arctic fish populations in, and adjacent to, the Planning Area over the life of this plan are not expected.

(2) Effects of Oil and Gas Activities

The following discussion of impacts from oil and gas exploration and development encompasses impacts to fish found within and adjacent to the Planning Area. Waterways that border the Planning Area are included in this analysis because freshwater and anadromous/amphidromous species can migrate between connected rivers and lakes.

If there are impacts to fish outside the Planning Area, they would most likely occur near the borders of the Planning Area (e.g., Ikpikpuk River) during oil and gas development. Material site excavation, construction of pads, roads, and airstrips, and spills (oil, gas, sea water) could have direct and indirect impacts on fish. The effects would be the same those as discussed for species within and adjacent to the Planning Area.

(a) Effects of Disturbances

1) Exploration

a) Effects from Seismic Surveys

Seismic programs in the Northwest NPR-A Planning Area are expected to use Vibroseis as the technique for seismic data collection. Acoustical energy pulses emitted by this equipment can locate subsurface geological structures that might contain oil or gas. The energy pulses are generated by special vibrator equipment mounted on all-terrain, low-ground-pressure vehicles. The equipment used can collect either 2-D or 3-D data depending upon evaluation needs. A typical 2-D operation would be expected to cover 400 to 800 line-miles per season, while a 3-D operation covering a 30- x 15-mi survey area would contain approximately 5,625 line-miles of data.

Survey lines in both 2-D and 3-D seismic operations form a grid and pass over both land and water (ice-covered lakes) in the course of data collection. Some of the lakes can be expected to harbor fish. When a vibrator operates on floating ice, a considerable portion of the wave field travels horizontally within the ice and water layers. Possible impacts to local populations of fish from the pressure waves are a concern to consumptive users and biologists. In an effort to quantify pressure wave action, Nyland (2002) conducted a field test on an unnamed fish bearing lake in the Colville River Delta in northern Alaska. Average ice thickness was 1.8 m and average water depth was 1.6 m. Vibrators were used to emit pressure waves at distances from 7.3 to 1,000 m from a base point in the lake. Hydrophones in the water collected the sound pressure levels. Variation in sound levels with the distance from the source and peak particle velocities were measured. Though no fish were examined as part of this study, maximum sound pressures recorded were below the Alaska Department of Fish and Game (ADF&G) guidelines for instantaneous pressure changes allowed in the swim bladders of fish.

Under the Preferred Alternative, it is assumed that two 2-D or 3-D seismic operations would occur each year in the Planning Area. Arctic fish are likely to be adversely affected by seismic surveys located above overwintering areas. The effects of vibration on most overwintering fish are expected to be short term and sub-lethal. Likely effects would include avoidance behavior and short term stress.

Based on the study outlined above, the relatively small number of seismic surveys expected, the short time duration of the pressure impulses in any given spot (several seconds), and the low density of arctic fish in most of the Planning Area in the winter, seismic surveys are not expected to have a perceptible effect on populations of arctic fish.

Fuel spills associated with seismic surveys are likely to be small (less than 5 gallons) and are unlikely to reach fish habitat. Refueling and storage are stipulated to occur at least 500 ft from fish-bearing waterbodies. The only exception is refueling of light duty equipment. Likely sources of spills are from tanks and from transfer of fuel from storage systems to equipment. Most spills would be contained with onsite absorbents. Hence, fuel spills associated with the Preferred Alternative are expected to have the same overall effect on fish populations as discussed for the other alternatives (e.g., no measurable effect on arctic fish populations).

b) Effects from Construction

Construction-related activities that may affect arctic fish include water withdrawal for construction of drill pads, roads, and airstrips, and discharges related to exploratory drilling.

Under the Preferred Alternative, it is anticipated that 5 to 12 exploration wells and 2 to 18 delineation wells would be drilled in the Planning Area as a result of the first lease sale (Table IV-05), for a total of 7 to 30 wells on ice pads. Assuming that the average ice pad is 500 ft by 500 ft (5.7 acres), water needs would equate to approximately 2 million gallons for each drill pad for a total of 14 to 60 million gallons of water. Each mile of ice road requires up to 1.5 million gallons of water to construct. It is assumed that 0 to 2 ice roads, 25 to 50 mi long, would be built each season for a maximum annual water need of 150 million gallons. Water needed for 3 drilling rigs, associated camps and airstrips, and maintenance of roads, pads, and airstrips would add approximately another 85 million gallons to the annual water use budget. Total annual maximum water need is estimated at 295 million gallons. When compared to the other alternatives, the water needs for exploration activity in the Preferred Alternative are approximately 30 percent less than Alternative A, similar to Alternative B needs, and 240 percent more than Alternative C.

Drill pads, roads, and airstrips (if needed) would be constructed of ice. These activities occur in the winter and could adversely affect arctic fish depending on the location of the construction and the quantity of freshwater withdrawn. For example, estimates by Craig (1989a) suggest that substantially less than 5 percent of the stream habitat on the North Slope is available to fish at the end of the winter season. In the Northwest NPR-A Planning Area, fish, such as grayling and whitefish species, that inhabit rivers in the winter, are limited to deeper pools that do not freeze. These pools provide a much smaller habitable space for fish than lakes. The amount of available overwintering habitat in any given pool varies naturally each year depending on the severity of the air temperatures and the amount of snow cover. Colder temperatures and lack of snow cause increased ice formation. This condition decreases available water in any given pool and can restrict flow which forces water to the surface and eliminates flow to downstream pools. Given that fish are essentially "confined" to overwintering sites, the severity of the weather, and in turn, a decreased water supply, can cause stress and mortality from overcrowding and oxygen depletion. Reproductive success can also be affected if eggs are frozen on the spawning grounds. If water were to be withdrawn from rivers for exploration purposes, the conditions described above would be exacerbated. The concern lies in that although the amount of free water and oxygen conditions may be adequate for fish survival at the time water is withdrawn in December and January when water is needed for pads, roads, and other construction, the fish are dependent on suitable living conditions of a particular pool until spring break up. Not being able to predict the severity of the freeze down (which is weather dependent), and thus the living conditions from time of use until breakup, may cause increased or complete mortality at overwintering pools. Dissolved oxygen concentrations could be reduced below the 7 ppm dissolved oxygen standard needed to sustain fish species (ADEC, 1999) and the increase in metabolic by-products may be fatal. Schmidt et al. (1989) reported such a loss under natural conditions in the Sagavanirktok River. Adverse effects of dewatering pools are also known from the Sagavanirktok River during early development of the Prudhoe Bay oil field.

Total fish loss in a river would be dependent on how many pools are tapped. Assuming that the entire population of any given species in a drainage is spread out between overwintering sites in a river or adjacent lakes, the loss in any given pool would not eliminate a population. Tapping multiple pools increases losses and recovery times for populations. Though reproductive strategies for arctic species are known, recovery times are difficult to predict

given the uncertainty of the numbers associated with any given loss(es) as compared to the total population abundance in the system.

Concerns related to river water withdrawal have been alleviated in the Preferred Alternative. In an effort to maintain fish populations and habitat, the Required Operating Procedures for the Preferred Alternative prohibit winter water withdrawal from rivers.

Fish have also responded to habitat reductions in winter by adopting migration patterns that take them to deep lakes. Fish overwintering in these lakes have a restricted supply of fresh water. Under natural conditions, most lakes in the NPR-A coastal plain tend to be supersaturated with oxygen (USDOI, BLM, 1998).

Construction activities such as airstrip or road construction over a lake, or water withdrawal to build pads, roads and airstrips, have the potential to impact all Planning Area freshwater and anadromous/amphidromous fish that inhabit these overwintering sites. The construction of an ice road or airstrip over a lake with minimal free water could cause freezedown 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. Their survival at these overwintering sites depends on an adequate supply of freshwater and dissolved oxygen.

Sources of freshwater within the Planning Area vary greatly in the amount of under-ice water available for construction during winter. Many lakes along the coastal plain are relatively shallow (6 ft), do not support fish populations, and are frozen to the bottom in winter. These lakes are a possible source of ice chips for winter construction. Use of ice chips would lessen the need for fresh water withdrawal. Shallow lakes may also provide water for construction in December and January (before complete freezedown) since ice depths are likely to be approximately 3 ft at this time of the year. Withdrawals from these lakes would not impact fish.

Those lakes deep enough to permit under-ice withdrawals for construction are also likely to support overwintering fish. Under-ice withdrawals from areas having water levels that are barely to moderately sufficient to support overwintering fish could negatively change the water chemistry to a point where a fish kill is possible. "Best Management Practices" implemented by federal and state agencies commonly provide protection by monitoring withdrawals through a sampling program that ensures water quality standards are met and by limiting water withdrawal to 15 percent of the estimated free water volume (excluding ice) in lakes ($\geq$ 7 ft in depth). Additional draw down is possible if no fish are known to inhabit the lake or if the proponent demonstrates that use beyond 15 percent would cause no harm. Lakes (< 7 ft deep) that are interconnected with streams are also in need of protection when inhabited by fish.

Assuming the AO follows the above common practices when approving water withdrawals, lake water withdrawal associated with the Preferred Alternative might be expected to kill a small number of individual fish but is expected to have no measurable effect on arctic fish populations in the Planning Area.

Exploratory drilling on lakebeds and streams could also impact fish under the Preferred Alternative. Drilling fluids could cause impacts depending on storage and disposal. In most instances, drilling wastes are reinjected into the wells immediately. However, if cuttings were allowed to be temporarily stored to facilitate reinjection or backhaul, water quality could be degraded. The impact to fish is indirect. Results of past studies have shown toxicity to sensitive zooplankton, which, as a group, are prey species to fish (Woodward et al, 1988, in USDOI, BLM ,1998). Proper and immediate disposal would minimize impacts.

2) Development

Activities related to development that could impact fish include excavation of material sites, construction of pipelines, pads, roads, airstrips, and causeways; and water withdrawals.

Material sites (for gravel extraction) needed for construction of roads, pads, pipelines, and airstrips have not been identified in the Northwest NPR-A Planning Area. A likely source includes river drainages. Other possibilities include importing gravel from borrow sites east of the Colville River, extracting gravel from existing sites, processing bedrock, and using ice or composite pads. For this analysis, it is assumed that 4 oil and gas fields would be developed (Table IV-04). Each field is expected to have a footprint of 100 acres requiring one million square yards of gravel. Total gravel needs would equal four million cubic yards if 4 fields were developed. Using composite (blended mixtures of sand/silt/foam) could potentially reduce gravel needs by 33 to 50 percent. Decisions regarding future gravel use and location of pits would be made on a case-by-case basis.

From a broad perspective, 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 a small percent of the Planning Area, gravel removal from these areas would be likely to result in spawning failure (loss of suitable substrate) and mortality (loss of overwintering pools) for many fish within the affected area. Gravel removal from non-overwintering or non-spawning areas of low fish density would likely 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.

Direct and indirect impacts to fish from gravel extraction are most likely to occur within the floodplains of rivers. Detrimental effects could include: loss of spawning and overwintering habitat (if not identified before extraction); blocking and rerouting of stream channels; high silt concentrations resulting in reduced primary production, loss of invertebrate prey species, mortality of fish eggs and larvae, and disruption of feeding patterns for sight dependent feeders (USDOI, BLM, 1989).

Within the Planning Area, gravel has been mined from the Meade River, near Atqasuk, and from lagoons near Barrow and Wainwright. Impacts were reported by Sekerak et al. (1985) for dredging in the Meade River. They noted that size composition, not quantity of sediments, was the most important determinant in effects on water quality (the Meade River is heavily laden with clay deposits). Disturbance during dredging led to fine sediment draining from the stockpile and flowing in suspension at least 60 km downstream. Turbidities and suspended sediments were approximately 20 and 50 times greater, respectively, than background levels. The authors of this study reported that effects of dredging on turbidity and sediment loads were unusually high in the Meade River compared to other North Slope dredging operations. Differences were attributable to high amount of fine sediment (clay) in the mined product. Impacts to specific fish habitat and fish species from future gravel mining are difficult to predict at this time because the potential mining locations are unknown.

One of the beneficial aspects of gravel extraction mining in or near floodplains has been the creation of deep pits that can be used by fish as overwintering habitat. In one instance, two pits were connected to small tundra streams, Arctic grayling were introduced, and the fish developed reproducing populations (Hemming, 1995). Least cisco, grayling, and broad whitefish have been also been documented using abandoned gravel pits connected to streams (Hemming, 1988). Based on the documented successful use of reclaimed gravel pits by fish, future mitigation of gravel pits should incorporate prescriptions to create fish habitat when feasible.

During production operations, drill pads, roads, and airstrips would be constructed of gravel. One impact related to these structures is the potential to alter flow patterns to, and within, waterbodies. Bridges, culverts, and low-flow crossings are integral features to road development. They can also interfere with migrations to spawning, feeding, and overwintering sites if improperly designed. Examples of problems in maintaining adequate flows for fish passage from past oil field development include placement of under-sized culverts and perching of culverts. Current concerns related to pad and road placement include diverting or eliminating flow from small tributaries that connect lakes or connect lakes and rivers. Whitefish species found in the planning area that move between these habitat types are vulnerable to impact. Potential loss of migratory capacity could stress

or kill these fish if they are unable to migrate to food-rich habitat in the summer, reach spawning areas, or move into overwintering habitat. Proper placement of these structures is critical in minimizing impacts to fish.

A second impact related to drill pads, roads, and airstrip construction is erosion and subsequent in-stream sedimentation. Destructive effects are similar to those discussed in the gravel-mining portion of this section and would be prevalent in river systems. All members of the biotic community could be affected. Potential effects of sedimentation on benthic macroinvertebrates, which are prey species for fish, include interference with respiration and interruption of filter feeding insects' capability to secure food. A more important impact to benthic invertebrates would be smothering of physical habitat (the streambed) by heavy sediments. A loss of interstitial space in the substrate would be highly detrimental to burrowing species. A decrease in abundance could be expected in these situations. In arctic environs, where fish depend on summer food sources to grow and, if food is abundant, to reproduce, a reduced prey base may preclude fish from directing energy towards spawning.

Direct threats to fish from sediment include changes to physical habitat, subsequent decreased reproductive success and loss of rearing habitat. Physical habitat changes from sediments are most often attributed to finer size particles. Developing eggs can be smothered and newly hatched fry can be killed by suspended sediment that prevents emergence from spawning gravels and interferes with respiration. Embedded sediments fill interstitial spaces and essential winter habitat used by juvenile fish. Filling of pool habitat further limits overwintering sites for adult and juvenile fish. In instances where stream reaches are aggrading due to heavy sediment loading, physical habitat is further degraded when flows are redirected and erode channel banks.

Sub-lethal impacts to fish from sedimentation are a further concern in stream environs. Effects such as avoidance, reduced feeding, and lessened tolerance to disease can work in combination to reduce fitness and survival. Habitat fouling would be especially detrimental if it occurred in a critical habitat segment of a river.

To minimize impacts to fish from unwanted erosion and sedimentation construction activities require adequate controls. Proper road surfacing and drainage, adequate cross-drainage, minimal number of stream crossings, and armoring and vegetation planting are some of the key features needed to minimize sedimentation and subsequent impacts to fish. Overall, impacts from sedimentation and altered flow patterns related to construction of drill pads, roads, and airstrips should be minor if adequate controls are in place. Impacts from erosion should be short term and proper placement of these structures, in combination with adequate and properly sited drainage systems, should minimize fish loss.

During production, up to 205 mi of pipeline (Table IV-29) within and east of the Planning Area to the Kuparuk oil field are projected to be constructed as a result of developing leases sold during the first sale under the Preferred Alternative. It is assumed pipelines would be constructed in winter, either from ice roads or via vehicular travel on the tundra. Pipeline alignments would generally be routed to avoid crossing lakes, though small shallow lakes may have elevated VSM's across them. New pipelines constructed on land, and around the shoreline of deeper lakes, would be suspended on VSM's. Pipe 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 would 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. Effects would be the degradation or loss of overwintering and spawning habitat, resulting in spawning displacement and mortality for those fish near the disturbance. 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. 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.

The construction of overland gas pipelines through waters supporting fish is likely to displace small numbers of fish short distances. However, those affected would soon reoccupy that habitat upon completion of the activities and would be otherwise unaffected. For these reasons, natural gas exploration and development is not likely to

have a measurable effect on fish populations.

Given that construction activities are in the winter and overwintering habitats would be largely avoided, it is expected that pipeline construction under the Preferred Alternative would have no measurable effect on arctic fish populations in the Planning Area.

The Preferred Alternative could also result in 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 and 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 is expected to be constructed in shallow nearshore waters. Additionally, the size of the facility is expected to be relatively small (up to several hundred feet), and to provide for the movement of coastal fish. Prohibiting causeways and docks in river mouths and deltas would offer further protection to migratory and marine fish species feeding in nearshore waters. Given the implementation of siting and design considerations discussed above, the construction of a coastal docking facility under the Preferred Alternative is not expected to have a measurable effect on arctic fish.

Water is needed during development for drilling, camp use, and ice roads for staging materials and equipment used in constructing new fields. Estimated quantities that may be required are derived from analysis of Alpine field development. Potable water demand (350-person crew) would be 35,000 gallons/day. Drilling water demand is estimated at 21,000 to 63,000 gallons/day. Since drilling locations are unknown, water demand for ice roads is not estimated. Impacts of water withdrawal are similar to those discussed in the exploration portion of this analysis.

(b) Effects of Spills

For the Northwest NPR-A Planning Area, the total estimate of oil spilled under the Preferred Alternative is given as a range based on an $18/bbl or $30/bbl scenario. No spills are assumed at $18/bbl. Assumed crude spill sizes at $30/bbl include 500 or 900 bbl for a large spill ($\geq$ 500 bbl) (Table IV-19) and 336 bbl for small spills (< 500 bbl) (Table IV-20). For small spills, an estimated 112 spills might occur at an assumed size of 3 bbl/spill (Table IV-17). Refined oil spill amounts are estimated at 194 bbl (Table IV-20). The oil spill analysis estimates that 65 to 80 percent of the crude oil spills associated with oil production in the Northwest NPR-A would occur on a drilling-pad. Most of the refined spills are likely to occur on pads. Because drilling-pad oil spills typically are small 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. Most of these cover a small area (about 500 ft^2). Impacts of these spills are discussed below.

The effects of oil spills on fish have been discussed in previous Beaufort Sea EIS's (e.g., Sale 144 final EIS [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 Starr, Kuwada, and Trasky, 1981; Hamilton, Starr, and Trasky, 1979; and Malins, 1977, for more detailed discussions). The specific effect depends on the concentration of petroleum present, the length of exposure, and the stage of fish development involved (eggs, larva, and juveniles are most sensitive). If lethal concentrations are encountered (or sub-lethal concentrations 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 percent of test organisms [LC50]) for fish generally are on the order of 1 to 10 ppm. Concentrations observed under the slicks 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 sub-lethal 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.

If a fuel spill of sufficient size were to occur in a small, fish-containing body of water with restricted water exchange, lethal and sub-lethal effects would be expected on most of the fish and food resources in that waterbody. Toxic concentrations of oil in a confined area would have greater lethal impacts on larval fish versus adults. McKim (1977) reviewed results from 56 toxicity tests and found that, in most instances, larval and juvenile stages were more sensitive than adults or eggs. Increased mortality of larval fish is expected since they are relatively immobile and are often found at the water's surface where contact with oil is most likely. Adults may be able to avoid contact with oiled waters during a spill in the open water season but survival would be expected to decrease if oil were to reach an isolated pool of ice covered water. An example of the impacts to fish food resources is provided by Barsdate et al. (1980), who studied the limnology of an arctic pond (490 m^2) with no outlet near Barrow after an experimental oil spill. They found that half of the oil was lost during the first year. The remaining oil was trapped along the edge of the pond with most of it sunk to the bottom by the end of summer. Researchers found no change in pH, alkalinity, or nutrient concentrations. Photosynthesis was briefly reduced and then returned to normal levels after several months. *Carex aquatilis*, a vascular plant, was impacted after the first year as a result of emerging leaves encountering oil. Certain aquatic insects and invertebrates that lived in these plant beds were reduced in numbers, presumably from entrapment in the oil on plant stems. Some of the insects were still absent 6 years after the spill. Since there were no fish in this pond the impact of the loss of a prey base to the fish could not be measured. However, reducing food resources in a closed lake, as described above, would decrease fitness and potentially reduce reproduction until prey species recovered.

Though lethal effects of oil on fish have been established in laboratory studies (Rice et al., 1979; Moles, Rice, and Korn, 1979), large kills following oil spills are not well documented. This is likely because toxic concentrations are seldom reached (Rice, 1985). For the Planning Area, most fuel spills are expected to occur on the pad where the fuel is stored and would not come in contact with fish habitat. In instances where oil does reach the water, sub-lethal effects are more likely to occur, including changes in growth, feeding, fecundity, 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. Areas of high fish concentration, including overwintering and estuarine feeding sites, provide the most potential for impact. Amphidromous species that inhabit planning area waters have a higher risk of impact due to their use of both of these habitat types.

Given the small size of the fuel spills anticipated and that occurrence is most likely on pads, fuel spills associated with the Preferred Alternative are not expected to have a measurable effect on arctic fish populations in the Planning Area over the life of this plan. Fuel spills occurring in a small, fish-containing body of water with restricted water exchange might kill a small number of individual fish, but are expected to have no measurable effect on arctic fish populations.

Natural gas exploration and development could adversely affect arctic fish from a natural gas blowout. In the unlikely event a natural gas blowout were to occur, 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. In general, very few fish are likely to be affected by a blowout, and any effects would not be measurable at the population level.

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 less likely to be affected by seawater spills because of 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 waterbodies seawater spills are expected to have from no effect to sub-lethal 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. 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 are not expected to have a measurable effect on arctic fish populations in the Planning Area over the production life of the field.

(c) Summary

The primary effects of the Preferred Alternative on freshwater fish would be from water withdrawal from rivers and lakes. The ROP's for this alternative limit potential loss of fish by precluding water withdrawals from streams in winter and limiting the volume of water withdrawn from lakes. Activities related to development that could impact fish include excavation of material sites and construction of pipelines, pads, roads, airstrips, and causeways. Gravel extraction has potential for habitat creation and enhancement. Impacts from sedimentation and altered flow patterns related to construction of drill pads, roads, and airstrips should be minor if adequate controls are in place. Given the small estimated size of the fuel spills and the fact that such spills are most likely to occur on drill pads, fuel spills associated with Preferred Alternative activities are not expected to have a measurable effect on the arctic fish populations in and adjacent to the Planning Area. Fuel spills occurring in a small fish-containing body of water with restricted water exchange might be expected to kill a small number of individual fish. In the event a natural gas blowout occurred, some fish in the immediate vicinity might be killed.

(3) Effectiveness of Stipulations and Required Operating Procedures

ROP's A-3, A-4, and A-5 would provide increased protection to fish and fish habitat during fuel use, handling, and storage. Stipulations B-1 and B-2 would provide protection for water withdrawals from rivers and lakes. ROP C-4 would protect rivers and lakes from additional freezedown. Stipulation D-1 would reduce impacts during oil and gas exploratory drilling. Stipulation E-3 would reduce the potential for disruption of fish passage. ROP's A-6, A-7, C-2, C-3, E-6, and E-8, and stipulations E-2, K-1, K-2, K-3, and K-8 would also be beneficial to fish habitat and fish.

(4) Conclusion--First Sale

Construction of pads, roads, and airstrips, and fuel spills associated with Preferred Alternative activities might be expected to kill a small number of individual fish, but are expected to have no measurable effect on arctic fish populations. Potential mortality from water withdrawals in lakes is also possible, although limits on withdrawal and monitoring of water quality should minimize concerns. Gravel extractions can lead to habitat enhancement under certain situations. Seismic surveys, non-oil and gas activities, causeways, and seawater spills under the Preferred Alternative are not expected to have a measurable effect on arctic fish populations over the production life of the oil fields. Potential mitigation measures address water withdrawal in rivers and lakes and gravel extraction.

(5) Multiple Sales

It is assumed that multiple sales under the Preferred Alternative would result in the development of an additional

4 oil/gas fields (Table IV-04 and Table IV-06), that exploratory well numbers would increase from 5 to 12 under a single sale to 15 to 36 for multiple sales, and delineation wells would increase from 2 to 18 under a single sale to 6 to 36 (Table IV-07). An additional 340 mi of pipeline is projected (Table IV-29). Seismic activity would remain the same.

Water withdrawals would increase in proportion to the activity level. Given the large number of lakes in the area likely to be developed, water withdrawal could be spread across a number of lakes. Increased water use is not expected to impact fish more severely than under a single sale. More production pads and roads for multiple sales are likely to have about twice the effect on arctic fish as the first sale (Table IV-05 and Table IV-07). It is estimated that the amount of crude oil spilled would double. The impacts would also double, though they would still be minor. However, if there were not enough time between activities to allow for full recovery, or if the level of activity of the selected alternative was to be significantly greater than that of the first sale, the effect of each additional sale on arctic fish populations would likely to be greater than estimated herein for multiple sales.

(6) Conclusion--Multiple Sales

Seismic surveys and pipelines associated with multiple sales are expected to have the same overall effect on arctic fish populations as with the first sale. Production pads and roads are expected to have about twice the effect as with the first sale. Fuel and oil spills are likely to have a greater, though still minor, 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.

b. Marine Fish

Under the Preferred Alternative, all lands within the Northwest NPR-A Planning Area would be available for oil and gas leasing. However, leasing would be deferred for 10 years on approximately 1,570,000 acres (about 17%) of the Planning Area in the vicinity of Wainwright. Stipulations and Required Operating Procedures would provide clearly defined setbacks, restrictions (including seasonal restrictions) and guidance for all aspects of oil and gas and related operations. Additional site-specific/activity-specific prohibitions and restrictions would be provided to protect marine fishes and their habitat. Several species of marine fish (see Figure III-25) occur year round or seasonally in coastal or marine waters in or adjacent to the Planning Area. Under the Preferred Alternative, some marine fishes may be impacted by oil and gas exploration and development activities.

On Dease Inlet, Admiralty Bay, Elson Lagoon, and the Barrier Islands there would be stipulations for exploration and development including a setback of ¾ mi seaward from shore and around natural islands (excluding the barrier islands) where no development could occur on or under the water. No exploration could occur between May 15 and October 15. Lease stipulations and associated standards for exploration and development activities are set high with the burden of proof resting with the lessee to demonstrate that approval by BLM is warranted.

(1) Effects of Non-Oil and Gas Activities

Activities not related to oil and gas exploration and development are not likely to have a measurable effect on marine fishes.

(2) Effects of Oil and Gas Activities

Oil and gas industry activities likely to affect marine fishes stem from seismic surveys, coastal construction and development, vessel traffic, and chemical spills (including oil or diesel spills). Such activities could be adverse or beneficial--or both--to marine fishes and their habitat. Additional details on these activities and their potential impacts are discussed below and can also be found in the MMS Beaufort Sea EIS (USDOI, MMS, 2003).

(a) Effects of Disturbances

Marine fishes and their habitat may be affected by the following routine impact-producing factors: seismic surveys, coastal construction and development, and marine vessel traffic. Such routine activities may result in lethal and/or sublethal impacts to marine fishes. Some species may be adversely impacted, while others may benefit from the impact-producing factors, although those species benefiting and those suffering adverse impacts would depend on a suite of dynamic variables. For example, the construction of a coastal docking facility may temporarily displace individuals of a species (e.g., arctic flounder) from the seafloor where construction is occurring, however, after construction ceases, the underwater footprint and structure of the docking facility may offer new heterogeneity refugia or habitat that could be exploited and repopulated by the displaced species (e.g., arctic flounder), and/or utilized by other species (e.g., snailfishes, prey species).

Seismic surveys in coastal waters of the Planning Area may be conducted during colder months. Vibroseis is the commonly used sound source for siesmic surveying in the arctic. Vibroseis, if used on sea ice, may temporarily disturb marine fishes that are in the proximate area, however, such impacts are not regarded to be biologically significant.

Drilling inland is not expected to yield measurable impacts to marine fishes or their habitats. However, onshore and offshore coastal lands are available for leasing, thereby probably leading to exploration and development; drilling in coastal waters may impact marine fishes and their habitat. Drilling introduces noise into the coastal/marine environment that may temporarily disturb marine fishes (e.g., Arctic cod, fourhorn sculpin, or Arctic flounder) or their prey (e.g., mysids and amphipods). Such effects are not expected to be biologically significant or measurable. Such disturbance may be advantageous to some individual fishes or species, or adverse for some species--or both. The North Slope is a zero discharge area, hence, drilling muds and cuttings are not expected to be introduced into coastal/marine waters where they might impact early life stages of marine fishes or introduce constituents into the food web for bioaccumulation or biomagnification.

The construction of various facilities associated with the Preferred Alternative may impact marine fishes. Those construction projects most likely to impact marine fishes include: coastal staging facilities, particularly docking facilities; coastal drilling or production facilities; waterflooding intake and treatment plants; causeways; and pipelines. Construction of docking facilities and similar staging facilities, particularly if they are located in coastal/marine waters would diminish the area available as fish habitat, yet also possibly create new habitat (most notably refugia) Also like coastal drilling, construction in coastal/marine waters would introduce additional noise into marine fish habitat, thereby possibly disturbing fishes or their prey. Such acoustic disturbance is expected to be localized and limited to the periods of noise production. The impacts may be adverse or beneficial, depending on the species and life history assemblages present at the time of construction activity. If the amount of coastal/marine construction of facilities is restricted in scope and activity (i.e. one coastal staging facility of limited size) over the lifetime of the Preferred Alternative, the impacts are not expected to be biologically significant or measurable.

Waterflooding intake and treatment plants may entrap and impinge marine fishes, if the intake is located where such fishes occur. Approximately 1.5 million fish larvae of 9 fish species were estimated to have been entrained in the Prudhoe Bay facility in 1985 (NRC, 2003). The cumulative impacts to marine fish populations in the region as a result of constructing additional waterflood intakes from coastal waters is difficult to predict, since the

abundance and population dynamics of the various marine fishes inhabiting the Planning Area and adjacent waters is poorly known or understood.

Construction of causeways may impact marine fishes. Causeways in the Beaufort Sea are among the most intensively studied anywhere (NRC, 2003). According to the NRC (2003), causeway studies revealed that, when wind is from the east, a wake eddy forms on the west side of the causeways that allows cold, high-salinity water to reach the surface. The cell of cold water on the west side of West Dock (a causeway on the Beaufort Sea) is the mechanism that most likely impedes fish movements. However, the issue of whether such impedance of fish movements by causeways is biologically significant is heavily disputed. The NRC (2003) cited Gallaway and Fechhelm (2000) as concluding that fish populations in the region appear to be fluctuating in response to naturally occurring physical phenomena, and that effects of existing causeways have been at least partially mitigated with retrofitted breaches, thereby permitting fish movement through the causeways. If causeways are constructed they may impact some marine fish species, but their impacts may be mitigated by incorporating breaches that permit fish movement. Causeways may also provide new habitat and refugia to marine fishes and their prey.

The construction of pipelines in coastal/marine waters may temporarily disturb marine fishes and their prey. Emplacement of a pipeline in coastal waters may destroy habitat or result in lethal and sublethal impacts to prey. Such impacts are expected to be localized and limited to period of physical disturbance caused by pipeline construction. Marine fishes may scatter from the area of physical disturbance for a short period, and return following the abatement of disturbance. Some marine fish species may return to the disturbed area to scavenge on benthic invertebrates that are displaced, killed or injured by the placement of the pipeline (a beneficial impact to some marine fishes).

Decommissioning and abandonment of facilities involves the removal of equipment and restoration of the facility site. Associated abandonment activities may result in disturbances of coastal/marine waters (e.g. decommissioning of a docking facility). Abandonment operations may occur over a period of years, although timing and scope of actual disturbances as a result of the operations may vary. Decommissioning and abandonment operations may result in lethal or sublethal effects to marine fishes and their prey, as well as destroy marine fish habitat created by the structures being decommissioned and dismantled. Some marine fishes may be opportunistically consumed by various predators, including other marine fishes, as individuals are suddenly exposed as a result of destroying refugia (e.g. pipes, braces, pilings, etc.) during decommissioning operations. In such cases, decommissioning and abandonment operations may be beneficial to some individual marine fishes, and/or adverse for other marine fishes.

Inland and coastal oil and gas exploration and development operations are contingent on logistic supplies and equipment barged into the region. Marine vessel traffic introduces ancillary acoustic noise and physical disturbances into the coastal/marine environment. Such acoustic or physical disturbances may be adverse and/or beneficial to marine fishes and their habitats, however, the disturbances are not believed to be biologically significant or measurable.

(b) Effects of Spills

Hydrocarbon spills may adversely impact marine fishes of any life history stage. Such impacts may include sublethal and/or lethal effects. The intensity of the effects upon a marine fish population or assemblage of species is dependent on a suite of dynamic factors. The size of the spill does not necessarily directly relate to the number of individuals that may be impacted. Hydrocarbons may be introduced into the coastal/marine environment as a result of marine vessel overboard discharges or facility spills.

Oil spills can more specifically affect marine fishes and their habitat in many ways, including the following:

- cause unnatural mortality to eggs and immature stages, abnormal development, or delayed growth from acute or chronic exposures in spawning or nursery areas;
- impede the access of migratory fishes to spawning habitat because of contaminated waterways;
- alter behavior;
- displace individuals from preferred habitat;
- constrain or eliminate prey populations normally available for consumption;
- impair feeding, growth, or reproduction;
- contaminate organs and tissues and cause physiological responses, including stress;
- reduce individual fitness and survival, thereby increasing susceptibility to predation, parasitism, zoonotic diseases, or other environmental perturbations;
- increase or introduce genetic abnormalities within gene pools, and
- modify community structure that benefits some fisheries resources and detracts from others.

Concentrations of petroleum hydrocarbons are acutely toxic to finfishes a short distance from and a short time after a spill event (Malins, 1977; Kinney, Button, and Schell, 1969). However, the majority of adult finfish are able to leave or avoid areas of heavy pollution and thus avoid acute intoxication and toxicity. Evidence indicates that populations of free-swimming finfish are not injured by oil spills in the open sea (Patin, 1999). Conversely, floating eggs, and juvenile stages of many species can be killed when contacted by oil (Patin, 1999), regardless of the habitat. In coastal shallow waters with slow water exchange, oil spills may kill or injure demersal finfish, shellfish, and other invertebrates in addition to cultivated species.

The contact of aquatic organisms with oil most often results in the appearance of oil odor and flavor in their tissues (Patin, 1999). In the case of commercially valued fishery resources, this certainly means the loss of their value and corresponding fisheries losses. Experimental studies show that the range of water concentrations of oil causing the taint in fish, crustaceans, and mollusks is very wide. Usually these concentrations vary between 0.01 and 1.0 milligrams per liter, depending on the oil type, composition, form (dissolved, slick, emulsion), duration and conditions of exposure, kind of organism, and other factors (Patin, 1999). Migratory fishes (for example, salmon or herring) tainted by oil in one location may move well beyond the recognized boundaries of an oil spill, thereby becoming available for harvesting elsewhere. Patin (1999) drew the following conclusions from various studies devoted to the tainting of commercial organisms in oil-polluted areas:

- The contact of commercial fish and invertebrates with oil during accidental oil spills practically always leads to accumulation of oil hydrocarbons in their tissues and organs (usually within the ranges of 1 to 100 milligrams per kilogram). In most cases, the organisms acquire an oil odor and flavor. This fact is the main reason for closing fisheries in the affected area.

- Species reared in coastal mariculture/aquaculture facilities can be exposed to severe impact of accidental oil spills. Observations showed that several months after the spill, salmon cultivated at facilities still had elevated concentrations of oil hydrocarbons in their tissues and suffered diseases and increased mortality (citing MLA, 1993a).

While tainting of fisheries resources in some regions may not pose a real threat to consumers (for example, the North Sea), fish tainting can be a real problem, especially for coastal fishing and aquaculture (Patin, 1999).

The most serious concerns arise regarding the potential sublethal effects in fisheries resources (including commercially valued species) when exposed to chronic contamination within their habitats (Patin, 1999). It is striking that the toxicity of oil pollution to aquatic populations has been seriously underestimated by standard short-term toxicity assays, and the habitat damage that results from oil contamination has been correspondingly underestimated (Ott, Peterson, and Rice, 2001). Research studies show that intertidal or shallow benthic substrates

may become sources of persistent pollution by toxic polycyclic aromatic hydrocarbons following oil spills or from chronic discharges (Rice et al., 2000). Bivalves exposed to background contamination of polycyclic aromatic hydrocarbons may experience biological responses at the cellular level, disease, and histopathological changes (Patin, 1999). Finfish sublethal responses include a wide range of compensational changes (Patin, 1999). These start at the subcellular level and first have a biochemical and molecular nature. Recent research, mostly motivated by the *Exxon Valdez* oil spill, has found (1) polycyclic aromatic hydrocarbons are released from oil films and droplets at progressively slower rates with increasing molecular weight, leading to greater persistence of larger polycyclic aromatic hydrocarbons; (2) eggs from demersally-spawning fish species accumulate dissolved polycyclic aromatic hydrocarbons released from oiled substrates, even when the oil is heavily weathered; and (3) polycyclic aromatic hydrocarbons accumulated from aqueous concentrations of less than 1 part per billion can lead to adverse sequelae appearing at random over an exposed individual's lifespan (Rice et al., 2000). These adverse effects likely result from genetic damage acquired during early embryogenesis caused by superoxide production in response to polycyclic aromatic hydrocarbons. Therefore, oil poisoning is slow acting following embryonic exposure, and adverse consequences may not manifest until much later in life. The frequency of any one symptom usually is low, but cumulative effects of all symptoms may be considerably higher (Rice et al., 2000). For example, if chronic exposures persist, stress may manifest sublethal effects later in a form of histological, physiological, behavioral, and even populational responses, including impairment of feeding, growth, and reproduction (Patin, 1999). Chronic stress and poisoning also may reduce fecundity and survival through increased susceptibility to predation, parasite infestation, and zoonotic diseases. These can affect population abundance and subsequently community structure. For more information summarizing the various adverse effects (both individual and population level) to ichthyofauna or their habitats (see Tables 29 and 30 of Patin, 1999).

There is an estimated 0 to 33 percent chance of one or more spills occurring. For purposes of analysis the spill could be a 500- or 900-bbl spill under the Preferred Alternative (Table IV-19). If this spill were to occur near the Dease Inlet/Admiralty Bay/Elson Lagoon area, some of the oil could reach coastal/marine waters, thereby exposing marine fishes, their prey, and habitats to hydrocarbons.

A range of 0 to 83 crude-oil spills of <1 bbl and 0 to 28 crude-oil spills ≥ 1 bbl and < 500 bbl (total volume of 0 to 336 bbl) and 0 to 227 small fuel-oil spills with an average size of 29 gal are projected to occur onshore under the Preferred Alternative for the first sale (Table App 9-7 and Table App 9-9). These small onshore spills are expected to have little effect on marine fishes. However, some of these spills could enter the Dease Inlet/Admiralty Bay/Elson Lagoon area, thereby exposing some marine fishes, their prey, and habitats to contamination.

Modeling projections of spill movement after entering coastal waters and its subsequent fate are unavailable at this time. Marine fish species (particularly eggs, larvae, and juvenile fishes) inhabiting shallow intertidal and subtidal waters are believed most vulnerable to the acute and chronic effects of oiling, although fishes with early life stages that frequent the upper few meters of the water column also may be acutely and adversely impacted by spilled hydrocarbons. There is a low likelihood that an inland spill may reach coastal/marine waters of the Planning Area, hence, it appears unlikely that a spill would result in a biologically significant or measurable impact to marine fishes. If a spill adversely impacted a rare and native marine fish species or its habitat, it might constitute a biologically significant impact.

A variety of toxic chemicals is used for exploration and production operations. Chemical spills (other than hydrocarbons) may occur. However, their introduction into coastal/marine waters inhabited by marine fishes is regarded as unlikely, chiefly because most permanent facilities would be set back at least ¾ mi from the coastline and ½ mi from a stream or riverbed.

(3) Effectiveness of Stipulations and Required Operating Procedures

Stipulation K-3 would prohibit oil and gas exploration operations on Dease Inlet, Admiralty Bay, and Elson Lagoon (including natural and barrier islands) between the periods of May 15 and October 15 of each season. This greatly minimizes the window of possible impacts to marine fishes and their habitat from exploration operations. The stipulation includes a number of other requirements. However, these requirements include caveats to be applied on a case-by-case basis that may influence their effectiveness.

Stipulation K-6 would require permanent oil and gas facilities to be located ¾ mi inland from the coastline to the extent practicable. Stipulation K-1 would require facility setbacks of ½ to ¾ mi from stream and riverbeds (waterway specific). These stipulations would thereby reduce the potential for accidental spills to enter coastal/marine waters where marine fishes might be impacted. They would increase the opportunity for oil-spill response and cleanup well before they enter either riverine or coastal/marine fish habitats. Consequently, they reduce the potential for a spill to adversely impact marine fishes.

ROP's A-1 through A-7 dealing with waste prevention, handling and disposal and spill prevention reduce the potential for introducing fuel and oil spills into environments inhabited by marine fishes. Because accidental spills occur, the preparation for and response thereto has the potential to greatly mitigate the magnitude of potentially adverse effects of hydrocarbon spills on marine fishes. Hence, the stipulations and ROP's may reduce the number of individual fishes impacted by a spill and the intensity of lethal and sublethal effects upon them.

(4) Conclusion--First Sale

Based on the assumptions discussed in the text, exploration and production activities resulting from the Preferred Alternative are not expected to have a biologically significant or measurable effect on marine fish populations. Hydrocarbons spilled and introduced into coastal/marine waters may adversely impact marine fishes. If such a spill were to occur in coastal/marine waters, it would likely result in lethal and sublethal impacts to marine fishes, particularly eggs, larvae, and juveniles of species that inhabit impacted intertidal, subtidal, and pelagic waters near the coast. Spill residuals in nearshore habitats may adversely impact marine fish populations utilizing such habitat for more than a decade.

(5) Multiple Sales

The most likely events to affect marine fish as a result of multiple lease sales are seismic surveys, drilling, construction, vessel traffic, and chemical spills. Additional NPR-A lease sales would proportionally increase the levels of activities relative to the levels conducted for the first sale, and thereby increase the probability of disturbance or spills into marine fish habitat.

(6) Conclusion--Multiple Sales

Multiple sales may result in increased impacts to marine fishes over those anticipated for a single lease sale. Insufficient recovery time between sales and/or greater levels of activity may result in greater overall imapcts to marine fish.

c. Essential Fish Habitat (EFH)

As discussed in the No Action Alternative (Section IV.B.8.c), EFH is unlikely to be affected. The potential impacts to the few salmon that are present in the Northwest NPR-A Planning Area are much the same as those for all other fish species. Consequently, impacts on salmon, as part of EFH, are evaluated in the freshwater fisheries analysis for this alternative.

9. Birds

This section discusses potentially adverse effects of management actions on non-endangered birds within the Northwest NPR-A Planning Area under the Preferred Alternative. Such actions--including oil and gas exploration and development--potentially could result in: 1) altered distribution, abundance and/or behavior resulting from disturbance during the breeding, molting, or migration periods; 2) alteration of habitats; and 3) effects resulting from pollution of the environment by crude oil or refined products, wastewater, and solid/liquid wastes of various toxicity. This analysis assumes the stipulations and required operating procedures (ROP's) in Section II.C.6 are in place. Nearly all of the approximately 70 species of regularly occurring birds are migrants, seasonally occupying a variety of wetland, tundra, riverine, and marine habitats in or adjacent to the Northwest NPR-A portion of the Arctic Coastal Plain (ACP). Principal bird groups considered here include loons and waterfowl, shorebirds, raptors, passerines, and seabirds.

a. Effects of Non-Oil and Gas Activities

Effects from management actions other than oil and gas exploration and development under the Preferred Alternative are likely to be somewhat greater than those discussed under the No Action Alternative, Section IV.B.9 , summarized below. This is because several categories of anticipated non-oil and gas activities, including aircraft use and duration of summer camp occupation, increase under the Preferred Alternative (Table IV-28). Anticipated numbers of overland trips and Colville River float trips are the same. The No Action Alternative proposes no new protected areas, while the Preferred Alternative proposes the Kasegaluk Lagoon for designation as a Special area and deferral or oil and gas leasing for 10 years in the eastern Northwest NPR-A Planning Area (see discussion under Section V.B.9.b below).

Most ground transport activities occur in winter and thus would not disturb most bird species or affect their habitats. Ptarmigan, gyrfalcon, and snowy owl may be displaced temporarily from vehicle routes--a negligible effect.

Bird species are likely to display variable displacement from within 700 ft to about 3,000 ft of large summer encampments (Grubb et al., 1992; Johnson et al., 2003; Murphy and Anderson, 1993; Skagen, Knight, and Orians, 1991; Stalmaster and Newman, 1978), causing a local decline in nest attempts or nesting success. Of particular concern are species that are sensitive to disturbing activities and are uncommon and/or have shown general or ACP population declines, such as yellow-billed and red-throated loons and Sabine's gull. Local breeding pairs of affected species are likely to experience minor declines in breeding attempts or success from disturbance in summers when camps are occupied. This is likely to vary depending upon the availability of appropriate habitat in the vicinity. Under the Preferred Alternative (as well as Alternatives A, B, and C), occupation of large camps is anticipated to be 12 weeks rather than 6 weeks, as under the No Action Alternative (Table IV-28). However, this difference is not likely to substantially alter the disturbance effects on birds because, in the context of the short arctic breeding season, those that are displaced when the camp is first occupied probably would not return to the area to re-nest after 6 weeks any more than after 12 weeks since there is insufficient time remaining in either scenario to raise a brood. Also, those individuals that are tolerant of camp activity for 6 weeks probably would be tolerant for 12 weeks.

Effects of a few small camps that are in place for a period of 6 to 12 weeks are likely to be negligible for most activities and species, but potentially could cause a minor loss of productivity if larger numbers of camps affect a larger area of habitat occupied by some species that are uncommon, decreasing, or recently declined, as discussed above for large camps. If predators, such as foxes and ravens, are attracted to camps, they may decrease local breeding success of local bird communities--still a negligible population effect. Habitat loss from non-oil and gas activities in Northwest NPR-A, though somewhat greater under the Preferred Alternative than the No Action Alternative, is expected to be negligible. Solid material removal and fuel spill cleanup and remediation may disturb local nesting, brood rearing, or molting birds for varying periods, resulting in a few failed nests or some decreased productivity. However, spills of refined-oil products are likely to be contained and cleaned up before contacting birds. Small groups traveling on the Colville and other rivers at the frequency anticipated are expected to cause negligible disturbance of nesting raptors or passerines. The overall effect of ground-based activities is expected to be negligible, except for the presence of large camps (and small camps if occupied in numerous locations), which could result in minor impacts.

Effects of routine aircraft flights into large camps may range from causing avoidance of certain areas by birds to abandonment of nesting attempts or lowered survival of young--minor effects. Regardless of where they originate, such flights may pass over high-density areas of one or more species. Aerial survey flights for monitoring bird or caribou populations have considerable potential for disturbance of birds because they are flown at low altitude. However, in any given area they are of short duration, and cover only a small percentage of the ACP per season, so areawide disturbance effects are likely to be minimal. Other aerial surveys also cover small percentages of the Planning Area. For this reason, the increase from 2 weeks of wildlife surveys under the No Action Alternative to 3 weeks under the Preferred Alternative--or increase of other surveys from occasional to several 1 to 2 week periods--is not likely to increase disturbance in any given area substantially (Table IV-28). In isolated areas, aircraft effects are likely to be negligible.

Quantitative effects of most factors may be difficult to separate from natural variation in population numbers. Stipulations and ROP's would minimize disturbance from most factors, prevent spilled fuel from reaching surrounding habitats, and help prevent pollution and degradation of essential bird habitats.

b. Effects of Oil and Gas Activities

Oil and gas leasing, exploration, and development/production is anticipated for all BLM-administered lands in the Planning Area under the Preferred Alternative (Map 18). The proposed Kasegaluk Lagoon Deferral Area (approximately 17% of the Planning Area) would not be offered for leasing for 10 years. Exploration and development/production activity could vary substantially depending on the per-barrel price of oil (Table IV-05 and Table IV-07). Thus, for the first sale the number of exploration wells could range from 5 to 12, delineation wells from 2 to 18, exploration/delineation rigs from 1 to 3, production pads from 0 to 6, and staging bases from 1 to 2 (Table IV-05); an estimated 205 new pipeline miles would be constructed (Table IV-29). If only exploration were to occur, activities would be expected to take place over a period of 7 years. If development were to follow, 10 years would be required. Production is estimated to last 22 years. Development in the Planning Area is expected to involve relatively small, interconnected gravel structures.

(1) Effects of Disturbances

(a) Exploration

During the exploratory phase, seismic surveys to gather geological data are carried out during winter months (December-April) when nearly all birds are absent from the region. Under the Preferred Alternative it is assumed that three seismic survey operations would occur during each winter season in the Planning Area. A typical 2-D

operation consists of 10 vehicles with a crew of 40 to 60 people traversing 200-ft-wide gridlines 5 to 10 mi apart, and may cover about 500 line-miles (804.5 km) in an area of about 1,200 mi^2 (3,108 km^2), which represents about 8.8 percent of the Northwest NPR-A Planning Area. Such an operation could displace small numbers of ravens, ptarmigan, gyrfalcons, and snowy owls temporarily from within 700 ft (213 m) to about 3,000 ft (1 km or 0.6 mi) of the local activity area around each 5- to 10-mi segment of the survey grid as it is occupied in sequence during the winter season, as well as around the mobile camp (moved every 3 to 7 days) that houses the crew during the survey. At average snowy owl densities of 0.023/km^2 (Larned, Stehn, and Platte, 2003) for example (assuming most individuals stay in the same general area for most of the winter), a potential maximum of 71 owls could be disturbed temporarily in sequence along the survey route traveled during one winter season. A 3-D operation (involving a crew of 50 to 80 people collecting 2 to 4 mi^2 (5.2 to 10.4 km^2) of data per day can cover about 450 mi^2 (724 km^2) per winter season, and could displace a maximum of 23 owls in sequence along the survey route.

However, because the camp sites and survey areas are occupied for relatively brief periods, and most of these nonbreeding birds are dispersed in relatively low numbers over a large area, the duration of disturbance incidents is likely to be brief and infrequent. Thus, although there is likely to be a brief displacement of birds from each local area occupied (causing a slight momentary increase in energy requirement) this would not result in a substantial adverse effect, and the overall population effect from this activity is likely to be negligible. Disturbance from tanker trucks, other vehicles, and aircraft supplying seismic operations could displace individuals of these species from the immediate area of the route from Kuparuk or other fuel and supply depot, but this effect also is likely to be negligible. If a seismic operation were to extend into May (an unlikely scenario since they typically last about 100 days beginning in early December), disturbance of early breeding season activities of these species could occur, causing some negligible decline in breeding success by the snowy owl and gyrfalcon. Seismic crews are required by stipulation to implement a waste-management plan that incorporates precautions to avoid attracting predators to the area or providing conditions that would increase their populations. Crews are required to remove waste materials from BLM lands; hence this activity is not expected to enhance the survival of predatory arctic foxes or ravens.

(b) Development and Production

Responses to disturbance can be categorized as: 1) causing injury or death, 2) causing increased energy expenditures that affect physiological condition and rate of survival or reproduction, or 3) causing long-term changes in behavior including traditional use of habitats (Calef et al., 1976). The latter could be the most serious overall effect from oil and gas development and production in Northwest NPR-A, although careful planning and scheduling could avoid most serious effects. Depending on location and season, oil and gas activities in areas where waterfowl and other species occur could potentially cause increased disturbance from routine aircraft operations, gravel-mining operations, presence of gravel pads and facilities, and associated vehicle and foot traffic. Initial developments are likely to occur in the extreme northern portion of the Planning Area, generally surrounding the Dease Inlet/Admiralty Bay area and to Smith Bay and the Chukchi coast. Various species could be affected to some extent by disturbance events (e.g., passage of aircraft), although most incidents are expected to result in negligible effects from which individuals would recover within hours to one day. However, the cumulative effect of repeated disturbance could extend for longer periods and potentially may adversely affect physiological condition, molt, nest success, and productivity. Ultimately this could result in minor local and regional population-level effects although these usually are difficult to separate from natural variation in population numbers. The presence of facilities and construction of gravel structures would result in displacement of birds from favored habitats and associated energy costs which could result in short-term, negative effects during breeding, brood-rearing, or migration periods; however, the footprint of such structures is quite small, so effects are not likely to be evident at the regional population level.

1) Bird Concentrations

Disturbance effects may be particularly serious in areas where higher densities of several bird species that are sensitive to disturbance occur during breeding season, or whose populations have declined or are declining. Such

areas include east, south, and west of Dease Inlet/Admiralty Bay; the south-central portion of the Planning Area to its southern boundary; the western Planning Area in the vicinity of Peard Bay, Wainwright, and Icy Cape/Kasegaluk Lagoon; and to some extent, the area south and southwest of Smith Bay. Species at particular risk from disturbance effects in the Dease Inlet/Admiralty Bay area include red-throated loon, tundra swan, brant, long-tailed duck, king eider, and Sabine's gull (Map 39, Map 40, Map 42, Map 43, and Map 46); in the vicinity of Smith Bay, yellow-billed loon, tundra swan, and Sabine's gull (Map 39 and Map 46); in the south-central area, yellow-billed and red-throated loons, king eider, and Sabine's gull (Map 37, Map 43, and Map 46); and in the western area, red-throated loon, brant, long-tailed duck, common eider, and king eider (Map 40, Map 42, Map 43, and Map 44).

2) Air-Traffic

Air traffic is likely to be the most important source of disturbance associated with oil and gas development; helicopters are the most disturbing type of aircraft. Although quantitative studies of the short-term effects of aircraft disturbance on molting brant have been done in the Teshekpuk Lake Special Area (Derksen et al., 1992; Jenson, 1990; Miller et al., 1994; Ward et al., 1999), few comparable studies have been done of effects on other species at other phases of the annual cycle, or of long-term effects on populations. When exposed to helicopters at typical altitudes and take-off or landing, behavioral responses of brant to the aircraft passage persisted for about five minutes. Increased lateral distance from the aircraft flight path reduced the duration of response. Brant exposed to helicopter flights moved five times farther than those not exposed, and this effect persisted at least for the number of days that such flights were repeated. The authors of this study thought it likely that such increased patterns of movement ultimately could affect habitat use. Brant responded to each aircraft overflight equally, showing no evidence of habituation to this disturbance.

In studies at the Alpine Development on the Colville River delta, Johnson et al. (2003) found that distributions of most species relative to the airstrip did not show detectable differences when control and impacted areas were compared before and after construction. Only trends in abundance of white-fronted geese, and ducks as a group, suggested a decline from pre-construction (pre-1999) to construction (1999-2001), although cool weather during the latter period was a potentially influential factor. When high levels of air traffic supporting heavy construction activity occurred, waterfowl nest density--particularly of white-fronted geese--was lower within 1,000 m of the strip than at more distant sites. However, over the course of the study, densities occasionally were lower farther from the strip than closer, and higher closer to the strip than at greater distances, somewhat confounding conclusions regarding disturbance. These latter results may reflect differences between the areas sampled to some extent, since it was a requirement to include the area adjacent to the airstrip, for which closely comparable habitat areas may not have existed nearby. There was no significant difference in average distance of nests from the airstrip between 1996 and 1999-2001, when there was little or no construction activity. White-fronted goose nests were redistributed relative to the airstrip during heavy construction years, although their use of habitats remained the same. Neither aircraft nor vehicle activity appear to negatively affect goose nest attendance. Distance of tundra swan nests from the airstrip also did not differ significantly between pre-construction and construction. Nest densities of shorebirds and songbirds were higher nearer the airstrip. However, TERA (1993b) found reduced density of shorebird nests within 100 m of a heavily used road, and Troy and Carpenter (1990) found that birds displaced by pad construction nested in adjacent similar habitat. These results support both the assumption that birds generally would avoid areas with potentially disturbing activity to some extent, and that they are more tolerant of such activity than might be expected. Evidently, the response of birds to potentially disturbing factors is complex, representing a synthesis of competing habitat requirements and behavioral factors.

Aircraft routinely flying over areas of higher bird density in the Planning Area (see Map 36 Map 37 Map 38 Map 39 Map 40 Map 41 Map 42 Map 43 Map 44 Map 45 Map 46) are likely to cause minor effects in the local populations of several species. For example, disturbance associated with developments in the northern area (where the first are likely to occur) could affect higher concentration areas of red-throated loon, yellow-billed loon, tundra swan, brant, long-tailed duck, king eider, and Sabine's gull adversely. In the past, red-throated loon numbers have shown a significant decline, as have king eider; and yellow-billed loon and Sabine's gull currently are declining at a non-significant rate (Larned, Stehn, and Platte, 2003). In the western Planning Area, aircraft activity over Kasegaluk Lagoon could cause minor disturbance effects to large numbers of fall-staging brant,

molting king eiders, and/or nesting or staging common eiders present in summer or fall. The brant studies noted above suggest that effects of aircraft operations are likely to be reduced substantially if 1) aircraft are flown at higher altitude (e.g., 3,000 ft), 2) the frequency of flights is reduced during periods when serious effects from disturbance are most likely, and 3) known high-density/critical activity areas are avoided.

3) Structures

Heavy equipment would be transported to staging areas or development sites in winter, with the same potential effects on the three species: ptarmigan, gyrfalcon, and snowy owl. The presence of pads, short connecting roads, facilities, and drilling operations would displace individuals of species breeding locally from the affected site, and also probably all but the most tolerant from the immediate area. In succeeding breeding seasons, displaced individuals may relocate in nearby comparable habitat, as suggested by studies at Prudhoe Bay (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 particular site (TERA, 1993b; Troy and Carpenter, 1990), but would be a long-term or permanent local result. Overall population effect is likely to be negligible.

4) Raptors

Hawks, eagles, or falcons nesting along the Colville and other rivers could experience adverse effects under this alternative, principally because of potentially greater levels of activity in the general vicinity of nest sites during development. However, there is little reason to expect more oil and gas activity near rivers than in other areas, and location of the Colville at the southern Planning Area boundary probably economically limits the likelihood of its use as a transportation corridor for oil and gas development. Overall effect on raptors in the Northwest NPR-A is likely to be negligible.

5) Gravel

Gravel within the Planning Area is expected to be mined from river drainages in winter and transported to development sites via ice roads. This activity would displace any nesting species from the local area (up to 50 acres per gravel mine) to undisturbed habitats, although few species are expected to be nesting on gravel bars in rivers where most gravel extraction is likely to occur. Mining could cause local disturbance and temporary displacement of the three resident species along the ice road transport route and at the mine site in winter; other species are absent during this season. Because primary development is likely to be confined to the northern portion of the Planning Area, at least initially, raptor habitat areas in the southern NPR-A (e.g., Colville River, Ikpikpuk River) with high raptor populations are not expected to be disturbed by gravel mining. Depending on location and extent of the mine site, the overall effect of habitat loss is likely to be negligible for species with abundant, stable, or increasing populations. Potentially minor effects could result if mining were to become widespread and eliminate specific areas of habitat used by species that have small populations and/or are declining (e.g., buff-breasted sandpiper).

6) Pipelines

Because construction of pipelines east to connect with Kuparuk and TAPS is likely to take place entirely during winter, effects on the three resident species may be similar to those discussed above under seismic effects. Presence of an aboveground pipeline is not likely to represent a significant collision hazard since migrating birds fly well above pipeline elevation, and much of the movement during the breeding season is by swimming. A gas pipeline leak is likely to cause only minor effects on local bird populations, mainly from presence of response personnel and equipment (see below for effects of crude oil spills). Overall impact of pipelines is likely to be negligible.

7) Predation

Potential predator enhancement at the level of development envisioned for NPR-A is not likely to approach that of the Prudhoe Bay area. This is because: a) development sites are likely to be few (8 fields) and relatively small and scattered, b) practices that have allowed artificially enhanced predator populations in the past are expected to be tightly controlled through adherence to ROP's A-2 and E-9, which would require all feasible precautions to avoid attracting wildlife (i.e., predators) to food and garbage, and utilizing best technology to prevent facilities from providing nesting, denning, or shelter sites for predators. At the Alpine Development, Johnson et al. (2003) found that predator numbers remained stable from pre-construction through construction periods. They also found no clear evidence that predation rates by either foxes or avian predators changed during their study. Thus, predator populations in the vicinity of small footprint developments are not expected to increase significantly. In addition, few of the species present on the western ACP nest in colonies, which would make them prone to substantial losses if discovered by predators. Brant are present in 30 to 40 colonies, most averaging 10 or fewer nests, occur on the western ACP (Ritchie, Lovely and Knoche, 2002). White-fronted geese, nesting in small loose colonies or as single pairs, would not be as subject to high predation losses. Overall, effects of predators on regional populations of most species is likely to be negligible; effects on brant could be more substantial in some years and/or colonies, representing minor losses on a subjective scale. Species whose world populations are small, such as the buff-breasted sandpiper, would experience disproportionately large effects if predator populations were artificially enhanced.

(2) Effects of Spills

A 500- or 900-bbl crude oil spill, assumed for purposes of analysis (see Table IV-17 and Table IV-19), from a pad or pipeline onto tundra, would be likely to cause mortality of small numbers of shorebirds and passerines, and possibly a few individual waterfowl. If it were to enter local lakes or inter-connected wetlands, small numbers of loons and waterfowl--and possibly additional shorebirds--could be contacted. Numbers of oiled individuals would depend primarily upon wind conditions and numbers and location of birds following entry of the spill into the water. If the spill were to enter a river, a variety of loon, waterfowl and shorebird species could be present, particularly where the river empties into the marine environment. For most species, such losses would be likely to represent negligible impacts at both the local and regional population level. Effects could be elevated to a minor or moderate levels if species with small and/or declining populations were involved.

If gyrfalcons, peregrine falcons, or rough-legged hawks were nesting in the vicinity of a spill, they could become secondarily oiled by preying on oiled birds. Mortality of breeding falcons, for example, could represent a minor loss for the local population, but (as with the species listed above) still would likely represent a negligible effect on the regional population.

Because of the oil-absorptive capacity of tundra habitats, it is likely that only a small part of a spill would enter a river or the marine environment. Required setbacks of 100 or 500 ft from water bodies (Stipulation E-2)--unless approval grants otherwise, 1/2 mi from specified rivers (Stipulation K-1), and 1/4 mi from deepwater lakes (Stipulation K-2) would delay entry of spills into waterbodies by absorption and allow additional cleanup time before the spill reached water. As a result of their small average size, onshore oil spills reaching aquatic habitats could be expected to cause losses of only up to a few tens of individuals. However, a few hundred individuals potentially could be killed by cumulative mortality from many small spills. The effect of such losses might not be detectable above the natural fluctuations of the populations. Under the Preferred Alternative, the Northwest NPR-A coastline could be available for oil and gas leasing, although the proposed Kasegaluk Deferral Area would not be available for leasing for 10 years. If a spill were to move into a delta area or into Admiralty Bay, Elson Lagoon, Dease Inlet, Peard Bay, Kasegaluk Lagoon, or other coastal waters, additional waterfowl species that breed, molt, or stage before or stop during migration would be at risk. A spill entering a river in spring could contaminate overflow areas or open water where spring migrants of several waterfowl species concentrate before occupying nesting areas. If either of these scenarios were to involve yellow-billed or red-throated loons, brant,

king or common eiders, black guillemots, or Ross' gulls the effect could potentially elevate to a moderate level.

Loons and flocks of brant, long-tailed duck, and eiders staging before or stopping during migration in protected coastal habitats--as well as black guillemots year-round or Ross' gulls in fall--could come into contact with a crude-oil spill from an offshore site (however, offshore rigs may not be used) during August or September when ice cover is less than 50 percent. An onshore spill of crude from a pad near the coast or a fuel-oil spill that reaches the marine environment (e.g., Elson Lagoon, Dease Inlet, Smith Bay, Kasegaluk Lagoon, and nearby barrier islands). Likewise, a fuel spill from hypothetical onshore staging sites at Cape Simpson, Barrow, or Peard Bay (Map 107)--or from fuel barges supplying these sites--could contact these species with similar effects (see below). Because of numbers of birds present, risk would be greatest from June through October. The probability of escaping fuel contacting nearshore lagoon areas and barrier islands within 30 days is less than 22 percent in summer (USDOI, MMS, 2003;vol. IV, table A2-21). Physiological effects on individual birds would be the same as described in the Northeast NPR-A IAP/EIS (USDOI, MMS, 1998). Lethal effects would be 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 that interfere with the reproductive process caused by oil ingested by adults during preening or feeding.

Some brood-rearing, molting, or staging loons, brant, eiders, long-tailed ducks, or other waterfowl might also contact oil in coastal habitats. Large numbers of staging brant, molting king eiders and nesting or staging common eiders in Kasegaluk Lagoon would not be at risk under the Preferred Alternative. Mortality of molting long-tailed ducks from a spill entering protected areas could be substantial, but the population effect would be difficult to determine because numbers of that species are stable, declining, or increasing in various areas (Conant, et al., 1997; Larned, Stehn, and Platte, 2003). Flocks of staging eiders could contact oil in nearshore or offshore areas. The king eider population apparently declined about 55 percent between 1976 and 1996 (Suydam et al., 2000), with the result that substantial mortality from spills could have a significant impact on the population. Likewise, common eiders nesting on barrier islands and along the coast, whose population also has declined significantly, could be contacted by a marine spill causing substantial losses. Substantial mortality of yellow-billed or red-throated loons probably would represent a serious loss, but of unknown population consequences. Also, several thousand shorebirds could encounter oil in shoreline habitats (e.g., river deltas); and the rapid turnover of migrants during the migration period suggests that many more could be exposed. A spill that enters open water off river deltas in spring could contact migrant loons and eiders. Because relatively small areas of terrestrial or marine environments would be likely to be oiled, a spill would be likely to contact relatively small numbers of birds, primarily causing minor effects.

A pipeline spill of seawater used in the waterflood enhancement stage of production would kill salt-intolerant tundra vegetation near the pipeline. The amount of tundra habitat affected would be expected to be no more than a few acres; such a small area of degraded habitat would not be likely to result in loss of productivity by displaced breeders that could be detectable at the population level.

(3) Summary

Principal bird groups inhabiting the Northwest NPR-A Planning Area or nearby marine waters are loons, waterfowl, shorebirds, raptors, passerines, and seabirds. Most ground transport activities under the Preferred Alternative, including those associated with oil and gas development, occur in winter and thus would not disturb most bird species. Ptarmigan, gyrfalcon, and snowy owl might be displaced temporarily from vehicle routes. Effects from seismic exploration activity in winter and small camps in summer would likely be negligible. Most bird species would be likely to be displaced from within 700 to 3,000 ft of large encampments that are in place for up to twelve weeks during the summer, possibly causing a minor local decline in nest attempts and productivity in some species. Minor population effects most likely would occur through exposure of species that are uncommon, declining or recently declined, and/or particularly sensitive to disturbing activities. Of particular concern are species that have shown general or ACP population declines, or that have small vulnerable populations such as yellow-billed loon, red-throated loon, king eider, common eider, and Sabine's gull. Impacts

on regional populations of species not showing declines likely would be negligible.

Although predators attracted to camps might decrease breeding success of local bird communities, this is likely to be a negligible effect. Fuel spill cleanup could disturb birds in the local area. Small survey parties on the Colville and other rivers would be expected to cause negligible disturbance of nesting raptors, waterfowl, and passerines.

Frequent aircraft flights into large camps could result in minor effects ranging from avoidance of certain areas by birds to local abandonment of nesting attempts or lowered survival of young. Regardless of where they originate, such flights would be likely to pass over high-density areas of one or more species; however, the effect on regional populations would likely be negligible. Aerial survey flights for monitoring bird or caribou populations have potential for disturbance of birds because they are flown at low altitude. However, in any given area they are of short duration, and cover only a small percentage of the ACP per season, so areawide disturbance effects would likely be negligible. In isolated areas aircraft effects would likely be negligible. Altitude and distance of aircraft from individual birds determines the duration of adverse response. Helicopter traffic would probably be the greatest source of disturbance associated with oil and gas development. Regional populations of species such as loons, swans, brant, long-tailed duck, king eider, and Sabine's gull--all with high density areas in the northern Planning Area where oil and gas development may first occur--could experience potentially minor effects from frequent aircraft overflights.

Habitat eliminated by gravel mines, pads, roads, and airstrips would likely represent a negligible loss. An oil spill that reached tundra could cause mortality of small numbers of waterfowl, shorebirds and/or passerines, but spills are likely to be contained and cleaned up before contacting birds, resulting in a negligible overall effect. Oil entering ponds, lakes, or rivers could contact small numbers of loons and waterfowl, causing a negligible effect for most species other than red-throated loon, yellow-billed loon, brant, and king eider for which the effect could be minor. A large spill entering the marine environment or river delta areas could contact molting, staging, or migrating loons, brant, long-tailed ducks, king and common eiders--and possibly Ross' gulls--resulting in minor to moderate impacts depending on population status and extent of mortality of the particular species. Substantial mortality of king and common eiders and yellow-billed and red-throated loons would be effects of concern. In most instances, activities and actions would likely affect only a relatively small proportion of available habitat of the type indicated and/or a relatively small proportion of a given species' regional population. Quantitative effects might be difficult to separate from natural variation in population numbers. Stipulations would decrease disturbance from most factors for most species, prevent spilled fuel and oil from reaching surrounding habitats, and help prevent oil pollution and degradation of important bird habitats.

Several factors suggest that the overall effect of the Preferred Alternative on birds would be less than Alternative A. Most importantly, the elimination of leasing in the proposed Kasegaluk Lagoon Special Area reduces potential risk to vulnerable staging brant, molting king eiders, and nesting and staging common eiders in particular, both from disturbance and oil spill contact. In addition, leasing in the western portion of the Planning Area--areas of higher density of Pacific loon, red-throated loon, white-fronted goose, long-tailed duck, northern pintail, scaup, several shorebird species, arctic tern, glaucous gull, jaegers, and Sabine's gull--would be deferred for 10 years, delaying potential impacts for at least this period. Also, several ROP's and one stipulation specifically applicable to birds that are not contained in the mitigation package for Alternative A, are attached to the Preferred Alternative. The ROP's include: a) avoidance of human-caused increases of ground nesting bird predators, b) design of structures so birds are less likely to strike them, c) design and location of facilities to minimize disturbance to yellow-billed loons when their presence in areas proposed for development is indicated by required aerial surveys , and d) a measure to decrease bird predator nesting/denning sites on facilities. Also included is a stipulation requiring lessees to minimize disturbance and loss or alteration of habitat near brant colonies and brood-rearing areas determined by aerial survey. Finally, shorter periods of aerial survey are anticipated under the Preferred Alternative (several 1- to 2-week periods) than under Alternative A (several 2- to 3-week periods). By comparison to Alternative B, the Preferred Alternative offers the additional ROP's and Stipulation discussed above, and the deferral of the western Planning Area from oil and gas leasing for 10 years, as the principal differences. In comparison to the No Action Alternative, it offers the mitigating measures noted above, and slight differences in levels of activity as outlined in Table IV-28.

c. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's could mitigate effects on birds of four types of problems that may result from oil and gas development activities: 1) disturbance from noise or activity, 2) adverse alteration of habitats, 3) contamination of waterbodies occupied by birds, and 4) mortality of fish that are prey for fish-eating birds.

ROP A-2, by controlling availability of food and garbage, could prevent artificial enhancement or concentration of bird predators; also, pollution of waterbodies by disposal of waste materials, which could cause toxic reactions in waterbirds or their prey, is prohibited.

ROP A-3, by preventing entry of fuel or other hazardous substances into waterbodies and wetlands through implementation of a Hazardous Materials Emergency Contingency Plan, could reduce contamination risk to birds from accidental spills.

ROP A-4, by preventing entry of fuel or liquid chemicals into waterbodies and wetlands through implementation of a comprehensive spill prevention and response contingency plan which includes specifications on clean-up, materials, storage containers, and liner materials, could reduce contamination risk to birds from accidental spills during oil and gas activities.

ROP A-5, by prohibiting the refueling of equipment within 500 ft of the active floodplain of fish-bearing and within 100 ft of the active floodplain of non-fish-bearing water bodies, could prevent spilled fuel from entering water bodies where fish prey of loons, mergansers, and terns, or individual water birds, could become contaminated and die, which could adversely affecting the breeding success of these water bird species.

ROP B-1, by prohibiting water withdrawal from rivers and streams in winter, could prevent winter die-off of fish prey of loons, mergansers, and terns, which could adversely affect the breeding success of these water bird species.

ROP B-2, by allowing only authorized water withdrawal from lakes could prevent winter die-off of fish prey of loons, mergansers, and terns, which could adversely affect the breeding success of these water bird species.

Stipulation E-2, by restricting approval for location of permanent oil and gas facilities within 500 ft of fish-bearing water bodies or within 100 ft of non fish-bearing water bodies to those that are likely to cause minimal impacts to wildlife, could reduce the loss (burial) of wetland habitats, important for breeding loons, waterfowl and shorebirds in particular.

ROP E-5, by requiring minimal facility footprint and reduction in air traffic, could minimize bird habitat burial and disturbance.

ROP E-7, by requiring that above ground pipelines be elevated an average of 7 ft above the surface, would increase the potential for bird collisions with pipelines.

ROP E-9, by requiring use of best available technology to prevent facilities from providing nesting, denning, or shelter sites for predators, could avoid artificial enhancement of bird predators.

ROP E-10, by requiring that exterior lights be directed inward and downward, may reduce collisions of birds with oil and gas facilities during low light conditions.

ROP E-12, by requiring development of an ecological land classification map for use in siting facilities, could help conserve important habitat types.

ROP F-1, by requiring that aircraft maintain an altitude of at least 1,500 ft AGL when within ½ mi of raptor nesting sites April 15-August 15 or gyrfalcon nest sites March 15-August 15, 2,000 ft AGL over the Caribou Study Area June 15-July31, and 2,000 ft AGL over the Caribou Coastal Insect Relief Areas June 15-July 31, and minimizing the number of takeoffs and landings at all airstrips, could mitigate aircraft disturbance of birds.

ROP I-1, by providing all personnel with information concerning applicable required operating procedures and stipulations, and importance of not disturbing biological resources, habitats, and bird colonies, could help reduce disturbance of birds.

Stipulation K-1, by prohibiting permanent oil and gas facilities within setback zones of ½ to 1 mi of listed waterways, could mitigate disturbance of raptors nesting along listed waterways and other birds occupying adjacent corridors, as well as avoiding destruction of habitats.

Stipulation K-2, by prohibiting permanent oil and gas facilities within ¼ mi of deep water lakes with depth greater than 4 m, could minimize the loss of habitats occupied by fish prey of loons, mergansers, and terns, which could adversely affect the breeding success of these water bird species.

Stipulation K-3, by prohibiting oil and gas exploration activity May 15-October 15, requiring adequate year round spill response capability, including during periods of broken ice, or alternate methods to prevent oil spills, requiring that facilities minimize impacts to seasonally concentrated birds, and requiring that daily activities are conducted to minimize impacts to seasonally concentrated birds, could protect bird habitats and avoid disturbance of seasonally concentrated birds.

ROP K-4, by requiring pre-construction aerial surveys of proposed development sites and surrounding ½ mi area, prohibiting development or curtailing activities within ½ mi of brant colonies and brood-rearing areas, could minimize habitat loss or disturbance of nesting and brood-rearing brant.

ROP K-7, by prohibiting significant alteration of high quality raptor foraging habitat within 15 mi of raptor nest sites, particularly in waterbody, wetland, and riparian habitats, could reduce impacts on important habitats of raptors and other birds occupying surrounding areas in the Colville River Special Area.

Stipulation K-8, by prohibiting permanent oil and gas facilities within the boundary of the Special Area, could protect birds using Kasegaluk Lagoon.

These stipulations and required operating procedures would minimize disturbance of most bird species from most factors; minimize adverse alteration of habitats; and could help prevent spilled fuel or other toxic materials from reaching waterbodies where waterbirds, prey of fish-eating birds, or surrounding nesting and brood-rearing habitats could become contaminated. The measures do not specifically establish minimum aircraft altitudes for routine flights over areas of high bird density. Also, the lack of a specific stipulation for summer use of ground vehicles in high bird density areas, except in the vicinity of raptor nest sites, could result in lowered nest success in local areas. In most cases, the stipulations and ROP's are likely to affect only a relatively small proportion of

available habitat of the type indicated, and/or a relatively small proportion of a given species' regional population.

d. Conclusion--First Sale

Under the Preferred Alternative, disturbance effects from transport operations, seismic exploration activities and gravel mining in winter and small camps, waste/fuel spill removal, river transport activity, and aerial surveys in summer are likely to be negligible for most local and regional bird populations. Elevated activity and air traffic in the vicinity of large summer camps could result in minor impacts on local populations. Regional populations are expected to experience negligible effects from such activity, except those of species that are uncommon, decreasing, or recently declined (loons, eiders), where a minor effect may occur. Routine helicopter traffic to oil and gas development sites in summer, especially over higher density areas, is likely to result in minor impacts. Gravel mining, pads, airstrips, short pad-connecting roads, and pipelines, although eliminating small areas of breeding habitat and displacing small numbers of nesting birds, are likely to result in negligible population effects. Raptors nesting along major rivers are expected to experience negligible effects from potentially disturbing activities.

Effects from crude oil spills when confined to terrestrial and freshwater aquatic habitats--where mortality of waterfowl, shorebirds, raptors, and passerines would likely be relatively low--could range from negligible for most species to minor for rare species or those with declining populations. Minor to moderate effects would be likely for stable/increasing and declining species populations, respectively. If a spill were to enter a river delta or nearshore Beaufort marine habitats occupied by substantial numbers of loons, sea ducks, black guillemots, or Ross' gulls. Effects (including disturbance) on any species utilizing Kasegaluk Lagoon and the western Planning Area--but particularly those with substantial numbers of post-breeding individuals concentrating in the lagoon (brant, king eider, common eider)--potentially could be lower and/or deferred under the Preferred Alternative than under Alternative A as a result of oil and gas activities being prohibited in the proposed Kasegaluk Lagoon Special Area and deferred for 10 years in the proposed Deferral Area. Also, several ROP's and one stipulation specifically applicable to birds are included in the Preferred Alternative.

Quantitative effects might be difficult to separate from natural variation in population numbers. Stipulations and ROP's would decrease disturbance from most factors for most species and help prevent fuel and oil pollution and degradation of important bird habitats. Several of these measures specifically applicable to birds apply only to the Preferred Alternative.

e. Multiple Sales

If multiple sales were to occur under the Preferred Alternative, construction activity could last 15 to 30 years, (deferred 10 years in the proposed Deferral Area), tapering off as existing infrastructure is used for each succeeding development. Under a multiple-sale scenario, depending on the price of oil, the combined number of exploration and delineation wells drilled could increase substantially (21 to 72 for multiple sales versus 7 to 30 for the first sale, Tables IV-07 and IV-05); the number of fields developed could increase from 4 for a single sale to as many as 8 for multiple sales (Tables IV-04 and IV-06), and production pads would be likely to increase from 0 to 6 for a single sale to 0 to 12 for multiple sales (Tables IV-05 and IV-07). Oil pipeline mileage could increase from 70 mi to 340 mi (Table IV-29).

Effects from disturbance factors and habitat alteration or loss for each development would likely be short-term and negligible to minor over most of the Planning Area (see discussion for the first sale). Habitat buried or excavated in the vicinity of development and production facilities or at gravel mine sites essentially would be lost to species present before development. Surface, air, and foot traffic could increase substantially in some areas if oilfield facilities associated with multiple sales were grouped in high resource interest areas. If these were located

in high-bird-concentration areas, as appears likely in the vicinity of Dease Inlet, greater numbers of individuals would be expected to be displaced and more species would be involved than with a single sale. Such effects could alter bird populations of these local areas substantially. For species with narrower habitat preferences, limited tolerance to disturbance factors, or small and/or declining populations (red-throated loon, yellow-billed loon, king eider, common eider, Sabine's gull, gyrfalcon, peregrine falcon, snowy owl), effects could extend to regional populations and involve long-term changes in distribution. Effects for these and other vulnerable species could be elevated to a moderate level if multiple developments were to be concentrated in a limited region.

The estimated number of onshore oil spills of 500 or 900 bbl for the first sale or multiple sales (Table IV-19) is expected to stay constant (0 for the $18/bbl no-development scenario, 1 for the $30/bbl development scenario).) Also, the number/volume of small crude oil and refined oil spills, projected at 112/277 under the first sale (average size 3/0.7 bbl or 126/29.4 gal.), is expected to remain constant if multiple sales occur (Table IV-20). These small, chronic spills generally are contained and cleaned up on pads and roads. Habitat contamination would be 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 would likely persist for several years but is expected to result in negligible effects for most species and potentially minor effects for sensitive species. Fuel spills at potential staging areas at Cape Simpson, Barrow, or Peard Bay (Map 18 and Map 107) could result in moderate losses if occurring when substantial numbers of birds are present in or downstream of these sites. Recovery of cumulative lost productivity and recruitment may not be detectable above the natural fluctuations of the population and survey methods/data available.

f. Conclusion--Multiple Sales

Under the Preferred Alternative, displacement of birds from disturbance and habitat alteration or loss would be expected to increase substantially if development and production facilities were to be located in a limited region of higher resource potential (i.e., northern Planning Area). This could occur in several portions of the Planning Area if multiple sales are held and development occurs in areas where higher density of several species overlap. Such development potentially could alter local populations in these areas. For species that appear more vulnerable to habitat changes or disturbance (e.g., loons, eiders, raptors) effects could extend to regional populations and involve long-term changes in distribution. Although most effects that would be likely to occur throughout the Planning Area are expected to be short-term and negligible to minor, moderate effects could occur if concentrations of several particularly vulnerable species--declining or with small or sensitive populations--were involved. The likely increase in numbers of small crude oil and refined oil spills (over single sale projections) would be expected to elevate losses of birds somewhat during the period of development resulting from multiple sales. In any scenario of losses and subsequent recovery of cumulative lost productivity and recruitment may not be detectable above the natural population fluctuations given the survey methods/data available. However, effects of oil and gas developments resulting from lease sales following the first sale are expected to be additive to those of the first, and may range from a slight increase to a doubling or tripling of effect. This would depend on whether the later developments were concentrated or scattered through areas of low or high density and distributional overlap of species that vary in their vulnerability to development activities (i.e., low: increasing/stable population and/or less sensitive species, versus high: declining population and/or sensitive species). If subsequent developments are scattered, they may occur by chance in areas of low bird vulnerability and thus add little to the effects of earlier sales.

10. Mammals

a. Terrestrial Mammals

(1) Effects of Non-Oil and Gas Activities

Effects of non-oil and gas activities on terrestrial mammals would be similar to those predicted under Alternative B and somewhat less than those predicted under Alternative A. 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), and overland moves. Overland moves occur during the winter on frozen tundra, ice roads, or stable shorefast ice. The other activities occur from summer to early fall (June-September).

Short-term displacement and/or disturbance (few minutes to a few hours) of terrestrial wildlife may result from helicopter and fixed-wing traffic, and ground traffic associated with these activities. 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 1,000 ft (45 to 300 m) (Calef, DeBock, and Lortie, 1976). These documented reactions were from aircraft that circled and repeatedly flew over caribou groups. While aircraft associated with aerial wildlife surveys may circle or fly over a group of caribou more than once, aircraft associated with support of survey/inventory camps would pass over caribou only once on any given flight to or from a camp. There may be additional disturbance impacts to TLH caribou under the Preferred Alternative due to ROP K-5 which requires a 3-year study of caribou movements within the Caribou Study Area before development (Map 91). Minor disturbance impacts to TLH caribou from studies would be offset by the improved mitigation of development impacts that would result from these studies.

Recreational and research camps may result in short-term displacement (24 hours to 6 weeks) or harassment of terrestrial mammals and minor disturbance to the vegetation and soil due to trampling (< 3/4 acre). Potential habitat disturbance from large camps would be reduced by using existing sites whenever possible. Camps may attract bears and foxes, 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 would contribute to cumulative adverse effects. Direct mortality and degradation of habitat of small rodents (such as lemmings and voles) may occur locally at excavations, camps, and on trails used for overland moves. These losses would not result in any population level impacts on small mammals or their predators on the Arctic Coastal Plain.

Very small fuel spills (< 1 bbl) could 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. Such events are not expected to have any adverse effects on terrestrial mammals.

Current management practices, stipulations developed through the permitting process and ROP's would effectively mitigate impacts to terrestrial mammals from non-oil and gas activities.

Under the Preferred Alternative, the Planning Area would be designated as limited for recreational OHV use. Over the short term, these designations would have no practical effect on terrestrial mammals as virtually no recreational OHV use currently occurs. Over the long term, if recreational OHV use were to increase substantially, having designations in place could reduce impacts to terrestrial mammals from recreational OHV use. Impacts would consist primarily of disturbance impacts from increased human access into terrestrial mammal habitats, and increased harvest from trapping and hunting.

(2) Effects of Oil and Gas Activities

(a) Effects of Disturbances

1) Seismic

Effects of seismic activities on terrestrial mammals would be similar to those predicted under Alternative B and somewhat less than those predicted under Alternative A. Two 2-D or 3-D seismic operations (70 to 110 people associated with each) would occur in each winter and could affect terrestrial mammals. Habitat impacts would be minor as seismic activities occur during the winter on frozen tundra, or ice. Potential causes of disturbance to terrestrial mammals from seismic activities include surface vehicular traffic and fixed-wing aircraft traffic. In most cases, these activities are expected to cause short-term (few minutes to 1 hour) displacements and/or disturbance of terrestrial mammals. With 3-D seismic exploration where survey lines are located only 500 to 2,000 ft apart, disturbance impacts to terrestrial mammals would increase. Localized displacement of terrestrial mammals could last for several days rather than minutes or hours. Effects on terrestrial mammals would be similar in type to those discussed under non-oil and gas activities, but greater in extent, frequency, and duration.

Seismic operations may temporarily disturb wintering Teshekpuk Lake herd (TLH) and Western Arctic herd (WAH) caribou. Avoidance of seismic lines and associated human activity could reduce their ability to avoid areas of deep snow. If multiple encounters occurred, the additional energy expenditure may result in increased winter weight loss. Aircraft traffic would be required to stay 1,000 ft above ground level (ROP F-1) over caribou wintering areas, reducing disturbance impacts to caribou and other terrestrial mammals. Unless seismic activity is intense, there should be few conflicts with wintering caribou. Only a small percentage of the WAH that winters north of the Brooks Range may be exposed to seismic activity. The TLH core wintering area (Map 54) is southwest of the high potential oil area, further reducing the potential for conflicts.

Studies of 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 were highly variable among individuals (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). Muskoxen are not able to easily travel and dig through snow. In the winter, they search out sites with shallow snow, and greatly reduce movements and activity to conserve energy (USDOI, FWS, 1999). Muskoxen survive the winter by using stored body fat and reducing movement to compensate for low forage intake (Dau, 2001). Because of this strategy, muskoxen may be more susceptible to disturbances during the winter. Repeated disturbances of the same animals during winter could result in increased energetic costs that may affect mortality rates. Depending upon the location of the seismic exploration, impacts on muskoxen would be non-existent to minimal. Most of the Planning Area is currently unoccupied by muskoxen but, suitable habitat exists and populations outside of the Planning Area are gradually expanding their range. At most, seismic operations would be expected to encounter no more than an occasional lone bull within the Planning Area. No breeding groups would be affected except possibly from seismic crews accessing the Planning Area on overland routes from the Kuparuk area.

Exploration activities and human presence pose potentially serious disturbances to denning bears. 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 et. al., 1986). The investigators suggest that seismic testing activities within about 600 ft of a den may cause abandonment of the den. Under this alternative, ROP C-1 prohibits cross-country use of heavy equipment and seismic activity within ½ mi of occupied grizzly bear dens. If den locations are known in the areas that seismic work occurs, impacts to hibernating bears would be reduced. If den locations were unknown, the stipulation would have little effect. Impacts to bears are expected to be relatively low since the area of highest potential for oil is the lowest density bear habitat.

Bears and foxes may also be attracted to camps. However, no adverse impacts are anticipated. Since seismic camps generally move at least once a week and proper handling of wastes is emphasized in the required operating procedures (ROP A-2), the potential for bears or foxes to be attracted to human food sources is low. In addition, most seismic activity would occur when bears are hibernating.

Potential effects on wolverines could include disturbance from air and surface-vehicle traffic, and increased human presence. Wolverines are considered a shy and secretive species, and they may be sensitive to disturbance. Winter seismic activities in the Pik Dunes area south of Teshekpuk Lake are known to have caused the displacement of a wolverine from its den (Harry Brower, Jr., as cited in USDOI, BLM, 1997a).

Small rodents (such as lemmings and voles) may be locally affected through direct mortality and minor loss of habitat from overland traffic associated with seismic operations. Their predators (such as short-tailed weasels) may be indirectly affected in local areas due to a reduction in prey. These losses would be insignificant at the population level.

2) Exploratory drilling

Impacts from exploratory drilling on terrestrial mammals would be similar to Alternative B and somewhat less than that predicted in Alternative A. Impacts to terrestrial mammals would be similar to those caused by seismic activity, though lesser in spatial terms and greater in temporal terms. Habitat impacts would be minimal, as exploratory drilling would occur during the winter on frozen tundra, packed snow roads, and ice roads. Potential causes of disturbance to terrestrial mammals from exploratory drilling include surface vehicular traffic, humans on foot, and aircraft traffic. In most cases, these activities are expected to cause short-term (few minutes to 1 hour) displacements and/or disturbance of terrestrial mammals. Camps at drill sites may result in localized disturbance and/or displacement of terrestrial mammals for several weeks to months. Exploratory drilling operations and ice roads would traverse TLH and WAH caribou wintering areas. Any caribou in the immediate vicinity of the activity would be disturbed, possibly having a negative effect on their energy balance. Aircraft traffic disturbance impacts to wintering caribou would be reduced by requiring a minimum altitude of 1,000 ft over caribou winter range. Few wintering WAH animals would be affected because less than 10 percent of the herd typically winters in the Planning Area. Because these animals are mobile and the operation is temporary, it is not expected that there would be any long lasting effects on caribou from exploratory drilling.

Muskoxen and moose winter distribution is such that exploratory drilling activities would be unlikely to have any impacts on these species unless located in the eastern or southeastern portions of the Planning Area (Map 55). In that case, impacts would include short-term displacement or disturbance similar to that caused by seismic activities. Impacts to arctic foxes, grizzly bears and wolverines would be similar to impacts from seismic activities, but would be more frequent or longer in duration. There would be a higher potential for bears and foxes to be attracted or habituated as camps associated with drill sites would be in place for several months vs. a week or less. Small rodents (such as lemmings and voles) may be locally affected due to direct mortality and minor loss of habitat from snow compaction or ice road construction. These losses would not result in population level impacts.

3) Oil and Gas Development

Primary effects on terrestrial mammals would come from construction of facilities such as roads and pipelines; motor vehicle traffic within the oil field(s) and on connecting roads; foot traffic near facilities and camps; aircraft traffic; crude-oil and fuel spills contaminating tundra, stream, and coastal habitats; and habitat alteration associated with gravel mining and construction. The greatest potential for significant impacts to caribou is through disruption of the movement of TLH caribou from insect relief habitat to foraging areas, and delay or disruption of caribou cows migrating to the calving grounds. Impacts to terrestrial mammals would be somewhat less than that predicted in Alternative A because of a lower level of anticipated development, deferral of leasing on approximately 17 percent of the Planning Area, the establishment of the Caribou Study Area and Coastal Area, and stipulations and ROP's applied to these areas.

a) Caribou

Although much of the construction associated with oil and gas development would occur during winter, development would bring year-round facilities and activities to caribou range. Caribou may be disturbed by traffic, humans on foot, and low-flying aircraft (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 the approaching disturbance source; frequency of disturbance; sex, age, and physiological condition of the animals; group size; 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.

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; 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. Some groups of caribou 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). It appears that caribou can habituate to structures, noise and odors but habituate slowly or not at all to humans on foot or large moving objects such as vehicles (Murphy and Lawhead, 2000). Most of the caribou in the Planning Area are from the TLH and WAH herds, have had less exposure to human activities, and are likely to be less tolerant of disturbances than animals habituated to Prudhoe Bay.

Some displacement of the Central Arctic herd (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). In the Kuparuk-Milne Point area, the relative distribution of calving has shifted away from development facilities (Lawhead et al., 1997; Wolf, 2000). Cameron et al. (2002) evaluated changes in distribution of calving CAH caribou associated with the Kuparuk-Milne Point area. Before construction of a road system to Milne Point, caribou were found in a single, more or less continuous concentration, roughly centered where the road was later built. After construction of the road, a bimodal distribution--with separate concentrations of animals east and west of the road--was clearly apparent, indicating that calving caribou are avoiding the infrastructure area. Ground observations of caribou within the Kuparuk area from 1978-1990 indicated that caribou increasingly avoided zones of intense activity, especially during the calving period (Smith et al., 1994). Data analyzed by Cameron et al. (2002) suggest that having roads too closely spaced would depress calving activity within the oil field complex. Other studies (Roby, 1978; Cameron et al., 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 to 4 km) of existing Prudhoe Bay area facilities by cows and calves during calving and early post-calving periods (May through June). An analysis of the distribution of radio-collared female CAH caribou from 1980-1993 suggests that caribou use of the oil field region at Prudhoe Bay has declined considerably from that observed in the 1970's (Cameron et al., 2002). Recent information on the body weight of CAH caribou calving in the oil fields compared to CAH caribou calving east of the Sagavanirktok River suggests that displacement-disturbance of cow caribou on the oil fields may be affecting caribou productivity (Cameron, 1994). Several data sets examined by Cameron et al. (2002) indicate reduced nutritional status and fecundity of female CAH caribou exposed to oil development west of the Sagavanirktok River compared to those in undeveloped areas to the east. Body-weight estimates, over-summer weight gain, the incidence of pregnancy in two successive years, and perinatal calf survival all tended to be lower for female caribou west of the Sagavanirktok River.

The TLH, WAH, and CAH core calving ranges lie outside the Planning Area. Development would not result in the loss of any core calving habitat. Thus, on-site development is expected to have no effect on caribou movements within the calving range, and no calving activity would be displaced unless access to calving grounds is disrupted. In some years, 5 to 10 percent of the WAH may winter on the North Slope. Depending upon the location of oil development infrastructure, movement of both WAH and TLH caribou from winter range to calving grounds could be disrupted by oil and gas development. The level of effect would depend upon the level of development. An above ground pipeline with no associated road would have little effect on movement between winter habitat and calving grounds. A road and associated traffic would have a greater impact. Pregnant caribou

may be delayed in reaching the calving grounds because of delays in crossing roads or attempts to detour around roads or oil fields. Calving en route to calving grounds may result in reduced calf survival.

One issue arising from oil field development is the ability of caribou to move freely through the oil fields during insect seasons. Caribou under extreme insect harassment initially move rapidly to insect-relief habitat. For the TLH, this is often coastal areas from Peard Bay to Smith Bay (Map 49 and Map 50). After reaching these habitats, they often continue to move rapidly and may cover long distances. Caribou are generally less sensitive to disturbance when under extreme insect harassment. When insect harassment abates, caribou drift inland to better foraging areas. At this time, they are more sensitive to disturbance; and infrastructure and activities in oil fields or roads between oil fields could delay or deflect movements of caribou from coastal insect-relief areas to foraging habitat further inland. Impaired movements between insect-relief habitat and inland foraging areas could depress energy balance (Smith, 1996) and rates of weight gain. The probability of producing a calf is directly related to body weight and/or fat content of females during the previous autumn (Cameron et al., 2000). Since reproductive success of caribou is highly correlated with nutritional status (Cameron et al., 2002), there could be reproductive consequences from extensive disruption of caribou during the insect season.

Cameron et al. (1995) noted that reports of insect-harassed caribou aggregations along the Beaufort Sea Coast and completely traversing the Prudhoe Bay complex as reported in the 1970's had become rare. An analysis of the distribution of radio-collared female CAH caribou from 1980-1993 suggests that caribou use of the oil field region at Prudhoe Bay has declined considerably from that observed in the 1970's (Cameron et al., 2002). However, the Prudhoe Bay field was not designed to facilitate caribou movement. It is complex and has many older pipelines that are less than 1.5 m above ground. Movement of insect-harassed caribou through the Kuparuk Oil Field has been examined in several studies (Johnson and Lawhead, 1989; Lawhead, Johnson, and Byrne, 1994; Smith, Cameron, and Reed, 1994). In the Kuparuk Field where all pipelines are elevated a minimum of 1.5 m above ground, insect-harassed caribou were able to pass through the field on their way to and from insect-relief habitat, although they typically detoured around drill pads and were often delayed up to several hours at road crossings. Smith, Cameron, and Reed (1994) monitored caribou movement in relation to roads and increasing development in the Kuparuk Area from 1978-1990. They found that groups of insect-harassed caribou were deterred from crossing roads with higher levels of vehicular traffic. Over the 12 years of the study, a change in access to the oil field area by insect-harassed caribou occurred. During the early years of construction, large insect-harassed groups of caribou approached the road from the middle section. By the end of the study, most large groups were observed at the extremes of the road transect indicating that caribou might be avoiding the core areas of industrial activity. Designing oil fields to facilitate movement of caribou reduces but does not eliminate impacts.

Development in the TLH insect-relief habitat is a likely development scenario given the high potential for oil and gas in the area. In this case, production pads, pipelines, within-field roads, and other facilities (housing, airfield, processing plant) could be located within important TLH insect-relief habitat (Map 50 and Map 49). Movements of the TLH caribou from coastal insect-relief areas to foraging areas further inland during the insect season would be adversely affected by pipelines and roads with vehicle traffic located between the Ikpikpuk River and Dease Inlet. There may be increased energetic costs to caribou and possible decreased weight gain. Summer is the season when female caribou need sufficient forage to meet the demands of lactation and to gain sufficient weight to enable conception in the fall (Cameron et. al., 1993). Reproductive pauses may occur if necessary weight gain is not achieved during summer (Cameron, 1994). There could be reproductive consequences to the TLH if extensive disruption of caribou occurs during the insect season. Extensive development in this area could result in the loss of some insect-relief habitat for TLH caribou.

Gravel pads and roads are sometimes used as fly-relief habitat by caribou (Johnson and Lawhead, 1989; Pollard et al., 1996b). Oestrid flies are less common in shade than in sunlit areas (Pollard et al., 1996a) and caribou sometimes use the shade of elevated pipelines and buildings to escape from flies (Murphy and Lawhead, 2000). There may be a similar disruption of some WAH caribou if an oil field or fields were developed in the southern part of the Planning Area. Population level effects to the WAH are unlikely as the majority of the herd uses insect-relief habitat that is south and west of the Planning Area. About 10 percent of the herd could use the Planning Area during the insect season and thus be exposed to development structures during the peak insect

season.

Impacts to caribou during the insect season would be reduced under this alternative by the establishment of the Caribou Study Area, coastal area setbacks and associated ROP's and stipulations. Pipelines and roads shall be designed to allow free movement of caribou regardless of location within the Planning Area. Before construction of facilities in the Caribou Study Area (Map 91), the lessee would study caribou movements in the insect-relief area to help determine the best facility design and location. Permanent facilities would be located at least ¾ mi from the coastline to the extent practicable to minimize alteration of caribou movements.

Curatolo and Murphy (1986) evaluated the ability of caribou to cross roads and pipelines. They concluded that crossing success was reduced where pipelines were adjacent to heavily traveled roads (> 15 vehicles/hour). Isolated pipelines or roads had lesser effects on crossing success. Groups did eventually cross the roads and move through the oil field, however the energetic costs associated with such delays are unknown. 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 to 60 vehicles/hour, or traffic levels of > 15 vehicles/hour) within the pipeline-road corridors (Murphy and Curatolo, 1984; Lawhead and Flint, 1993). Caribou may be hesitant to cross the Dalton Highway and other roads on the oil fields because of the 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 (Curatolo, 1984). Caribou generally hesitate before crossing under an elevated pipeline 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 as cited in USDOI, 1998). ROP E-7 requiring elevation of pipelines and 500 ft separation between roads and pipelines would help minimize disruption of caribou movements.

A pipeline from the oil field(s) in the northern part of the Planning Area would connect to the TAPS through facilities at the Kuparuk fields (Map 108). The pipeline would be constructed during winter using ice roads and no permanent road would be built. During construction, air traffic could temporarily disturb some caribou within about 1.2 mi (2 km) of the pipeline. Disturbance effects on caribou are expected to be short term, interference with their movements would be temporary (a few minutes to less than a few days), and they eventually would cross the pipeline area. Also, disturbance reactions would diminish after construction is complete. The mere physical presence of a pipeline would probably have minimal effect on the behavior, movement, or distribution of caribou, particularly when designed to facilitate movement. 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). Elevation of the pipeline to 7 ft above ground level as required by the ROP would reduce the potential for drifting snow effects. Also, such an effect is expected to be temporary and local, with the caribou moving across the corridors at locations where the snow is shallower or has melted during the spring. Construction of additional pipelines through Northeast NPR-A to the Kuparuk area would add to the cumulative effect of development on TLH and CAH caribou. Construction of a pump station in NPR-A would result in the loss of up to 40 acres of tundra habitat and temporary displacement or disturbance of caribou during construction.

Development of an oil field or fields could result in impacts to wintering TLH (Map 54) and WAH caribou. Depending upon the location of the development, some TLH migration movements may be temporarily disrupted or diverted by air and surface traffic along pipelines and roads within the oil field. Wintering animals may be temporarily disturbed or avoid the development area. Repeated disturbance of the same animals during the winter could have negative impacts on individual animals' energy balance. A required minimum altitude AGL over identified caribou wintering ranges would reduce impacts to caribou from aircraft over flights. Most of the WAH animals winter south of the Brooks Range (Map 47) and would not be affected.

Development of oil fields would require up to 5 million yd^3 of gravel. Gravel is a scarce resource in NPR-A and if local sources of gravel are not available, alternative strategies may be used, including: barging construction materials to coastal staging areas for later transit over ice roads; processing bedrock for construction materials;

using year-round ice pads; or reusing gravel from previous Husky drill sites. 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 of small numbers of individual animals but would not affect the overall distribution and abundance of caribou. The loss of relatively small areas of tundra habitat to gravel pads, roads, and other alterations has not had significant effects on the CAH caribou and would have minimal impact on the TLH and WAH.

If a system to transport North Slope natural gas to southern markets were developed, a natural gas pipeline would be constructed from oil fields in the Planning Area to Prudhoe Bay. The pipeline would be buried and thus would not affect caribou movements. Wintering caribou could be temporarily disturbed or displaced during construction. A relatively small amount of habitat both within (45 to 90 acres) and outside (305 to 610 acres) of the Planning Area would be disturbed by trenching.

Compared to Alternative A, impacts to caribou would be reduced under this alternative by the establishment of the Caribou Study Area, deferral of leasing in approximately 17 percent of the Planning Area, coastal area setbacks, ROP's and stipulations.

b) Moose

Moose occur in low densities in the Planning Area during the summer and are concentrated in major drainages at the southern edge of the Planning Area in the winter (Map 55). Unless an oil field were to be developed in the southeastern portion of the Planning Area such as the headwaters of the Ikpikpuk or near the Colville River, development would be unlikely to impact moose. A number of studies show that the TAPS has had little 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 the Preferred Alternative, a crude oil pipeline (elevated 7 ft) connecting with the TAPS is not expected to affect moose habitat use and movements regardless of the location of the field(s). Depending upon the location, construction of a pump station would result in the loss of up to 40 acres of moose habitat. Given the amount of habitat available in NPR-A, the impacts would be negligible. Moose could be temporarily disturbed or displaced during construction if the pump station were located in winter moose range.

If gravel is mined from riverbeds in the Planning Area, there is a potential for temporary displacement and disturbance of moose. From 20 to 50 acres of moose habitat could be destroyed or degraded by borrow pit operations. Construction of a natural gas pipeline would have minimal impact on moose. The pipeline would be constructed during the winter, north of winter moose habitat in the Planning Area. Outside the Planning Area, moose in the Colville River may be temporarily displaced or disturbed during pipeline construction.

c) Muskoxen

Potential effects of oil and gas development activities include displacement and disturbance of individual animals, 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); conversely, 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. Muskoxen are still uncommon in the Planning Area. Initial oil and gas development activities are unlikely to impact muskoxen. However, as populations continue to expend west into the Planning Area, they may move into areas of development. In this case, mitigation measures for

caribou such as elevated pipelines and minimum altitudes AGL for aircraft would also reduce impacts to muskoxen. Immigration into specific areas could be slowed by development. Construction of oil and gas pipelines to Prudhoe Bay may result in temporary disturbance of mixed-sex groups of muskoxen in the Colville and Fish river areas. Repeated disturbance of the same group during the winter could negatively affect energy balance of individual animals and potentially contribute to winter mortality.

d) Grizzly Bears

Major sources of noise include construction of roads, pipelines and pump stations, gravel mining, and drilling operations. These activities may disturb grizzly bears occurring within a few miles of the noise sources. Industrial activities and human presence also pose potentially serious disturbances to denning bears. 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 Follmann, 1986). The investigators suggest that seismic testing activities within about 600 ft of the den may cause abandonment of the den. A similar effect could occur from construction activities within 600 ft of dens. 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).

Human scent and other noises also may disturb the bears. When grizzly bears first encounter humans on foot, their initial 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). Both the increase in human presence and resulting encounters with grizzly bears associated with recreation and tourism are temporary in nature. However, the establishment of permanent settlements such as oil fields usually leads to human-bear encounters on a regular basis--and to conflict, particularly if bears learn to associate humans with food (Schallenberger, 1980; Harding and Nagy, 1980; Miller and Chihuly, 1987; McLellan, 1990). Grizzly bears initially 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. These encounters often lead to the loss of bears (Archibald, Ellis, and Hamilton, 1987). Individual bears, especially females with cubs, vary in the degree of habituation-tolerance to human presence, and some would continue to avoid areas when humans are present (Olson and Gilbert, 1994). Although studies show that cub survival is higher in bears using anthropogenic food sources in the oil field region (Prudhoe and Kuparuk), this effect is countered by the fact that these bears have a lower than normal survival rate after becoming sub-adults (Shideler and Hechtel, 2000). The attraction of grizzly bears to garbage and/or food odors at oil- and gas-related facilities has led 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).

Oil exploration and development under the Preferred Alternative are expected to attract some grizzly bears to oil field facilities and may result in the loss of some bears due to interactions with humans. The level of impacts to bears would be dependant upon the location of the oil fields. Bears are much less common in the coastal plain than in the foothills and mountains of the southern part of the Planning Area. Oil development in the area with the highest potential for oil reserves (the north) would initially have fewer impacts on bears than development in the middle to southern portion of the Planning Area. However, if bears are attracted to development, impacts may increase over time. Shideler and Hechtel (2000) estimated bear densities in the oil field region (Prudhoe and Kuparuk) to be 4 bears/1,000 km^2 more than twice the highest density estimate for the coastal plain. This higher density could not be attributed to anthropogenic food sources and the authors speculated that the oil field region was higher quality habitat than other parts of the coastal plain.

Gravel mining in riparian corridors along major rivers could result in disturbance and loss of 20 to 50 acres (per material site) of bear habitat. Shideler and Hechtel (2000) found that bears often used riparian habitats on the

North Slope. An average of 51 percent of the observations of radio-collared bears were in riparian corridors along major rivers and streams.

Construction of a natural gas pipeline would have minor impacts on bears. The pipeline would be constructed during the winter, when bears are generally hibernating. If construction were to occur within 600 ft of an occupied bear den, hibernating bears could be disturbed by noise and could abandon the den. Minimal habitat disturbance would occur at river crossings.

e) Wolves

Potential effects on wolves include short-term disturbance from air and surface traffic and human presence, and increased hunting and trapping pressure through improved access or increased human presence that may be associated with oil development. If caribou abundance were negatively affected by oil and gas development, wolf abundance could in turn be adversely affected. Wolves are generally not abundant in the Planning Area and the highest populations are located in the southern and eastern portions of the area. Oil and gas development in the high potential area would have minimal impact on wolves.

f) Wolverines

Potential effects on wolverines from oil and gas development could include disturbance from air and surface vehicle traffic, increased human presence, and habitat alteration. Wolverines may be sensitive to 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, 1997c). 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 or gas pipeline construction could adversely affect wolverines, especially during the winter, when theses habitats provide cover and important hunting areas. Some wolverines may be displaced near (within a few miles) oil field facilities.

g) Foxes

Oil and gas development activities would affect the arctic fox by increasing the availability of food and shelter. 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). Localized oil development activities do not appear to have any dramatic, deleterious effect on arctic fox populations (Eberhardt et al., 1982). A study of den sites and fox productivity near 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). If development occurs in the arctic foothills or mountains similar impacts to red foxes could occur.

h) Other Mammals

Small rodents and their predators would be affected locally (direct mortality and loss of habitat of individuals or small groups of lemmings and voles) along pipelines, gravel pads, and other facilities. Arctic ground squirrels sometimes den in gravel fill in the oil fields (Shideler and Hechtel, 2000). The availability of suitable burrowing

habitat may increase local densities of ground squirrels. These effects are expected to be insignificant to populations on the Arctic Slope of Alaska.

(b) Effects of Spills

The extent of impacts to terrestrial mammals from spills would depend upon the type and amount of materials spilled, the location of the spill, and effectiveness of the response. The following effects would be more likely to result from a large spill. Most small spills would be contained on the gravel pad and thus have no impact on terrestrial mammals or their habitat. In the case of a spill, terrestrial mammals could become oiled, ingest contaminated vegetation or be disturbed/displaced by spill response activities. Potential impacts to terrestrial mammals would be similar to those discussed under Alternative B and somewhat lower than those discussed under Alternative A. Approximately 17 percent of the Planning Area would be deferred from leasing for 10 years; no impacts from spills would be expected during the deferral period. No population-level effects on terrestrial mammals are anticipated.

Adult caribou, moose, and muskoxen that become oiled are not likely to suffer from a loss of thermal insulation during the summer, although toxic hydrocarbons could be absorbed through the skin or inhaled. However, the oiling of young calves could significantly reduce thermal insulation, leading to their death (USDOI, BLM, 1998). 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 coats, oiling would not be expected to affect thermal insulation, because the outer guard hairs of caribou are hollow. No documented caribou deaths have been attributed to the numerous spills associated with TAPS. 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. Exposure of horses and cattle utilizing grazing lands that support oil extraction have resulted in mortality and morbidity (Edwards 1985). Exposure may involve heavy metals, salt water, caustic chemicals, crude oil, and condensates. In cattle, this exposure may result in a wide variety of symptoms including effects on the central nervous system, cardio-pulminory abnormalities, gastrointestinal disorders, inhalation pneumonia, and sudden death (Edwards 1985). For large spills that are not successfully cleaned up, the potential for contamination would persist for a longer time and there would be a greater likelihood of animals being exposed to the oil. Cleanup success may vary depending upon the environment. Over time, any remaining oil would gradually degrade. Although oiling of animals would likely not remain a threat after clean-up efforts, some toxic products could remain for some time. Depending upon the spill environment, part of the oil could persist for 5 years (USDOI, BLM, 1998).

If a release from a pipeline, or a spill large enough to escape from a gravel pad were to occur, some tundra vegetation would become contaminated. 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 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). For most spills, 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. In most cases, onshore oil spills are not expected to affect caribou, moose, and muskoxen through ingestion of oiled vegetation.

Spill response would result in disturbance impacts to some species of terrestrial mammals. The extent of the disturbance would depend upon a variety of factors including species affected, spill size and location, response actions, and season of year. Disturbance to moose and muskoxen is unlikely given their distribution within the Planning Area. Aircraft or overland vehicles responding to the spill may cause disturbance of terrestrial mammals such as caribou and grizzly bears. Disturbance response may last from a few minutes to a several hours. Larger and more mobile species would be temporarily displaced by human activity around the cleanup site. Displacement may last from a few days to a few weeks. Cow caribou with calves may be displaced up to 2.5 mi (4 km). These disturbance impacts are not expected to have population level effects on any terrestrial mammals.

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 (McKendrick and Mitchell, 1978). The length of time a spill persists is dependant upon soil moisture, and concentration of the product spilled. McKendrick (2000) reported that complete vegetation recovery occurred within 20 years on a wet sedge meadow without any clean up. A dry habitat exposed to the same application supported less than 5 percent vegetative cover after 24 years. For the most part, onshore oil spills would be very local in their effects and would not significantly contaminate or alter caribou, moose, and muskoxen habitat. 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 water bodies.

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 were to contaminate beaches and tidal flats along the Beaufort Sea coast, some grizzly bears would be likely to ingest contaminated food, such as oiled birds, seals, or other carrion (USDOI, BLM, 1998). Such ingestion could result in the death of a few 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 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). Spills estimated to occur under the Preferred Alternative could result in the loss of small numbers of grizzly bears through ingestion of contaminated prey or carrion.

Small mammals and furbearers may be affected by spills from oiling or ingestion of contaminated forage or prey items. Small mammals such as lemmings and voles may be killed during spill response. These impacts would be localized around the spill area and would not have population level impacts.

If seawater were used for enhancement of oil production, a saltwater spill could occur within the NPR-A. According to McKendrick (2000), brine spills kill plants on contact and increase soil salinity to the point that many species of plant cannot survive. Unlike oil, salts are not biodegradable, and natural recovery occurs only after salts have leached from the soil. A spill would have adverse effects on salt-intolerant vegetation near the seawater pipeline, but the amount of tundra habitat affected would be small, no more than a few acres. Thus potential saltwater spills are not likely to affect forage availability for caribou, muskoxen, moose, or other terrestrial mammals in the Planning Area. In cattle, injestion of saltwater at > 10,000 ppm salt can cause sodium-ion toxicity and at lower levels may affect rumen activity (Edwards, 1985). In the case of a saltwater spill on tundra habitat the water would likely be absorbed into the vegetative mat or in wet habitats, diluted with fresh water. Response and rehabilitation activities would likely keep terrestrial wildlife out of the spill area for the short-term. Over the long-term, mortality of vegetation in the area affected by the spill would make the area undesirable for grazing by terrestrial mammals until the vegetation recovers.

In the event of a natural gas well blowout or pipeline rupture, there would be a short-term release of gas (1 day) that could extend downwind for about 1 km and would quickly dissipate once the blowout or leak was stopped. Terrestrial mammals in the immediate vicinity of the blowout could be killed. Natural gas and condensates that did not burn in the blowout would be hazardous to any terrestrial mammal exposed to high concentrations. Given the small area that would be exposed to the plume and the rapid dissipation of the gas, it is not likely that any animals other than individuals present in the immediate vicinity at the time of the blowout would be affected. The

likelihood of caribou, moose, muskoxen, wolves, or grizzly bears being exposed to toxic amounts of gas and condensates is very low and (should it occur) would probably only affect a few individuals. Smaller, less mobile species with small home ranges, such as squirrels, voles, and lemmings may be affected in larger numbers. However, there would be no population level impacts on any species.

(c) Summary

Among the terrestrial mammal populations that could be affected by management actions under the Preferred Alternative are the TLH, WAH, and CAH caribou. Caribou could be temporarily exposed to aircraft traffic and other human activities associated with resource inventories, seismic operations, exploratory drilling, and pipeline construction, but such exposure is not expected to have any effects at the population level. The TLH caribou movements within insect-relief areas may be disrupted by oil development activities with undetermined levels of effects on the productivity of the herd. The WAH caribou maybe exposed to oil development facilities in localized areas. The CAH caribou may be exposed to disturbance impacts from construction of off-site facilities such as a pipeline to existing infrastructure. Moose, muskoxen, grizzly bears, wolves, wolverines, foxes, and small mammals may be locally affected by activities associated with oil and gas exploration and development.

(3) Effectiveness of Stipulations and Required Operating Procedures

ROP A-1 through ROP A-7, regarding solid- and liquid-waste disposal, fuel handling, and spills, would reduce the potential effects of spills and human refuse on grizzly bears, arctic foxes, and other terrestrial mammals. ROP A-8 requiring a bear-interaction plan would reduce impacts to grizzly bears by reducing human/bear interactions. These ROP's would benefit bears by reducing both the number of bears killed in defense of life and property (DLP) and the number of bears becoming habituated to anthropogenic food sources.

ROP C-1, requiring avoidance of known grizzly bear dens, would potentially reduce impacts to denning grizzly bears from seismic operations. The success of this ROP would be relative to the effort made to locate bear dens before initiating work.

ROP C-2: This measure puts restrictions on the types of heavy equipment used and the seasons of allowable use and would be beneficial to terrestrial mammals by reducing the amount of habitat disturbed during overland moves and seismic work. Use of low-ground-pressure vehicles may also reduce the mortality of small mammals.

Stipulation D-1: This stipulation prohibiting exploratory drilling in active floodplains would reduce the potential for damage to the riparian habitats that are so important to many species of terrestrial mammals, including moose, bear and wolverine. Disturbance impacts to wolverines and moose would also be reduced.

ROP E-5: This ROP would require the lessee to minimize the development footprint and would be beneficial to terrestrial wildlife in that it would reduce the amount of habitat lost and decrease disruption of caribou movements. Conversely, it would also reduce the number of gravel habitats created that can be used to advantage by ground squirrels. Although caribou may also use gravel pads for insect-relief habitat, the negative effects of development outweigh any positive impacts. Overall, the effect of this ROP would be beneficial to most terrestrial wildlife.

ROP E-4: Quality assurance/quality control would reduce the potential for pipeline spills or blowouts from manufacturing, maintenance or operation failures. This would reduce the potential for direct mortality of terrestrial mammals due to toxic exposure and the contamination of prey and forage. There would be fewer spills, resulting in less cleanup activity along pipelines and fewer disturbance impacts to terrestrial mammals. Positive results associated with this ROP would not be significant under the Preferred Alternative but would contribute to reducing impacts in the cumulative case.

ROP E-7: This ROP, requiring design of roads and pipelines to allow for free movement of caribou, would greatly reduce impacts of oil development on caribou and other large mammals. Average pipeline height of 7 ft, and separation of roads and pipelines by 500 ft would facilitate movement of TLH caribou from insect-relief habitat to inland foraging habitat. This ROP would reduce (but not eliminate) impacts of oil development on caribou movements. Since caribou are sensitive to humans on foot and moving vehicles, there would be some negative effects on their ability to freely move through the area regardless of how well the facilities were designed.

ROP E-12: This ROP, requiring an assessment of wildlife habitat before development of permanent facilities would facilitate site-specific mitigation of impacts to terrestrial mammals and should reduce the overall impact of development.

ROP F-1: This ROP would minimize disturbance of caribou by requiring minimum altitudes of 1,000 to 2,000 ft above ground level (AGL) for aircraft over occupied caribou winter range and caribou insect-relief areas, respectively, during critical times of the year.

ROP I-1: This ROP, requiring training of all personnel regarding stipulations, ROPs, and environmental concerns, would reduce impacts on terrestrial mammals by making workers more aware of the potential impacts of their activities on wildlife. Education of employees should reduce the potential for harassment and direct mortality of terrestrial mammals. This ROP would reduce the likelihood of DLP killing of bears.

ROP K-5: This ROP, requiring a 3-year study of caribou movements within the Caribou Study Area before construction, would greatly reduce (but not totally eliminate) impacts on TLH caribou. The presence of facilities and associated human activity would still result in disturbance impacts to caribou. Caribou distribution can vary from year to year depending upon many factors. What appears to be the best design and location based on a minimum of 3 years of data may not hold true over the life of the facility or may be altered as additional infrastructure is constructed in other areas.

(4) Conclusion--First Sale

Non-oil and gas activities, seismic work, exploration wells, and spills would have minor effects on terrestrial mammals. Projected levels of oil and gas development would result in increased disturbance of caribou and other terrestrial mammals. Increased habitat alteration would include the development of up to 4 oil fields, an elevated pipeline to Kuparuk, and a buried gas pipeline to Prudhoe Bay. Some TLH caribou would be expected to be disturbed and their movements delayed along the pipeline during periods of air traffic and construction. Near the oil fields, surface, air, and foot traffic would be expected to displace some terrestrial mammals. If extensive development were to occur in the TLH insect-relief area, movements of caribou from coastal insect-relief areas to foraging areas would be disrupted to some extent. This effect would be minimized by locating and designing oil and gas facilities to allow for free movement of caribou. Within the Caribou Study Area, a study of caribou movements would be undertaken before facility development to better reduce impacts of development on caribou movements. Extensive development in this area could result in the functional loss of some insect-relief habitat for TLH caribou.

Overall, activities under the Preferred Alternative are not expected to significantly affect terrestrial mammal populations.

(5) Multiple Sales

If several lease sales were to occur under the Preferred Alternative, considerably more exploration activity would be expected to occur in the habitat of the TLH and WAH caribou, with 3 times as many exploration wells being drilled (Table IV-7). Twice as many oil fields would be developed (Table IV-6) and the number of staging areas and pipeline miles would increase. In addition to development predicted to occur under the first sale, an oil field or fields could be developed in the southern portion of the Planning Area within the summer range for WAH (Map 47).

For many years, the WAH has exhibited a consistent pattern of movement during the summer (ADF&G comments on Draft IAP/EIS). After calving in the Utukok Uplands, the herd moves west into the Lisburn Hills (west of the Planning Area). During the height of the insect season (early July), 80 to 90 percent of the herd forms into large aggregations in the western DeLong Mountains and western North Slope (south of the Planning Area). During late July through early August, they move rapidly back east toward Howard and Anaktuvuk Pass (south of the Planning Area) and then disperse north and west onto the North Slope and the Planning Area during late August and early September. Since most of the WAH animals are outside the Planning Area during most of the insect season, there would be minimal impacts on movement of insect-harassed WAH animals. Within the Planning Area, insect-harassed groups of WAH caribou may have to detour around oil fields. Impacts would be limited to short term disruption or displacement.

An elevated pipeline would likely be constructed from the oil field east to TAPS Pump Station 2. This would cross the route used by the CAH to migrate between their winter habitat in the Brooks Range and calving grounds along the Arctic Ocean (Map 47). Short-term impacts during construction would be the same as those discussed above for construction of a new pipeline to the Kuparuk area. No road would be associated with the new pipeline and the mere physical presence of the pipeline would probably have minimal effect on the behavior, movement, or distribution of caribou, except perhaps during periods of heavy snowfall or intensive human activity (e.g., during major pipeline repairs or spill cleanup). Human activities associated with transportation routes can affect the behavior and distribution of caribou. Frequent disturbance can have adverse effects on caribou energy levels. In the cumulative case, two additional manmade features would be introduced into the range of the CAH--a caribou population that has already been affected by development at Prudhoe Bay and Kuparuk--in the form of a gas pipeline from the southern part of the Planning Area to Prudhoe Bay and an elevated oil pipeline connecting to TAPS.

The increase in the number or length of roads and pipelines, and number of oil fields that would accompany development under multiple sales is expected to further impede movements of TLH caribou from insect-relief areas along the coast to inland foraging areas (Map 49 and Map 50). This would be minimized to the extent possible by locating and designing facilities to allow free movement of caribou. This effect is expected to persist over the productive life of the oil fields and may reduce productivity of the TLH.

Impacts to moose, wolverines, wolves, and bears would be similar to those discussed under the single sale scenario. However, if the oil field facilities were to be located in the southern part of the Planning Area, a greater number of animals could be exposed to oil exploration and development, as densities of these species are greater in the foothills and mountains than on the coastal plain. Moose and muskoxen could be temporarily disturbed during construction of a southern pipeline and second gas pipeline.

Spills under the multiple sale scenario would be expected to have about the same type and level of effects on terrestrial mammals and their habitats as under the single sale scenario but with a higher likelihood of impacts to

WAH and CAH caribou, grizzly bear, moose, wolverine, and wolf. Impacts to these populations and species would be expected to be higher because more exploration and development would occur in the southern part of the Planning Area, and a southern pipeline would be constructed.

(6) Conclusion--Multiple Sales

Multiple sales under the Preferred Alternative would be expected to increase disruption of TLH caribou movements within insect-relief areas and cause some disruption of CAH and WAH caribou. Impacts to grizzly bears, moose, wolves, and wolverines would be greater as more development would be located in higher density habitats for these species.

b. Marine Mammals

Under the Preferred Alternative, the northern coast of the Planning Area, including Dease Inlet-Admiralty Bay and Elson Lagoon, would be open to leasing. Leasing would be deferred for 10 years in the eastern portion of the Planning Area, including Peard Bay and the coastline to the east. The Kasegaluk Lagoon would be designated as a Special Area under the Preferred Alternative. Seven species of nonendangered marine mammals--ringed, spotted, and bearded seals, walruses, polar bears, beluga, and gray whales--commonly occur year round or seasonally in coastal habitats within or adjacent to the Planning Area. Under the Preferred Alternative, some individual members of these species--particularly spotted and ringed seals and polar bears--may be exposed to effects from oil and gas exploration and development activities as well as from other activities that could occur in Dease Inlet-Admiralty Bay and Elson Lagoon. Important spotted seal and beluga whale habitats--including Kasegaluk Lagoon and Peard Bay--would be deferred from oil and gas leasing for 10 years. No permanent or temporary facilities would be allowed within ½ mi of the bank of the Kuk River estuary, an important habitat of beluga whales (Map 18).

(1) Effects of Non-Oil and Gas Activities

The primary potential causes of disturbance of marine mammals would be helicopter traffic (1 to 2 round trips per day for 3 to 6 weeks per survey party), fixed-wing aircraft traffic (2/week/party), and humans on foot. Overland moves and seismic operations occur during the winter on stable sea ice or frozen tundra. Other activities take place in summer and early fall (June-September). These activities, if they occur along the coast of the Planning Area, could cause short-term (< 1 hour) displacements or harassment 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 would be expected to be affected, however, because of the low number of recorded maternal den sites in and adjacent to the Planning Area (Map 51). Seismic surveys 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. However, possible seismic operations in Dease Inlet-Admiralty Bay and Elson Lagoon could affect ringed seals that den on the floating shorefast ice during the winter. Ringed seals den during the winter, however denning ringed seals could be expected to be exposed to the noise and activity associated with offshore seismic operations if it occurs in the

floating-fast ice zone at the mouth of Dease Inlet or in Elson Lagoon. Local displacement of some denning ringed seals could occur, but this activity is not expected to affect ringed seal distribution and abundance adjacent to the Planning Area.

The overland moves typically occur each winter; travel from Prudhoe Bay or Oliktok Point to Cape Simpson and the Barrow area; 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 may attract bears in some cases, 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 would 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. Fuel spills are required to be cleaned up immediately, if possible. Such events are not expected to have any significant effects on marine mammals in the Planning Area.

The effects on marine mammals--seals, polar bears, and whales--of activities other than oil and gas exploration and development under the Preferred Alternative would be local and short term, with no significant adverse effects to the populations.

(2) Effects of Oil and Gas Activities

(a) Effects of Disturbances

Some potential noise and disturbance to marine mammals from aircraft traffic and seismic activities could occur in and along the coast--primarily in the Dease Inlet/Admiralty Bay area and Elson Lagoon--and these effects are expected to be local and short term (generally < 1 year or intermittent during construction periods).

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 projected 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 and spotted seals hauled out on the ice or 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.
In Dease Inlet/Admiralty Bay and Elson Lagoon the number of spotted and ringed seals affected would depend on the number of disturbance incidents. Aircraft disturbance of large groups of hauled-out spotted seals in the Planning Area (such as on Oarlock Island in Admiralty Bay) could result in injury or death to young spotted seal pups if they were trampled by other seals during the disturbance or were abandoned by their mothers. 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.

Exploratory drilling is projected to occur during the winter (December to mid-April) over about 9 years using 1 or 2 drill rigs (Table IV-05). If it occurred in Dease Inlet-Admiralty Bay, or Elson Lagoon, or 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 USFWS 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 in or on the coast of Dease Inlet/Admiralty Bay and Elson Lagoon (Map 51, Map 57, Map 58, and Map 59). Development construction activities are assumed to occur over a 7-year period, with production to occur over the assumed 20-year life of the oil fields using 6 production rigs and as much as 230 mi. of pipelines (Table IV-05 and Table IV-29). Most of the exploration and development activities are assumed to occur onshore but some activity may occur in Dease Inlet-Admiralty Bay and Elson Lagoon, with pipelines routed across the NPR-A and connecting to TAPS (Map 108). Gas development is expected to follow similar onshore pipeline routes. These onshore activities would affect local tundra habitats and would not likely affect individual marine mammals or populations.

(b) Effects of Spills

1) Effects from a Large Spill

There is an estimated 0 to 33 percent chance of one or more spill occurring. For purposes of this analysis, the spill could be a 500- or 900-bbl spill under the Preferred Alternative (Table IV-19). If this spill were to occur near the Dease Inlet area, some of the oil could reach the marine environment. Within the marine environment some spotted seals (perhaps as many as a few hundred) could be exposed to the spill if it occurred during the open-water season. It could affect ringed seals if it occurred during melt-out in the spring. Assuming the spill occurred during the summer open-water period, several square kilometers of coast line could be contaminated in the Dease Inlet/Admiralty Bay area and the spill could sweep over 100 km^2 during open water or 100 km^2 to about 200 km^2 if it occurred during melt-out. Several hundred spotted seals that congregate in Dease Inlet/Admiralty Bay near the mouths of streams flowing into the inlet could be exposed to the spill. Small aggregations of ringed seals may also be present in the area. Such an event could result in the contamination and possible loss of some spotted seals (perhaps 10 to 50 seals out of a population of about a thousand animals could suffer lethal effects). The population is likely to replace this loss within one year. The number of ringed seals affected if the spill occurred during meltout could potentially be in the tens to perhaps one hundred seals. The ringed seal Beaufort Sea resident population of about 40,000 is likely to replace this potential loss within one year. The pipeline spill is not likely to affect many bearded seals, walruses, beluga and gray whales because these species tend to occur offshore of Dease Inlet/Admiralty Bay and the spill is expected to disperse before it reaches migration routes and offshore habitats where these species could be exposed to the spill. Few if any bearded seals, walruses, beluga and gray whales are likely to be exposed to the spill and suffer sublethal or lethal effects. These species populations would not be affected by this spill.

Little or no significant contamination of benthic food organisms and bottom-feeding habitats of walruses, bearded seals, and gray whales would be expected, from a pipeline spill because only a very small amount of oil would be expected to reach feeding areas. A small fraction of the spill (1 to 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 spill is likely to be very small and represent an insignificant proportion of the prey and benthic habitat available to walruses, bearded

seals and beluga, and gray whales. Thus, the 500- or 900-bbl spill is not likely to have any food-chain effects on marine mammals.

Polar bears would be most vulnerable to a spill if it were to reach the barrier islands from Elson Lagoon to Point Barrow (Map 51). However, the number of bears likely to be contaminated or to be indirectly affected by a local contamination of seals probably would be small. Even in a severe situation where a concentration of perhaps 10 to 30 bears (such as at a whale-carcass site) were contaminated by a 500- or 900-bbl spill and many of the bears died (a worst case), this one-time loss would not expected to significantly affect the polar bear population of 2,272 to 2,500 bears (USFWS, 2002).

2) Effects from Small Onshore Spills

A range of 0 to 83 crude-oil spills of < 1bbl and 0 to 28 crude-oil spills ≥ 1 bbl and < 500 bbl (total volume of 0 to 336 bbl) and 0 to 227 small fuel-oil spills with an average size of 29 gal are estimated to occur onshore under the Preferred Alternative for the first sale (Table App 9-7 and Table App 9-9). These small onshore spills are expected to have little effect on seals, walruses, gray and beluga whales, and polar bears. However if some of these spills occur in or contaminate streams in the Dease Inlet 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 were to reach the marine environment during early winter, resulting perhaps in the death of some pups (10 to 30 animals, because of the small size of these spills and the sparse distribution of pupping lairs). If some of the spills were to reach the Dease Inlet area during the summer open-water season, some spotted seals that frequent the inlet could be exposed to the oil and suffer sublethal and possibly lethal effects. Perhaps as many as a few hundred seals could be exposed to the contamination, with heavily oiled individuals suffering lethal effects (perhaps 10 to 30 animals). Smaller numbers of polar bears would be exposed to and affected by these small spills. The losses of small numbers of seals, and possibly a few polar bears, would not be expected to affect the seal and polar bear populations in the Beaufort and Chukchi Seas. These spills are not likely to affect bearded seals, walruses and beluga and gray whales that occur offshore of Dease Inlet.

(3) Effectiveness of Stipulations and Required Operating Procedures

Oil and gas activities in Dease Inlet-Admiralty Bay, Elson Lagoon, and on barrier islands would be under special stipulations for exploration and development (see Stipulation K-3). Oil and gas exploration operations would not be allowed on Dease Inlet, Admiralty Bay, and Elson Lagoon including natural and barrier islands, between May 15 and October 15 of each season. This measure would avoid disturbance of spotted seals and other marine mammals during the open water season. There would be a ¾-mi setback seaward the shore and around natural islands (excluding the barrier islands) where no development could occur on or under the water. This setback would include Oarlock Island in Admiralty Bay, an important haul-out area for spotted seals. This stipulation would minimize disturbance and habitat effects on spotted seals in the Dease Inlet-Admiralty Bay area. Stipulation K-3 measures would include oil spill cleanup capability, and oil-spill response activities that could help to minimize effects on marine mammals in the Dease Inlet-Admiralty Bay and Elson Lagoon areas.

Stipulations on waste prevention, handling and disposal and on spill prevention and cleanup are expected to reduce potential marine pollution and effects on marine mammals in the Dease Inlet/Admiralty Bay area where oil exploration and development may occur under the Preferred Alternative. Stipulations on waste prevention, handling and disposal such as handling of food and garbage are expected to prevent the attraction of polar bears to camp sites that could result in human/bear interactions and the taking of polar bears. Under Overland Moves stipulations and BLM/operators planned winter activities including seismic operations within 25 mi of the coast shall consult with USFWS to prevent disturbance of denning polar bears. Activities would be prohibited within 1 mi of known bear dens. This consultation is expected to prevent some disturbances of denning polar bears under the Preferred Alternative.

(4) Conclusion--First Sale

For the Preferred Alternative, the effects of activities other than oil and gas on marine mammals--particularly polar bears and spotted seals along the coast of the Planning Area--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 an increase in potential noise and disturbance along the coast, primarily in the Dease Inlet-Elson Lagoon Area, and these effects are expected to be local and short term (generally <1 year or intermittent during construction periods). Under the Preferred Alternative, seals and polar bears could be affected by possible oil development offshore from a production island and subsequent oil development on or along the coast of the Northwest NPR-A in the Dease Inlet Area. Effects of these activities would be local and are not likely to affect marine mammal populations. Potential oil spills are likely to affect small numbers of marine mammals with population recovery expected within 1 year.

A small number of seals and polar bears might be adversely affected or killed by a 500- or 900-bbl crude-oil spill occurring onshore if such a spill were to contaminate Dease Inlet, or by small fuel spills occurring in and contacting Dease Inlet and Elson Lagoon, but these losses would not be significant to marine mammal populations. The overall effects of the Preferred Alternative are expected to be short term, with no significant adverse effects on marine mammal populations.

(5) Multiple Sales

If several lease sales were to occur under the Preferred Alternative, considerably more exploration activity is projected to occur in the southern and central part of the Planning Area, with the number of exploration wells drilled increasing to 15 ($18/bbl) to 36 ($30/bbl) for multiple sales from the 5 ($18/bbl) to 12 ($30/bbl) wells for one sale. The amount of development also is projected to increase. The number of production pads would double for multiple sales as compared to those projected for the 1 sale (12 pads, up from 6 pads), and pipeline mi would increase to 685 mi for multiple sales from the 205 mi for one sale (Table IV-05, Table IV-07, and Table IV-29). The number of small crude-oil and refined-oil spills is estimated to be about the same for multiple sales as for the first sale (Table App 9-7 and Table App 9-9). Only a small increase in potential noise and disturbance effects on marine mammals would be expected along the coast, primarily in the Dease Inlet-Admiralty Bay and Elson Lagoon Area, and these effects are expected to be local and short term (generally < 1 year, intermittent during construction periods).

(6) Conclusion--Multiple Sales

The overall effects of oil and gas activities under the Preferred Alternative with multiple sales would be expected to be about the same as they would be for the single sale, but the duration and extent of activities would be over a longer period of time, as would potential disturbance effects.

11. Endangered and Threatened Species

The U.S. Department of the Interior (USDOI), Bureau of Land Management (BLM) initiated the process for the Northwest National Petroleum Reserve-Alaska (Northwest NPR-A) Integrated Activity Plan/Environmental

Impact Statement (IAP/EIS) to fulfill BLM's responsibility for managing lands in the Northwest NPR-A Planning Area (the Planning Area). The IAP/EIS includes various management activities that may affect endangered and threatened species, such as aircraft use, hazardous- and solid-material removal and remediation, overland moves, seismic activities, and oil and gas exploration and development. Such activities--particularly oil and gas exploration and development/production activities, and aircraft traffic associated with wildlife studies and other surveys--may result in noise and disturbance, altered habitat, and spilled oil or other contaminants that could adversely affect the behavior, distribution, and abundance of individuals or populations occurring in or adjacent to the Planning Area.

If a sale were to be held in the Northwest NPR-A, it would be the seventh sale in the NPR-A since January 1982. The first two oil and gas lease sales were held in January and May 1982. Two subsequent sales followed in 1983 and 1984, and a fifth lease sale was canceled. Sales in the Northeast NPR-A were held in 1999 and 2002. In all, approximately 129 wells have been drilled in the NPR-A (including shallow core test wells, those on ASRC lands, and wells outside the current NPR-A boundary). Twenty-four exploration wells have been drilled in the Northwest NPR-A Planning Area since 1944, and 13 have been drilled from 2000 to 2002. Of 688 leases issued in various federal offshore Beaufort Sea sales, 52 are still active, and 30 exploration wells have been drilled, plugged and abandoned. Nine offshore wells were considered producible but uneconomic for development and production at current oil prices, and one offshore production well (Northstar) is in operation east of the NPR-A.

This section discusses potentially adverse effects of management actions, including proposed oil and gas exploration and development/production, on endangered and threatened species within the Northwest NPR-A Planning Area under the Preferred Alternative. Potential mitigating measures to reduce adverse effects on listed species conclude the analysis. This document provides adequate information for the consultation on the Northwest NPR-A Planning Area that has concluded with an opinion regarding the reasonable likelihood of leasing and exploration violating Section 7(a)(2) of the Endangered Species Act (ESA), as amended. Because of the uncertainty of development and production at this time, this section provides less detail on these activities. However, sufficient general information on development and production is available to provide an adequate basis for a generalized impact analysis. Should commercially producible quantities of oil be discovered and development and production be proposed, consultation would be reinitiated regarding these activities. The need for further consultation also would be considered if: 1) additional species were listed; 2) critical habitat were designated; 3) the proposed action were substantially modified; or 4) significant new effects-related information were developed. A detailed description of the endangered and threatened species within the Planning Area and an analysis of the effects of similar proposed actions are found in the Northeast NPR-A Final IAP/EIS (August 1998) and the Biological Opinion issued for that project. Details concerning the consultation process are included below and in Appendix 10.

A description of the threatened and endangered species that occur in or near the Planning Area is provided in Section III.B.6 of this document, the Biological Opinions for the *Northeast NPR-A Final IAP/EIS* (USDOI, BLM and MMS, 1998), the *Arctic Region Biological Opinion* (USDOC, NOAA, NMFS, 2001), and the Biological Opinion for this *Northwest NPR-A Final IAP/EIS* . No critical habitat in or near the Planning Area has been identified for these species.

Primary effects on bowhead whales would result from disturbance during their semiannual migration past the Planning Area. Primary effects on spectacled eider and Steller's eider exposed to such activities would be: 1) altered distribution, abundance and/or behavior resulting from disturbance during the breeding, staging, or migration periods; 2) alteration of habitats; and 3) effects resulting from pollution of the environment by crude- or refined-oil products, wastewater, and solid/liquid wastes of varying toxicity. This analysis assumes the stipulations and required operating procedures (ROP's) in Section II.C.6 and Table II-03 are in place.

a. Consultation Assumptions

In accordance with the Endangered Species Act (ESA) Section 7 regulations governing interagency cooperation, the early consultation process was initiated when BLM requested notification from the U.S. Fish and Wildlife Service (FWS) (memorandum dated June 10, 2002) and the National Marine Fisheries Service (NOAA Fisheries) (letter dated June 10, 2002) of the listed and proposed species and critical habitat to be referenced in the memorandum and letter to follow requesting initiation of formal consultation for this project. The FWS responded (memorandum, dated July 24, 2002), specifying the threatened spectacled and Steller's eiders as the species to be included in the IAP/EIS for the Planning Area; and NOAA Fisheries responded (letter, dated July 26, 2002), specifying the endangered bowhead whale as the species to be included. These letters are reproduced in Appendix 10. No critical habitat is located within the Northwest NPR-A Planning Area.

The endangered bowhead whale may occur seasonally adjacent to or in the Planning Area, and the threatened spectacled and Steller's eiders occur seasonally in the Planning Area; each of these species may be exposed to activities associated with the Northwest NPR-A management plan. 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 to the point at which it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. NOAA Fisheries agreed that the proposed project was unlikely to adversely affect the bowhead whale and found that formal consultation was not required, as noted in their July 26, 2002 letter (Appendix 10). Section 7 consultation with FWS was reinitiated in September 2003 to address the BLM's Preferred Alternative developed for the Final IAP/EIS. Additional and updated information and analysis on the potential impacts of selected factors on spectacled and Steller's eiders can be in the *Biological Assessment for Threatened and Endangered Species with Respect to the Proposed Northwest National Petroleum Reserve-Alaska Integrated Activity Plan* (Appendix 10) prepared for the reinitiation of the Section 7 consultation with FWS.

b. Effects of Non-Oil and Gas Activities

Under the Preferred Alternative, effects of management actions within the Planning Area on bowhead whales potentially could include minimal changes in nearshore behavior and/or distribution. For spectacled and Steller's eiders, such actions may include altered distribution, abundance, and/or behavior resulting from disturbance. Such changes may be associated with aerial surveys (including wildlife surveys), human presence and activities such as summer camps and hazardous- and solid-material removal and remediation during breeding, staging, or migration periods, and alteration and pollution of eider habitats. Effects of non-oil and gas activities on eiders may be somewhat greater than those discussed under the No Action Alternative, Section IV.B.11.a. This is because several categories of anticipated non-oil and gas activities, including aircraft use for aerial surveys and duration of camp occupation, are increased under the Preferred Alternative (Table IV-28).

(1) Effects on Bowhead Whales

Bowhead whales may be present in the Beaufort Sea offshore of the northern Planning Area primarily from August through October during their westward fall migration from Canadian waters to wintering areas in the Bering Sea. They may be present in the Chukchi Sea off the western Planning Area in April to early June during their northward spring migration. Under the Preferred Alternative, only when exceptional circumstances prevail is it likely bowheads would be disturbed by activities associated with the management plan. This could occur when whales migrate near the coast coincident with the presence of barge traffic, or possibly air traffic to supply a shoreline camp, or aerial surveys along barrier islands or offshore areas. For example, in 2000 when median distance of migrating whales offshore was just 11.0 km, and several individuals in the vicinity of Dease Inlet approached shore, the potential for some disturbance from underwater or airborne noise would have existed.

Effects from such exposure are likely to be negligible.

(2) Effects on Spectacled and Steller's Eiders

Spectacled eiders are widely distributed near lakes or coastal margins throughout much of the Planning Area in summer (Larned et al., 2001; Larned, Stehn, and Platte, 2003; Ritchie and King, 2002) and are essentially absent from the area from October to May. Highest densities occur in several areas from Dease Inlet west to the Chukchi coast and west of the village of Atqasuk to Peard Bay and Kuk River/Wainwright Inlet (Map 62). Females with broods typically are found offshore later in summer. Steller's eiders are sparsely distributed in the Planning Area, particularly in the northwest portion between Dease Inlet/Admiralty Bay and the Chukchi coast, and nest attempts apparently are relatively infrequent. They are absent from the area from late October to May. Effects of management actions on spectacled and Steller's eiders are likely to be similar to those discussed for other rare and/or declining waterfowl species in Section IV.B.11.a but their ESA-listed status is assumed to lend greater significance to a given level of effect.

(a) Effects of Ground Activities

Most ground transport activities occur in winter and thus would not disturb eiders or affect their habitats. However, during the summer breeding season, noise and visual presence of personnel resulting from various activities may disturb eiders. Eiders are likely to be displaced from within 700 ft to 0.6 mi of large summer encampments, causing a local decline in nest attempts and success (Grubb et al., 1992; Johnson et al., 2003; Murphy and Anderson, 1993; Skagen, Knight, and Orians, 1991; Stalmaster and Newman, 1978). Under the Preferred Alternative, occupation of large camps is anticipated to be 12 weeks rather than 6 weeks as under the No Action Alternative (Table IV-28). However, this difference is not likely to alter the disturbance effects on birds significantly because--in the context of the short arctic breeding season--those that are displaced when the camp is first occupied probably would not return to the area to renest after 6 weeks any more than 12 weeks because of insufficient time remaining in either scenario to raise a brood. Lack of mate availability at the end of these periods also would limit success. Those individuals that are tolerant of camp activity for 6 weeks probably would be tolerant for 12 weeks. Local eider populations may experience minor declines in breeding success from disturbance in summers when camps are occupied, although this may not be as relevant to Steller's eiders with their scattered distribution. Habitat loss in Northwest NPR-A, though greater under the Preferred Alternative than the No Action Alternative from potential for oil and gas activities, is expected to be negligible. Predators attracted to camps may decrease breeding success of local nesting eiders. Effects of small, frequently moved camps are likely to be negligible; those in place for 6 to 12 weeks (Table IV-28) may cause minor local loss of nest success and productivity. Small groups of travelers on the Colville and other rivers at the frequency anticipated are expected to cause minimal disturbance of eiders.

Hazardous material, fuel spill, and solid-material removal and remediation may disturb local nesting birds for varying periods, resulting in lowered nest success or failure for those at the site. Because these activities may be conducted during summer months, they could disturb or displace eiders that are brood rearing in the area; nesting eiders probably would abandon their nests. Assessment of the nature and extent of contamination of the site and cleanup might involve the use of drill rigs, hydropunches, or backhoes. Removal and remediation activities may continue for as long as 3 to 4 weeks. Females with broods would move out of the area immediately, as would those not yet sitting on eggs. Spills of refined oil products are likely to be contained and cleaned up before contacting eiders. If contact occurs, effects probably would be similar to those described for an oil spill below (Section V.B.11.c.2).

(b) Effects of Aircraft

Both fixed-wing aircraft and helicopters could be used to transport personnel, supplies, and equipment into summer field camps and to fly aerial surveys. Helicopter traffic in particular, may potentially cause substantial disturbance of eiders, although Balogh (1997) indicated that fixed-wing aircraft flown at 150 ft often caused spectacled eiders to flush while helicopters flown at similar altitudes in the vicinity of Prudhoe Bay did not. Also, behavioral reactions of pre-nesting birds to aircraft overflights may not represent the behavior of incubating or brood-rearing birds. It is possible that some eiders may be disturbed by these activities and experience temporary, non-lethal effects lasting less than an hour. Effects of routine aircraft flights into large camps may range from causing avoidance of certain areas by eiders to abandonment of nesting attempts or lowered survival of young. Regardless of where they originate, such flights may pass over areas where eiders occur at higher density. There is a potential for displacement of some nesting eiders near routinely used aircraft landing sites as a result of numerous overflights, landings and takeoffs. However, although the reaction of eiders to aircraft overflights is unpredictable, there is a potential for habituation to routine air traffic by spectacled eiders. In the Prudhoe Bay area nests are regularly located in wetlands within 1 km of the Deadhorse Airport (TERA, 1995b), including one less than 250 m from the runway (Martin, 1997), suggesting that some individuals are tolerant of aircraft activity in the vicinity of nests.

Aerial survey flights for monitoring bird or caribou populations also have considerable potential for disturbance of eiders because they are flown at low altitude. However, in most areas they are of short duration, and cover only a small percentage of the ACP per season, so areawide disturbance effects are likely to be minimal. In the northeastern portion of the Northwest NPR-A Planning Area, wildlife survey activity may be more frequent during a 3-week period in June and July (Table IV-28), thus disturbing larger areas or certain areas more intensively, than elsewhere in the Planning Area. Also, eiders may be disturbed by helicopters used in studies in which caribou are captured for attachment of radio collars. Other aerial surveys and point-to-point transport air traffic are likely to cover a small percentage of the Planning Area. Also, relatively few nest sites are expected to be affected because eider nest sites generally are scattered at relatively low density over much of the northern half and west-central portion of the Planning Area, and even lower density in the remainder. For these reasons (and with the possible exception of the northeastern portion of the Planning Area noted above), the increase from an estimated 14 days of aerial surveys under the No Action Alternative to 21 days under the Preferred Alternative, or increase of other surveys from occasional to several 1 to 2 week periods, may not increase disturbance in any given area significantly (Table IV-28). In isolated areas, aircraft effects are likely to be negligible, although potentially minor effects could occur in the vicinity of large camps. Areas suspected of containing hazardous material may be surveyed initially from aircraft, with the potential for disturbance to eiders as noted above. Quantitative effects resulting from most factors are likely to be difficult to separate from natural variation in population numbers.

c. Effects of Oil and Gas Activities

(1) Effects of Disturbance

Oil and gas leasing, exploration, and development/production is anticipated for all BLM-administered lands in the Planning Area under the Preferred Alternative (Map 18). The proposed Deferral Area (approximately 17% of the Planning Area) would not be offered for oil and gas leasing for 10 years. Thus, the Preferred Alternative is likely to result in lower effects from oil and gas activities than Alternative A. Exploration and development/production activity for the first sale could vary substantially depending on the per-barrel price of oil (Table IV-05 and Table IV-07). The number of exploration/delineation wells for the first sale ranges from 5/2 to 12/18, exploration/delineation rigs from 1 to 3, production pads from 0 to 6, staging bases from 1 to 2, and 205 new pipeline-miles (Table IV-05 and Table IV-29). If exploration alone were to occur, activities would be expected to take place over a period of 7 years. If development were to follow exploration, it is expected to require 10 years, plus 4 years for additional production well drilling. Production is estimated to last 22 years. It is expected that any development in the Planning Area would involve relatively small, interconnected gravel structures.

(a) Effects of Exploration

Exploration may result in noise and disturbance and altered habitat effects that may affect behavior, distribution, and abundance of individual eiders or populations occurring in or adjacent to the Planning Area. The discussion of potential effects in this section is based on activities projected to occur under the Preferred Alternative. Contaminants such as drilling muds and cuttings would not be released during exploration activities, and no adverse effects should result to individuals either through direct contact or indirectly as a result of effects on their prey populations or important habitats. Based on industry's record, the probability of crude-oil release during exploration is assumed to be zero. Seismic activity and exploration drilling would be conducted entirely during the winter months. Information on drilling operations and logistical support for them is found in Section IV.A.1.

1) Effects on Bowhead Whales

Bowhead whales move through the Beaufort Sea offshore of the NPR-A during their fall migration to wintering areas in the Bering Sea. No drilling activities would occur in OCS waters under this IAP/EIS, and potential offshore exploration effects would be limited to noise-producing activities. Noise-producing aircraft and marine vessel traffic are the activities most likely to affect bowhead whales during exploration. Other noise-producing activities, including seismic surveys and drilling activities, would take place in winter (early December to mid-April) when most bowheads are absent from the area. A detailed description of these activities and their potential effects on bowhead whales in the Beaufort Sea OCS and the NPR-A can be found in the *Beaufort Sea Sale 144 Final EIS* (USDOI, MMS, 1996a:Sec. IV.B.6), the *Beaufort Sea Multiple Sale Final EIS* (USDOI, MMS, Alaska OCS Region, 2003:Sec. IV.C.5), and in the *Biological Evaluation for Beaufort Sea Sale 170* (USDOI, MMS, 1998).

a) Seismic Activity and Exploratory Drilling

Seismic and drilling activities would be far removed from the typical bowhead migratory corridor and may occur in winter using all-terrain vehicles supported by light aircraft when few or no whales are likely to be present. Thus these activities are not likely to expose whales to underwater noise or cause any disturbance effects.

b) Vessel and Aircraft Activity

Only under exceptional circumstances--when whales migrate near the coast coincident with the presence of barge traffic in support of shoreline staging areas--is it likely that bowheads would be disturbed by these exploration activities. For example, in 2000, when median distance of migrating whales offshore was just 11.0 km and several individuals in the vicinity of Dease Inlet were near shore, the potential for some disturbance of those individuals from underwater or airborne noise or visual presence would have existed. There may be some barge transport of heavy equipment during the summer open water season (mid-July to early October) to staging areas along the coast where it would be stockpiled 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 quickly away when vessels approach rapidly and directly. Avoidance usually begins when a rapidly approaching vessel is 0.62 to 2.5 mi (1 to 4 km) away. A few whales may react at distances from 3 to 8 mi (4.8 to 12.8 km), and a few whales may not react until the vessel is less than 0.62 mi (1 km) 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 (4 km) (Richardson and Malme, 1993, as cited in USDOI, MMS, 1996a). Fleeing from a vessel generally stops within minutes after the vessel passes, but scattering may persist for a longer period. In some instances, bowheads return to their original locations. Bowhead whales could 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 along the coastline in the Planning Area.

The effect of vessel traffic on bowheads is likely to be temporary and negligible.

Aircraft flying at low altitude (below 300 m or 984 ft) often cause hasty dives by bowheads, but they generally are not affected by overflights above this altitude. Flights supporting oil and gas operations in the Planning Area are not likely to occur over marine waters beyond the nearshore zone, and then only when approaching a shoreline staging base, well outside the typical whale migration corridor. Effect on bowhead behavior from any aircraft or vessel exposure is likely to be temporary and negligible.

2) Effects on Eiders

Spectacled eiders are widely distributed throughout the coastal plain portion of the Planning Area in summer and are essentially absent from the area from late October to May. Manmade noise and activities--as well as human presence--may result in disturbance of some eiders in the Planning Area. Noise-producing activities, including aircraft traffic and marine-vessel traffic, are the activities most likely to affect spectacled and Steller's eiders. Because of the relatively low density of eiders in the Planning Area during the summer breeding season, substantial disturbance may not be expected to occur. 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.

a) Seismic Activity and Exploratory Drilling

Seismic surveys and drilling activities occur during winter months (December-April) when eiders are absent from the region. If a seismic operation were to extend into May (an unlikely scenario since they typically last about 100 days beginning in early December), disturbance of early-arriving eiders could occur, causing negligible increases in energy use.

b) Vessel and Aircraft Activity

There could be some transportation of equipment and supplies through the marine environment during the summer open water season (mid-July to early October). 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-early October) for operations at inland sites during the winter months. Vessel traffic generally would be limited to routes in shallow nearshore waters between staging areas near existing infrastructure (such as West Dock or Oliktok Point) and staging areas along the coastline in the Planning Area (e.g., Cape Simpson, Barrow, Peard Bay). Spectacled and Steller's eiders that are accompanying young or are staging or migrating in coastal or offshore waters during the relatively brief staging/migration periods (spectacled eider males: late June/early July, females w/juveniles: late August/September) could encounter a few vessels associated with oil and gas activities in the Planning Area during their migration. These birds are expected to experience negligible disruption of foraging activity because of the low probability of disturbance by vessel activities.

Because spectacled and Steller's eiders are absent from the Planning Area during winter, winter aircraft flights associated with seismic surveys and drilling operations during exploration would have no effects on these species. Aircraft activity over the marine environment during the open water season as a result of exploration operations in the Planning Area is likely to be minimal. Because of the low probability that these areas would be overflown by support aircraft, 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 spectacled eider nest sites are scattered at relatively low density over the northern half of the Planning Area, substantial disturbance of nesting or brood-rearing females

and young is not expected to occur. Some eiders may experience temporary, non-lethal effects, probably lasting less than an hour. Also, because 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, substantial disturbance of nesting or brood-rearing Steller's eiders is not expected to occur.

(b) Effects of Development and Production

Activities during development and production may result in disturbance and altered habitat effects on behavior, distribution, and abundance of individuals and local or regional populations in or adjacent to the Planning Area. Potentially disturbing factors can be categorized as: 1) causing injury or death, 2) causing increased energy expenditures that affect physiological condition and rate of survival or reproduction, or 3) causing long-term changes in behavior, including traditional use of habitats (Calef et al., 1976). The latter could be the most serious overall effect from oil and gas development and production in Northwest NPR-A, though careful planning and scheduling could avoid most serious effects. Effects on bowhead whales could result from vessel traffic and aircraft overflights. Depending on location and season, oil and gas activities in areas where eiders occur potentially could cause increased disturbance from routine aircraft or vessel operations, construction activities, presence of gravel mines, pads, and roads, facilities, associated vehicle and foot traffic, and drilling activities. Although regular seismic surveys would not disturb either bowheads or eiders (because they are conducted in winter when these species are not present), a commercial discovery could result in seismic surveys being carried out when these species are present in or near the Planning Area, possibly causing disturbance.

Initial developments are likely to occur in the extreme northern portion of the Planning Area, generally surrounding the Dease Inlet/Admiralty Bay area to Smith Bay, and possibly westward to the Chukchi coast. Substantial numbers of spectacled eiders (Map 62) could be affected to some extent by potentially disturbing isolated events (e.g., passage of aircraft), though most incidents are expected to result in negligible effects from which individuals would recover within hours to one day. However, the cumulative effect of repeated disturbance could extend for longer periods and potentially may adversely affect physiological condition, molt, nest success, and survival of individuals. Ultimately this could result in redistribution of individuals in local populations, though such effects usually are difficult to separate from natural variation in population distribution unless it involves substantial numbers of individuals. The construction of gravel structures and facilities that displace eiders from favored habitats could result in short-term negative effects during breeding, brood-rearing, or migration; however, the footprint of such structures is small enough that effects are not likely to be evident at the regional population level. Assuming that the current protocol of smaller facility footprints would be followed, it is unlikely that the amount of habitat removed would represent a significant loss. Information on development and production activities is found in Section IV.A.1.

1) Effects on Bowhead Whales

The bowhead whale migration route typically is well offshore (median 32.2 km) of where any oil and gas development is likely to occur (Treacy, 2002). Noise-producing aircraft and marine vessel traffic are the activities most likely to affect bowhead whales during development and production. Only under exceptional circumstances--if whales migrated near the coast coincident with the presence of barge traffic or air traffic to supply a shoreline staging area--is it likely they would be disturbed by these activities (see discussion under exploration, above). Thus it is unlikely whales would experience intense or frequent disturbance from noise originating from Northwest NPR-A activities that would modify normal behavior beyond a negligible extent. If a commercial discovery were made, transport of equipment and supplies by barge to the Planning Area would increase, although it still would occur shoreward of the bowhead migration route.

Seismic activity would likely occur entirely during winter months when most whales are absent from the vicinity

of the Planning Area. Virtually all development and production drilling activity is likely to occur on shore and thus would not affect bowhead whales. Likewise, most construction of pipelines and other structures would occur in winter and/or away from marine waters.

2) Effects on Eiders

Most nesting occurs west from the Sagavanirktok River. The highest densities of nesting spectacled eiders in the Planning Area occur in areas south of Barrow and in the west-central Planning Area (Map 62). Females are present in the breeding area from May to September, males from May to late June. Steller's eiders are sparsely distributed, primarily west of the Colville River. Females with broods are present in the breeding area from early June to late August or early September.

Manmade noise and activities, as well as human presence, may result in disturbance of some spectacled eiders in the Planning Area. Noise-producing activities, including aircraft traffic and marine vessel traffic, are the activities most likely to affect spectacled and Steller's eiders. Seismic surveys would be conducted in winter so would not affect eiders except under exceptional timing circumstances; typically, eider early arrival dates are 1 to 2 months or more beyond the end of seismic activities, as noted in the exploration discussion above.

Disturbance effects may be particularly serious in areas where higher densities of spectacled eiders occur. Such areas are west of Dease Inlet; south of Barrow; the southwest-central portion of the Planning Area; and the western Planning Area south of Peard Bay, east of Wainwright, and east of the Kuk River (Map 62). Steller's eiders usually are sparsely scattered across the northern Planning Area (Map 63), with a somewhat greater concentration south of Barrow.

a) Air Traffic and Vessel Effects

Air traffic is likely to be the most important source of disturbance associated with oil and gas development; helicopters are the most disturbing type. Although quantitative studies of the short-term effects of aircraft disturbance on molting brant have been done in the Teshekpuk Lake Special Area (Derksen et al., 1992), few comparable studies of effects on other species at other phases of the annual cycle--or long-term effects on populations--have been done. Also, it is not clear whether eiders and brant are at all comparable in this regard. In studies at the Alpine Development on the Colville River delta, Johnson et al. (2003) found distributions of most species relative to the airstrip did not show detectable differences when control and impacted areas were compared before and after construction (see discussion at Section V.B.9.b.1.b). Numbers of nests of some species did decline between non-construction and construction years, but because cooler temperatures coincided with heavy construction activity, it was not possible to show a direct link between nest declines and level of disturbance. In general, these investigations found waterfowl nest densities lower within 1,000 m of the airstrip during the period when construction air traffic was high. However, there was no significant difference in average distance of nests from the airstrip. White-fronted geese nests, and probably nests of other species as well, were redistributed relative to the airstrip to nearby comparable habitat during heavy construction.

Aircraft routinely flying over the areas of higher density in the Planning Area noted above are likely to cause minor effects in the local eider populations. For example, disturbance associated with development in the northern area where the first development is likely to occur could adversely affect higher concentration areas of both eiders south of Barrow. Aircraft support of winter seismic operations would not affect eiders since they are absent from the area during this season. It is likely there would be minimal aircraft flights over the marine environment during the open water season as a result of oil and gas activities in the Planning Area. 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 would be used to look for leaks in the pipeline. Although Balogh (1997) indicated that fixed-wing aircraft flying at an altitude of 150 ft (45.7 m) often cause spectacled eiders to flush, few nest sites are expected to be affected, because nest sites occur

at relatively low density in most of the Planning Area and females with their broods are scattered. Some displacement of Steller's eiders in the vicinity of pipeline corridors 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, as with the spectacled eider. Oil and gas activity would be deferred for 10 years in the Deferral Area under the Preferred Alternative; potential impacts also would be deferred.

There may be some transportation of equipment and supplies through the marine environment during the summer open water season (mid-July to early October). 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-early October) for operations at inland sites during the winter months. Vessel traffic generally would be limited to routes in shallow nearshore waters between staging areas near existing infrastructure (such as West Dock or Oliktok Point) and staging areas along the coastline in the Planning Area (e.g., Cape Simpson, Barrow, or Peard Bay). Spectacled and Steller's eiders that are accompanying young, or are staging or migrating in coastal or offshore waters during the relatively brief staging/migration periods (late June/early July, late August/September) and that encounter a few vessels associated with oil and gas activities in the Planning Area during their fall migration are expected to experience negligible disruption of foraging because of the low probability of disturbance by vessel activities.

b) Gravel

Gravel within the Planning Area is likely to be obtained from river drainages and transported to a site on ice roads during winter. Gravel mining is not likely to affect eiders since they are absent from the area during winter and are not often found in riverine areas, potentially the major gravel sources, except immediately following spring migration. Habitat burial by pad/road/airstrip construction would displace any nesting individuals from the local area (up to 50 acres) to undisturbed habitats, with potential for lowered productivity. Depending on location and extent of each material site, overall effects could range from negligible to minor in cases in which mining eliminates breeding habitat of the spectacled eider, whose coastal plain population is declining at a non-significant rate.

The presence of pads and short connecting roads is expected to displace local breeding individuals from the affected sites, and probably also from the immediate area. In succeeding breeding seasons, displaced individuals may relocate in nearby comparable habitat as suggested by studies at Prudhoe Bay (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 could constitute a local long-term or permanent result. Overall effect, particularly at the regional level, is likely to be negligible. Permanent roads connecting to infrastructure to the east may be considered.

c) Structures, Facilities and Drilling Operations

The presence of facilities (including pipelines) and drilling operations is expected to displace local breeding individuals from affected sites, and probably also from the immediate area. In succeeding breeding seasons, displaced individuals may relocate in nearby comparable habitat. 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, but could constitute a local long-term or permanent result. If a commercial discovery is made, drilling activity during the summer is likely to increase, and a small number of nesting or brood-rearing individuals could be affected. Disturbance from a drilling operation is likely to be limited to within a kilometer of the activity; a few eiders may experience temporary, non-lethal effects which may continue through the summer. Affected eiders may respond to drilling disturbance or other activities by relocating before or during the nesting phase, abandoning a nest, or relocating the brood at a more distant area once hatching is completed. Overall effect of these factors, particularly at the regional level, is likely to be negligible. The presence of an aboveground pipeline is not likely to represent a significant collision hazard since migrating eiders generally fly at greater elevation than

pipelines are constructed, and most movement during the breeding season is by swimming. Disturbance from onshore construction and maintenance of pads, facilities, and roads is likely to be minimal beyond a kilometer from the activity.

d) Predation

Potential predator enhancement at the level of development envisioned for NPR-A is not likely to approach that of the Prudhoe Bay area. This is because: a) development sites are likely to be few (12 drilling pads at 8 fields) and relatively small and scattered; and b) practices that have allowed artificially enhanced predator populations in the past are expected to be tightly controlled by ROP's A-2 and E-9 that would require operators to avoid attracting wildlife to food and garbage, and preventing facilities from providing nesting, denning or shelter sites for predators. At the Alpine Development, Johnson et al. (2003) found that predator numbers remained stable from pre-construction through construction periods. They also found no clear evidence that predation rates by either foxes or avian predators changed during their study. Thus, predator populations in the vicinity of small footprint developments are not expected to increase significantly. In addition, spectacled eiders only occasionally nest in semi-colonial groupings, which could make them subject to elevated losses if discovered by predators. Overall, effects of predators on regional eider populations is likely to be negligible to minor on a subjective scale.

(2) Effects of Spills

Crude oil released during development or production could cause adverse effects on listed species, either through direct contact or indirectly as a result of effects on prey populations or important habitats. Oil prices of $30/bbl are likely to stimulate development and production sufficient to result in one large (500 or 900 bbl) crude oil spill (38% chance of 1 or more occurring) over the production life of Northwest NPR-A Planning Area (Table IV-19) though the most likely number of spills is 0 (see Section IV.A.2). At $18/bbl no spills are likely. Small crude or refined oil spills could number 130 crude (average size $\geq$ 3 bbl) and 323 refined (average size = 0.7 bbl) if the price of oil is at $30/bbl (Table IV-17 and Table IV-20). Approximately 65 to 80 percent of all crude oil spills occur on a pad. The remaining approximately 20 to 35 percent occur on or reach the surrounding environment. These spills generally remain on a limited area of tundra unless they reach a river, stream, or waterbody where they can affect aquatic environments. Off-pad spills generally cover a small area (less than 500 ft^2 [46.5 m^2]). Larger contamination areas may occur as a result of wind blowing a fine oil mist (e.g. from a pipeline leak) over a larger area.

An oil spill is not likely to occur in the marine environment, or to reach typical bowhead migration habitat from onshore locations at concentrations that would cause adverse effects. Small spills are not likely to reach marine habitats, and thus have a low probability of affecting bowheads. Short-term exposure to spilled oil is likely to have negligible effects on bowheads (St. Aubin, Stinson, and Geraci, 1984) or their prey (Bratton et al., 1993. Spill containment and cleanup in the marine environment could cause minor diversion of migrating bowheads if they involve vessels operating beyond the nearshore zone; this is still likely to have a negligible effect. A detailed discussion of potential effects of oil on whales can be found in *Beaufort Sea Planning Area Final EIS* (USDOI, MMS, 2003:Sec. IV.C.5.a).

A crude oil spill from a pad or pipeline onto tundra and then into local lakes or other inter-connected wetlands could cause mortality of small numbers of eiders, especially during the brood-rearing period later in summer. Numbers of individuals oiled would depend primarily upon wind conditions, and numbers and locations of birds following entry of the spill into the water. It is likely the above effects would be negligible to minor with regard to proportion of regional population involved. Because of the oil-absorptive capacity of tundra habitats, probably only a small proportion would enter a river and, subsequently, the marine environment. Under the Preferred Alternative, much of the western coast of Northwest NPR-A may not be available for oil and gas development if leasing in the proposed Kasegaluk Deferral Area is deferred. If a spill were to reach a delta area or Elson Lagoon,

Dease Inlet, or other coastal waters, eiders staging before fall migration would be at risk, with the potential to elevate effects to moderate. However, it is possible that most spectacled eiders nesting in the western part of the Planning Area migrate overland directly to the Chukchi Sea, thereby avoiding potential spills into the Beaufort from the northern Planning Area. As a result of their small average size, onshore oil spills reaching aquatic habitats are expected to cause losses of fewer than 20 individuals--a minor effect--but potentially tens of individuals could be killed by cumulative total mortality from many small spills. Onshore spill cleanup involving personnel, equipment, and aircraft could result in displacement of pre-nesting birds, or nest abandonment if it were to occur later in the season. Most spills would be contained on the pads where they occur, and would affect a small area. Because of the relatively small average 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 only a few eiders would be displaced from favored habitats or otherwise be affected by these activities. The effect of such losses may not be detectable above the natural fluctuations of the population.

Physiological effects of oil on individual birds would be the same as those described in the Northeast NPR-A IAP/EIS (USDOI, BLM and MMS, 1998). Lethal effects are expected to result from moderate to heavy oiling of any birds contacted. Oiled individuals may lose the water repellency and insulative capacity of their feathers and subsequently die from hypothermia. Light to moderate exposure could reduce future reproductive success as a result of pathological effects on liver or endocrine systems (Holmes, 1985) that interfere with the reproductive process and that are caused by oil ingested by adults during preening or feeding. Stress from ingested oil can be additive to ordinary environmental stresses such as low temperatures, and metabolic costs of breeding or migration. Oiled females could transfer oil to their eggs, which at this stage could cause mortality, reduced hatching success, or deformities in the young. Flocks of staging eiders could contact oil in nearshore areas. Food resources could be adversely affected by oil, causing indirect, sub-lethal effects that decrease survival, future reproduction, and growth of the affected individuals. Because the spectacled eider population has declined 50 percent or more, even relatively low mortality still is likely to represent a minor to moderate effect.

d. Effectiveness of Stipulations and Required Operating Procedures

The stipulations and ROP's could mitigate the effects on eiders of three types of problems that may result from oil and gas development activities: disturbance from noise or activity, adverse alteration of habitats, and contamination of waterbodies occupied by eiders. No stipulations specifically apply to bowhead whales.

ROP A-2, by controlling availability of food and garbage, and also by prohibiting pollution of waterbodies by disposal of waste materials, which could cause toxic reactions in eiders or their prey, could prevent artificial enhancement or concentration of eider predators.

ROP A-3, by preventing entry of fuel or other hazardous substances into waterbodies and wetlands through implementation of a Hazardous Materials Emergency Contingency Plan, could reduce contamination risk to eiders from accidental spills.

ROP A-4, by preventing entry of fuel or liquid chemicals into waterbodies and wetlands during oil and gas activities through implementation of a comprehensive spill prevention and response contingency plan, which includes specifications on cleanup, materials, storage containers, and liner materials, could reduce contamination risk to eiders from accidental spills.

ROP A-5, by prohibiting the refueling of equipment within 500 ft of the active floodplain of fish-bearing and within 100 ft of the active floodplain of non-fish-bearing water bodies, could prevent spilled fuel from entering water bodies where individual eiders could become contaminated and die (adversely affecting the breeding success of these eiders).

Stipulation E-2, by restricting approval for location of permanent oil and gas facilities within 500 ft of fish-bearing water bodies or within 100 ft of non-fish-bearing water bodies to those that are likely to cause minimal impacts to wildlife, could reduce the loss (burial) of wetland habitats (important for breeding eiders).

ROP E-5, by requiring minimal facility footprint and reduction in air traffic, could minimize eider habitat burial and disturbance.

ROP E-7, by requiring that above ground pipelines be elevated an average of 7 ft above the surface, could increase the potential for eider collisions with pipelines.

ROP E-9, by requiring use of best available technology to prevent facilities from providing nesting, denning, or shelter sites for predators, could avoid artificial enhancement of eider predator numbers.

ROP E-10, by requiring that exterior lights be directed inward and downward, may reduce collisions of eiders with oil and gas facilities during low light conditions.

ROP E-11, by requiring aerial surveys to identify breeding pairs of eiders in areas proposed for development, and consultation with FWS and BLM concerning the design of structures before approval of any construction if listed eiders are present in such areas, could minimize take of ESA-listed eiders.

ROP E-12, by requiring development of an ecological land classification map for use in siting facilities, could help conserve important habitat types.

ROP F-1, by requiring that aircraft maintain an altitude of at least 1,500 ft AGL when within ½ mi of raptor nesting sites from April 15 to August 15, or gyrfalcon nest sites from March 15 to August 15, 2,000 ft AGL over the Caribou Study Area from June 15 to July 31, and 2,000 ft AGL over the caribou coastal insect-relief areas from June 15 to July 31, and minimizing the number of takeoffs and landings at all airstrips, could mitigate aircraft disturbance of eiders nesting in the vicinity of raptor nest sites, Caribou Study Area or insect-relief areas, and airstrips.

ROP I-1, by providing all personnel with information concerning applicable required operating procedures and stipulations, and importance of not disturbing biological resources, habitats, and bird colonies, could help reduce disturbance of eiders.

Stipulation K-1, by prohibiting permanent oil and gas facilities within setback zones of ½ to 1 mi of listed waterways, could mitigate disturbance of eiders nesting in or occupying listed waterways or adjacent corridors, as well as avoiding destruction of eider habitat.

Stipulation K-2, by prohibiting permanent oil and gas facilities within ¼ mi of deep water lakes with depth less than 4 m, could minimize the loss of eider habitats (which could adversely affect their breeding success).

Stipulation K-3, by prohibiting oil and gas exploration activity from May 15 to October 15, requiring adequate year round spill response capability (including during periods of broken ice) or alternate methods to prevent oil spills, requiring that facilities minimize impacts to seasonally concentrated birds, and requiring that daily activities are conducted to minimize impacts to seasonally concentrated eiders, could protect eider habitats and avoid disturbance of seasonally concentrated eiders.

ROP K-7, by prohibiting, within 15 mi of raptor nest sites significant alteration of high quality raptor foraging habitat, particularly in waterbody, wetland, and riparian habitats, could reduce impacts on important habitats of eiders occupying the Colville River Special Area.

Stipulation K-8, by prohibiting permanent oil and gas facilities within the boundary of the Special Area, could protect eiders using Kasegaluk Lagoon.

These stipulations and ROP's would minimize disturbance of eiders from most factors, minimize adverse alteration of habitats, and could help prevent spilled fuel or other toxic materials from reaching waterbodies where eiders (including nesting or brood-rearing eiders occupying adjacent habitats) could become contaminated. In most cases, the stipulations and ROP's are likely to affect only a relatively small proportion of available habitat of the type indicated, and/or a relatively small proportion of a regional population of eiders.

e. Conclusion--First Sale

Under the Preferred Alternative, only if bowhead whales were to migrate exceptionally near the coast coincident with the presence of vessel or low altitude aircraft traffic is it likely they would be disturbed by activities associated with either non-oil and gas transport activities or oil and gas transport and seismic activities discussed in the IAP/EIS. Bowheads may exhibit temporary avoidance behavior in the presence of vessels. Effects from such exposures are likely to be short-term and negligible.

Disturbance of eiders from non-oil and gas survey aircraft operations, small summer camps, waste/fuel spill removal, river transport activity, habitat loss, aerial surveys, winter ground transport, oil and gas seismic exploration and gravel mining activities on spectacled and Steller's eiders are likely to be short term and localized, and result in negligible effects. Aircraft overflight effects on eiders are likely to be temporary and non-lethal, probably lasting less than an hour. Gravel mines, pads, roads, airstrips, and pipelines that would eliminate breeding habitat are likely to result in negligible population effects. Elevated activity and air traffic in the vicinity of large summer camps may result in minor impacts on both local and regional populations of these two species. Routine helicopter traffic to oil and gas development sites in summer, especially over higher density areas, is likely to result in minor impacts. Depending on the nature and duration of behavioral changes caused by disturbance, such effects could be considered a "take" under the ESA.

Effects from crude-oil spills would be expected to be minor when confined to terrestrial and freshwater aquatic habitats where mortality of these eiders is likely to be relatively low. Minor to moderate effects are likely for these eider populations if a spill were to enter a river delta or nearshore marine habitats during a period when occupied by substantial numbers of brood-rearing, staging or migrating individuals. There is a potential for a significant impact as a result of an oil spill in these circumstances. Quantitative effects may be difficult to separate from natural variation in population numbers. Stipulations would decrease disturbance from most factors for threatened eiders and help prevent fuel and oil pollution and degradation of important bird habitats.

Several factors suggest that the overall effect of the Preferred Alternative on birds could be somewhat less than Alternative A. The elimination of leasing in the proposed Kasegaluk Lagoon Special Area could reduce potential risk to any eiders that use this area prior to proceeding to molting areas in fall. In addition, leasing in the proposed Kasegaluk Deferral Area would be deferred for 10 Years, delaying potential impacts for at least this period. This area contains substantial areas of medium-high and high spectacled eider density and possibly higher Steller's eider density as well. Also, several of the ROP's and one stipulation specifically applicable to birds are contained in the mitigation package for the Preferred Alternative but not those applied to Alternative A. The ROP's include: a) a measure to decrease bird predator nesting/denning sites on facilities, b) design of structures (e.g., lighting) so

birds are less likely to strike them, c) approval of design and location of facilities minimize disturbance of eiders if their presence is indicated, and d) a requirement to develop an ecological map to be used in siting structures with minimum adverse effect. The stipulation is one prohibiting oil and gas structures within the Kasegaluk Lagoon Special Area. Finally, somewhat shorter periods of aerial survey are anticipated under the Preferred Alternative (several 1- to 2-week periods) than under Alternative A (several 2- to 3-week periods). In comparison to Alternative B, the Preferred Alternative offers the additional ROP's and stipulation discussed above and the deferral of the western Planning Area from oil and gas leasing for 10 years as the principal differences. In comparison to the No Action Alternative, it offers the mitigating measures noted above, and slight differences in levels of activity as outlined in Table IV-28 .

f. Multiple Sales

If multiple sales were to occur under the Preferred Alternative, construction activity could last 15 to 30 years, tapering off as existing infrastructure is used for each succeeding development. Under the multiple-sale scenario, depending on the oil price, 2 to 3 times the number of exploration and delineation wells could be drilled (21 to 72 for multiple sales versus 7 to 30 for the first sale; see Table IV-07 and Table IV-05); the number of fields developed could increase from 4 for a single sale to as many as 8 for multiple sales (Table IV-04 and Table IV-06); and the number of production pads is projected to increase from 0 to 6 for the first sale to 0 to 12 for multiple sales (Table IV-05 and Table IV-07). Total pipeline mileage would be likely to increase (driven by the price of oil, which dictates whether any development would occur) from 70 to 340 mi (Table IV-29). Effects from disturbance factors and habitat alteration or loss from each development are likely to be short term and negligible to minor over most of the Planning Area (see discussion for the first sale). Habitat buried or excavated in the vicinity of development and production facilities or at gravel mine sites essentially would be lost to species present before development. Surface, air, and foot traffic could increase substantially in some areas if oil-field facilities associated with multiple sales are grouped in high resource interest areas. If these are located in higher concentration areas, as appears to be likely in the vicinity of Dease Inlet, greater numbers of individuals are expected to be displaced than with a single sale. Multiple sales likely would result in increased vessel traffic over a longer period of years, although the general effects on bowhead whales and eiders are likely to be similar to those described above. Such effects could alter the eider populations of these local areas substantially, and effects could extend to regional populations and involve long-term changes in distribution. With multiple developments concentrated in a limited region, population effects on eiders could be elevated to a moderate level. Effects of multiple sales on the bowhead population is expected to be negligible.

The estimated number of onshore oil spills of 500 or 900 bbl is expected to stay constant (0 for the $18/bbl no development scenario, 1 for the $30/bbl development scenario) for both first sale and multiple sales (Table IV-19). Also, the number/volume of small crude- or refined-oil spills--estimated at 112 crude/277 refined under the first sale (average size 3/0.7 bbl; 126/29.4 gal.)--is expected to remain constant if multiple sales occur (Table IV-20). These small, chronic spills generally are contained and cleaned up on pads and roads. 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 expected to result in negligible to potentially minor effects. Recovery of cumulative lost productivity and recruitment may not be detectable above the natural fluctuations of the population and survey methods/data available.

g. Conclusion--Multiple Sales

Under the Preferred Alternative, displacement of eiders by disturbance and habitat alteration or loss is expected to increase substantially if development and production facilities are concentrated in limited regions with higher resource potential (i.e., northern Planning Area). This could occur in several portions of the Planning Area if multiple sales are held and development occurs in areas where higher density of eiders occurs. Such development potentially could alter local populations in these areas. For Steller's eider that may be particularly vulnerable to habitat changes or disturbance in the vicinity of the nesting area south of Barrow, effects could extend to regional

populations and involve long-term changes in distribution. Although most effects that would be likely to occur throughout the Planning Area are expected to be short-term and negligible to minor, moderate effects could occur if concentrations were contacted more frequently by the likely increased number of crude and refined oil spills under the multiple sale scenario. The likely increase in numbers of small crude oil and refined oil spills (over single sale projections) would be expected to elevate losses of eiders somewhat during the period of development resulting from multiple sales. Although in any losses and subsequent recovery of cumulative lost productivity and recruitment may not be detectable above the natural population fluctuations given the survey methods/data available, they are considered significant for these ESA-listed species. Effects of oil and gas developments resulting from lease sales following the first sale are expected to be additive to those of the first, and may range from a slight increase to a doubling or tripling of effect. This would depend on whether the later developments were concentrated or scattered through areas of low or high density of eiders that may, through time, vary in their vulnerability to development activities. If subsequent developments are more scattered, they may occur by chance in areas of low eider vulnerability and thus add little to the effects of earlier sales.

12. Economy

a. Effects of Non-Oil and Gas Activities

For the Preferred Alternative, recreation-field employment would be generated by 30 one-week float-trip parties per year. This is equal to 1 person working for 8 months each year (Delaney, 2002, pers. comm.).

b. Effects of Oil and Gas Activities

The Preferred Alternative lease sale would generate economic activity manifested primarily in revenues to: 1) government, 2) employment, and 3) personal income. The economic effects would occur in the North Slope Borough (NSB), South Central Alaska, and Fairbanks. The exploration and development projections shown in Table IV-06 and discussed in Section IV.A.1.b. form the basis for analysis of potential economic effects in this section. The reader should refer to these sections for a description of timing of activities including wells, rigs, production pads, pipelines, and staging bases. The activities and construction and operation of infrastructure described in the exploration and development scenario generate economic activity. A description of the Preferred Alternative, including deferrals and limitations on oil and gas leasing and development of all lands administered by BLM in the Northwest NPR-A Planning Area, is in Section II.C.5 and Section II.C.6 .

(1) Revenues

With long-term oil prices at $18 or lower per barrel--with corresponding gas prices at or below $2.56 per Tcf and with the expectation that long-term oil prices will remain at or about $18/bbl--projected revenues could be expected to be similar to those accruing from the 1999 Northeast NPR-A Lease Sale, i.e., the NSB would show a 1-year, 9 percent revenue increase, and the State and Federal governments would show a negligible revenue increase. In the 1999 sale, the State of Alaska received $38 million in bonus bids, of which it transferred $28 million to the NSB in grants. The Federal Government also received $38 million in bonus bids. The State and Federal governments each receive approximately $2 million per year in rentals. (Note: for details of the distribution of revenues from the 1999 Northeast NPR-A lease sale, see Section III.C.1.) Because the NSB cannot collect property tax on infrastructure or improvements on Federal lands, no property taxes would accrue to the NSB from any oil or gas activity on NPR-A.

The activities projected with $30/bbl oil prices ($4.27/Tcf for gas) would, in the early years of production, generate an increase of 24 percent in revenues from royalties to the NSB above those projected for the no-development scenario. In the latter years of production, royalty revenues would taper to 5 percent above the level they would have been without development. The assumption for this analysis is that the State would allocate half of its share of royalty revenues to the NSB--$30 million in the first year of production, tapering to $3 million in the latter years. These are percentages of the NSB budget, estimated at $120 million in 2013 (hypothetical first year of production) and $60 million in latter years.

The activities in the early years of production would generate increases in revenues from royalties to the State of Alaska of 3.1 percent above the level they would have been without development. The increases would taper to less than 0.3 percent above the no-development level in the latter years of production. In this analysis, these numbers represent revenue expressed as a percentage of the State budget ($4.3 billion in 2000) and are assumed to be constant in real dollars for future years. The royalty revenue to the State would be about $60 million in the first year of production, tapering to $6 million in the latter years. This figure is based in turn on the Federal royalty rate of 16.67 percent. According to law, the Federal Government must share 50 percent of the Federal royalty rate with the State; and the state must share a portion of its royalty with the affected local government (see Section III.C.1). The affected local government in this case is assumed to be the NSB. The State can collect severance tax of 12.5 percent for the first 5 years and 15 percent for the following years. The average annual State severance tax is estimated to be $101 million in the early years declining to $10 million in the latter years.

Production activities would generate increases in revenues from royalties to the Federal Government of less than 0.004 percent above the no-development level of the Federal budget--about $60 million in the first year of production, tapering to $6 million in the latter years, based on the Federal royalty rate of 16.67 percent.

(Note : These figures represent the Federal Government's 50 percent share of the projected royalty.)

(2) Employment and Personal Income (Not Related to Oil Spills)

With long-term oil prices at $18 or lower per barrel (with corresponding gas prices at or below $2.56 per Tcf)--and with the expectation that long-term oil prices will remain at or about $18/bbl--employment and personal income are shown in Table IV-30 . The difference would be less than 0.1 percent above the 1999 baseline for the NSB and for the rest of Alaska. Employment and personal income would be generated during the 6 years of exploration, as shown in Table IV-30.

For employment and personal income, the potential economic effects of development would occur in three major phases: exploration, development and production. In general, employment and associated personal income are at relatively low levels in exploration, peak during development, and drop to a plateau in production phase. This pattern of economic effect is reflected in the exploration and development scenario described in Table IV-02 and Table IV-03 and in Section IV.A.1.b. All direct workers are assumed to stay in enclaves on the North Slope during their work time and commute to residences elsewhere in their time off. Their places of residence during the time they are not in an enclave are assumed to be in NSB villages or in South Central Alaska or the Fairbanks area as indicated in Table IV-31 .

Note: Approximately 30 percent of current North Slope workers in the classification of oil and gas commute to residences outside Alaska (Hadland, pers. comm., 2002; Hadland and Landry, 2002). The workers who commute to residences outside Alaska would not generate the economic effects of indirect and induced employment--or expenditure of income in the State--and would have a negligible effect on the economy of the rest of the U.S.

All workers would be present at a new enclave staging base somewhere in the Northwest NPR-A or in associated

enclave-support facilities in and near the Prudhoe Bay complex for approximately half of the days in any year.

For activities projected with $30/bbl oil prices, the increase in total employment and personal income is shown in Table IV-31. The difference is less than 1 percent above the 1999 baseline for the NSB and the rest of Alaska (except for NSB personal income during the development phase, which would be 3.1% above baseline).

Note: These activities also generate employment and personal income in the rest of the U.S., but the percent contribution to the overall U.S. economy is so small that it is negligible.

For activities projected with $30/bbl oil prices, exploration phase would occur between 2005 and 2014, development phase would occur between 2011 and 2018, and production phase would occur between 2013 and 2034. To simplify analysis, data for employment and personal income are presented as annual averages for the three main activity phases.

"Direct employment" refers to jobs that are actually in the fields of oil and gas exploration, development, and production. "Indirect employment" refers to jobs that support exploration, development and production activities. For example, jobs involved with providing food to workers while they are working on the North Slope would be "indirect employment." Helicopter pilots and mechanics on the North Slope are another example of indirect workers. Both direct and indirect workers spend a part of their earnings for food, housing, clothing, etc. The aggregate of jobs associated with providing those goods and services is termed "induced employment." Compensation derived from direct, indirect, and induced employment is defined as "personal income" in Table IV-30 and Table IV-31 .

As another example, through the development (or the continued use) of facilities that are taxable by the NSB, the NSB would have additional revenues available that most likely would be used for its ongoing operations. This in turn results in NSB government jobs. This is in large part how the indirect and induced jobs are generated in the NSB.

(3) Employment Related to Spills

No employment would be generated from cleanup of small spills of less than 500 bbl, large spills of 500 bbl from a pipeline, or a 900-bbl crude or diesel spill from a facility. On-site workers doing other operations would clean up spills of these sizes.

(4) Subsistence as a Part of the NSB Economy

The predominately Inupiat residents of the NSB have traditionally relied on subsistence activities. Although not fully part of the cash economy, subsistence hunting is important to the NSB's whole economy and even more important to its culture. For effects on these aspects, see Section IV.C.14 Subsistence-Harvest Patterns, and Section IV.C.15 Sociocultural Systems.

c. Effectiveness of Stipulations and Required Operating Procedures

Stipulations and ROP's of the Preferred Alternative would not alter the economic effects.

d. Conclusion--First Sale

The Preferred Alternative, at $30/bbl, would generate a 24 percent increase in NSB revenue above the no-development level of NSB revenues in the early years of development, tapering to a 5 percent increase in the latter years. The Preferred Alternative in the early years of production would generate increases in revenues to the State of Alaska of 3.1 percent above the no-development level that would taper to less than 0.3 percent in the latter years of production. For the NSB, Southcentral Alaska and Fairbanks, the increase in total employment and personal income during exploration, development and production would be less than 1 percent over the 1999 baseline (except for NSB personal income during development phase, which would be 3.1 percent). The Preferred Alternative, at $18/bbl (assuming 6 years of exploration), would generate a 1-year (lease year), 9 percent NSB revenue increase and less than 0.1 percent increase in employment and personal income for the NSB, South Central Alaska, and Fairbanks.

e. Multiple Sales

The effect of multiple sales for the Preferred Alternative would likely heighten the economic effect in any given year, as exploration, development, and production resulting from subsequent lease sales occur in the same years. Multiple sales would lengthen the period of economic impact as lives of new fields extend beyond those fields resulting from the earlier lease sales.

f. Conclusion--Multiple Sales

The effect of multiple sales for the Preferred Alternative is projected to be approximately twice that of the first sale.

13. Cultural Resources

a. Effects of Non-Oil and Gas Activities

Archaeological research/excavation is conducted by BLM and by permit within the Northwest NPR-A annually. While excavation is a destructive activity, it is necessary for the recovery of scientific data, such as for geological and paleontological research. Excavation and collection normally occur during the summer. Geological and paleontological researchers are trained to recognize cultural resources and respond to such encounters accordingly. Because of the surface and near-surface contexts of cultural resources they are often encountered by chance. Some Pleistocene-age animal remains are occasionally recovered in archaeological deposits. 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 belonging to the regional paleontological record.

The temporary summer field camps commonly associated with scientific or resource assessment work generally impact 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--in and of themselves--to have any significant effect on cultural resources.

b. Effects of Oil and Gas Activities

Because seismic data gathering activity is permitted only during the winter using low-ground-pressure vehicles such as Rolligons (ROP C-2 a, c, and d), there is little chance that significant impacts to below-ground cultural resources could occur. Impact to surface cultural resources could occur from the passage of seismic vehicles under certain circumstances. In most cases, surface cultural resources--usually structures of some type--can be visually detected and subsequently avoided, even when snow covered. Surface cultural resources that are not structures are not easily detectable, but given their nature, are usually sufficiently protected from impacts by snow cover and frozen vegetation. The exception to this is human skeletal remains that lie on the surface.

It is worth noting that cultural resources are not ubiquitous in the Planning Area as are wildlife and habitat. Although cultural resources, because of their near-surface and surface contexts (as well as other factors), are more common than paleontological deposits, generally they are more easily recognized and therefore avoided. As a result, it is quite possible that oil and gas exploration or development activities would have limited impact on cultural resources simply because in most cases oil and gas activities could be conducted so as to avoid the locations of cultural resources.

(1) Effects of Disturbances

Under the Preferred Alternative the level of activity in the Planning Area could be fairly high. However, because most of the activity would occur during the winter months, the potential for impact to buried cultural resources remains relatively low.

The likelihood of impacting surface cultural materials is also low because of their isolated occurrence and because of a variety of stipulations and ROP's governing oil and gas exploration activities.

Although the drilling of between 8 and 12 exploration wells and 12 to 18 delineation wells could occur under the Preferred Alternative, the limited availability of drill rigs would provide for no more than a few wells to be drilled at one time. If 20 to 30 wells were to be drilled, drilling would certainly 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 gravel or rock needed--no significant disturbance of the ground would occur and buried cultural resources would not be in jeopardy. The only significant subsurface disturbance that would occur as a result of the actual drilling would be the creation of the drill hole itself. It is possible that drilling the hole could impact important accessible cultural material, but the likelihood of that occurrence is minuscule.

The effects of disturbance from development (i.e., the construction of 4 to 6 production pads connected by roads, an airstrip, a pump station, a staging base and approximately 205 mi of pipeline) could occur under the Preferred Alternative. Surface disturbance resulting from this work would probably impact between 150 and 200 acres. However, there would be little subsurface impact associated with these activities. The primary source of potential impacts to cultural resources would result from the excavation of material for the construction of the permanent facilities. If the pads/roads/airstrip material source is terrestrial, then extraction of material could impact cultural resources. For this analysis it is assumed that pipelines would not have associated all-weather roads or pads and would be constructed during the winter months from an ice road and/or 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, though highly unlikely, that buried cultural resources would be impacted. If buried pipelines were to be used, disturbance and impacts to cultural

resources could occur during excavation, construction and burial--depending on the depth, size, and location of the pipeline. The potential for impacts to surface cultural resources under this alternative have been previously discussed.

(2) Effects of Spills

An estimated 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. In the exploration stage, 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 and resulting impacts to cultural resources would be minimal if they occurred at all. Surface cultural resources would be more at risk than would those in a subsurface context. Spills and spill cleanup associated with development could have a greater effect on both surface and subsurface cultural resources because they could occur during the snow-free months when cleanup procedures are more invasive.

c. Effectiveness of Stipulations and Required Operating Procedures

Under the Preferred Alternative, ROP C-2a, c, and e bear on paleontological resources. This ROP provides protection from seismic and overland move activities that could potentially disturb the vegetative mat and impact cultural resources that are near the surface. In addition, ROP's A-3 and A-4 b, c, d and f help to prevent large fuel or crude-oil spills, and consequently reduce the small potential for impacts to paleontological resources from spill cleanup. Stipulations K-1 and K-6 provide ½-, ¾-, and 1-mi setbacks along the major rivers and streams and a ¾-mi setback along the coast providing additional protection for paleontological resources. The NHPA requires that an archaeological resource survey be completed before any undertaking occurs on Federal lands. Ground-disturbing activities such as the construction of buried pipelines are considered undertakings. If paleontological resources are identified during such a survey, BLM guidelines and policy require that all impacts to these resources be mitigated to the satisfaction of the land manager and the State Historic Preservation Office.

d. Conclusion--First Sale

Under the Preferred Alternative, impacts to cultural resources from management activities other than oil and gas exploration and development would be as previously stated. Impacts would include displacement and/or destruction of resources and are anticipated to be minimal regardless of the level of seismic activity. Under the Preferred Alternative, the overall potential impacts to cultural resources from first sale oil and gas exploration and development would probably be minor because of the environmental constraints that would be in effect. These constraints would benefit cultural resources because of the high probability of cultural resources being located near lakes, streams and rivers, which are afforded more protection from oil and gas exploration under Stipulation E-1.

e. Multiple Sales

Under the Preferred Alternative, the potential for impacts to cultural resources should be relatively low. While the scattered nature of cultural deposits and the fact that the locations of most remain unknown--making it somewhat difficult to assess the likelihood and severity of potential impacts--the environmental constraints present in the Preferred Alternative are expected to significantly reduce the probability of potential impacts.

f. Conclusion--Multiple Sales

Under the Preferred Alternative, the overall potential impacts to cultural resources from management activities other than oil and gas exploration and development would be as previously described. Overall, the probability of the occurrence of impacts would increase somewhat simply because multiple sales would increase the amount of land that could potentially be impacted.

14. Subsistence-Harvest Patterns

Under the Preferred Alternative, lagoons and estuaries along the western coast of the Northwest NPR-A Planning Area--including the proposed Kasegaluk Lagoon Special Area, Peard Bay, and the Kuk River system (Wainwright Inlet)--as well as important terrestrial subsistence harvest areas for the community of Wainwright, would be included in a large deferral area (approximately 17% of the Planning Area) where leasing would be deferred for 10 years.

Special stipulations would apply to oil and gas exploration and development in the Dease Inlet/Admiralty Bay area and in Elson Lagoon, specifically: (1) a ¾-mi coastal shoreline and natural island setback that would exclude development on or under the water; (2) no exploration occurring between May 15 and October 15; and (3) the burden of proof rests with the lessee to demonstrate that BLM approval of exploration and development plans is warranted.

A set of setbacks and restrictions (including seasonal ones), and site-specific/activity-specific prohibitions would protect important habitats and subsistence and natural resources. There would be no temporary or permanent facilities on lakes and no permanent facilities within ¼ mi of a lake. There would be no permanent facilities in river beds (as defined by the 100-year floodplain) and there would be a ½-mi setback on all rivers for permanent facilities. There would be ¾-mi setbacks on segments of rivers designated particularly important for subsistence, specifically the Alaktak, Chipp, Oumalik, Ikpikpuk, Topagoruk, Meade, Usuktuk, Nigisaktuvik, and Inaru rivers, and Kucheak and Pikroka creeks. Other portions of the Ikpikpuk, Oumalik, Titaluk, Kigalik, Topagoruk, Meade, and Avalik rivers, and Maybe and Ishuktak creeks would have designated ½-mi setbacks. There would be a 1-mi setback for development on the portion of the Colville River within the Planning Area and on the upper Ikpikpuk River. There would also be restrictions on where and how facilities could occur within ¾ mi of the entire coastline managed by BLM. No permanent facilities would be allowed within ¼ mi of deepwater lakes and no temporary or permanent facilities would be allowed on deepwater lakes.

Multi-year studies for brant and caribou are required before authorization of development activities in identified study areas in the northern portion of the Planning Area. There would be no restrictions on subsistence use of all-terrain vehicles (ATV's), except that summer use of airboats would be limited to streams, lakes and estuaries that are seasonally accessible by motorboats. Airboat use would be prohibited in seasonally flooded tundra and shallow waters with land vegetation adjacent to streams, lakes and estuaries.

Exploration and development/production activity for the first sale could vary depending on the per barrel price of oil. Thus, the number of exploration/delineation wells could vary from 5/12 to 12/18 from 1 to 3 drilling rigs. The number of staging bases projected is 1 to 2, the number of production pads 0 to 6, and pipeline miles 0 to 195-250. If only exploration occurs, it is expected to take place over a period of 7 years. If development occurs, it is expected to require 10 years. Production is estimated to last 22 years. We expect that any development in the Planning Area would involve relatively small, interconnected gravel structures.

a. Effects of Non-Oil and Gas Activities

Effects to subsistence-harvest patterns result from effects on subsistence resources. The effects of disturbances from non-oil and gas activities under the Preferred Alternative on terrestrial mammals, freshwater fish, marine fish, birds, bowhead whales, beluga whales, and other marine mammals (ringed, spotted, and bearded seals; walruses; polar bears; and gray whales) were analyzed earlier in this section (Sec. V.B) and are summarized below.

The fall and winter harvest seasons are times when subsistence resources are available well past coastal areas and rivers accessible in the summer. Winter allows access to an expanded harvest area for ungulates and furbearers and can lead to greater potential industry and hunter contact and consequent disruption of harvest activities. Winter also is a time when wildlife are more vulnerable to natural environmental stresses limited forage, severe cold, high winds, and compacted snow cover. The effects on certain subsistence resources and their harvest from stresses produced from seismic activities may actually be more pronounced during winter.

Terrestrial Mammals: Kasegaluk Lagoon would be proposed for designation as a Special Area and the northeast portion of the Planning Area would be a designated caribou study area. Over the long-term, this would result in protection of some terrestrial mammals and their habitat from development.

Air traffic, excavation, and the presence of resource-inventory-survey camps are expected to increase somewhat under the Preferred Alternative, as compared to the No Action Alternative, but would be slightly less than under Alternative A. Impacts would be similar to those under the No Action Alternative but could be more frequent, greater in extent, or longer in duration. A greater number of individual animals would likely be exposed to human activities. Aircraft traffic would more often pass overhead of caribou and other terrestrial mammals during flights 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 less than 1 hour. Some terrestrial mammals may avoid inventory-survey and recreation camps during the 6 to 12 weeks of activities, while bears and foxes may be attracted to the camps by food odors. Impacts from recreation and overland moves would be the same as the No Action Alternative. Current management practices and stipulations attached to land use authorizations for temporary facilities, overland moves, and recreation permits would be expected to mitigate impacts from these activities to terrestrial mammals.

Freshwater Fish: Actions and impacts associated with the Preferred Alternative which could cause disturbance to fish are similar to those described under the No Action Alternative.

Marine Fish: Activities other than oil and gas exploration and development are not likely to have a measurable effect on marine fishes.

Birds: Effects from management actions other than oil and gas exploration under the Preferred Alternative are likely to be about the same as those discussed under Alternative A. This is because the anticipated level of activity in all categories except number of acres disturbed by excavation and collection (4 vs. 2) is the same.

Bowhead Whales: Bowhead whales may be present in the Beaufort Sea off the northern portion of the Planning Area boundary primarily from August through October during their westward fall migration from Canadian waters to wintering areas in the Bering Sea. They may be present in the Chukchi Sea off the western portion of the Planning Area in April to early June during their northward spring migration. Under the Preferred Alternative, only under exceptional circumstances--when whales migrate near the coast coincident with the presence of barge traffic, or possibly air traffic to supply a shoreline camp--is it likely that bowhead whales would be disturbed by activities associated with the management plan. Effects from such exposure are likely to be negligible.

Beluga Whales and Other Marine Mammals: Effects under the Preferred Alternative would be similar to those for the No Action Alternative and Alternative A--local and short term, with no significant adverse effects to the marine mammal populations as a whole.

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

Terrestrial Mammals: Two seismic operations would occur in the Planning Area each winter. Impacts to terrestrial mammals would be similar to those discussed under the Seismic Option of the No Action Alternative but would be greater in frequency and extent. A greater number of individual animals would likely be exposed to human activities. Aircraft traffic would more often pass overhead of caribou and other terrestrial mammals during flights to or from seismic camps. The disturbance reactions of caribou and other terrestrial mammals are expected to be brief. Some terrestrial mammals may avoid seismic camps, while bears and foxes may be attracted to the camps by food odors. The potential for disturbance of hibernating bears would be greater because of the increased level of seismic activity occurring in the Planning Area. A greater number of lemmings and voles may be killed or disturbed by surface vehicles. These impacts are not expected to be significant on a population level. Under the Preferred Alternative, 15 to 36 exploration wells and 6 to 36 delineation wells would be drilled. Impacts to terrestrial mammals would be the same as those discussed under Alternative A, but may be lesser in extent as fewer fields would be developed.

Under this alternative, 4 to 8 oil fields may be discovered and developed. Primary effects on terrestrial mammals would come from construction of facilities such as roads and pipelines; motor-vehicle traffic; foot traffic near facilities and camps; aircraft traffic; small, chronic crude-oil and fuel spills contaminating tundra, stream, and coastal habitats; and from habitat alteration associated with gravel mining and construction. The greatest potential for significant impacts to caribou is through disruption of the movement of mosquito-harassed TLH caribou between insect-relief habitat and foraging areas. Impacts to caribou would be the same as those discussed under Alternative A but would generally be lesser in extent as fewer fields would be developed. Infrastructure and activities in oil fields could still delay or deflect movements of TLH caribou between coastal insect-relief areas and foraging habitat further inland. If an oil field or fields are developed near the coast, production pads, pipelines, within-field roads, and other facilities (housing, airfields, processing plants) could be located within important TLH insect-relief habitat. Movements of the TLH caribou from coastal insect-relief areas to foraging areas further inland during the mosquito season (late June- mid-July) would be adversely affected by pipelines and roads with vehicle traffic. There may be increased energetic costs to caribou. Extensive development in this area could result in the loss of some insect-relief habitat for TLH caribou. Impacts to the WAH and CAH would be the same as those discussed under Alternative A, although under the Preferred Alternative's K-5 ROP authorization for construction within the Caribou Study Area (TLH insect-relief habitat), would be based on a 3-year study by lessees to construct facilities so as not to disturb caribou migration to insect-relief areas. Impacts to moose, muskoxen, grizzly bears, wolves, wolverines, foxes, and small mammals would be the same as those discussed under Alternative A but may be lesser in extent as fewer fields would be developed.

Freshwater Fish: Under the Preferred Alternative, it is assumed that two 2-D or 3-D seismic operations would occur each year in the Planning Area. While the Preferred Alternative is likely to involve more seismic surveys than the No Action Alternative--thereby increasing the probability of seismic activity occurring above overwintering habitat--such events are likely to be infrequent. As a result, seismic surveys associated with the Preferred Alternative are expected to have the same overall effect on fish as those discussed for the No Action Alternative (i.e., no measurable effect on arctic fish populations). While the Preferred Alternative is likely to involve more fuel spills than the No Action Alternative, the amount of fuel entering fish habitat is not expected to significantly increase since spills are anticipated to be small (< 5 gallons) and are likely to occur on developed pads. Fuel spills associated with the Preferred Alternative are expected to have the same overall effect on fish populations as those discussed for the No Action Alternative (i.e. no measurable effect on arctic fish

populations).

Construction-related activities that may affect arctic fish include water withdrawal related to the construction of drill pads, roads and airstrips, and discharges related to exploratory drilling. Under the Preferred Alternative, it is anticipated that 5 to 12 exploration wells and 2 to 18 delineation wells would be drilled in the Planning Area as a result of the first lease sale, for a total of 7 to 30 wells on ice pads. Assuming that the average ice pad is 500 ft by 500 ft (5.7 acres), water needs would equate to approximately 2 million gallons for each drill pad for a total of 14 to 60 million gallons of water. Each mile of ice road requires up to 1.5 million gallons of water to construct. It is assumed that 0 to 2 ice roads, 25 to 50 mi long, would be built each season for a maximum annual water need of 150 million gallons. Water needed for 3 drilling rigs, associated camps and airstrips, and maintenance of roads, pads, and airstrips would add approximately another 85 million gallons to the annual water use budget. Total annual maximum water need is estimated at 295 million gallons. Decreased exploration activity under the Preferred Alternative (as compared to 420 million gallons in Alternative A) represents a corresponding 30 percent decreased water budget. Assuming that a typical large tundra lake (1 mi long and > 6 ft deep) has approximately 20 to 40 million gallons available for pumping, the decreased water need would equate to about 4 fewer lakes being pumped. Assuming water needs are reduced, potential impacts to fish in relation to water withdrawal in rivers and lakes are slightly reduced from Alternative A to the Preferred Alternative.

Water pumping could still adversely affect arctic fish, depending on the location of the withdrawal and the quantity of freshwater withdrawn. Withdrawals from rivers are of greater concern than lakes because of the smaller habitable space in over-wintering pools. Regardless of the amount of water pumped, withdrawals would be monitored through a required operating procedure that would ensure that water quality standards are met. Given the current regulations and proposed management practices, lake water withdrawal associated with the Preferred Alternative might be expected to kill a small number of individual fish but is not expected to have a measurable effect on arctic fish populations in the Planning Area. Exploratory drilling on lakebeds and streams could also impact fish under the Preferred Alternative. Impacts are the same as those described in Alternative A.

Activities related to development that could impact fish include excavation of material sites, construction of pipelines, pads, roads, airstrips, and causeways, and water withdrawals. Material sites (for gravel extraction) needed for construction of roads, pads, pipelines, and airstrips have not been identified in the Northwest NPR-A Planning Area. One likely source includes river drainages. Other possibilities include importing gravel from borrow sites east of the Colville River, extracting gravel from existing sites, processing bedrock, and using ice or composite pads. Under the Preferred Alternative, it is assumed that from 0 to 4 oil and gas fields would be developed rather than 0 to 5 for Alternative A. Each field is expected to have a footprint of 100 acres, requiring 1 million square yards of gravel. Total gravel needs for 4 fields would equal 4 million yds^2 . This represents a 20 percent decrease in gravel needed for pads from Alternative A. Using composite (blended mixtures of sand/silt/foam) could potentially reduce gravel needs by 33 to 50 percent. Decisions regarding future gravel use and location of pits would be made on a case-by-case basis. Direct and indirect impacts to fish from gravel extraction are similar to those under Alternative A, though fewer in-river sites should reduce overall impacts to fish. As was the case in Alternative A, beneficial aspects of gravel extraction are available in the form of deep pits that can be used by fish as over-wintering habitat. Based on the documented successful use of reclaimed gravel pits by fish, future mitigation of gravel pits should incorporate prescriptions that create fish habitat when feasible.

Impacts from sedimentation and altered flow patterns related to construction of drill pads, roads, and airstrips should be the same as those under Alternative A. Impacts from erosion should be short term and proper placement of these structures, in combination with adequate and properly sited drainage systems, should lead to minimal fish loss. Impacts of water withdrawal needed during development are similar to those discussed in the exploration portion of this analysis and remain the same as described in Alternative A. Up to 250 mi of pipeline could be constructed during production activities under the Preferred Alternative. This compares to 275 mi of pipeline constructed in Alternative A. Impacts are expected to be similar to Alternative A with no measurable effect on arctic fish populations in the Planning Area.

Marine Fish: While the Preferred Alternative differs from that of Alternative A, these differences would not

result in a measurable change in their effects on marine fish populations. Effects from seismic surveys are likely to be similar to those of Alternative A, i.e., no measurable effect.

Birds: One seismic operation is expected to occur each winter under the Preferred Alternative, as compared to alternate winters under Alternative A. It is not likely that this increased frequency would result in substantially greater effects than the negligible effects indicated under Alternative A. This is because camps and survey areas are occupied for only brief periods and wintering bird species are present in low densities, thus disturbance incidents are likely to be few and of short duration. All routine oil and gas exploration, development and production activities under this alternative are somewhat less than those under Alternative A, thus it is likely that local disturbance effects would be somewhat less unless most or all developments occurred in a limited portion of the Planning Area (i.e., the Dease Inlet area). Designating Kasegaluk Lagoon as a Special Area could exclude a small proportion of the higher density areas for Pacific loon, white-fronted goose, and long-tailed duck. This is not likely to result in significant reduction of effects where most potential effects already are quite low. Impacts to nesting and brood rearing brant habitat in the Brant Study Area are expected to be reduced under the Preferred Alternative's K-4 ROP. This ROP would require a 2-year study by lessees to survey brant nesting and brood-rearing areas so as to keep facilities at least ½ mi away from identified brant habitat. Overall effects of routine oil and gas activities at the regional population level are likely to be negligible for most activities and species, but could be elevated to minor for species that are uncommon, decreasing, or recently declined. Effects of air traffic and gravel mining are likely to remain at the minor level.

Bowhead Whales: The bowhead whale migration route typically is well offshore, so it is unlikely whales would experience intense or frequent disturbance from noise originating from Northwest NPR-A activities that modify normal behavior.

Beluga Whales and Other Marine Mammals: Some potential noise and disturbance from aircraft traffic and seismic activities could occur along the coast, primarily in the Dease Inlet/Admiralty Bay area, and these effects are expected to be local and short term (generally < 1 year). 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 projected oil exploration activities. Aircraft traffic (several helicopter round trips/day during exploration centered out of Deadhorse-Prudhoe Bay, traveling to and from NPR-A exploration facilities) is assumed to be a potential source of disturbance to ringed or spotted seals hauled out on the ice or beaches along the coast and to polar bears using coastal habitats. 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.

Under the Preferred Alternative, special stipulations would apply to oil and gas exploration and development in the Dease Inlet/Admiralty Bay area and in Elson Lagoon, specifically: (1) a ¾-mi coastal shoreline and natural island setback that would exclude development on or under the water; (2) no exploration occurring between May 15 and October 15; (3) requirements to prevent operational and siting conflicts with traditional subsistence activities; (4) spill response capabilities in broken ice conditions; (5) consultation requirements with the Alaska Eskimo Whaling Commission to minimize impacts to fall and spring subsistence whaling activities; and (6) requiring that the burden of proof rest with the lessee to demonstrate that BLM approval of exploration and development plans is warranted.

Exploratory drilling is assumed to occur during the winter (December to mid-April) over about 9 years using 1 to 2 drill rigs. If exploratory drilling activities occurred 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 on the coast of the Dease Inlet/Admiralty Bay area. Most of the exploration activities are assumed to occur onshore across the Northwest NPR-A.

(2) Effects of Spills

Terrestrial Mammals: Under the Preferred Alternative, an estimated 112 small crude-oil spills (averaging 3 bbl in size) and 277 small, refined oil spills (averaging 29 gal) are assumed to occur over the production life of the Planning Area. A maximum of 1 large spill (500 or 900 bbl) could occur. The extent of environmental impacts would depend upon the type and amount of materials spilled, the location of the spill, and effectiveness of the response. The general effects of spills on terrestrial mammals would be the same as those discussed under Alternative A, but somewhat lesser in frequency or extent, as fewer spills are anticipated.

Freshwater Fish: The individual effects of oil on fish from the Preferred Alternative are the same as those discussed for Alternative A. The oil-spill assessment estimates that the amount of crude oil spilled during the life of the field would be up to 336 bbl for the Preferred Alternative versus 393 bbl for Alternative A. Large spill volumes are identical for both Alternatives (500 or 900 bbl). Refined spill estimates under the Preferred Alternative would be up to 194 bbl versus 226 bbl in Alternative A. The reductions in small crude and refined spills are not expected to alter the overall effect of oil spills on arctic fish. Hence, oil spills associated with the Preferred Alternative are expected to have the same overall effect on arctic fish as those discussed for Alternative A (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 those of Alternative A (no measurable effects on arctic fish populations in the Planning Area over the production life of the field).

Marine Fish: The absence of marine construction in coastal areas would reduce the probability that an oil or diesel spill associated with the Preferred Alternative would adversely affect marine fish. This is due to the fact that the only way a spill could enter nearshore marine waters under the Preferred Alternative would be for it to enter from a river as a result of an onshore oil or diesel spill. Based on the size and number of the spills assumed for the Preferred Alternative, and the distance a spill is likely to have to travel to get to the ocean, that would be a highly unlikely event. Nevertheless, if an onshore oil or diesel spill did contact nearshore waters, it would be likely to have even less of an effect on marine fishes than that of Alternative A (no measurable effect).

Birds: Like Alternative A, one large spill is assumed for the Preferred Alternative. Because areas of higher probable oil and gas resources and development in the northern portion of the Planning Area are not deleted from this alternative, an oil spill is likely to contact approximately the same areas as under Alternative A, and, thus, produce about the same adverse effects. There would be a reduction in probability of offshore spill occurrence because permanent facilities would not be allowed in these waters; thus, these areas would be accessed from onshore facilities. Stipulations applied to all marine areas, the northeastern portion of the Planning Area surrounding Dease Inlet to south of Smith Bay, major river corridors, and other areas, could reduce somewhat the chance of spilled oil entering aquatic habitats, and thus, the chance of contacting loons, waterfowl, and shorebirds. These additional protective measures are not likely to reduce most effects of an oil spill under the Preferred Alternative below the minor level as determined for Alternative A, but could reduce spill effects in marine waters or river delta areas, where concentrations of waterfowl or other species occur, to below the moderate level. Small crude/refined oil spills are reduced somewhat from 130/323 assumed for Alternative A to 112/277 assumed for the Preferred Alternative; this reduction is not likely to reduce the already small effect (negligible) anticipated from small spills.

Bowhead Whales: Pad or pipeline spills are not expected to impact migrating bowhead whales whose migration route typically is well offshore of onshore locations where oil and gas development is likely to occur. A spill

occurring in Dease Inlet is expected to disperse before it reaches migration routes and offshore habitats where bowhead could potentially be exposed to the spill.

Beluga Whales and Other Marine Mammals: There is an estimated 0 to 33 percent chance of a 500- or 900-bbl pipeline spill occurring under the Preferred Alternative. If this spill were to occur near the Dease Inlet area, some of the oil could reach the marine environment. Some of the several hundred spotted seals that congregate in Dease Inlet/Admiralty Bay near the mouths of streams flowing into the inlet could be exposed to the spill. Such an event could result in the contamination and possible loss of a small number of spotted seals (perhaps 10 to 30 seals) out of a population of about a thousand animals. The population is likely to replace this loss within 1 year. The 500- or 900-bbl pipeline spill is not likely to affect many ringed seals, bearded seals, walruses, polar bears, beluga whales, or gray whales because these species tend to occur offshore of Dease Inlet/Admiralty Bay during the summer open-water season and the 500- or 900-bbl spill is expected to disperse before it reaches migration routes and offshore habitats where these species could be exposed to the oil. Few if any ringed seals, bearded seals, walruses, polar bears, beluga whales, or gray whales are likely to be exposed to the spill and suffer sublethal or lethal effects. A small fraction of the spill (1 to 5%) is expected to be widely dispersed in the water column and to be weathered and degraded by bacteria. The amount of benthic prey killed or contaminated by the spill is likely to be very small and represents an insignificant proportion of the prey and benthic habitat available to walruses, bearded seals, and gray whales. Thus, the 500- or 900-bbl spill is not likely to have any food-chain effects on marine mammals.

Polar bears would be most vulnerable to a spill if it were to reach the barrier islands of Elson Lagoon to Point Barrow. However, the number of bears likely to be contaminated or to be indirectly affected by a local contamination of seals probably would be small. Even in a severe situation where a concentration of perhaps 10 bears (such as at a whale-carcass site) were to be contaminated by a 500- or 900-bbl pipeline spill and all the bears died (a worst case), this one-time loss is not expected to significantly affect the polar bear population of 2,272 to 2,500 bears.

A total of 0 to 83 crude-oil spills (< 1 bbl) and 0 to 28 crude oil spills ($\geq$ 1 bbl and $\leq$ 500 bbl) with total volume of 0 to 336 bbl and a total of 0 to 277 small fuel-oil spills with an average size of 29 gal (less than half a barrel) are estimated to occur onshore under the Preferred Alternative for the first sale. These small onshore spills are expected to have little effect on seals, walruses, and polar bears. However, if some of these spills occur in or contaminate streams in the Dease Inlet 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 to 30 animals, because of the small size of these spills and the sparse distribution of pupping lairs). If some of the spills reach Dease Inlet during the summer open-water season, some spotted seals that frequent the inlet could be exposed to the oil and suffer sublethal and possibly lethal effects. Perhaps as many as a few hundred seals could be exposed to the contamination with heavily oiled individuals suffering lethal effects (perhaps 10 to 30 animals). Smaller numbers of polar bears are expected to be exposed to and affected by these small spills. The losses of small numbers of seals, and possibly a few polar bears, are not expected to affect seal and polar bear populations. These spills are not likely to affect walruses and beluga whales that occur offshore of Dease Inlet.

c. Effectiveness of Stipulations and Required Operating Procedures

Stipulations D-1, K-3, and K-6 and ROP's A-1, A-2, A-4, A-5, C-1, E-1, E-4, E-7, E-12, F-1, and K-5 would all provide increased protection for terrestrial mammals. Stipulations E-2, E-3, K-2, and K-3 and ROP's A-3, A-4, A-5, A-6, A-7, B-1, B-2, C-2, C-3, C-4, E-4, E-6, E-8, and E-12 would all provide increased protection to fish and fish habitat during fuel use, handling, and storage, gravel mining and reclamation of fish habitat, protection for water withdrawals from rivers and certain lakes, disruption of fish passage, and effects of fuel and oil spills. The Preferred Alternative incorporates the following protective measures for birds: Stipulations K-1 and K-6 and ROP's A-3, A-4, A-5, A-6, A-7, E-1, E-8, E-9, E-10, E-11, E-12, F-1, and K-4.

Stipulation K-3 would apply specifically to bowhead whales, and some protection from disturbance of the few bowhead whales that rarely occur in nearshore areas potentially could be accomplished if aircraft flying in coastal or nearshore areas were operated in a manner to minimize exposure of whales to noise, and if personnel in coastal or nearshore areas conducted activities using procedures designed to avoid disturbing wildlife that are presented in orientation program briefings. Effective mitigation for marine mammals would be Stipulation K-6 and ROP's A-3, A-4, C-1, E-4, and E-12.

Subsistence Resources and Harvest Patterns: Stipulations articulate minimum protection against impeding subsistence pursuits as set down in ANILCA (P.L. 96-487). Specifically for subsistence, Stipulations E-1 and E-3 protect subsistence use and access to traditional hunting and fishing areas, specifically areas adjacent to waterbodies with identified subsistence values. Stipulation K-1 specifically identifies the waterbodies of prime importance to subsistence and the setback requirements: the Colville, Alaktak, Chipp, Oumalik, Ikpikpuk, Titaluk, Kigalik, Topagoruk, Meade, Usuktuk, Nigisaktuvik, Avalik, and Inaru rivers, and Kucheak, Maybe, Ishuktak, and Pikroka creeks. Stipulation K-3 protects subsistence resources and access in Dease Inlet, Admiralty Bay, and Elson Lagoon. This stipulation specifies: 1) a ¾-mi coastal shoreline and natural island setback that would exclude development on or under the water; 2) no exploration occurring between May 15 and October 15; 3) requirements to prevent operational and siting conflicts with traditional subsistence activities; 4) spill response capabilities in broken ice conditions; 5) consultation requirements with the Alaska Eskimo Whaling Commission to minimize impacts to fall and spring subsistence whaling activities; and 6) that the burden of proof rest with the lessee to demonstrate that BLM approval of exploration and development plans is warranted.

ROP E-5 addresses impacts of the development footprint so as to minimize environmental, economic, and social impacts; ROP E-7addresses the disruption of caribou movement by requiring pipelines and roads to be designed to allow the free movement of caribou and the safe and unimpeded passage of subsistence hunters. Specifically: 1) ground pipelines would be elevated an average of at least 7 ft to facilitate wildlife passage and subsistence passage and access; 2) the requirement of ramps--after consultation with appropriate Federal, State, and North Slope Borough regulatory and resource management agencies--where facilities or terrain funnel caribou movement; and 3) a minimum separation of 500 ft between pipelines and roads to reduce disturbance to caribou movements. ROP E-12 would require ecological mapping of wildlife habitat prior to development of permanent facilities, in order to conserve important habitat types during development. ROP F-1 would minimize the effects of low-flying aircraft on wildlife, traditional subsistence activities and local communities. This ROP is designed to minimize aircraft disturbance of caribou, moose, and bird populations and sensitive habitat areas, especially near known subsistence camps and cabins or during sensitive subsistence hunting periods (spring goose hunting and fall moose hunting) should be kept to a minimum.

ROP H-1 is subsistence-specific mitigation designed to provide opportunities for participation in planning and decision-making to prevent unreasonable conflicts between subsistence uses and oil and gas and related activities. Consultation is considered to be in-person meetings, teleconferences, videoconferences, and exchanges of written documents. It does not include public meetings that are primarily for the purpose of information distribution, unless it is explained at the beginning of the meeting that there is an open dialogue, and that comments, concerns or other information are being actively solicited. The specific terms of consultation include: 1) the lessee consulting with directly affected subsistence communities, the North Slope Borough, and the NPR-A Subsistence Advisory Panel to discuss the siting, timing, and methods of proposed operations. Through this consultation, the applicant shall make every reasonable effort, including such mechanisms as conflict avoidance agreements and mitigating measures to ensure that proposed activities would not result in unreasonable interference with subsistence activities; 2) the lessee submitting documentation of their consultation efforts as part of their operations plan. The proposed plan of operations would provide an adequate time for review and comment by the NPR-A Subsistence Advisory Panel and allow time for formal government-to-government consultation with Native Tribal Governments. The applicant shall submit documentation of their consultation efforts and a written plan that shows how its activities, in combination with other activities in the area, would be scheduled and located to prevent unreasonable conflicts with subsistence activities. Operation plans must include a discussion of the potential effects of the proposed operation, and the proposed operation in combination with other existing or reasonably foreseeable operations; 3) the lessee's subsistence plan would provide a detailed description of the

activity(s) taking place (including the use of aircraft); a description of how the lessee/permittee would minimize and/or deal with any potential impacts identified by the AO during the consultation process; a detailed description of the monitoring effort to take place, including process, procedures, personnel involved and points of contact both at the work site and in the local community; information on how the applicant would keep potentially affected individuals and communities up to date on the progress of the activity and locations of possible, short-term conflicts (if any) with subsistence activities; procedures necessary to facilitate access by subsistence users to conduct their activities; recognition that the AO would resolve conflict between the lessee and subsistence hunters; during development, monitoring plans would be established for new permanent facilities, including pipelines, to assess an appropriate range of potential effects on resources and subsistence as determined on a case-by-case basis; the scope, intensity, and duration of such plans would be established in consultation with the AO and Subsistence Advisory Panel.

ROP H-2 is further subsistence-specific mitigation designed to prevent unreasonable conflicts between subsistence activities and geophysical (seismic) exploration. This ROP provides for additional consultation requirements for geophysical exploration beyond those required in ROP H-1. Specifically, geophysical operators: 1) would notify in writing all potentially effected long-term cabin and camp users; 2) operators would use as their source the North Slope Borough's most current inventory of cabins and campsites; 3) a potentially affected cabin or campsite is defined as any camp or campsite within the boundary of the area subject to proposed geophysical exploration and/or within 1,200 ft of actual or planned travel routes used to supply the seismic operations while it is in operation; 4) a copy of the notification letter and the list of potentially affected users would be provided to the office of the appropriate Native Tribal Government; 5) based on this consultation, the AO may prohibit seismic work up to 1,200 ft from any known, long-term cabin or campsite. Generally, the AO would allow wintertime seismic work to be conducted within 300 ft of a long-term cabin or campsite that is not in use.

ROP I-1 requires the lessee to provide a cultural orientation program for all oil and gas workers involved in NPR-A activities in order to minimize cultural and resource conflicts with local inhabitants. This orientation program, as it relates to subsistence pursuits and cultural concerns would: 1) provide sufficient detail to notify personnel of applicable stipulations and required operating procedures, as well as inform them about specific types of environmental, social, traditional and cultural concerns that relate to the region; 2) address the importance of not disturbing archaeological and biological resources and habitats and provide guidance on how to avoid disturbance; 3) include guidance on the preparation, production and distribution of information cards on endangered and/or threatened species; 4) be designed to increase sensitivity and understanding of personnel to community values, customs, and lifestyles in areas where personnel would be operating; 5) include information concerning avoidance of conflicts with subsistence, commercial fishing activities, and pertinent mitigation; and 6) include information for aircraft personnel concerning subsistence activities and areas/seasons that are particularly sensitive to disturbance by low flying aircraft. Of special concern is aircraft use near traditional subsistence cabins and campsites, flights during spring goose hunting and fall moose hunting seasons, and flights near North Slope communities.

d. Conclusion--First Sale

(1) Effects on Subsistence Species

Terrestrial Mammals: The effects of oil and gas activities on terrestrial mammals would be similar to but somewhat less than those projected under Alternative A. Habitat alteration would include the development of up to 4 oil fields and a northern pipeline to the TAPS. Some TLH caribou are expected to be disturbed and their movements delayed along the pipeline during periods of air traffic and construction. Near the oil fields, surface, air, and foot traffic is expected to increase significantly and to displace some terrestrial mammals. If a field is developed in critical TLH insect-relief areas, movements of the TLH caribou from coastal insect-relief areas to foraging areas may be adversely affected by pipelines and road corridors. There may be increased energetic costs to caribou. Extensive development in this area could result in the loss of some insect-relief habitat for TLH caribou. The number of small, chronic crude-oil and fuel spills is expected to result in the loss of small numbers

of terrestrial mammals but impacts would not be significant at the population level.

Freshwater Fish: Construction of pads, roads, and airstrips, and fuel spills associated with the Preferred Alternative might be expected to kill a small number of individual fish but are expected to have no measurable effect on arctic fish populations. Increased mortality is anticipated when water withdrawals occur in river pools. Potential mortality from water withdrawals in lakes is also possible, although limits on withdrawal and monitoring of water quality should minimize concerns. Decreased exploration activity under the Preferred Alternative (as compared to Alternative A) represents a corresponding 30 percent decreased water budget. This would also lessen the potential for fish kill in lakes. Gravel requirements for oil and gas field pads in the Preferred Alternative are 20 percent less than those in Alternative A. Gravel extractions can lead to habitat enhancement under certain situations. Seismic surveys, non-oil and gas activity, causeways, and 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. These last conclusions mirror those from Alternative A.

Marine Fish: Seismic surveys, and oil or diesel fuel spills associated with the Preferred Alternative are not expected to have a measurable effect on marine fish populations.

Birds: Under the Preferred Alternative, disturbance effects from non-oil and gas activities, winter seismic surveys, and routine oil and gas activities for most species are likely to be negligible, or minor for uncommon/decreasing species, as under Alternative A. Effects of air traffic and gravel mining are likely to remain at the minor level under the Preferred Alternative. Effects of a large spill for most species are likely to remain at the minor level; moderate effects where waterfowl or other birds concentrate may be reduced by stipulations covering marine waters and major rivers that drain into this habitat.

Bowhead Whales: Both disturbance and oil spill effects could be somewhat less than those for Alternative A as a result of removal of Kasegaluk Lagoon from oil and gas leasing and protections in Dease Inlet, Admiralty Bay, and Elson Lagoon.

Beluga Whales and Other Marine Mammals: For the Preferred Alternative, the effects of activities other than oil and gas, on marine mammals--particularly polar bears and spotted seals--along the coast of the Planning Area 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 Dease Inlet-Elson Lagoon 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 Northwest NPR-A. Effects of these activities would be local and are not likely to affect marine mammal populations.

A small number of spotted seals (perhaps 10 to 30 animals) and no more than a few polar bears might be adversely affected or killed by a 500- or 900-bbl crude-oil spill occurring onshore and possibly contaminating Dease Inlet, 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.

(2) Effects on Subsistence-Harvest Patterns

The overall effects of oil and gas activities under the Preferred Alternative on subsistence resources and harvest patterns are expected to be the same or less than those under Alternative A. Effects on terrestrial mammals (other than caribou), freshwater fish, marine fish, most birds, bowheads whales, beluga whales, and other marine mammals are expected to range from negligible to local and short term (generally less than 1 year), and have no

regional population effects.

If a field were to be developed in critical Teshekpuk Lake caribou herd (TLH) insect-relief areas, movements of caribou from coastal insect-relief areas to foraging areas would be adversely affected by pipelines and road corridors, and caribou movements within insect-relief areas could be disrupted, with unknown levels of effects on the productivity of the herd. Effects of crude-oil spills on birds could range from minor--when confined to terrestrial and freshwater aquatic habitats where the mortality of few waterfowl, shorebirds, raptors, and passerines is likely to be relatively low--to moderate if a spill were to enter a river delta or nearshore marine habitat occupied by loons, large numbers of seaducks whose populations have declined, black guillemots, or Ross' gulls.

Effects on subsistence-harvest patterns are expected to be the same or somewhat less than those for Alternative A, with subsistence resources being periodically affected but no resource becoming unavailable, undesirable for use, or experiencing overall population reductions. Low to moderate effects on species of waterfowl and shorebirds with declining populations could be expected, and even with one fewer field being developed under the Preferred Alternative, moderate to high effects could still be expected on the productivity of TLH caribou if development were to take place in critical insect-relief areas. If the latter were to occur, effects on subsistence-harvest patterns would elevate from low to moderate or high as an important subsistence resource would become unavailable, undesirable for use, or experience reduced availability for a period greater than 2 years. ROP K-5, providing for multi-year studies of caribou before authorization of development activities in identified TLH insect-relief areas, could help minimize potential effects to the TLH in the northern portion of the Planning Area.

Industrialization clearly displaces subsistence users from traditional use areas even if no legal impediments to access are imposed (NSB, 2003). Therefore, if development were to occur in areas containing concentrations of subsistence cabins, camps, and if traditional use sites and subsistence resources experienced even minor impacts, subsistence users would be displaced and impacts would be expected to be far greater. The BLM expects its subsistence stipulations to mitigate potential exploration and development conflicts with subsistence cabins, camps, and use sites.

(3) Effects on Communities

Effects to the communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut from impacts to subsistence resources and subsistence-harvest patterns from ground-impacting activities, small oil spills, and exploration and development are expected to be minor with subsistence resources being periodically affected but no resource becoming unavailable, undesirable for use, or experiencing overall population reductions. Low to moderate effects on species of waterfowl and shorebirds with declining populations could be expected, and moderate to high effects could be expected on the productivity of TLH if development takes place in critical insect-relief areas. If the latter occurred, effects on subsistence-harvest patterns would elevate from low effects to moderate or high effects as one or more important subsistence resources would become unavailable, undesirable for use, or experience population reductions for a period greater than 2 years.

Below is a brief summary of community traditional knowledge of effects on resources and harvests, A fuller discussion of traditional knowledge and quoted statements from North Slope residents in the following potentially affected communities can be found in Section IV.C.14.d.3.

(a) Point Lay

Beluga whales are a prized subsistence resource, and for this reason Point Lay residents object to nearshore or offshore noise disturbances (Tukrook, 1987; Tucker, 1996). Hunters believe such nearshore or offshore development and oil spills would disturb migrating whales, change migration routes, and make them impossible to hunt or adversely affect their population (Huntington and Mymrin, 1996). Point Lay residents have expressed concern about the overall health of caribou, beluga whales, polar bears, brown bears, wolves, and wolverines in the area (Stalker, 1998). Hunters believe health problems of caribou are related to contaminants (Tucker, 1998). Dorcas Neakok, interviewed in 1988 and 1989, reflected on her difficult interactions with Point Lay DEW-Line and oil exploration workers (Neakok, 1989).

(b) Wainwright

Wainwright residents object to nearshore or offshore disturbances of any kind because of the displacement of game they have already observed (Aveoganna, 1987; Oktullik, 1996). Residents expressed concerns about potential contamination from oil and about oil-spill cleanup capabilities (Aveoganna, 1987; Kagak, 1987). Local residents state explicitly that there are no viable substitutes for subsistence food resources (Ahmaogak, 1987). Hunters have observed waste sites and contamination and the changes that have occurred to fish, caribou, and polar bear behavior and to local ocean conditions (Peetook, 1998; Angashuk, 1998; D. Tagarook, 1998; G. Tagarook, 1998). There is a local concern that BLM, in its planning protocol for NPR-A, would designate certain areas off limits to subsistence (Peetook, 1998). Also of concern to the community is the ongoing issue of impact assistance to local communities from oil activity impacts (Agnasagga, 1986).

The ongoing "Human and Chemical Ecology of Arctic Pathways by Marine Pollutants" collaborative project between the Wainwright Traditional Council and University of Calgary researchers that produced the report entitled *"Passing on the Knowledge: Mapping Human Ecology in Wainwright, Alaska"* revealed a number of observations by local hunters concerning changes in subsistence resource behaviors and populations. Community members noted changes in the skin color of beluga whales "from the normal white to a yellowish tinge." Changes in ice conditions have produced major changes to polar bear behavior. In recent years, the late formation of sea ice "has left many bears trapped on the land." Because they are not able to reach the ice and hunt for seals, many polar bears appear to be starving. Caribou migration corridors have changed, as well. In the last 50 years, local hunters report that more caribou are staying closer to the community rather than following the herd on its migration. Shorter, thinner fur on small furbearers has been reported, especially wolverine. Villagers attribute this change to unusually warm fall and winter seasons. Hunters have reported that "birds harvested in the fall have enlarged livers and gizzards and white (rather than yellow) fat." A number of changes to fish have been observed. A greater number of salmon and a greater number of salmon types have been reported. Fewer fish are reported when boats travel the rivers, and more fish have been found with open sores. Finally, mature grayling seem to be smaller than in the past (Kassam and the Wainwright Traditional Council, 2000).

(c) Atqasuk

Community members of Atqasuk have expressed concern for areas critical to calving caribou and nesting waterfowl and have suggested that special management zones be established for these populations. Hunters believe oil development has affected animal migrations and duck populations near Prudhoe Bay and recommend that development should not occur any closer than 15 to 20 mi to their habitats (Kagak, 1997). Arnold Brower, Sr. 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, then NSB Planning Director, indicated at the March 1997 Atqasuk Northeast NPR-A Scoping Meeting that inspection of seismic crews is necessary to keep their activities in line with permitting guidelines that require them to adequately clean up small spills and pick up debris left behind (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 NE Area NPR-A Coordinator, said that similar firearm restrictions to those already exisiting around Prudhoe Bay oil-development sites would create additional detours for subsistence hunters. Thomas Brower, Jr. expressed concerns about drilling contaminants because he has seen wildlife dying from drilling wastes left behind by past drilling activity (USDOI, BLM, 1997a).

(d) Barrow

Community residents have concerns over pipeline construction restricting subsistence access and have told BLM that it must identify stipulations to protect subsistence-hunting sites, traditional fish camps, and access routes from development impacts (C. Brower, 1986; Hepa, 1997). The issue of BLM's failure to resolve local allotment claims is a serious long-term concern. There are also concerns about past contamination and potential new contamination of watersheds from oil exploration (Leavitt, 1980; Aiken, 1997) and seismic impacts on fish and other wildlife (Itta, 1997, H. Brower, 1997).

(e) Nuiqsut

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 and others from Nuiqsut maintain 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; Brower and Opie, 1997). Leonard Lampe, past Mayor of Nuiqsut, and other local residents have expressed further concern for air-pollution and habitat problems, asserting that Nuiqsut has been experiencing these effects for some time (Lavrakas, 1996:1, 5; USDOI, BLM, 1997a; Ahtuangaruak, 1997; Brower and Opie, 1997). Seismic activity that leaves trails and sometimes wire cable has caused problems with winter subsistence travel; seismic activity has also threatened traditional sites and is suspected of altering the caribou food chain (Lavrakas, 1996:1, 5; Napageak, 1997). Some believe that increased traffic on the Dalton Highway might be interfering with caribou migrations by spooking the animals (Lampe, 1997; Adams, 1997:5, 9).

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). Locally oil development impacts are believed to be the cause of reduced numbers of arctic cisco, smaller whitefish (Woods, 1979; Dames and Moore, 1996b; Brower and Opie, 1997; Ahtuangaruak, 1997).

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; Ahvakana, 1990; Dames and Moore, 1996c).

In Northeast Area 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 (Napageak, 1997; Lampe, 1997).

A major issue with the NPR-A development has been the velocity of the environmental assessment process and the way it has taxed the resources of the Native community. Nuiqsut residents believe it precludes them from having a meaningful involvement with the planning process and a thorough compilation of the vast cultural knowledge the Inupiat have gained over millennia (Lampe, 1997; Adams, 1997:5, 9; Ahtuangaruak, 1997; Napageak, 1997; Hepa, 1997). Oil spills also are an identified threat. Thomas Napageak stated in his testimony at the Nuiqsut NE Area 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)

(f) Other Subsistence Communities

Because overall impacts to migratory birds in the Northwest NPR-A Planning Area, except eiders, are expected to be minor and these birds in general disperse over large migration and wintering areas, effects on stakeholders (including subsistence hunters) are also expected to be minor. Some mortality to subsistence waterfowl species in the Northwest NPR-A would be expected, but the mortality rates are expected to be low. There is no realistic way to translate this potential impact in the Northwest NPR-A Planning Area into a level of measurable effect on more distant subsistence users.

e. Multiple Sales

Terrestrial Mammals: If several lease sales were to occur under the Preferred Alternative, considerably more exploration activity would be expected to occur in the habitat of the TLH and WAH caribou, with twice as many exploration wells being drilled. Up to 8 oil fields would be developed and the number of pipeline miles would be slightly less than those under Alternative A. A southern pipeline route to TAPS Pump Station 2 may be constructed, resulting in some disruption of CAH caribou. An increase in the number or miles of roads and pipelines with development under multiple sales is expected to further impede movements of TLH caribou to insect-relief areas along the coast. This effect is expected to persist over the life of the oil fields and may reduce productivity of the TLH. The number of spills, either small or large, is not expected to increase. However, the location of the spills may change. Small, chronic spills are expected to have about the same effect on terrestrial mammals and their habitats as under the single sale scenario but with a higher likelihood of impacts to WAH caribou.

Freshwater Fish: It is assumed that additional lease sales under the Preferred Alternative would result in an additional 0 to 4 oil/gas fields developed, exploratory well numbers would increase from 5 to 12 wells to 10 to 24 wells, and delineation wells would increase from 2 to 18 wells to 4 to 18 wells. An additional 200 to 270 mi of pipeline would be added. Seismic activity would remain the same. Water withdrawals would increase in proportion to the activity level. Given the large quantity of lakes in the area likely to be developed, increased water use is not expected to impact fish more severely than under a single sale. Gravel pads and roads for multiple sales are likely to have about twice the effect on arctic fish as the first sale. Doubling the miles of pipeline would not in and of itself increase the measurable effect on arctic fish populations in the Planning Area. It is estimated that the amount of crude oil spilled would double. The impacts would also double, though they would still be minor. 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 here for multiple sales.

Marine Fish: The most likely events to affect marine fish for the first lease sale, and any subsequent sale, include seismic surveys, fuel spills, and oil spills. Additional NPR-A lease sales would add to the seismic surveys from the first sale, and thereby would increase the probability of seismic activity occurring above over-wintering habitat. However, 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 marine fish as discussed for the first sale. If several lease sales occur under the Preferred Alternative, considerably more exploration activity is expected to occur in the Planning Area. 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. On the basis of this estimate, crude-oil spills for multiple sales are expected to have a slightly greater effect on marine fish than those under 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 marine fish populations is likely to be greater than estimated here for multiple sales.

Birds: If multiple sales occur under the Preferred Alternative, it is likely that disturbance from development activity and any oil-spill effects would be concentrated in the northern portion of the Planning Area, as under Alternative A, where stipulations governing various activities apply. Disturbance associated with multiple sales is likely to result in a substantial increase of local effects, and potentially at a regional level for species that are uncommon and/or decreasing in numbers, over that expected from the first sale, especially if sales are concentrated in the northern Planning Area. However, the overall effect of routine oil and gas activities at the regional population level is likely to be negligible for most activities and species because there still is a relatively low level of activity projected, and most species populations are scattered over a large area. Effects could be elevated to the minor level for species that are uncommon, decreasing, or recently declined. Effects of gravel mining are likely to remain at the minor level because some sites probably would be used for several projects. Effects of air traffic with multiple sales, particularly if developments are concentrated in a limited portion of the Planning Area, could be elevated to a moderate level especially in the case of species with limited habitat preferences, small and/or declining populations (red-throated loon, yellow-billed loon, king eider, common eider, Sabine's gull, gyrfalcon, peregrine falcon, snowy owl). Effects could extend to regional populations and involve long-term changes in distribution.

The stipulations applied to marine areas and rivers also could reduce the probability that an oil spill would reach areas where birds concentrate (e.g., waterfowl in marine waters or rivers) by providing setbacks from aquatic habitats and prohibiting permanent facilities in marine waters. However, multiple sales in the northern area, for example, even though reduced somewhat from Alternative A, could elevate the overall probability of spill occurrence in that area, thereby increasing the potential for oil to reach waterfowl concentration areas, and causing substantial mortality well above that for the first sale. Effects from pipelines required to transport oil to existing eastern pipelines are likely to be considerably less that for the first sale because only shorter accessory lines would be constructed to individual successive projects.

Bowhead Whales: Effects to bowhead whales are not expected to increase under the multiple sale scenario.

Beluga Whales and Other Marine Mammals: 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 10 to 24 for multiple sales from the projected 5 to 12 wells for one sale. The amount of development also is expected to increase. The number of production pads would be the same for multiple sales as for one sale, and pipeline miles would increase to 0 to 220-270 mi for multiple sales from 0 to 195-250 mi for one sale. The number of small crude-oil and refined-oil spills is estimated to be about the same as under Alternative A. Only a small increase in potential noise and disturbance effects on marine mammals is expected along the coast, primarily in the Dease Inlet-Barrow Area, and these effects are expected to be local and short term (generally < 1 year).

Subsistence Resources and Harvest Patterns: For the multiple sales under the Preferred Alternative, most resources would see increases in effects from increases in development activity although overall effects on terrestrial mammals (other than caribou), freshwater fish, marine fish, most birds, bowhead whales, beluga whales, and other marine mammals are still expected to be local and short term (generally < 1 year), and to have no regional population effects--the same effects levels expected for a single sale. On the other hand, some birds with limited habitat, limited tolerance to disturbance, or declining populations could experience long-term population effects. The TLH would also see population effects and reduced productivity under the multiple sale scenario. and there would be a small increase in potential noise and disturbance effects on marine mammals expected along the coast, primarily in the Dease Inlet-Barrow Area. Stipulation K-3 could help minimize potential effects to these resources and to subsistence practices.

Industrialization clearly displaces subsistence users from traditional use areas even if no legal impediments to access are imposed (NSB, 2003). Therefore, if development occurred in areas containing concentrations of subsistence cabins, camps, and traditional use sites and subsistence resources experienced only minor impacts, subsistence users would be displaced and impacts would be expected to be far greater. The BLM expects its subsistence stipulations to mitigate potential exploration and development conflicts with subsistence cabins, camps, and use sites.

Effects to subsistence harvest practices in the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut would still be expected to be minor as well. But with more development taking place and with a potential southern pipeline route to TAPS Pump Station 2 being constructed, some disruption of CAH caribou during migration would be expected. A second gas pipeline from the southern part of the Planning Area would be constructed to Prudhoe Bay. An increase in the number or miles of roads and pipelines with development under multiple sales is expected to further impede movements of TLH caribou to insect-relief areas along the coast. This effect is expected to persist over the life of the project and may reduce productivity of the TLH. This level of effect on caribou would elevate expected effects on community subsistence-harvest patterns to high or very high effects as one or more important subsistence resources would become unavailable, undesirable for use, or experience population reductions for a period up to 5 years or longer. ROP K-5, providing for multi-year studies of caribou before authorization of development activities in identified TLH insect-relief areas, could help minimize potential effects to the TLH in the northern portion of the Planning Area. Under the Preferred Alternative, lagoons and estuaries along the western coast of the Northwest NPR-A Planning Area, including the proposed Kasegaluk Lagoon Special Area, Peard Bay, and the Kuk River system (Wainwright Inlet), as well as important terrestrial subsistence harvest areas for the community of Wainwright would be included in a large deferral area (approximately 17% of the Planning Area) where leasing would be deferred for 10 years. Deferring leasing in this area would reduce for 10 years any potential disturbance from exploration and development on subsistence practices in the area by Point Lay and Wainwright hunters.

f. Conclusion--Multiple Sales

Terrestrial Mammals: The effect of multiple sales under the Preferred Alternative is expected to cause disruption of TLH caribou movements to insect-relief areas along the coast and cause some disruption of CAH and WAH caribou. Impacts to grizzly bears, wolves and wolverines would be higher than those under the single

sale scenario as development would be located in higher density habitats for these species. When compared to Alternative A, fewer oil fields would be developed but both the southern and northern pipelines would still be constructed. Impacts would be similar to that projected under Alternative A but somewhat lesser in extent as fewer fields would be developed.

Freshwater Fish: 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 and roads are expected to have about twice the effect as the first sale. Fuel and oil spills are likely to have a greater (though still minor) 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 here for multiple sales. The impacts under multiple sales are the same for Alternative A.

Marine Fish: Seismic surveys and oil or diesel fuel spills are likely to have a slightly greater overall effect on marine fish than under the single sale for the Preferred Alternative. Insufficient recovery time between sales and/or greater levels of activity would be likely to result in greater oil-spill-related effects than estimated for multiple sales.

Birds: Although the projected level of activity is somewhat less under the Preferred Alternative than under Alternative A, and additional protective stipulations applied to marine and riverine areas and elsewhere in the Planning Area, and no leasing allowed in the extreme western portion, the probable concentration of development in the northern portion is likely to result in negligible to minor levels of disturbance and minor to moderate levels of oil-spill mortality among the species of varying sensitivity and vulnerability affected--that is, no significant reduction in overall effect. Effects of multiple sales over a longer period in the northern (or other areas) could elevate the overall probability of disturbance and spill occurrence in that area, thereby increasing the potential for disturbing breeding birds, and for spilled oil to reach waterfowl or other water bird concentration areas that could cause mortality well above that of the first sale.

Bowhead Whales: Effects to bowhead whales are not expected to increase under the multiple sale scenario.

Beluga Whales and Other Marine Mammals: The effect of oil and gas activities under the Preferred Alternative with multiple sales is expected to be about the same as that for the single sale, but the duration and extent of activities would occur over a longer period of time, as would potential disturbance effects.

Subsistence Resources and Harvest Patterns: For the multiple sales under the Preferred Alternative, most resources would see increases in effects from increases in development activity although overall effects on terrestrial mammals (other than caribou), freshwater fish, marine fish, most birds, bowhead whales, beluga whales, and other marine mammals are still expected to be local and short term (generally < 1 year), and to have no regional population effects--the same effects levels expected for a single sale. On the other hand, some birds with limited habitat, limited tolerance to disturbance, or declining populations could experience long-term population effects. The TLH would also see population effects and reduced productivity under the multiple sale scenario. Effects to subsistence harvest practices in the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut would still be expected to be minor as well. But if caribou experienced these population effects, elevated effects on community subsistence-harvest patterns would increase to high or very high effects, as one or more important subsistence resources would become unavailable, undesirable for use, or experience population reductions for a period up to 5 years or longer.

ROP K-5, providing for multi-year studies of caribou before authorization of development activities in identified TLH insect-relief areas, could help minimize potential effects to the TLH in the northern portion of the Planning Area. Under the Preferred Alternative, lagoons and estuaries along the western coast of the Northwest NPR-A Planning Area, including the proposed Kasegaluk Lagoon Special Area, Peard Bay, and the Kuk River system (Wainwright Inlet), as well as important terrestrial subsistence harvest areas for the community of Wainwright

would be included in a large deferral area (approximately 17% of the Planning Area) where leasing would be deferred for 10 years. Deferring leasing in the deferral area would reduce for 10 years any potential disturbance from exploration and development on subsistence practices in the area by Point Lay and Wainwright hunters.

15. Sociocultural Systems

Under the Preferred Alternative, lagoons and estuaries along the western coast of the Northwest NPR-A Planning Area--including the proposed Kasegaluk Lagoon Special Area, Peard Bay, and the Kuk River system (Wainwright Inlet)--as well as important terrestrial subsistence harvest areas for the communities of Wainwright and Point Lay would be included in a large deferral area (approximately 17% of the Planning Area) where leasing would be deferred for 10 years. Special stipulations would apply to oil and gas exploration and development in the Dease Inlet/Admiralty Bay area and in Elson Lagoon.

The primary aspects of the sociocultural systems that could be impacted are: (1) social organization, (2) cultural values, and (3) social health. See Section IV.C.15 for additional discussion on potential stresses to Inupiat sociocultural systems.

The close relationship between the spirit of the Inupiat people, their social organization, and the cultural value of subsistence hunting may be unparalleled when compared with other areas in America where energy-development is taking place. The Inupiat's continuing strong dependence on subsistence foods, particularly marine mammals and caribou, creates a unique set of potential effects from onshore and offshore oil exploration and development on the social and cultural system.

One analysis of Inupiat concerns about oil development was based on a compilation of approximately 10 years of recorded testimony at North Slope public hearings for State and Federal energy-development projects. Most concerns centered on the subsistence use of resources, including damage to subsistence species, loss of access to subsistence areas, loss of Native foods, or interruption of subsistence-species migration. These four concerns were expressed in 83% of all the testimony taken on the North Slope (Kruse et al., 1983: Table 35; USDOI, MMS, 1994; Human Relations Area Files, Inc., 1992).

Other important factors in any analysis of sociocultural systems that will or already are affecting Inupiat society would include: changes in employment, increases in income, decreases in Inupiaq fluency, rising crime rates, substance abuse, and cumulative impacts. Statistics on homicides, rapes, and wife and child abuse present a sobering picture of some aspects of life in NSB communities. Violent deaths account for more than one-third of all deaths on the North Slope. The Alaska Native Health Board notes the "overwhelming involvement of alcohol (and drug) abuse in domestic violence, suicide, child abuse, birth defects, accidents, sexual assaults, homicide and mental illness" (Alaska Native Health Board, 1985). The lack of comparable data makes it impossible to compare levels of abuse and violence between aboriginal (prior to contact with Caucasians), traditional (from the time of commercial whaling through the fur trade), and modern (since World War II) Inupiat populations. Nonetheless, it is apparent that there has been a drastic increase in these social problems, although a study conducted in the early 1980's on the North Slope indicates that no direct relationship was found between energy development and "accelerated social disorganization" (Kruse, Kleinfeld, and Travis, 1982, cited in Impact Assessment, Inc., 1990b). Studies in Barrow (Worl and Smythe, 1986) detail the important changes in Inupiat society occurring in the last decade as a response to these problems. Services from outside institutions and programs have recently begun to assume a greater responsibility for functions formerly provided by extended families. Today, there is an array of social services available in Barrow that is more extensive for a community of this size than anywhere in the U.S. (Worl and Smythe, 1986).

In 1970 and 1977, residents of North Slope villages were asked about their state of well-being in a survey conducted by the University of Alaska Anchorage, Institute of Social and Economic Research (Kruse et al.,

1983). The survey identified notable increases in complaints about alcohol and drug use in all villages between 1970 and 1977. Health and social services programs have attempted to address these problems with treatment programs and shelters for abused wives and families, as well as well as enhanced recreational programs and services. More recently, a lack of adequate financing for city governments within the NSB has hampered the development of these programs, and declining revenues from the State have seriously impaired the overall performance of these city governments. In the last decade, all communities in the NSB have struggled with banning the sale, use, and possession of alcohol. The issue of whether a community will become "dry" or stay "wet" is constantly brought before local voters.

The baseline of the present sociocultural system includes change and strain. The very livelihood and culture of North Slope residents come under increasing scrutiny, regulation, and incremental alteration. Increased stresses on social well-being and on cultural integrity and cohesion come at a time of relative economic well-being. The expected challenges on the culture by the decline in CIP funding from the State have not been as significant as once expected. The buffer effect has come mostly through the dramatic growth of the Borough's own permanent fund, the NSB taking on more of the burden of its own capital improvement, and its emergence as the largest employer of local residents. However, Borough revenues from oil development at Prudhoe Bay are on the decline, and funding challenges (and subsequent challenges to the culture) continue as the Alaska State Legislature alters accepted formulas for Borough bonding and funding for rural school districts.

a. Subsistence Resources and Harvest Patterns

See Section V.B.14.d.2 for a discussion of effects on Subsistence-Harvest Patterns.

b. Effects on Subsistence Communities

See Section V.B.14.d.3 for a discussion of effects on Subsistence Communities.

c. Effectiveness of Stipulations and Recommended Operating Procedures

ROP I-1 would require the lessee to provide a cultural orientation program for all oil and gas workers involved in NPR-A activities in order to minimize cultural and resource conflicts with local inhabitants. This orientation program, as it relates to subsistence pursuits and cultural concerns would: 1) provide sufficient detail to notify personnel of applicable stipulations and required operating procedures, as well as inform them about specific types of environmental, social, traditional and cultural concerns that relate to the region; (2) address the importance of not disturbing archaeological and biological resources and habitats and provide guidance on how to avoid disturbance; 3) include guidance on the preparation, production and distribution of information cards on endangered and/or threatened species; 4) be designed to increase sensitivity and understanding of personnel to community values, customs, and lifestyles in areas where personnel will be operating; 5) include information concerning avoidance of conflicts with subsistence, commercial fishing activities, and pertinent mitigation; 6) include information for aircraft personnel concerning subsistence activities and areas/seasons that are particularly sensitive to disturbance by low flying aircraft. Of special concern is aircraft use near traditional subsistence cabins and campsites, flights during spring goose hunting and fall moose hunting seasons, and flights near North Slope communities.

See Section V.B.14.c for a discussion of the effectiveness of stipilations and recommended operating procedures as they relate to subsistence.

d. Conclusion--First Sale

Effects would be the same or slightly reduced from Alternative A. As most subsistence resources are expected to experience local, short-term impacts with no resources becoming unavailable, undesirable for use, or experiencing overall population reductions, effects on subsistence harvest practices in the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut would experience minor effects as well. But if development took place in critical insect-relief areas of the TLH, effects on subsistence-harvest patterns and on communities would elevate from low effects to moderate or high effects as one or more important subsistence resources would become unavailable, undesirable for use, or experience population reductions for a period greater than 2 years. ROP K-5, that provides for multi-year studies of caribou before authorization of development activities in identified TLH insect-relief areas, could help minimize potential effects to the TLH in the northern portion of the Planning Area.

Effects on the sociocultural systems of the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut could come from disturbance from oil exploration and development activities, from changes in population and employment, and from periodic interference with subsistence-harvest patterns from oil spills and oil-spill cleanup. Altogether, subsistence effects periodically could disrupt but not displace ongoing social systems, community activities, and traditional practices for harvesting, sharing, and processing subsistence resources.

e. Multiple Sales

For multiple sales under the Preferred Alternative, most resources would see increases in effects from increases in development activity although overall effects on terrestrial mammals (other than caribou), freshwater fish, marine fish, most birds, bowhead whales, beluga whales, and other marine mammals are still expected to be local and short term (generally < 1 year) and to have no regional population effects--the same effects levels expected for a single sale. On the other hand, some birds with limited habitat, limited tolerance to disturbance, or declining populations could experience long-term population effects. The TLH would also see population effects and reduced productivity under the multiple sale scenario. Effects on subsistence-harvest practices in the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut would still be expected to be minor. But with increased effects anticipated on TLF caribou, elevated effects would be expected on these communities because this important subsistence resource would become unavailable, undesirable for use, or experience population reductions for a period up to 5 years or longer.

Industrialization clearly displaces subsistence users from traditional use areas even if no legal impediments to access are imposed (NSB, 2003). Therefore, if development occurred in areas containing concentrations of subsistence cabins, camps, and traditional use sites and subsistence resources experienced only minor impacts, subsistence users would be displaced and impacts would be expected to be far greater. The BLM expects its subsistence stipulations to mitigate potential exploration and development conflicts with subsistence cabins, camps, and use sites.

ROP K-5--in providing for multi-year studies of caribou before authorization of development activities in identified TLH insect-relief areas--could help minimize potential effects to the TLH in the northern portion of the Planning Area. Under the Preferred Alternative, lagoons and estuaries along the western coast of the Northwest NPR-A Planning Area--including the proposed Kasegaluk Lagoon Special Area, Peard Bay, and the Kuk River system (Wainwright Inlet)--as well as important terrestrial subsistence harvest areas for the community of

Wainwright would be included in a large deferral area (approximately 17 % of the Planning Area) where leasing would be deferred for 10 years. Not allowing leasing in Kasegaluk Lagoon and deferring leasing for 10 years in the deferral area would reduce any potential disturbance from exploration and development on subsistence practices in harvest areas used by Point Lay and Wainwright subsistence hunters.

f. Conclusion--Multiple Sales

Anticipated subsistence effects could cause chronic disruption of sociocultural systems for a number of years and although traditional practices for the harvesting, sharing, and processing of subsistence resources could be disrupted, subsistence impacts would not be expected to displace existing institutions or ongoing social systems.

The deferral of estuarine areas along the western coast of the Northwest NPR-A Planning Area for the next 10 years--including the proposed Kasegaluk Lagoon Special Area, Peard Bay, and the Kuk River system (Wainwright Inlet)--as well as important terrestrial subsistence harvest areas for the community of Wainwright and Point Lay would further reduce sociocultural effects in these two communities by reducing potential effects to subsistence resources and practices. ROP H-1 provides opportunities for local stakeholder participation in planning and decision-making to prevent unreasonable conflicts between subsistence uses and oil and gas and related activities and ROP H-2, designed to prevent unreasonable conflicts between subsistence activities and geophysical (seismic) exploration would further reduce subsistence conflicts and any consequent sociocultural impacts.

16. Environmental Justice

a. Introduction

Alaska Inupiat Natives, a recognized minority, are the predominant residents of the North Slope Borough, the area potentially most affected by activities in the Northwest NPR-A Planning Area under the Preferred Alternative. Effects on Inupiat Natives could occur because of their reliance on subsistence foods, and potential effects may affect subsistence resources and harvest practices. Potential effects from noise, disturbance, and oil spills on subsistence resources and practices and sociocultural patterns would focus on the Inupiat communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut within the North Slope Borough (NSB). The Environmental Justice Executive Order includes consideration of potential effects to Native subsistence activities. (For a detailed discussion of Environmental Justice effects, see Section IV.C.16 and the cumulative-effects analyses for subsistence-harvest patterns and sociocultural systems in Section IV.F.8.n and Section IV.F.8.o.)

As described in Section 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 5 as having a potentially significant impact on subsistence also would have a significant impact on minorities and low-income populations and communities. Stipulations and other protective measures identified for the Preferred Alternative would help to mitigate impacts on these groups.

b. Demographics

(1) Race

In 1993, the NSB conducted the North Slope Borough Census of Population and Economy. Of the Native population, 97.71% or 4,828 were Inupiat Eskimo. Of the 1998 Native population, 96.83%, or 5,285, were Inupiat Eskimo. For the Borough as a whole in 1993, the population was 74% Inupiat and 26.1% non-Inupiat; in 1998, the population was 72.24% Inupiat and 27.76% non-Inupiat (NSB, 1995, 1999). The 2000 Census counted 7,385 persons resident in the North Slope Borough; 5,050 identified themselves as American Indian and Alaska Native for a 68.4% indigenous population (U.S. Bureau of the Census, Census 2000).

In the potentially affected communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut, there are no significant "other minorities." In Point Lay "other minorities" composed 2.8% of a total population of 246 in 1998, in Wainwright 1.3% of a total population of 649, in Atqasuk 3.4% of a total population of 224 in 1998, and in Nuiqsut 1.4% of a total population of 420. In Barrow in 1998, "other minorities" constituted 16.8% of the total population of 4,641, but the Inupiat minority population is the only minority population allowed to conduct subsistence hunts for marine mammals. "Other minorities" are not allowed to participate in the subsistence marine mammal hunt and they do not constitute a potentially affected minority population (NSB, 1999). With the Borough's homogenous Inupiat population it is not possible to identify a "reference" or "control" group within the potentially affected geographic area to determine if the Inupiat are affected disproportionately. This is because a non-minority group does not exist in a geographically dispersed pattern along the potentially affected area of the North Slope (See Section IV.C.16).

(2) Income

According to the U.S. Department of Commerce, the average household income in 1993 for the State of Alaska was $64,652, and the average State per capita income was $23,000. The Borough figures determined an average household income of $54,645 and a per capita income of $15,218 in 1993. When figured for ethnicity, the average Inupiat household income was $44,551 compared with $74,448 for non-Inupiat. The average Inupiat per capita income was $10,765 and the non-Inupiat per capita income was $29,525. Of all the households in the North Slope Borough that were surveyed, 23% qualified as very low-income households and another 10% qualified as low-to-moderate-income households. Because 66% of the total households surveyed was Inupiat, it would appear that a large portion of those households falling into the very low- to low-income range is Inupiat. Poverty-level families in the NSB numbered 88, or 6% of all households. Poverty level thresholds used by the NSB were based on the U.S. Bureau of the Census, March 1996 Current Population Survey; low income is defined by the U.S. Census Bureau as 125% of poverty level (NSB, 1995; NSB, 1999).

The *North Slope Borough 1998/99 Economic Profile and Census Report* showed household income increasing from $54, 645 in 1993 to $63,884 in 1998. The average Inupiat household income increased by an average of $11,685, from $44,551 to $56,236. The average Inupiat per capita income rose from $10,765 in 1993 to $12,550 in 1998. One hundred five households qualified as poverty level and 37 qualified as very low income. This translates into a total of 381 individuals living below the poverty level--an increase of 12 individuals since 1993 (North Slope Borough, 1999). The 2000 Census found an average per capita income of $20,540 and a median household income of $63,173. The 2000 census found 132 Families (8.6% of a total 1,538 NSB families) in poverty status in 1999 (397 individuals 18 years and older) (U.S. Bureau of the Census, Census 2000) (See Section IV.C.16).

c. Consumption of Fish and Game

As defined by the NSB Municipal Code, subsistence is "an activity performed in support of the basic beliefs and nutritional needs of the residents of the borough and includes hunting, whaling, fishing, trapping, camping, food gathering, and other traditional and cultural activities" (ADNR, 1997). This definition gives only a glimpse of the importance of the practice of the subsistence way of life in Inupiat culture, but it does underscore that it is a primary cultural and nutritional activity upon which Alaska Native residents of the North Slope depend. For a more complete discussion of subsistence and its cultural and nutritional importance, see Section III.C.3, Subsistence-Harvest Patterns. For statements of the traditional importance of subsistence practices, see Inupiat Traditional Knowledge Commentary in Section IV.C.13, Effects on Subsistence-Harvest Patterns, and Section IV.C.14, Effects on Sociocultural Systems. See also the Cumulative Effects and the Affected Environment sections for these resources for more traditional knowledge.

Potential effects focus on the Inupiat communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut within the NSB. The sociocultural and subsistence activities of these Native communities could be affected by disturbance to key subsistence species that leads to disruption, displacement, or long-term changes in species' populations. Communities could be affected by accidental oil spills, as well. Possible oil-spill contamination of subsistence foods is the main concern regarding potential effects on Native health (See Section IV.C.16).

d. Effectiveness of Stipulations and Required Operating Procedures

In general, the stipulations and ROP's articulate minimum protection against impeding subsistence pursuits as set down in ANILCA (P.L. 96-487) and protection of subsistence pursuits helps to guard against potential sociocultural disruptions that then fall under the purview of environmental justice. Stipulations E-1 and E-3 would protect subsistence use and access to traditional hunting and fishing areas. ROP E-5 addresses impacts of the development footprint so as to minimize environmental, economic, and social impacts and ROP E-7addresses the disruption of caribou movement by requiring pipelines and roads to be designed to allow the free movement of caribou and the safe and unimpeded passage of subsistence hunters. ROP E-12 would require ecological mapping of wildlife habitat before development of permanent facilities in order to conserve important habitat types during development. ROP F-1 would minimize the effects of low-flying aircraft on wildlife, traditional subsistence activities and local communities. ROP H-1 is subsistence-specific mitigation designed to provide opportunities for participation in planning and decision-making to prevent unreasonable conflicts between subsistence uses and oil and gas and related activities. ROP H-2 is further subsistence-specific mitigation designed to prevent unreasonable conflicts between subsistence activities and geophysical (seismic) exploration. This ROP would provide for additional consultation requirements for geophysical exploration beyond those required in ROP H-1. ROP I-1 would require the lessee to provide a cultural orientation program for all oil and gas workers involved in NPR-A activities in order to minimize cultural and resource conflicts with local inhabitants. See Section Section IV.C.16 for a detailed discussion of Environmental Justice in-place mitigation and on-going mitigation initiatives and an in-depth discussion of the consultation process (See also Section IV.E on Government-to-Government consultation).

e. In-Place Mitigation and On-Going Mitigation Initiatives

See Section IV.C.16.e for a detailed discussion of Environmental Justice in-place mitigation and on-going mitigation initiatives and an in-depth discussion of the consultation process (See also Section VI.E Government-to-Government consultation).

In evaluating potential sociocultural impacts, BLM has produced a substantial Environmental Justice analysis for Alaska as it relates to the Native Alaskan subsistence way of life. An Environmental Justice analysis was also prepared for the Northeast NPR-A IAP/EIS. It has also sought the expertise of Minerals Management Service

social scientists who have written Environmental Justice analyses for MMS Lease Sales 144 and 170, the Liberty Project EIS, and the Beaufort Sea and Cook Inlet Multiple Sale DEIS's.

The Northeast NPR-A IAP established procedures and advisory bodies to address subsistence and research inventory and monitoring concerns. Stipulation 61 delineated a conflict avoidance procedure to address subsistence concerns with oil and gas exploration and development activities. Through it, lessees consult with the NSB, affected communities, and the Subsistence Advisory Panel, a special body created in 1998 to represent subsistence issues. Under the existing IAP for the Northeast NPR-A, representatives from Federal, State, and NSB agencies, oil industry, environmental groups, academia, and other interested parties have been invited to participate on a research and Monitoring team. This team, chartered under the Federal Advisory Committee Act, has been set up to coordinate research and monitoring projects related to the effectiveness of stipulations and surface resource impacts and seeks the advice of the Subsistence Advisory Panel.

Stipulation 59 directs industry to prepare subsistence plans that specify plans for monitoring the effects of oil industry drilling on subsistence activities (specifically Nuiqsut for drilling activities in the Northeast NPR-A). To date Phillips Alaska, BP, and Anandarko have prepared these plans and they have been accepted by the BLM. Plans require the lessee to hire local Subsistence Representatives (SR's) as points of contact with potentially affected villages. These SR's field local subsistence issues that arise from oil activities and communicate them to the lessee who resolves them. More complicated issues may involve monitoring and the lessee is tasked with establishing a monitoring plan that is approved by the BLM, the Subsistence Advisory Panel, the local and tribal governments, and the NSB Planning Commission. The Lessee also conducts public community meetings to field developing subsistence issues. Subsistence issues and other SR business is tracked by the SR in a log book. This log book is used to generate biannual reports that summarize issues gathered from individuals and public meetings and their resolutions, any required monitoring efforts and results, any lessons learned and steps taken to prevent future subsistence conflicts, and any ongoing and unresolved issues. No formal biannual reports have been prepared, but Phillips Alaska circulated an informal memorandum in March 2002 that identified its Nuiqsut SR's, their activities working at the Nanuq drilling site and as ice road monitors, permitting progress for the Puviag project, community meetings conducted, and the desire to publish a newsletter summarizing winter drilling activities.

The BLM has also fostered tribal government participation in the EIS planning process through the formation of the Subsistence Advisory Panel. The panel is made up of representatives from the communities of Anaktuvuk Pass, Atqasuk, Barrow, Nuiqsut, and Wainwright, as well as BLM decision-makers, and a representative from the North Slope Borough. Since its inception, the panel has met ten times in Barrow, Nuiqsut, and Wainwright and has developed an ongoing dialogue on the issues that will serve to guide the BLM in its decision-making on future exploration and development activities in the NPR-A Northwest area. In Nuiqsut, the oil industry, in coordination with the local community, has established and partially funded a Subsistence Oversight Panel to field the concerns of local subsistence hunters and to monitor local subsistence resources.

f. Benefits of the Preferred Alternative

For the development scenario for the Preferred Alternative, the revenue to the NSB would be about $30 million in the first year of production, tapering to $3 million in the latter years. This revenue is based on the Federal royalty rate of 16.67 percent. 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. The affected local government is assumed to be the NSB and local North Slope communities.

Under the NPR-A leasing program, the BLM refunds a portion of the received lease fees to the State of Alaska. These funds are for the purpose of granting funds to communities that have experienced adverse effects from oil development. Local North Slope communities applied for and received a total of $28 million in grants from NE NPR-A leasing in 1999. Atqasuk received 2 grants totaling $199,000, Barrow received 4 grants totaling

$3,280,000, Nuiqsut received 8 grants totaling $8,896,200, and the NSB received 10 grants totaling $15,624,800. Much of the award to the NSB went toward surveying fish resources, monitoring caribou, performing waterfowl surveys, and subsistence harvest research monitoring. The NE NPR-A Resale in June 2002 made another $33,000,000 available for community grants (See Section IV.C.16).

The NSB received almost $2 million from the State under the federally funded Coastal Impact Assistance Program. Industry local hire initiatives are increasing in terms of the variety of programs being offered to train and attract Inupiat workers for long-term employment on the North Slope. BLM cannot require local hire, but BLM and other Federal Agencies can inform the operator of Native concerns for more local employment from nearby oil and gas developments.

g. Conclusion -- First Sale

(1) Effects on Subsistence Species and Subsistence-Harvest Patterns

The overall effects of oil and gas activities under the Preferred Alternative on subsistence resources and harvest patterns are expected to be the same or less than those under Alternative A. If a field is developed in critical Teshekpuk Lake caribou herd (TLH) insect-relief areas, movements of caribou from coastal insect-relief areas to foraging areas would be adversely affected by pipelines and road corridors, and caribou movements within insect-relief areas may be disrupted with unknown levels of effects on the productivity of the herd.

Subsistence-harvest patterns effects are expected to be the same or somewhat less than those under Alternative A, with subsistence resources being periodically affected but no resource becoming unavailable, undesirable for use, or experiencing overall population reductions. Even with one fewer field being developed under the Preferred Alternative, moderate to high effects could still be expected on the productivity of TLH if development takes place in critical insect-relief areas. If the latter occurred, effects on subsistence-harvest patterns would elevate from low effects to moderate or high effects as one or more important subsistence resources would become unavailable, undesirable for use, or experience reduced availability for a period greater than 2 years. ROP K-5, which provides for multi-year studies of caribou before authorization of development activities in identified TLH insect-relief areas, could help minimize potential effects to the TLH in the northern portion of the planning area.

Industrialization clearly displaces subsistence users from traditional use areas even if no legal impediments to access are imposed (NSB, 2003). Therefore, if development occurred in areas containing concentrations of subsistence cabins, camps, and traditional use sites and subsistence resources experienced only minor impacts, subsistence users would be displaced and impacts would be expected to be far greater. The BLM expects its subsistence stipulations to mitigate potential exploration and development conflicts with subsistence cabins, camps, and use sites.

(2) Effects on Subsistence Communities

Effects to the communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut from impacts to subsistence resources and subsistence-harvest patterns from ground-impacting activities, small oil spills, and exploration and development are expected to be minor, with subsistence resources being periodically affected but no resource becoming unavailable, undesirable for use, or experiencing overall population reductions. Low to moderate effects on species of waterfowl and shorebirds with declining populations could be expected, and moderate to high effects could be expected on the productivity of TLH if development takes place in critical insect-relief areas. If the latter occurred, effects on subsistence-harvest patterns would elevate from low effects to moderate or high effects as one or more important subsistence resources would become unavailable, undesirable for use, or

experience population reductions for a period greater than 2 years.

(3) Effects on Sociocultural Systems

Effects would be the same or slightly reduced from Alternative A.As most subsistence resources are expected to experience local, short-term impacts with no resources becoming unavailable, undesirable for use, or experiencing overall population reductions, effects on subsistence harvest practices in the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut would experience minor effects as well. But if development took place in critical insect-relief areas of the TLH, effects on subsistence-harvest patterns and on communities would elevate from low effects to moderate or high effects as one or more important subsistence resources would become unavailable, undesirable for use, or experience population reductions for a period greater than 2 years.

Effects on the sociocultural systems of the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut could come from disturbance from oil exploration and development activities, from changes in population and employment, and from periodic interference with subsistence-harvest patterns from oil spills and oil-spill cleanup. Altogether, subsistence effects periodically could disrupt but not displace ongoing social systems, community activities, and traditional practices for harvesting, sharing, and processing subsistence resources.

(4) Effects on Environmental Justice

The Environmental Justice E.O. includes consideration of potential effects to Native subsistence activities. The BLM's analysis indicates that the only substantial source of potential environmental justice related effects from the NW NPR-A Planning Area development under the Preferred Alternative to the Native villages would occur from long-term population and productivity effects to the Teshekpuk Lake caribou herd if development occurred in critical insect-relief areas. Disproportionate, high adverse effects would be experienced by Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut, communities which all harvest caribou from the Teshekpuk Lake herd.

ROP K-5, which provides for multi-year studies of caribou before authorization of development activities in identified TLH insect-relief areas, could help minimize potential effects to the TLH in the northern portion of the planning area. The deferral of estuarine areas along the western coast of the Northwest NPR-A Planning Area for the next 10 years, including the proposed Kasegaluk Lagoon Special Area, Peard Bay, and the Kuk River system (Wainwright Inlet), as well as important terrestrial subsistence harvest areas for the community of Wainwright and Point Lay would further reduce sociocultural effects and ensuing environmental justice effects in these two communities by reducing potential effects to subsistence resources and practices. ROP H-1 that provides opportunities for local stakeholder participation in planning and decision-making to prevent unreasonable conflicts between subsistence uses and oil and gas and related activities and ROP H-2 designed to prevent unreasonable conflicts between subsistence activities and geophysical (seismic) exploration would both serve to further reduce subsistence conflicts and any consequent sociocultural and environmental justice impacts.

h. Multiple Sales

(1) Subsistence Resources and Harvest Patterns

For the multiple sales under the Preferred Alternative, most resources would see increases in effects due to increases in development activity although overall effects on terrestrial mammals (other than caribou), freshwater fish, marine fish, most birds, bowhead whales, beluga whales, and other marine mammals are still expected to be local and short term (generally < 1 year), and to have no regional population effects—the same effects levels expected for a single sale. On the other hand, some birds with limited habitat, limited tolerance to disturbance, or declining populations could experience long-term population effects. The TLH would also see population effects and reduced productivity under the multiple sale scenario and there would be a small increase in potential noise and disturbance effects on marine mammals expected along the coast, primarily in the Dease Inlet-Barrow area. Lease Stipulation K-3 could help minimize potential effects to these resources and to subsistence practices.

Industrialization clearly displaces subsistence users from traditional use areas even if no legal impediments to access are imposed (NSB, 2003). Therefore, if development occurred in areas containing concentrations of subsistence cabins, camps, and traditional use sites and subsistence resources experienced only minor impacts, subsistence users would be displaced and impacts would be expected to be far greater. The BLM expects its subsistence stipulations to mitigate potential exploration and development conflicts with subsistence cabins, camps, and use sites.

Effects to subsistence harvest practices in the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut would still be expected to be minor, as well. But with more development taking place and with a potential southern pipeline route to TAPS Pump Station 2 being constructed, some disruption of CAH caribou during migration would be expected. A second gas pipeline from the southern part of the planning area would be constructed to Prudhoe Bay. An increase in the number or miles of roads and pipelines with development under multiple sales is expected to further impede movements of TLH caribou to insect-relief areas along the coast. This effect is expected to persist over the life of the project and may reduce productivity of the TLH. This level of effect on caribou would elevate expected effects on community subsistence-harvest patterns to high or very high effects as one or more important subsistence resources would become unavailable, undesirable for use, or experience population reductions for a period up to 5 years or longer. ROP K-5, that would provide for multi-year studies of caribou prior to authorization of development activities in identified TLH insect-relief areas, could help minimize potential effects to the TLH in the northern portion of the planning area. Under the Preferred Alternative, lagoons and estuaries along the western coast of the Northwest NPR-A Planning Area, including the proposed Kasegaluk Lagoon Special Area, Peard Bay, and the Kuk River system (Wainwright Inlet), as well as important terrestrial subsistence harvest areas for the community of Wainwright would be included in a large deferral area (approximately 17% of the Planning Area) where leasing would be deferred for 10 years. Deferring leasing in the deferral area would reduce for 10 years any potential disturbance from exploration and development on subsistence practices in the areas used by Point Lay and Wainright hunters.

(2) Sociocultural Systems

For the multiple sales under the Preferred Alternative, most subsistence resources would see increases in effects from increases in development activity although overall effects on most resources are still expected to be local and short term (generally < 1 year), and to have no regional population effects. These are the same effects levels expected for a single sale. The TLH would also see population effects and reduced productivity under the multiple sale scenario. Effects to subsistence harvest practices in the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut would still be expected to be minor, as well. But with increased effects anticipated on TLH caribou, elevated effects would be expected on these communities because this important subsistence resource would become unavailable, undesirable for use, or experience population reductions for a period up to 5 years or longer.

Industrialization clearly displaces subsistence users from traditional use areas even if no legal impediments to access are imposed (NSB, 2003). Therefore, if development occurred in areas containing concentrations of subsistence cabins, camps, and traditional use sites and subsistence resources experienced only minor impacts,

subsistence users would be displaced and impacts would be expected to be far greater. The BLM expects its subsistence stipulations to mitigate potential exploration and development conflicts with subsistence cabins, camps, and use sites.

ROP K-5, that provides for multi-year studies of caribou prior to authorization of development activities in identified TLH insect-relief areas, could help minimize potential effects to the TLH in the northern portion of the Planning Area.

(3) Environmental Justice

The Environmental Justice Executive Order (E.O.) includes consideration of potential effects to Native subsistence activities. Our analysis indicates that the only substantial source of potential environmental justice related effects from the Northwest NPR-A Planning Area development under the Preferred Alternative to the Native villages would occur from long-term population and productivity effects to the Teshekpuk Lake caribou herd from development in critical insect-relief areas.

i. Conclusion -- Multiple Sales

(1) Effects on Subsistence Resources and Harvest Patterns

For the multiple sales under the Preferred Alternative, most resources would see increases in effects from increases in development activity although overall effects on terrestrial mammals (other than caribou), freshwater fish, marine fish, most birds, bowhead whales, beluga whales, and other marine mammals are still expected to be local and short term (generally < 1 year), and to have no regional population effects. These are the same effects levels expected for a single sale. The TLH would also see population effects and reduced productivity under the multiple sale scenario. Effects to subsistence harvest practices in the communities of Point Lay, Wainwright, Atqasuk, Barrow, and Nuiqsut would still be expected to be minor, as well. But if caribou experienced these population effects, elevate effects on community subsistence-harvest patterns would increase to high or very high effects, as one or more important subsistence resources would become unavailable, undesirable for use, or experience population reductions for a period up to 5 years or longer.

ROP K-5, that provides for multi-year studies of caribou prior to authorization of development activities in identified TLH insect-relief areas, could help minimize potential effects to the TLH in the northern portion of the Planning Area.

(2) Effects on Sociocultural Systems

Anticipated subsistence effects could cause chronic disruption of sociocultural systems for a number of years and although traditional practices for the harvesting, sharing, and processing of subsistence resources could be disrupted, subsistence impacts would not be expected to displace existing institutions or ongoing social systems.

The deferral of estuarine areas along the western coast of the Northwest NPR-A Planning Area for the next 10 years, including the proposed Kasegaluk Lagoon Special Area, Peard Bay, and the Kuk River system (Wainwright Inlet), as well as important terrestrial subsistence harvest areas for the community of Wainwright

and Point Lay would further reduce sociocultural effects in these two communities by reducing potential effects to subsistence resources and practices. ROP H-1 that provides opportunities for local stakeholder participation in planning and decision-making to prevent unreasonable conflicts between subsistence uses and oil and gas and related activities and ROP H-2 designed to prevent unreasonable conflicts between subsistence activities and geophysical (seismic) exploration would both serve to further reduce subsistence conflicts and any consequent sociocultural impacts.

(3) Effects on Environmental Justice

The Environmental Justice E.O. includes consideration of potential effects to Native subsistence activities. The BLM's analysis indicates that the only substantial source of potential environmental justice related effects from the Northwest NPR-A Planning Area development under the Preferred Alternative to the Native villages would occur from long-term population and productivity effects to the Teshekpuk Lake caribou herd from development in critical insect-relief areas. Disproportionate, high adverse effects would be experienced by Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut, communities which all harvest caribou from the Teshekpuk Lake herd.

ROP K-5, which provides for multi-year studies of caribou before authorization of development activities in identified TLH insect-relief areas, could help minimize potential effects to the TLH in the northern portion of the Planning Area. The deferral of estuarine areas along the western coast of the Northwest NPR-A Planning Area for the next 10 years, including the proposed Kasegaluk Lagoon Special Area, Peard Bay, and the Kuk River system (Wainwright Inlet), as well as important terrestrial subsistence harvest areas for the community of Wainwright and Point Lay would further reduce sociocultural effects and ensuing environmental justice effects in these two communities by reducing potential effects to subsistence resources and practices. ROP H-1 that provides opportunities for local stakeholder participation in planning and decision-making to prevent unreasonable conflicts between subsistence uses and oil and gas and related activities and ROP H-2 designed to prevent unreasonable conflicts between subsistence activities and geophysical (seismic) exploration would both serve to further reduce subsistence conflicts and any consequent sociocultural and environmental justice impacts.

17. Coastal Zone Management

a. Effects of Non-Oil and Gas Activities

The ground-impacting management actions for non-oil and gas activities are associated with:

- aircraft use to transport personnel, supplies, and equipment for fieldwork and to fly aerial surveys;
- excavation and collection of archaeological, paleontological, geological, and soil samples;
- ground activities associated with aircraft use and camps for field survey and recreational activities;
- hazardous- and solid-material removal and remediation;
- overland moves of equipment and supplies and seismic activities; and
- recreational activities.

Subsistence uses of the coastal resources in the NPR-A continue to be a very high priority for the Inupiat, given cultural and historic patterns of existence within NPR-A. Permitted uses are guided by specific ROP's. The Preferred Alternative would designate the Planning Area as Limited for recreational use of off-highway vehicles (OHV's). OHV use would be limited to winter use of snow machines and other low-ground-pressure vehicles.

Within NPR-A, no summer recreational use of OHV's would be permitted. The summer use of OHV's, including all-terrain vehicles and airboats, to support traditional subsistence activities and access would be allowed. The use of airboats during summer would be limited to streams, lakes, and estuaries that are seasonably accessible by motorboat. Airboat use in areas of seasonal flooding of tundra and temporary shallow waters adjacent to streams, lakes and estuaries would be prohibited to prevent impacts to soils, water quality, vegetation, and wildlife (in particular nesting fowl).

The analysis of effects of non-oil and gas activities in Section V.B.14 Subsistence-Harvest Patterns indicates that disturbance reactions of terrestrial mammals are expected to be brief, lasting for a few minutes to less than 1 hour. Current management practices and stipulations attached to land-use authorizations for temporary facilities, overland moves, and recreation permits would be expected to mitigate impacts to terrestrial mammals. Effects on marine mammals, including bowhead whales and beluga whales are likely to be negligible.

It is expected that non-oil and gas activities under the Preferred Alternative would proceed consistent with the ACMP and the NSB CMP. If specific proposals have reasonably foreseeable effects on any coastal use or resource of the coastal zone, the proposed activities would be subject to a consistency review before approval by BLM.

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

In the following analysis, policies of the NSB CMP are assessed in conjunction with the most closely associated statewide standard.

(a) Coastal Development (6 AAC 80.040)

This standard gives priority to uses and activities in coastal areas that are water-dependent. The intent of this policy is to ensure that onshore development and activities that can be placed inland do not displace activities dependent upon shoreline locations, including marine, lake, and river waterfronts. Activities and uses that are neither water dependent nor water related would be given priority if there is no feasible or prudent alternative to meet the public need.

NSB CMP Policy 2.4.4(i) requires causeways to be sited and designed to allow free passage of fish, marine mammals, and molting birds. Several Best Effort Policies in NSB CMP 2.4.5 address development policies that must be complied with unless there is a significant public need for the proposed use and activity and the development has rigorously explored and objectively evaluated all feasible and prudent alternatives to the proposed use or activity and cannot comply with the policies. NSB CMP Policies for Minimization of Negative Impacts include NSB CMP 2.4.6(b) , which requires that the siting, design, construction, and maintenance of transportation and utility facilities (including ice roads) minimize alteration of shorelines, water courses, wetlands, and tidal marshes.

The area identified as the Kasegaluk Lagoon Deferral Area would not be offered for leasing or petroleum exploration for 10 years under the Preferred Alternative. Stipulation K-3 would allow development in Dease Inlet, Admiralty Bay, and Elson Lagoon only under very strict criteria and consultation requirements. Permanent facilities would be prohibited within ¾ mi of the shoreline, with the exception of linear features such as pipelines. These provisions, with the added protections of the additional Stipulations and ROP's, would contribute to operations that are consistent with the ACMP and the NSB CMP, as applicable.

Setback restrictions would provide no-development buffers along major rivers, deep lakes, and most shorelines.

(b) 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 could occur. Development in these areas would be 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 would be considered during the course of review and approval of specific plans. 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 19.70.050L.3). The use of BLM's current management practices and site-specific requirements would address these concerns at the time specific proposals are submitted for review and approval.

It is anticipated that activities associated with oil and gas exploration and development would be able to proceed in compliance with this policy.

(c) 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 and increasing public access to coastal waters.

The NSB has identified many areas within NPR-A as high recreational use areas. The BLM issues Special Recreation Permits (SRP's) to commercial recreation operators such as hunting and float-trip guides, with most activity along the Colville River and southern foothills. Oil and gas exploration activities could result in short-term impacts as a result of temporary on-site location of structures with related noise from generators, vehicles, aircraft, etc., and human presence. These impacts would be greatest within a 2-mi radius of a drill site and result in temporary loss of solitude, naturalness, or primitive/unconfined recreation in the immediate vicinity.

Development impacts would be most intense around the facilities during construction. With the cessation of construction and closure of material sites, the remaining structures, human presence, and associated activity and noise would still have impacts on solitude, naturalness, or primitive/unconfined recreations. Pipelines and pump

stations would also impact recreational values. Pipelines would be elevated about 7 ft and, except during construction and repair, there would be no ground activity. Long-term impacts from pipelines are expected to be minimal. In the unlikely event of a large oil spill that reaches a river and moves rapidly downstream, a high short-term impact would be expected. Fishing, boating, camping, scenic values, and other recreational pursuits would be impacted if the spill occurred in a riverine environment used by recreationists. Short-term effects would be oil residues in areas of use. Long-term effects would possibly be the loss of fishing and diminished scenic values of the area.

ROP's A-4(b, c, and d) and A-5 under Waste Prevention, Handling, and Disposal and Spills would greatly increase the protection of wilderness and recreation resources. These ROP's would help reduce, if not eliminate, the possibilities of large fuel spills. These ROP's would not unduly restrict recreationists from using the Planning Area's resources and would adequately protect the resources from being impacted. In addition, ROP's A-2(a and b), dealing with the handling of garbage, would help protect the area's recreation/wilderness resources. Other ROP's that would benefit the recreation resources are C-1(b) and C-2(a) for wilderness only and A-1, A-4(e), C-2(b-e), C-4, and F-1(a, b, e, and f).

BLM-permitted activities having reasonably foreseeable effects on any coastal use or resource of the coastal zone would be reviewed for consistency at the time the activity is proposed. It is expected that with the requirements of the ROP's and any additional conditions that may be applied at the time permits are requested, oil and gas activities could proceed within the parameters of this policy.

(d) 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. These criteria are listed in Section III.C.6.b.1 . 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).

The ROP's related to facility design and construction address concerns related to this standard. Stipulation E-2 would require demonstration that impacts to fish, water quality, and aquatic and riparian habitats would be minimal prior to approving the design and location of permanent oil and gas facilities within 500 ft of fish-bearing, or 100 ft of non-fish-bearing water bodies. Stipulation E-3 would prohibit causeways and docks in river mouths or deltas. Artificial gravel islands and bottom-founded structures would be prohibited in river mouths or active stream channels on river deltas. All of these must be designed to ensure free passage of marine and anadromous fish and to prevent significant changes to nearshore oceanographic circulation patterns and water quality characteristics. A monitoring program is required to address the objectives of water quality and free passage of fish.

ROP E-5 would require development footprints be minimized to the extent practicable. ROP E-7 would minimize disruption of caribou movement and subsistence use along pipelines and roads. ROP E-12 would require the use of ecological mapping as a tool to assess wildlife habitat before development of permanent facilities to conserve important habitat types.

In addition, activities that have reasonably foreseeable effects on any coastal use or resource of the coastal zone would require a consistency review by the State and the NSB to determine whether the proposal meets the requirements of this State standard and related NSB enforceable policies.

(e) Transportation and Utilities (6 AAC 80.080)

This 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 policies related to transportation. All but two of the policies are "best-effort policies." NSB CMP Policy 2.4.4.(h) requires offshore oil transport systems (e.g., pipelines) be specially designed to withstand geophysical hazards, specifically sea ice. NSB CMP Policy 2.4.4.(i) requires causeways to be sited and designed to allow free passage of fish, marine mammals, and molting birds; to prevent changes in water circulation patterns and to ensure adequate sediment transport.

ROP E-6 would require water crossings be designed and constructed to ensure free passage of fish, maintenance of natural drainage, and minimal adverse effects to natural stream flow. Additional protective measures include ROP E-1 and Stipulations E-2 and E-3. These measures would require minimal environmental impacts: protection of fish-bearing water bodies, water quality and aquatic habitats, and maintenance of free passage of fish.

No specific transportation or utility routes have been proposed. Proposals that are presented for BLM approval would be reviewed for consistency if they have reasonably foreseeable effects on the coastal uses and resources of the coastal zone.

(f) 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 docks, pads, roadbeds, berms and causeways 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. Sand and gravel may be extracted from coastal waters, intertidal areas, barrier islands, and spits when no feasible and prudent non-coastal alternative is available to meet the public need. NSB CMP 2.4.5.1.(j) prohibits substantial alternation of shoreline dynamics. If gravel is not obtained from inland sites, constraints may be placed on extraction activities to lessen environmental degradation of coastal lands and waters, and to ensure floodplain integrity (NSB CMP 2.4.5.2.(a) and (d).

Gravel mine site design and reclamation must be in accordance with a plan approved by the Authorized Officer (AO) and would be conducted in accordance with existing regulations and BLM management practices. ROP E-8 would require the plan consider locations outside the active flood plain, design and construction of gravel mine sites within active floodplains to serve as water reservoirs for future use, and potential use of sites for enhancing fish and wildlife habitat.

Applicability of these policies and standards would be determined on a case-by-case basis as proposals are presented to BLM for approval.

(g) Subsistence (6 AAC 80.120)

The statewide standard for subsistence guarantees opportunities for subsistence use of coastal areas and resources. Subsistence use of coastal resources and maintenance of the subsistence way of life are primary concerns of the residents of the NSB. The NSB CMP Policy 2.4.3.(d) requires that development not preclude reasonable subsistence user access to a subsistence resource. Development that would cause access to be reduced or restricted can occur only if no feasible or prudent alternative is available, and then it is subject to the conditions of the best effort policies.

Several NSB CMP policies address adverse effects on subsistence resources. The NSB CMP Policy 2.4.3.(a) related 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) addresses "development that likely will result in significantly decreased productivity of subsistence resources or their ecosystems." Such development would not be allowed unless the requirements of the best effort policies are met: there is a significant public need for the proposed use and activity and the development has rigorously explored and objectively evaluated all feasible and prudent alternatives to the proposed use or activity and cannot comply with the policy.

Section V.B.14, Subsistence-Harvest Patterns, analyzes the potential for impacts to subsistence activities and resources. Evidence of the extent of the protections and restrictions developed to provide increased protection to the varied number of subsistence resources and subsistence-harvest patterns is provided in the discussion in Section V.B.14.c, Effectiveness of Stipulations and Required Operating Procedures.

The use of these stipulations and ROP's and any other conditions that may be required as a condition of permit approval would provide protection against impeding subsistence pursuits.

Projects presented to BLM for approval would be reviewed for their potential to have reasonably foreseeable effects on any coastal uses or resources. If applicable, the proposals would be subjected to an ACMP consistency review.

(h) Habitats (6 AAC 80.130)

Part (a) of the statewide Habitats standard lists 8 types of habitat that are subject to the ACMP, including 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. Part (b) of the standard requires that these 8 habitats be managed to maintain or enhance the biological, physical, and chemical characteristics of the habitat. Part (c) provides management guidance for the first 7 of the habitats. Part (d) includes a provision to allow uses and activities to occur that do not conform to parts (b) and (c) of the standard if: (1) there is significant public need; (2) there are no feasible and prudent alternatives; and (3) all feasible and prudent steps to maximize conformance with the standard have been taken.

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]). 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]).

Much of the uplands in the NSB is 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]). 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.

The potential for impacts to habitats important to fish resources, birds, and mammals are analyzed in Section V.B.8, Section V.B.9, and Section V.B.10 , respectively. The discussions in paragraph "c. Effectiveness of Stipulations and Required Operating Procedures" in each of these sections provides evidence of the extent of the protections and restrictions developed to provide increased protection to habitats used by these species.

Gravel extraction from or near freshwater and anadromous/amphidromous fish over-wintering and spawning habitat is likely to adversely affect arctic fish by reducing the amount and quality of habitat available to them. However, gravel extraction also has potential for habitat creation and enhancement. Water withdrawals in lakes could cause adverse effects on habitats, but limits on withdrawal and monitoring water quality would minimize impacts. The proposed mitigation addresses water withdrawal in rivers and lakes and gravel extraction.

Marine fishes and their habitat may be affected by impact-producing factors such as seismic surveys, coastal construction and development and marine vessel traffic. It is also possible that some species may benefit from the impact-producing factors. Site-specific/activity-specific prohibitions and restrictions would be provided to protect marine fishes and their habitat, including seasonal restrictions and clearly defined setbacks.

For birds, habitat eliminated by gravel mines, pads, roads, and airstrips is likely to represent a negligible loss. The elimination of leasing in Kasegaluk Lagoon Special Area reduces potential risk to several species of birds. In addition, leasing in the western portion of the Planning Area would be deferred for 10 years, delaying potential impacts for at least this period. Several ROP's and one stipulation are specifically applicable to protection of birds. The stipulation would require lessees to minimize disturbance and loss or alteration of habitat near brant colonies and brood-rearing areas determined by aerial survey.

Terrestrial mammal habitat alteration may be brought about by the development of oil fields, an elevated pipeline, and buried pipeline. Near the oil fields, surface, air, and foot traffic is expected to displace some terrestrial mammals. Some caribou are expected to be disturbed; however, effects would be minimized by locating and designing oil and gas facilities to allow for free movement of caribou. Within a "Caribou Study Area" a study of caribou movements would be undertaken before facility development to assist in reducing impact on caribou movements. The NSB CMP policy 2.4.6.(e) emphasizes this practice and provides a set of guidelines and an intent statement for implementation of this policy. There is no inherent conflict between the crossing requirements and the assumed activities.

Several species of marine mammals occur year round or seasonally in coastal habitats within or adjacent to the Planning Area. Important spotted seal and beluga whale habitats such as Kasegaluk Lagoon and Peard Bay would be deferred from oil and gas leasing for 10 years under this alternative. No permanent or temporary facilities would be allowed within ½ mi of the bank of the Kuk River estuary, an important habitat of beluga whales. The effects of the Preferred Alternative on marine mammals are expected to be short term, with no significant adverse effects on populations.

The use of stipulations and ROP's and any other conditions that may be required for permit approval would provide protection against serious long-term loss of habitat.

Projects presented to BLM for approval would be reviewed for their potential to have reasonably foreseeable effects on any coastal uses or resources (including habitats). If applicable, the proposals would be subjected to an ACMP consistency review.

(i) 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 accidental 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. Effects of oil spills are discussed in "(2) Effects of Spills" of this section.

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." Discharges of muds, cuttings, and drilling fluids are closely regulated. Eight ROP's included under the category A. Waste Prevention, Handling, Disposal, Spills and Public Safety are included as part of the Preferred Alternative. Except as specifically provided BLM would require compliance with EPA, ADEC, and AOGCC regulations and procedures. 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. If muds and cuttings were to be stored on the surface, sediments and other contaminants could be flushed into the watershed. The potential for this is reduced by requiring that wastes be stored in lined and bermed areas and disposed of before spring breakup. Oil spill contingency plans are required, and refueling operations are prohibited within 500 ft of the active floodplain of any fish-bearing water body and 100 ft from non-fish-bearing water bodies. Surface discharge of reserve pits is prohibited unless authorized by applicable NPDES, ADEC, and NSB permits (as appropriate) and approved by the Authorized Officer.

The ROP E-8 is designed to minimize impacts on air, land, and water resources by placing restriction on gravel site mine design and reclamation. Stipulation D-1 would prohibit exploratory drilling in rivers and streams, as determined by the active floodplain, and fish-bearing lakes, except where the lessee can demonstrate that impacts would be minimal or it is determined that there is no feasible or prudent alternative. Stipulation E-2 would place restriction on the design and location of permanent oil and gas facilities to protect water quality. Stipulation G-1 would require that upon abandonment or expiration of the lease, all oil- and gas-related facilities would be removed and sites rehabilitated to as near the original condition as practicable unless the Authorized Officer determines it is in the best interest of the public to retain some or all facilities.

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) that requires "industrial and commercial development be served by solid waste disposal facilities which meet State and Federal regulations." Air quality also must conform to 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 V.B.6 indicates that conformance is anticipated, and that no conflict between air quality and coastal policies should occur.

As site-specific proposals are presented to BLM for approval, they would be reviewed for reasonably foreseeable effects on the coastal zone and its uses and resources. If applicable, they would be required to undergo a consistency review as required by the Federal CZMA and Alaska's CMP.

(j) Statewide Historic, Prehistoric, and Archaeological Resources (6 AAC 80.150)

The 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 has developed additional policies to ensure protection of its heritage. The NSB CMP 2.4.3.(e) states 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 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 clearly establish what is required.

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 sites.

The analysis in Section V.B.2 states that paleontological resources are not ubiquitous in the Planning Area and it is quite possible that oil and gas activities would have no impact on these resources simply because those activities would occur where paleontological resources are not present. In addition, most activities would occur during the winter months and the impact to any buried paleontological resources would be low. The likelihood of impacting surface paleontological materials is also low because of their isolated and rare occurrence and because of guidance governing oil and gas exploration activities in the areas they are most likely to occur.

Section V.B.13 is a discussion of the cultural resources of the area and the potential for impacts as a result of activities described in the scenarios. Seismic data gathering activity is permitted only during winter using low-ground-pressure vehicles and there is little chance that significant impacts to below-ground cultural resources could occur. Impact to surface cultural resources could occur from passage of seismic vehicles under certain circumstances. In most cases, surface cultural resources, usually structures of some type, can be visually detected and subsequently avoided, even when snow covered. Surface cultural resources that are not structures are not easily detectable, but given the nature, are usually sufficiently protected from impacts by snow cover and frozen vegetation. The exception to this is human skeletal remains that may lie on the surface. Cultural resources are not ubiquitous in the Planning Area as are wildlife and habitat. Although cultural resources, because of their near-surface and surface contexts are more common than paleontological deposits, generally they are more easily recognized and therefore avoided. In most cases, oil and gas activities could be conducted to avoid the locations of cultural resources.

Several Stipulations and ROP's address protection of these resources as discussed in Section V.B.2.c and Section V.B.13.c. ROP C-2 would provide protection from seismic and overland moves. The ½-, ¾-, and 1-mi setbacks along major rivers and streams and the ¾-mi setback along the coast would provide additional protection. The National Historic Preservation Act requires that an archaeological resource survey be completed before any undertaking occurs on federal lands. If resources are identified, BLM guidelines and policy require that all impacts to these resources be mitigated to the satisfaction of the land manager and the State Historic Preservation Office. Additionally, any post-lease activity requiring a BLM permit engaged in by a lessee would require an action/site-specific NEPA document. In that event, the protection of cultural resources in the Planning Area would follow the established and proven permitting procedures developed by the BLM as a result of past NPR-A activities.

It is expected that oil and gas activities associated with the Preferred Alternative can be conducted in compliance with this standard and the NSB policies. At the time specific plans are submitted for approval by the BLM, activities that may have reasonably foreseeable effects on any coastal use or resource would be subject to consistency review.

(2) Effects of Spills

The likelihood of a future spill would be greatest for small spills, such as fuel spills. The oil spill analysis in Section IV.A.2 includes a discussion of small spills of crude or refined oil from facilities and pipelines both onshore and offshore. Under the Preferred Alternative, 112 small crude oil spills (averaging 3 bbl) and 194 small, refined oil spills (averaging 29 gallons) are hypothesized for analytical purposes. The ROP A-3 would require development and implementation of hazardous-materials contingency plans before transportation, storage, or use of fuel or hazardous substances. In addition, ROP A-4 would require development of a comprehensive spill prevention and response contingency plan. The ROP A-5 addresses requirements for refueling to minimize the impact of contaminants on fish, wildlife and the environment, ROP A-6 addresses minimization of impacts from contaminants associated with exploratory drilling, and ROP A-7 would require specific procedures for the disposal of produced fluids. Stipulation D-1 would protect fish-bearing rivers, streams, and lakes from blowouts, and ROP E-4 would minimize the potential for pipeline leaks.

An estimated 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 a pad. For the exploration stage, 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 effects of spills and spill cleanup associated with development would be similar to those associated with exploration except that they could occur during snow-free months. Cleanup from these spills might be more invasive because of the non-frozen surface environment. The analysis for small spills assumes that most spills are contained or cleaned up. The effects of such spills are expected to be minor and, given the mitigating measures addressing prevention and response assumed for Alternative A, no conflicts with any of the statewide standards or district enforceable policies are anticipated.

A large spill would have greater impacts on subsistence resources, habitats, and land and water quality than the small spills analyzed in this IAP/EIS. Winter is the predominant activity season in the Planning Area, making the unlikely event of an accidental large spill even more unlikely to occur during the summer months. If a spill occurs during the winter months, cleanup efforts would be conducted during the winter months and would be less likely to impact the resources or uses of the coastal zone. However, even if a large spill were to occur during the summer months, it is not anticipated that any species would become unavailable or unharvestable as a result of such a spill. While localized availability and harvestablility could be impacted, it is expected that subsistence activities would continue outside the localized spill area. Habitats would also be impacted locally if a spill were to occur during summer months or breakup. Water quality in the area of the spill could be compromised but the effect would be short term.

The oil spill analysis in Section IV.A.2.a addresses large spills and states that the most likely number of large spills ($\geq$ 500 bbl) is 0. The analysis of effects on coastal zone management is based on reasonably foreseeable effects. A large spill would be an accidental and unlikely event, and the limited analysis of effects on coastal management reflects those conclusions.

c. Effectiveness of Stipulations and Required Operating Procedures

Mitigating measures are assumed to be in place for this analysis. Stipulations and ROP's are grouped into 10

categories (Section II.C.6):

- Waste Prevention, Handling, Disposal, Spills and Public Safety
- Water Use for Permitted Activities
- Winter Overland Moves and Seismic Work
- Oil and Gas Exploratory Drilling
- Facility Design and Construction
- Use of Aircraft for Permitted Activities
- Oil Field Abandonment
- Subsistence Consultation for Permitted Activities
- Orientation Programs Associated with Permitted Activities
- Area Specific

All of these require specific actions or restriction of actions that advance the likelihood of activities being conducted consistent with the ACMP statewide standards and enforceable policies of the district program. Energy facilities (6 AAC 80.070) are addressed in several of the ROP's under the heading of Facility Design and Construction. These procedures address concerns related to this statewide standard and related district policies. The statewide standard for subsistence (6 AAC 80.120) and related district policies are specifically addressed in the stipulation and ROP's under Subsistence Consultation for Permitted Activities. However, all of the stipulations and ROP's applicable to the Preferred Alternative would result in increased protection of subsistence species, maintaining their availability for subsistence uses, and reducing conflicts with subsistence activities. Similarly, several of the measures address concerns related to the statewide standard for "Habitats" (6 AAC 80.130). Specifically, the measures provided for Ice Roads and Water Use, Overland Moves and Seismic Work, and Facility Design and Construction would result in enhanced habitat protection. The statewide standard on Air, Land, and Water Quality (6 AAC 80.140) and related district policies are also addressed in several of the categories. ROP A-3 would address compliance with EPA, ADEC, and AOGCC regulations and procedures related to discharges and water quality. The remaining ROP's under this category relate to solid and liquid waste handling and hazardous material disposal and cleanup. All of these would provide protections to the quality of the air, land, and water in and adjacent to the Planning Area.

d. Conclusion--First Sale

There are no inherent conflicts between exploration and development activities envisioned under the Preferred Alternative and the statewide standards and enforceable policies of the NSB CMP. With mitigating measures and regulatory oversight, it should be possible to comply with all of the standards and policies relevant to oil and gas activities that have reasonably foreseeable effects on the coastal resources or uses of the coastal zone. Applicable policies can be more precisely addressed when specific proposals are brought forward by lessees. All plans that may have reasonably foreseeable effects must be accompanied by a consistency certification for State review and concurrence. No permit would be issued for activities having reasonably foreseeable effects unless the State concurs or the Secretary of Commerce overrides the State's objection. The proposal being analyzed at this time includes oil and gas lease sales. This proposal, does not conflict with the standards of the ACMP or the enforceable policies of the NSB CMP. As specific proposals for ground activities are presented, they would be subjected to further analysis. Consistency certifications would be required for activities determined to have foreseeable effects on any coastal use or resource.

e. Multiple Sales

Although the duration and extent of activities would increase, the type of activities would remain the same. The number, duration, and extent of activities does not change the applicability of the relevant policies of the ACMP and the district program--they remain the same regardless of the number of sales held. Applicable policies would

be addressed at the time each proposal is submitted to BLM for approval. No permit would be issued for activities having reasonably foreseeable effects on coastal uses or resources of the coastal zone unless the State concurs or the Secretary of Commerce overrides the State's objection.

f. Conclusion--Multiple Sales

The potential for conflict with the statewide standards of the ACMP and the enforceable policies of the NSB CMP is the same as for a single sale. No conflicts are anticipated.

18. Recreation Resources and Wilderness

a. Effects of Non-Oil and Gas Activities

The BLM issues Special Recreation Permits (SRP's) to commercial recreation operators such as hunting and float-trip guides, most of whom focus their activity along the Colville River and southern foothills. The BLM estimates that 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 (since the Colville River is outside the Planning Area). Up to two permittees, accounting for up to four parties of four persons each, may conduct trips in the Arctic Plain and Foothills of the Planning Area. This use would be during the summer to enjoy the scenic, wildlife, and paleontological resources of the area. 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 on floats taking hunters or sightseers to lakes within the Planning Area. These flights may result in camping similar to that of fly camps or backpack camps.

Floating parties along the Colville would carry enough fuel for a small stove and their boat engines. They would camp for no more than one 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 the Preferred Alternative, most impacts to recreation resources would result from activities such as archaeological collection efforts, field camps, survey work, and overland moves. Between June and September, two camps doing 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 solitude, naturalness, or primitive/unconfined recreation. These adverse, short-term impacts would be confined primarily to the activity site (camp) view shed (i.e., approximately ½ mi in any direction from the site). Therefore, each site (camp) area would impact (on a short term basis) approximately 500 acres of land. Under the Preferred Alternative, the impacts are not expected to affect more than approximately 1,000 acres at a time (two camps @ 500 ac/camp). A longer lasting impact from overland moves would be from "green trails," which are discussed under Visual Resources (Section IV.B.20).

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

(a) Exploration

Under the Preferred Alternative, seismic survey work would continue and increase from one operation (as under the No Action Alternative) to two seismic operations. This includes both 2-D and 3-D operations. Assuming two crews working per season, ongoing seismic operations are expected to affect no more than 1,000 acres (2 crews @ 500 acres impacted/crew) at a time or, about 500 acres more than the non–oil and gas activities. Linear green trails (see Visual Resources, Section V.B.20) resulting from these operations would increase in direct relationship to increased seismic operations.

A total of 7 wells (5 exploration wells and 2 delineation wells) are projected under the $18/bbl oil scenario; the projected number of exploration/delineation wells increases to 30 wells (12 exploration wells and 18 delineation wells) under the $30/bbl oil scenario. Because of the limited number of drill rigs available, no more than one rig is available with oil at $18/bbl and no more than four are available with oil at $30/bbl. Drilling would occur over several winter seasons using ice pads, roads, and airstrips. Temporary on-site location of structures (i.e., drilling rigs); noise from generators, vehicles, aircraft, etc.; human presence and associated activity--all would have adverse, short-term impacts on solitude, naturalness, or primitive/unconfined recreation during the winter season. These impacts are expected to be greatest within a 2-mi radius of a drill site, an area of approximately 8,000 acres per well site. Accordingly, under this alternative, there would be a temporary loss of solitude, naturalness, or primitive/unconfined recreation over an area of approximately 56,000 acres (7 wells @ 8,000 acres/well) assuming oil at $18/bbl and this would jump to 240,000 acres with oil at $30/bbl.

In addition to the short-term impacts that would result from exploratory drilling operations, summer season visual impacts to the area's naturalness would result from the greening of vegetation under vacated ice pads, airstrips, and roads (see Visual Resources, Section V.B.20).

Exploration wells also would leave behind a marker pipe expected to be no larger than one square foot on the surface and 6 ft tall. This is essentially a permanent impact but almost unnoticeable from several hundred feet away.

(b) Development

The following discussion assumes oil prices up to $30/bbl and gas prices up to $4.27/Mcf (2002$). Under such price scenarios, up to 6 production pads, a pump station, 205 mi of pipeline, and 2 staging areas could be constructed. Impacts would be the most intense at and around development and production facilities during construction. With the cessation of construction and closure of material sites, the remaining structures, human presence, and associated activity and noise would still have adverse impacts on solitude, naturalness, or primitive/unconfined recreation. Because production could occur for 30 years, these impacts would be long term. These long-term, adverse impacts are expected to be greatest within 2 mi of production or staging sites (an area of about 8,000 acres per site). Additionally, pipelines and associated facilities would impact recreation values. Pipelines would be elevated about 7 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. This equates to about 640 acres per mile of pipeline. The long-term loss of solitude, naturalness, or primitive/unconfined recreation from all of these development aspects together would impact an area of up to approximately 203,200 acres ([8,000 acres/pad x 6 pads] + [8,000 acres/staging area x 2 staging areas] + [8,000 acres/pump station] + [640 acres/mi x 205 mi of pipeline]).

(2) Effects of Spills

Most spills (65 to 80%) would 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.

A large spill that reaches a river and moves rapidly downstream would have disastrous short-term (and possibly long-term) impacts on recreation values. Fishing, boating, camping, scenic values, and other recreation pursuits would be severely impacted as a result of an oil spill in a riverine environment that is used by recreationists. The obvious short-term effects would be the oil residues in areas of use. The long-term effects would possibly be the loss of fishing, and diminished scenic value of the area, as oil residue may take a long time to dissolve and vanish.

(3) Impacts to Wilderness Values

Impacts to wilderness values of naturalness and outstanding opportunities for primitive recreation or solitude would be as described above and in the Visual Resources section (Sec. IV.C.20). Under the Preferred Alternative, no areas would be protected by Wilderness designation.

c. Effectiveness of Stipulations and Required Operating Procedures

ROP A-4 (b, c, and d) and A-5 under Waste Prevention, Handling, and Disposal and Spills would greatly increase the protection of wilderness and recreation resources. These ROP's would help reduce, if not eliminate, the possibilities of larger fuel spills in pristine areas, or areas that can ill afford any type of fuel spill. These two ROP's would not unduly restrict recreationists from using the area's resources for their endeavors and yet would adequately protect these resources from being impacted from fuel spills. In addition to the above, ROP's A-2 (a, b), dealing with the handling of garbage, would help protect the area's recreation/wilderness resources as well as the users.

Other ROP's that would benefit the recreation/wilderness resources and users of the area are ROP's C-2 (a), for wilderness only and ROP's A-1, A-4 (e), and C-2 (b-e), C-3 and C-4 (for both recreation and wilderness) and F-1 (a, b, e, and f) for wilderness values only.

d. Conclusion--First Sale

Under the Preferred Alternative, there would be an increase of approximately 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 drilling activities would impact 56,000 acres (at $18/bbl of oil) and 240,000 acres (at $30/bbl of oil).

Oil and gas development would result in the long-term loss of solitude, naturalness, or primitive/unconfined recreation over very few acres with oil at $18/bbl, however, if oil should go to $30/bbl, the long-term loss would

be an area of approximately 203,200 acres (or 2.2% of the Planning Area) for the life of pipelines and production fields.

e. Multiple Sales

It is projected that additional lease sales under the Preferred Alternative would result in additional 0 to 4 oil/gas fields developed; exploratory well numbers would increase, as would delineation wells. An additional 480 mi of pipeline in and east of the Planning Area to the Kuparuk oil field is also projected. Total pipeline mileage for new oil, gas, and service lines could reach 685 mi, of which 340 mi would be new oil and gas pipelines in the Northwest NPR-A (Table IV-29).

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 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. At $18/bbl for oil, there would be no production pads, no pipeline miles, and no staging areas and therefore, no real facility increase over that needed for a single sale. However, if oil were to reach $30/bbl, the affected area would total up to approximately 273,600 acres ([8,000 x 6 pads] + [8,000 x 1 staging area] + [640 acres x 340 mi of new oil and gas pipeline]). Some of the pipeline would be outside the Planning Area. The length of pipeline within the Planning Area is projected to be 340 mi; the length outside the Planning Area is projected to be 345 mi (Table IV-29).

f. Conclusion--Multiple Sales

Long-term impacts for multiple sales would be about the same as those of the first sale. Should oil sell for $30/bbl (2002$), long-term impacts would increase about 41 percent over those for the first sale, affecting a total of 494,400 acres. Approximately 273,600 acres would be within the Planning Area, about 3.4 percent of the Planning Area.

Restricting activities such as exploratory oil and gas operations and overland moves to winter months would considerably reduce impacts to recreation values. Few recreationists visit the area during winter months. On a relative scale, few recreationists visit the area summer or winter.

19. Wild and Scenic Rivers

Under the Preferred Alternative, no rivers would be found to be suitable for inclusion in the National Wild and Scenic Rivers System, although 22 rivers were identified as eligible. Other methods of river protection were chosen, as shown in Table V-01, and stipulations were crafted to protect key river values.

a. Effects of Non-Oil and Gas Activities

The effects of non-oil and gas activities on outstandingly remarkable river values--including subsistence resources

and use, fisheries, wildlife, and cultural resources--are described elsewhere in this section. The infrastructure and economic development in the area and local communities are expected to lead to some additional vehicular use for non-oil and gas activities, which might lead to some additional erosion of stream banks, particularly at subsistence use sites. More subsistence cabins are also expected. But some decline is expected in the time spent on subsistence activities if significant numbers of local residents obtain employment under this alternative.

The Avak, Tunalik, Nokotkek, and Ongoravik rivers in the Kasegaluk Lagoon area are currently not noticeably impacted by non-oil and gas activities although they are used for subsistence, and this situation is likely to continue because of the distance from local communities and difficulties of access.

Much of the area would be classified as "limited" or "closed" to off-highway vehicle use. OHV use would be expected to expand as vehicular technology improves and more cash comes into the economy, so limits on their use would mitigate potential negative impacts on river values including fish, wildlife, cultural, and fossil resources.

The Colville River riparian area is managed by the State of Alaska and the ASRC. These entities could authorize improvements such as airstrips, lodges, cabin sites, or storage facilities in the riparian area that would impact the scenic quality and primitive roadless nature of the river.

Under this alternative, the impacts of non-oil and gas activities to river values, including outstandingly remarkable values as well as water quality and free flow would be minimal, similar to those identified under the No Action Alternative.

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

The effects of seismic activity on outstandingly remarkable river values--including subsistence resources and use, fisheries, wildlife, and cultural resources--are described elsewhere in this section, as are the effects of seismic activity on water quality and instream flow.

The effects of disturbances related to oil and gas development on river values would be minimal, largely because of the deferral area, river buffer areas where facilities are prohibited, and the stipulations that limit disturbances along many rivers, lakes, and coastal areas. Perhaps the most critical stipulation is the prohibition of winter water withdrawals from streams. The exception to these statements of course, is the Colville, where BLM does not have management authority.

(2) Effects of Spills

The effects of spills under the Preferred Alternative on water quality, subsistence, fish, and wildlife values are described elsewhere in this chapter.

c. Effectiveness of Stipulations and Required Operating Procedures

Stipulations and required operating procedures A-1, A-2, A-3, A-4, A-5, A-6, A-7, B-1, C-2, C-3, C-4, D-1, E-1, E-2, E-3, E-4, E-6, E-8, H-1, H-2, and I-1 all limit the impacts that oil and gas exploration and development would have on river values. Without these stipulations, greater impacts from spills, damage to stream banks at river crossings, reductions in water quality, reductions in critical flows, obstruction to fish passage, loss of critical winter habitat, and declines in outstandingly remarkable values for fish, wildlife, and subsistence use would be expected.

ROP B-1 is essential for preserving instream flows in eligible rivers, and in protecting over-wintering habitat for fish.

The stipulations taken together contribute to the conclusions regarding the minimal anticipated impacts of development on fish, wildlife, and instream flows. This is a strong package of stipulations and ROP's, although there is still some risk to riparian areas and water quality because of unavoidably subjective language and the provision for exceptions to be granted.

d. Conclusion--First Sale

Under the Preferred Alternative, the impacts of the first sale on wild and scenic river values would be limited in scope. Impacts are expected to be minimized by the deferral area, coastal area, river buffers, and stipulations and ROP's that protect stream banks, and limit potential withdrawals of water. The Colville River would likely see the greatest negative impact to river values because it is not under BLM management, and would likely be crossed by access trails, ice roads, and pipelines. The Avak, Tunalik, Nokotkek, and Ongoravik rivers in the Kasegaluk Lagoon area are currently not impacted by oil and gas activities, and this situation is likely to continue because of low potential for development.

e. Multiple Sales

Multiple sales would have little additional impact on river values.

f. Conclusion--Multiple Sales

Multiple sales would have little additional impact on river values.

20. Visual Resources

Under the Preferred Alternative, the Colville River area would be designated Visual Resource Management (VRM) Class I to continue with the assigned class along the upper part of the river, i.e., upstream of Umiat (*Northeast National Petroleum Reserve-Alaska Integrated Activity Plan/Environmental Impact Statement* Record of Decision). The other 21 rivers identified as eligible for designation as Wild and Scenic Rivers and identified estuarine areas would be designated VRM Class III (Map 23). These two VRM classes extend 3 mi from the banks of all identified water bodies. The rest of the Planning Area would be designated VRM Class IV. Implementation of VRM prescriptions would take place in individual environmental analysis of each proposed

activity.

a. Effects of Non-Oil and Gas Activities

Most impacts to visual resources would result from summer on-the-ground management activities such as aircraft landings and fuel caches; wildlife surveys; cultural and paleontological surveys with possible excavation activities; field camps; hazardous and solid material removal and remediation activities with possible gravel pads and roads; and in the winter, overland moves using OHV's. Between 20 and 60 overland moves may occur during a single season.

Temporary structures (e.g., sleds, tents), vehicles (e.g., rolligons, tractors), aircraft, human presence, and associated activities would have some minimal short-term impact on visual resources or scenic quality. These adverse, short-term impacts would be confined primarily to the activity site viewshed (approximately ½ mi in any direction from the site) and are expected to affect no more than approximately 500 acres in any one season. The number of camps would be 2 per season; however, only 1 camp would be operating at a time.

A longer lasting impact would be "green trails" resulting from winter overland moves. Green trails are created by vehicles compacting snow and dead vegetative material 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 the overland move, but where they do occur, they can be very detectable from the air for 2 to 5 years, and in some cases longer. They are usually difficult to recognize from the ground. Another impact along these trails that has occurred in the past is vegetation actually being damaged or the tops of tussocks being scraped off. Current operating procedures make this an infrequent problem but one that can occur in conjunction with overland moves. Because overland moves are a relative constant year to year and generally follow the same route(s), approximately 100 mi of intermittent green trails would be visible from the air during any one summer season.

b. Effects of Oil and Gas Activities

(1) Effects of Disturbances

Under this alternative, seismic-survey work would continue with two operations each winter season. This work would occur in winter using cat trains with low-ground-pressure 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 and associated activities would result in a short-term adverse impact on visual resources or scenic quality of the area. These impacts would be confined primarily to the activity-site viewshed, or approximately ½ mi in any direction. Assuming two seismic 2-D or 3-D operations per season, seismic operations are expected to affect 1,000 acres annually.

A longer lasting impact would be "green trails" resulting from winter overland moves. Green trails are created by vehicles compacting snow and dead vegetative material 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 the overland move, but where they do occur, they can be very detectable from the air for 2 to 5 years, and in some cases longer. They are usually difficult to recognize from the ground. Another impact along these trails that has occurred in the past is vegetation actually being damaged or the tops of tussocks being scraped off. Current operating procedures make this an infrequent problem but one that can occur in conjunction with overland moves. Approximately 200 mi of intermittent green trails from seismic activities would be visible

from the air during any one summer season.

For the first sale, between 7 and 30 exploration or delineation wells are anticipated under this alternative. However, because of the limited number of drill rigs available, no more than three wells would be anticipated to be drilled at any one time. These impacts would be expected to be greatest within a ½- to 3-mi radius of each drill site--an area of approximately 4,000 acres per well site. Accordingly, under the first sale in this alternative, there would be a temporary loss of visual quality over an area of approximately 12,000 acres.

In addition to the short-term impacts that would 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. There is also a "ring effect" around ice pads, airstrips, and roads, where vegetation dies adjacent to these snow and ice structures. Assuming approximately 50 acres of ice pads, airstrips, and roads per drill site, as many as 1,500 acres (30 vacated sites x 50 acres per site) would be in various states of recovery from greening and ring effects.

Exploration wells also would 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.

Under the first sale,a total of as many as 6 production pads and 205 mi of pipeline would be anticipated under this alternative. Although with the cessation of construction activities and closure of material sites, the intensity likely would be reduced from the development phase to the production phase, remaining structures, and associated activities would have adverse impacts on visual quality. Because production could occur for 30 years, impacts would be long term. These long-term, adverse impacts are expected to be greatest within ½ to 3 mi of the pad sites (an area of about 4,000 acres per site). Pipelines would be expected to be elevated about 7 ft but could be placed up to 20 ft above ground level. Except during construction and repair, there would be no associated on-the-ground activity. Therefore, long-term impacts to visual resources from pipelines are expected to be minimal beyond about ½ mi. This equates to about 640 acres per mile of pipeline. Under this alternative, production pads would impact up to 24,000 acres while pipelines would impact up to 131,200 acres.

Under this alternative, 1 to 2 staging bases and one pumping station are also expected. Adverse impacts to visual resource values would be similar to those resulting from a production pad and its facilities, or about 4,000 acres per staging base. Accordingly, under this alternative, there would be long-term loss of visual resources over an area of approximately 4,000 to 8,000 acres from the staging bases and approximately 3,500 acres from the pumping station.

(2) Effects of Spills

Most spills (65 to 80%) would be confined to a pad. Spills not confined to a pad usually are confined to the limited area immediately around the pad or pipeline. Therefore, impacts on visual resources resulting from spills likely would be confined to the same area described above under development activities.

c. Effectiveness of Stipulations and Required Operating Procedures

The Colville River area would be designated Visual Resource Management (VRM) Class I under this alternative

(Map 23). As Class I, the level of change to the landscape should be very low and must not attract attention. This class provides for the natural ecological changes; however, it does not preclude very limited management activities. The objective is to preserve the existing character of the landscape. The other 21 rivers identified as eligible for designation as Wild and Scenic Rivers and identified estuarine areas would be designated VRM Class III (Map 23). As Class III, the level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the landscape. The rest of the Planning Area would be designated VRM Class IV. As Class IV, the level of change to the characteristic landscape can be moderate. Management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements found in the predominant natural features of the landscape.

d. Conclusion--First Sale

As compared with the No Action Alternative, there would not be an increase in adverse, short-term impacts to visual resources from activities other than oil and gas exploration and development.

Short-term impacts from ongoing seismic activities would impact approximately 1,000 acres. The greening and ring effect of vegetation resulting from ice pads, roads, airstrips and compacted snow would impact up to 1,500 acres. Short-term impacts from exploratory drilling would encompass approximately 12,000 acres.

Oil and gas development would result in the long-term loss of visual resources of approximately 166,700 acres (or 2% of the Planning Area) for the life of production fields and pipelines.

e. Multiple Sales

For multiple sales, between 21 to 72 exploration and delineation wells are anticipated under this alternative. However, because of the limited number of drill rigs available, no more than three wells would 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, bermed drill materials, equipment, and housing); vehicles, aircraft, human presence and associated activities would have adverse, short-term impacts on visual quality during the winter season. These impacts would be expected to be greatest within ½ mi radius of each drill site (50 acres)--a total area of approximately 4,000 acres impacted per well site. Accordingly, under this alternative, there would be a temporary loss of visual quality over an area of approximately 12,000 acres for the 3 wells being drilled at any one time.

In addition to the short-term impacts that would result from ongoing exploratory drilling operations, summer season visual concern would exist as a result of the greening of vegetation under vacated ice pads, airstrips, and roads (as described above). There is also a "ring effect" around ice pads, airstrips, and roads, where vegetation dies adjacent to these snow and ice structures. Assuming approximately 50 acres of ice pads, airstrips, and roads per drill site, as many as 3,600 acres (72 vacated sites x 50 acres per site) would be in various states of recovery from greening and ring effects.

Exploration wells also would 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 away.

Under multiple sales, a total of as many as 12 production pads and 685 mi of pipeline would be 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 and associated activities would have adverse impacts on visual quality. Because production could last for 30 years, impacts would be long term. These long-term, adverse impacts would be expected to be greatest within ½ mi of the pad sites (about 4,000 acres for each pad site). Pipelines would be expected to be elevated about 7 ft but could be placed up to 20 ft above ground level. Except during construction and repair, there would be no associated on-the-ground activity. Therefore, long-term impacts to visual resources from pipelines would be expected to be minimal beyond about ½ mi. This equates to about 640 acres/mi of pipeline. Under this alternative, production pads would impact up to 48,000 acres while pipelines would impact up to 438,400 acres.

Under this alternative, three staging bases and one pumping station would be expected to be built. Adverse impacts to visual resource values would be similar to those resulting from a production pad and its facilities about 4,000 acres per staging base. Accordingly, under this alternative, there would be long-term loss of visual resources over an area of approximately 12,000 acres for the staging bases and approximately 3,500 acres from the pumping station.

f. Conclusion--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, 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 that such facilities would be necessary to support exploration and production. It is anticipated that such facilities would impact about 6 percent of the Planning Area and would affect a total of approximately 505,500 acres.

21. Overview of Effects on Wetlands and Floodplains

In compliance with Executive Order 11990, Protection of Wetlands and Floodplains, the BLM has prepared a comprehensive impact analyses on those areas within Northwest NPR-A Planning Area that are considered to have the function and value of wetlands as described in Section III.B.2. Resources included in the overview discussion below would be classified as having the function and value of wetlands and floodplains on the Arctic North Slope.

Vegetation (Section V.B.7)

Effects of First Sale: Impacts from activities other than oil exploration and development would involve disturbance or destructive impacts to a small fraction of the Planning Area, and overall impacts would be minor to negligible.

Impacts from oil exploration would include vegetation disturbance on 22,500 to 366,000 acres per year from 2-D and 3-D seismic surveys over the entire exploration period (10 years). About 25 percent of the disturbance would be at a medium to high level, and, after 9 years, recovery would be about 90 percent. Ice road construction would have impacts on < 420 acres per year, and ice pads on < 170 acres. Exploration activities would cause permanent, minor vegetation destruction and alteration from the construction of exploration well cellars.

The combined effect of development activities, such as the construction of gravel pads, roads, airstrips, pipelines,

one pump station, and the excavation of material sites, would cause the destruction of vegetation on < 650 acres and the alteration in plant species composition on < 1,915 acres, affecting a total of over < 2,565 acres. These impacts would be permanent assuming that gravel pads would remain after production ends although some plant species would be able to grow on the pads (McKendrick, 2000).

Effects of Multiple Sales: Impacts from oil exploration would include about double the vegetation disturbance from seismic work expected for a single-sale. However, 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 visible disturbance. Exploration activities also would cause < 0.03 acres of permanent vegetation destruction around well cellars and alteration of < 1,940 acres per year around and under ice pads and roads.

Development activities would also impact vegetation, and the combined effect of exploration and development activities over all lease sales would cause the destruction of vegetation on < 1,260 acres and the alteration in plant species composition on < 4,050 acres, for a total of < 5,310 acres. These impacts would be permanent, assuming that the gravel pads would remain after oil production ends; recovery, thus, would be moot. Impacted areas (3,920 acres) represent about 0.04 percent of the total land cover, and, as such, they would not be likely to adversely affect any plant species or community. If a development facility were to be placed over a rare plant population, the effects on that taxon could be severe. However, careful siting of facilities after site-specific environmental analysis is expected to avoid and protect rare plant species. Oil spills would affect <8.6 acres.

Soils (Section V.B.1)

Effects of First Sale: Soil stability depends closely on vegetative cover; where vegetation is disturbed, impacts on soils follow. Impacts from activities other than oil exploration and development would be minor to negligible. Impacts from winter exploration and well drilling would be expected to be minor to negligible. Development would cause loss or disturbance of up to 600 acres of soils. The duration of these impacts would be permanent. Oil spills would be cleaned up immediately, causing minimal disturbance to soils. Impacts from development activities to soils would be minor to low.

Effects of Multiple Sales: Little impact to soils is expected from exploration activities; impacts from development activities would disturb or result in the loss of small- to moderate-sized areas. The overall impact to soils would be negligible (with seismic) to moderate (with development).

Water Resources (Section V.B.3)

Effects of First Sale: Seismic impacts are expected to be minimal. Impacts from oil and gas development activities on the water resources in the Planning Area are from gravel roads, pads, and structures. The potential short-term impacts from exploration and delineation would be water removal from up to 90 lakes, and during construction, increased water impoundments, diversions, thermokarst erosion and sedimentation of up to 2,000 acres. Long-term impacts from development of gravel roads, pads and pits could impact up to 1,000 acres. Overall impacts would be about 3,000 acres of short-term impacts and 1,500 acres of long-term impacts.

Effects of Multiple Sales: Seismic impacts are expected to be minimal. Impacts from oil and gas activities could be several times greater than impacts from a single sale, while indirect impacts might take years to develop. Short-term impacts include water removal of up to 1,800 acre/ft from 180 lakes for exploration and delineation drilling, increased water impoundments, diversions, thermokarst erosion, and sedimentation of up to 4,000 acres for construction activities. Long-term impacts from development of gravel roads, pads, and pits could impact up to 2,000 acres from water impoundments, diversions, and thermokarst erosion. Shared infrastructure could reduce the adverse effects to water resources from multiple sales.

Freshwater Quality (Section V.B.4)

Effects of First Sale: Seismic and exploratory activity would create short-term (usually one season) and localized effects on water quality. Short-term (year-or-more) effects from annual ice-pad and ice-road construction, drilling, and domestic needs for water could require winter extraction of unfrozen water from over 900 acre/ft of nearby lakes. Gravel construction of pads, within-field roads, and field airstrips would cover about 400 acres total for the four fields proposed. Docks or staging areas could cover up to 400 more acres. Gravel construction can result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel. Long-term (decade-or-more) effects from development of gravel roads, pads and pits could occur on nearly 1,000 acres. Oils spills could degrade water quality over the course of a few weeks along a short stretch of nearby rivers and lakes and cause about 6 ponds or small lakes to remain toxic to sensitive species for about 7 years.

Effects of Multiple Sales: Short-term (year-or-more) effects of multiple sales would be similar to those for a single sale. Long-term (decade-or-more) effects of multiple sales are assumed to double over that of a single sale, while indirect impacts may take years to develop. Water quality could be affected on up to 2,000 acres from water impoundments, diversions, and thermokarst erosion, depending on the level of exploration and development activities, and the locations of roads, pipelines, and infrastructure. Oil spills could result in waters of about 8 ponds or small lakes remaining toxic to sensitive species for about 7 years.

Estuarine Water Quality (Section V.B.5)

Effects of First Sale: Discharges of drilling and human waste would be prohibited within NPR-A estuaries; no unregulated discharges of produced water would be allowed; and no adverse effects on kelp or special benthic communities from construction of ice islands or ice roads are expected. The effects of gravel-island construction and buried-pipeline construction would probably be minor and temporary. A short dock or jetty in estuarine waters probably would not affect hydrologic conditions, but a long causeway with inadequate breeches would probably have measurable, long-term impacts. If a 500- or 900-bbl spill occurred during the open water season, formed a slick or become dissolved in the water column, it could contaminate approximately two-thirds of the coastline in an estuary like Admiralty Bay, and the hydrocarbon concentration might exceed the 0.015-ppm chronic criteria for up to 30 days in an area that ranges up to 70 mi^2 (180 km^2). Effects probably would not extend outside the estuaries unless the spill involved fuel at a coastal staging site, such as Cape Simpson. Stipulations G-1 and K-3 might be effective at moderating the effects of long causeways and estuarine spills.

Effects of Multiple Sales: The effects of multiple sales on estuarine water quality would probably be slightly lower than for the first sale because of technological developments in extended-reach drilling.