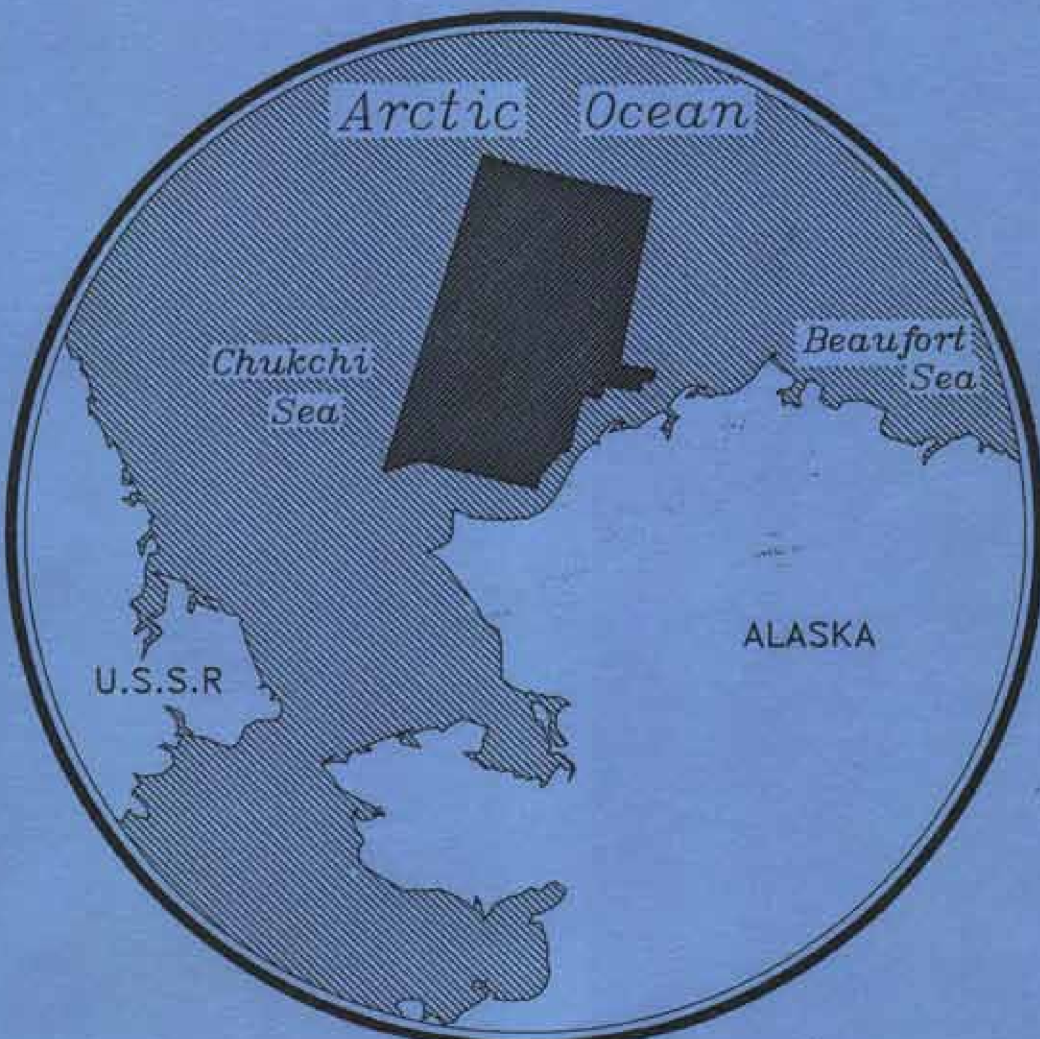
OCS EIS/EA
MMS 90-0095

Alaska Outer Continental Shelf

Chukchi Sea
Oil & Gas Lease Sale 126

Final Environmental Impact Statement

Volume I



U.S. Department of the Interior
MMS Minerals Management Service
Alaska OCS Region

This Environmental Impact Statement (EIS) is not intended, nor should it be used, as a local planning document by potentially affected communities. The exploration, development and production, and transportation scenarios described in this EIS represent best-estimate assumptions that serve as a basis for identifying characteristic activities and any resulting environmental affects. Several years will elapse before enough is known about potential local details of development to permit estimates suitable for local planning. These assumptions do not represent an MMS recommendation, preference, or endorsement of any facility, site, or development plan. Local control of events may be exercised through planning, zoning, land ownership, and applicable State and local laws and regulations.

With reference to the extent of the Federal Government's jurisdiction of the offshore regions, the United States has not yet resolved some of its offshore boundaries with neighboring jurisdictions. For the purposes of the EIS, certain assumptions were made about the extent of areas potentially subject to United States jurisdiction. The offshore boundary lines shown in the figures and graphics of this EIS are for purposes of illustration only; they do not necessarily reflect the position or views of the United States with respect to the location of international boundaries, convention lines, or the offshore boundaries between the United States and the coastal states concerned.

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January 1991

FINAL ENVIRONMENTAL IMPACT STATEMENT

Proposed Outer Continental Shelf
Oil and Gas Lease Sale
Chukchi Sea
Sale 126

Summary Sheet

( ) Draft (X) Final

U.S. Department of the Interior, Minerals Management Service, Alaska OCS Region, 949 East 36th Avenue, Room 110, Anchorage, Alaska 99508-4302.

1. Type of Action: Proposed Oil and Gas Lease Sale 126, Chukchi Sea.

(X) Administrative ( ) Legislative

2. Description of the Action: The leasing proposal (Alternative I) consists of 9.58 million hectares (approximately 23.68 million acres) of Outer Continental Shelf (OCS) lands. The 4,319 blocks in the proposed Sale 126 area encompass a portion of the Chukchi Sea Planning Area and are located in waters that are from about 6.5 to 370 kilometers (3.5-200 miles) offshore in water depths that range from about 30 to 80 meters (98-263 feet). The undiscovered, economically recoverable resources assumed to be leased in the sale area as a result of Sale 126 (base case) are estimated to be 1,610 million barrels (1,610 MMbbl), with a marginal probability of 0.21 for hydrocarbons. Natural gas is presently assumed to be uneconomic (see Appendices A and B). If found, produced gas could be reinjected for pressure-maintenance purposes. This lease sale is tentatively scheduled to be held in late 1991.

3. Environmental Effects: Petroleum-related activities on all blocks offered pose some degree of pollution risk to the environment if leased, explored, and developed. The risk is related to adverse effects on the environment and other resource uses that may result from accidental or chronic oil spills and other operational activities. Socioeconomic effects from onshore development could have regional and local implications. Several alternatives and mitigating measures could be adopted (see Sec. II), which may reduce the type, occurrence, and extent of adverse effects associated with this proposal. In spite of mitigating measures, some effects from oil spills are considered unavoidable. For instance, if oil were discovered and produced, oil spills would be statistically probable and there would be some disturbance to fishery and wildlife resources and associated subsistence use; and some onshore development could occur in undeveloped areas.

4. Alternatives to the Proposed Action:

a. No Lease Sale (Alternative II):

b. Delay the Sale (Alternative III): This alternative would delay the sale for up to a 3-year period.

c. Point Lay Deferral Alternative (Alternative IV): This alternative would modify the proposed action by deferring leasing on 501 blocks (1.15 million hectares) in the southern portion of the sale area near Point Lay. This alternative would offer 3,818 blocks for lease.

5. Other Environmental Impact Statements, OCS Reports, Reference Papers, and Technical Papers: This Environmental Impact Statement (EIS) refers to numerous EIS's, OCS reports, reference papers, and technical papers previously prepared by the Alaska OCS Region. Applicable portions of these documents are referenced in the appropriate discussions throughout this EIS. Copies of referenced documents have been

placed in a number of libraries throughout Alaska and in the Department of the Interior Library in Washington, D.C. Single copies of these publications are available from the Alaska OCS Region Library and the National Technical Information Service.

6. Public Hearings: Public hearings on the Sale 126 DEIS were held in August 1990 in the following Alaska communities--Barrow on August 27, Wainwright on August 28, Point Lay on August 29, and Anchorage on August 31. Oral and written comments were obtained and are responded to in this FEIS.

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Summary of Environmental Impact Statement
for Proposed Chukchi Sea Sale 126

This Environmental Impact Statement (EIS) examines a proposal for oil and gas leasing in the Chukchi Sea, three alternatives to the proposal, the major issues identified through the scoping process, and the potential mitigating measures associated with the proposal.

The proposal (Alternative I) consists of 4,319 blocks (approximately 9.58 million hectares) in the Chukchi Sea that are located about 3.5 to 200 miles (about 6.5 to 370 km) offshore in water depths that range from about 98 to 263 feet (about 30-80 m). Alternative II (No Lease Sale) would cancel the proposed lease sale, scheduled for late 1991. Alternative III (Delay the Sale) would delay the proposed lease sale for a period of up to 3 years. Alternative IV (Point Lay Deferral Alternative) would defer leasing on 501 blocks (about 1.15 million hectares) identified in the proposal, resulting in the deferral alternative being moved offshore from about 25 to 75 miles (40 to 120 km). The Secretary of the Interior will decide which of these options or combination of options will take place.

The potential effects of Alternative I (Proposal) are based on three separate cases that represent a range of possible oil and gas activities resulting from Sale 126. The cases are the low case, base case, and high case. It is assumed that natural gas resources would not be economic to produce and would not be developed (see Appendices A and B).

Low Case: The low case assumes that 430 million barrels (MMbbl) of oil would be discovered but that this volume is below the minimum economic resource required for development. As a result, two exploration wells would be drilled, plugged, and abandoned, with industry activity ceasing at this point. This case represents a minimum amount of petroleum industry activity that could occur in the Sale 126 area. The probability of a major oil spill occurring would be negligible. The only spills estimated to occur would be from minor operational spills. The environmental analysis focuses on the effects associated with exploration activities.

Base Case: The base case represents the most likely amount of hydrocarbon resources that could be assumed to be developed from leasing in the Sale 126 area if commercial quantities of hydrocarbons are discovered. It is assumed that 1,610 MMbbl of oil would be discovered and produced in the sale area. It is assumed that natural gas resources would not be economic and would not be developed. The MMS estimates a 0.21 marginal probability, which means that there is an approximately 21-percent chance of economically recoverable hydrocarbons being present in the unleased sale area. For the base-case-resource estimate, two spills of 1,000 barrels or greater (≥ 1,000 bbl) are estimated to occur over the life of the field, with an 87-percent chance of one or more spills occurring.

For the base case, assuming that commercial quantities of hydrocarbons are present in the area and developed, there is a 1-percent chance that one or more spills of ≥ 1,000 bbl would occur and contact land during the summer within 30 days. There is a 25-percent chance that one or more spills of ≥ 1,000 bbl would occur and contact land during the entire winter. The effects from oil spills would be mitigated by the extent to which weathering of oil occurred at sea and by the effectiveness of any oil-spill-cleanup measures.

The base-case-environmental analysis focuses on oil exploration and development and production activities. The analysis uses a hypothetical transportation scenario in which oil production from offshore-production platforms would be piped ashore near Point Belcher and transported overland by pipeline to connect with the Trans-Alaska Pipeline (TAP) near Pump Station No. 2. The oil would be transported south by TAP to Valdez and shipped to the continental U.S. by tankers.

High Case: The high case represents a maximum resource volume of hydrocarbons likely to be present in commercial quantities. It is assumed that 3,540 MMbbl of oil would be discovered and produced in the sale area. It is also assumed that natural gas resources would not be economic and would not be developed. The marginal probability of hydrocarbons in commercial quantities being present in the sale area is the same as in the base case (0.21). For the high-case-resource estimate, four spills of ≥ 1,000 bbl are estimated to occur over the life of the field. Assuming that commercial quantities of hydrocarbons are present in the area and developed, there is a 1-percent chance that one or more spills of ≥ 1,000 bbl would occur and contact land during summer within 30 days. There is a 46-percent chance that one or more spills of ≥ 1,000 bbl would occur and contact land during the entire winter. The probability of one or more spills of ≥ 1,000 bbl occurring is 99 percent. The degree of adverse effects from oil spills would be mitigated by the extent to which weathering of oil occurred at sea and by the effectiveness of any oil-spill-cleanup measures.

The high-case environmental analysis focuses on exploration and development and production activities. The analysis uses a hypothetical transportation scenario in which oil production from offshore-production platforms would be transported to the TAP in the same manner as in the base case. The oil would be transported south by TAP to Valdez and shipped to the continental U.S. by tankers.

Alternative II (No Lease Sale) would remove the total area proposed for leasing from further consideration. Therefore, effects identified to occur as a result of the proposal would not occur. This alternative could perpetuate the need for imported oil and add to the need for developing alternative-energy resources.

Alternative III (Delay the Sale) would delay the proposed lease sale for a period of up to 3 years. Effects of this alternative would be the same as for Alternative I (the proposal), but they would be delayed up to 3 years.

Alternative IV (Point Lay Deferral Alternative) would defer leasing on 501 blocks (about 1.15 million hectares), resulting in the deferral alternative being moved from about 25 to 75 miles (40 to 120 km) offshore. The purpose of the deferral alternative is to include those marine mammal habitats not deleted from the sale area during Area Identification, provide additional protection for important coastal habitats, and furnish an additional protective buffer for offshore subsistence-harvest areas of the community of Point Lay. In this alternative, it is assumed that 1,610 MMbbl of oil would be discovered and produced in the sale area, the same as in the base case. It is also assumed that natural gas resources would not be economic to produce and would not be developed (see Appendices A and B). The marginal probability of hydrocarbons in commercial quantities being present in the sale area (0.21) is the same as in the base case. The number and probability of oil spills estimated to occur also are the same as in the base case, assuming that commercial quantities of hydrocarbons are present in the area and developed. The degree of adverse effects from oil spills would be mitigated by the extent to which weathering of oil occurred at sea and by the effectiveness of any oil-spill-cleanup measures.

The environmental analysis for the Point Lay Deferral Alternative focuses on the effects associated with exploration and development and production activities. The analysis uses a hypothetical transportation scenario in which oil production from offshore-production platforms would be transported to the TAP in the same manner as in the base case. The oil would be transported south by TAP to Valdez and shipped to the continental U.S. by tankers.

Table S-1 summarizes the possible effects that are likely to occur as a result of the leasing proposal (Alternative I) and the alternatives to the proposal on those resources identified as major concerns during the scoping process (see Table S-2 for the definitions used in assessing effects). The analyses supporting the conclusions in Table S-1 assume that all current laws and regulations are in place for the leasing proposal. If the potential mitigating measures described in Section II.F.2 of this EIS were adopted, some of the effects described in Section IV would be reduced (the effectiveness of potential mitigating measures is discussed in Sec. II.F.2).

This EIS is not intended, nor should it be used, as a local planning document by potentially affected communities. The facility locations and transportation scenario described in this EIS represent assumptions that were made as a basis for identifying characteristic activities and any resulting environmental effects. These assumptions do not represent a Minerals Management Service recommendation, preference, or endorsement of any facility, site, or development plan. Local control of events may be exercised through planning, zoning, land ownership, and applicable State and local laws and regulations.

Table S-1
Summary of Effects[1/] for Alternatives I and IV and the Cumulative Case[2/]
Chukchi Sea Lease Sale 126

Resource Category	Alternative I Low Case	Alternative I Base Case	Alternative I High Case	Alternative IV Point Lay Deferral Alternative	Cumulative Case
1. Air Quality	VERY LOW	VERY LOW	LOW	VERY LOW	LOW
2. Water Quality					
Local	VERY LOW	MODERATE	MODERATE	MODERATE	MODERATE
Regional	VERY LOW	LOW	LOW	LOW	LOW
3. Lower-Trophic-Level Organisms	VERY LOW	LOW	LOW	VERY LOW	LOW
4. Fishes (except Pacific Salmon)					
Marine Habitats	VERY LOW	VERY LOW	LOW	VERY LOW	LOW
Freshwater Habitats		VERY HIGH	VERY HIGH	VERY HIGH	VERY HIGH
Pacific Salmon					LOW
5. Marine and Coastal Birds	LOW	LOW	LOW	LOW	
Shorebirds					LOW
Waterfowl					MODERATE
Seabirds					MODERATE
Bald Eagle					MODERATE
6. Pinnipeds and Polar Bear					
Walrus	LOW	LOW	LOW	LOW	MODERATE
Ice Seals	LOW	LOW	LOW	LOW	LOW
Harbor Seal					MODERATE
Northern Fur Seal					HIGH
Polar Bear	LOW	LOW	LOW	LOW	MODERATE
Sea Otter					MODERATE
7. Endangered and Threatened Species					
Bowhead Whale	VERY LOW	VERY LOW	VERY LOW	VERY LOW	MODERATE
Gray Whale	VERY LOW	VERY LOW	VERY LOW	VERY LOW	MODERATE
Steller Sea Lion					VERY HIGH
Arctic Peregrine Falcon	VERY LOW	VERY LOW	LOW	VERY LOW	LOW
8. Belukha Whale	VERY LOW	VERY LOW	VERY LOW	VERY LOW	MODERATE
9. Caribou	VERY LOW	LOW	LOW	LOW	MODERATE
10. Economy of the North Slope Borough	VERY LOW	HIGH	VERY HIGH	HIGH	HIGH

Table S-1
Summary of Effects[1] for Alternatives I and IV and the Cumulative Case[2]
Chukchi Sea Lease Sale 126
(Continued)

Resource Category	Alternative I Low Case	Alternative I Base Case	Alternative I High Case	Alternative IV Point Lay Deferral Alternative	Cumulative Case
11. Subsistence-Harvest Patterns					
Barrow	VERY LOW	MODERATE	MODERATE	MODERATE	HIGH
Wainwright	VERY LOW	HIGH	HIGH	HIGH	HIGH
Point Lay	VERY LOW	MODERATE	MODERATE	MODERATE	HIGH
Atqasuk	VERY LOW	MODERATE	MODERATE	MODERATE	HIGH
Nuiqsut	VERY LOW	LOW	LOW	LOW	HIGH
Point Hope	VERY LOW	LOW	LOW	LOW	MODERATE
12. Sociocultural Systems	VERY LOW	MODERATE	MODERATE	MODERATE	HIGH
13. Archaeological Resources	LOW	MODERATE	MODERATE	MODERATE	MODERATE
14. Land Use Plans and Coastal Management Programs	LOW	HIGH	HIGH	HIGH	HIGH
15. Wetlands	[3]	[3]	[3]	[3]	[3]

[1] Refer to Table S-2 for the definitions of levels of effect for each resource category.

[2] Alternative II (No Lease Sale)--The effects associated with Alternative I or other alternatives would not occur with this alternative. Alternative III (Delay the Sale)--The effects associated with this alternative would be the same as those of Alternative I, except the sale could be delayed for up to 3 years.

[3] Effects on wetlands from infrastructure construction, especially the onshore pipeline to the TAP, are discussed in Sections IV.B.15, IV.C.15, IV.D.15, IV.G.15, and IV.H.1.k.

Table S-2
Definitions Assumed in Effects Assessment

MAJOR ISSUES	VERY HIGH	HIGH	MODERATE	LOW	VERY LOW
Air Quality[1/]	Emissions cause substantial increases in concentrations of criteria pollutants over an entire Federal attainment area, resulting in consumption of the entire available PSD increment for NO_2, SO_2, or TSP or all of the available NAAQS concentration for PM_{10}, CO, or O_3, causing the area to become a non-attainment area; serious adverse long-term effects on human health or vegetation; and/or significant decrease in onshore visibility.	Emissions cause measurable increases in concentrations of criteria pollutants over more than half of a Federal attainment area (regional effect), resulting in the consumption of at least 50 percent but not all of the available PSD or NAAQS concentration increments; readily identifiable adverse long-term effects on human health or vegetation; and/or significant decrease in onshore visibility.	Emissions cause measurable increases in concentrations of criteria pollutants over more than half of a Federal attainment area (regional effect), resulting in the consumption of at least 20 percent of the available PSD increment for NO_2, SO_2, or TSP or 5 percent of the available NAAQS concentration for PM_{10}, CO, or O_3; small but measurable short-term adverse effects on human health or vegetation; and/or significant decrease in onshore visibility.	Emissions cause measurable increases in concentrations of criteria pollutants over more than a localized portion of a Federal attainment area, resulting in the consumption of at least 5 percent but less than 20 percent of the available PSD increment for NO_2, SO_2, or TSP or 5 percent of the available NAAQS concentration for PM_{10}, CO, or O_3; no observed adverse effects on human health or vegetation; and/or significant decrease in onshore visibility.	Emissions cause measurable increases in concentrations of criteria pollutants (e.g. SO_2, CO, NO_2, O_3, and PM_{10}) over one localized portion of a Federal attainment area, resulting in the consumption of less than 5 percent of the available PSD increment for NO_2, SO_2, or TSP or 5 percent of the available NAAQS concentration for PM_{10}, CO, or O_3,; no observed adverse effects on human health or vegetation; and/or significant decrease in onshore visibility.
Water Quality[2/]	A regulated contaminant is discharged into the water column and the resulting concentration of contaminant is above the acute (toxic) State standard or EPA criterion more than once in a 3-year period and averages more than the chronic State standard or EPA criterion.	A regulated contaminant is discharged into the water column and the resulting concentration of contaminant is above the acute (toxic) State standard or EPA criterion more than once in a 3-year period.	A regulated contaminant is discharged into the water column and the resulting concentration of contaminant averages more than the chronic State standard or EPA criterion but does not exceed acute (toxic) State standards or EPA criterion.	A regulated contaminant is discharged into the water column and the resulting concentration of contaminant occasionally exceeds but does not increase the average beyond the chronic State standard or EPA criterion.	No regulated contaminant is discharged into the water column, or some amount is discharged, but the resulting concentration of contaminant does not exceed the acute or chronic State standards or EPA criterion.

Table S-2
Definitions Assumed in Effects Assessment
(Page 2 of 3)

MAJOR ISSUES	VERY HIGH	HIGH	MODERATE	LOW	VERY LOW
Biological Resources	A population changes in abundance and/or distribution, requiring three or more generations to recover to its former status.	A population changes in abundance and/or distribution, requiring one or two generations to recover to its former status.	A population or portion of a population changes in abundance and/or distribution but would recover to its former status within one generation.	A population or portion of a population changes in abundance and/or distribution in a localized area and/or for a short time period.	Individuals in a population experience sublethal effects that do not change population abundance or distribution.
Endangered and Threatened Species	A substantial population decline that results in a change in the distribution and/or abundance of the species, with recovery in more than one generation or more than 10 years.	A population decline resulting in a change in the distribution and/or abundance of the species, with recovery in less than one generation or 6 to 10 years.	A population decline (including lethal effects to a number of individuals), resulting in a minor change in the distribution and/or abundance of the species. The expected duration of the effects on the population is 3 to 6 years.	No discernible population decline (no lethal effects), but a number of individuals experience sublethal effects and would recover to pre-activity conditions within 1 to 3 years. Distribution changes affecting a low number of individuals in a small local area would last no longer than the project.	No discernible population decline (no lethal-decline effects), but a number of individuals experience sublethal effects and would recover to pre-activity conditions within 1 year.
Economy of the North Slope Borough	Economic effects that will cause important and sweeping changes in the economic well-being of residents of the area. Local employment is increased by 20 percent or more for at least 5 years.	Economic effects that will significantly affect the economic well-being of residents of the area. Local employment is increased by 20 percent or more for less than 5 years.	Economic effects that will moderately affect the economic well-being of residents of the area. Local employment is increased 10 to 19 percent for at least 5 years.	Economic effects that may marginally affect the economic well-being of residents of the area. Local employment is increased by 10 to 19 percent for less than 5 years.	Economic effects that will not have a measurable effect on the economic well-being of the residents of the area. Local employment is increased by less than 10 percent.
Subsistence-Harvest Patterns	One or more important subsistence resources would become unavailable, undesirable for use, or available only in greatly reduced numbers for a period of 2 to 5 years.	One or more important subsistence resources would become unavailable, undesirable for use, or available only in greatly reduced numbers for a period of 1 to 2 years.	One or more important subsistence resources would become unavailable, undesirable for use, or available only in greatly reduced numbers for a period not exceeding 1 year.	Subsistence resources would be affected for a period not exceeding 1 year, but no resource would be unavailable, undesirable for use, or greatly reduced in number.	Subsistence resources could be periodically affected but with no apparent effects on subsistence harvests.

Table S-2
Definitions Assumed in Effects Assessment
(Page 3 of 3)

MAJOR ISSUES	VERY HIGH	HIGH	MODERATE	LOW	VERY LOW
Sociocultural Systems	Continuous disruption of sociocultural systems occurs for a period of more than 5 years with a tendency toward the displacement of existing institutions.	Chronic disruption of sociocultural systems occurs for a period of 2 to 5 years with a tendency toward the displacement of existing institutions.	Chronic disruption of sociocultural systems occurs for a period of 1 to 2 years without a tendency toward the displacement of existing institutions.	Disruption of socio-cultural systems occurs for a period of less than 1 year without a tendency toward the displacement of existing institutions.	Periodic disruption of sociocultural systems occurs without the displacement of existing institutions.
Archaeological Resources	An interaction between an archaeological site and an effect-producing factor occurs and results in the loss of unique archaeological information.	An interaction between an archaeological site and an effect-producing factor occurs and results in the loss of significant, but not unique, archaeological information.	An interaction between an archaeological site and an effect-producing factor occurs and results in the loss of archaeological data that are not significant.	An interaction between an archaeological site and an effect-producing factor occurs, but effects are temporary and reversible.	Little damaging interaction between an effect-producing factor and an archaeological site occurs.
Land Use Plans and Coastal Management	Activities are incompatible and displace a preferred land use, or they conflict with four or more policies of local, State, or Federal coastal management programs and land use plans.	Activities alter a preferred land use, or they conflict with three policies of local, State, or Federal coastal management programs and land use plans.	Activities infringe on existing land use, or they conflict with two policies of local, State, or Federal coastal management programs and land use plans.	Activities infringe on proposed land use, or they conflict with one policy of local, State, or Federal coastal management programs and land use plans.	Activities generally conform with existing land use and with policies of local, State, and Federal coastal management programs and land use plans.

Source: USDOI, MMS, Alaska OCS Region.

1/ NAAQS are based on the protection of human health. Numerical standards for each pollutant are given in Table III-A-2. PSD increments are supplements to the NAAQS protecting existing high air quality areas. "Regional" refers to effects on areas that are as large as, or larger than, about one-half the area of the North Slope of Alaska. "Local" refers to effects limited to tens of miles near the shoreline. Short-term refers to hours, days, or weeks; long-term refers to seasons or years.

2/ "Regional" refers to effects on areas of approximately half or more of the North Slope of Alaska; "local" refers to effects limited to tens of kilometers near the shoreline; short-term refers to hours, days, or weeks, and long-term refers to seasons or years.

I

PURPOSE FOR ACTION

I

I. PURPOSE AND BACKGROUND OF THE PROPOSED ACTION

The U.S. Department of the Interior (USDOI) is required by law to manage the exploration and development of oil and gas resources on the Outer Continental Shelf (OCS). These resources are to be developed prudently and in an evironmentally sound manner. The Federal Government must, among other things, balance orderly resource development with protection of the human, marine, and coastal environments; ensure that the public receives a fair return for these resources; and preserve and maintain free-enterprise competition.

In compliance with the Outer Continental Shelf Lands Act of 1953 (OCSLA), as amended (43 U.S.C. 1331 et seq.), the Secretary of the Interior submits a proposed 5-year leasing program to the Congress, the Attorney General, and the governors of affected states. The Secretary annually reviews, revises as necessary, and maintains the oil and gas leasing program. Goals of the leasing program include (1) the orderly development of OCS oil and gas resources in an environmentally acceptable manner, (2) the maintenance of an adequate supply of OCS production to help meet the Nation's energy needs, and (3) the reduction of dependency on foreign oil. The purpose of this proposed lease sale is to contribute to attaining those goals.

Current U.S. energy demands are met primarily by domestic and foreign fossil fuel. Since the 1973 Arab oil embargo, it has become increasingly apparent that our Nation must become less dependent on foreign imports, lessen our vulnerability to supply economics and supply interruptions, and prepare for the time when oil production approaches its capacity limitation. In 1978, Congress mandated the USDOI to engage in "expedited exploration and development of" the OCS in order to "assure national security, reduce dependence on foreign sources, and maintain a favorable balance of payments in world trade."

The OCS leasing program does not represent a decision to lease in a particular area. Instead, it is representative only of the Department's intent to consider leasing in certain areas, and to proceed with the offering of such areas only if it should be determined that leasing and development would be environmentally acceptable and technically feasible. As a part of the current 5-year OCS leasing program, the USDOI has tentatively scheduled Chukchi Sea Sale 126 for late-1991.

A. Leasing Process

The OCSLA charges the Secretary of the Interior with administering mineral exploration and development on the U.S. OCS and with conserving its natural resources. The Secretary has delegated authority to carry out offshore leasing and resource management functions to the Minerals Management Service (MMS). This program provides relevant information about potential effects of oil and gas activities on the environment (OCS Environmental Studies Program) and on communities and regions or Alaska as a whole (Social and Economic Studies Program). The Environmental Studies Program also supports monitoring of potential post-sale changes in environmental conditions to provide a basis for mitigating any unforeseen effects. For specific information on the MMS Studies Program, refer to Appendix F. The OCS leasing program is implemented by 30 CFR 256. Lease supervision and regulation of offshore operations is implemented by 30 CFR 250. The following steps summarize the leasing process for the proposed lease sale.

1. Leasing Schedule: The OCSLA, as amended, requires that the Secretary prepare and maintain a 5-year OCS Oil and Gas Leasing Program and that he review the program annually to ensure that it is current. The present 5-year OCS Oil and Gas Lease Sale Schedule announced by the USDOI in April 1988 consists of 38 proposed lease sales for the period August 1987 through June 1992, including 12 sales offshore Alaska. Chukchi Sea Sale 126 istentatively scheduled to be held in late 1991.

2. Call for Information and Nominations and Notice of Intent to Prepare an Environmental Impact Statement (EIS): A Call for Information and Nominations (Call) and Notice of Intent to Prepare an EIS (NOI) are notices published in the *Federal Register* inviting the oil industry, governmental agencies, environmental groups, and the general public to comment on areas of interest or special concern in the

proposed lease-sale area. The Call for proposed Chukchi Sea Sale 126 was published in the Federal Register on January 13, 1989 (54 FR 1634). The Chukchi Sea Sale 126 Call area was located generally off the northwest coast of Alaska in the Arctic and covered approximately 12 million hectares (approximately 29 million acres) containing 5,450 blocks.

In response to the Call, nine companies submitted indications of interest in areas for leasing. The nominations received indicated interest in 5,450 blocks. Comments were received from six companies as well as from the North Slope Borough, the State of Alaska, the National Park Service (NPS), the Fish and Wildlife Service (FWS), the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Coast Guard (USCG). Comments received on the Call provided information on the size of the area being offered for lease and lease terms and identified significant environmental issues.

The comments received on the NOI are discussed in Sections I.A.3 and I.D.

3. Area Identification: Based on information received in response to the Call, on May 9, 1989, the Secretary of the Interior selected 4,319 blocks in the Chukchi Sea, an area of approximately 9.58 million hectares (23.68 million acres) for analysis in this EIS (see Figs. I-1 and I-2). The area identified reflects a decision to eliminate about 6 million nearshore acres from further consideration in this sale.

4. Scoping: The NOI, published in the same document as the Call (Sec. I.A.2), serves to announce the scoping process that will be followed for the EIS. The Council on Environmental Quality defines scoping as "an early and open process for determining the scope of issues to be addressed in an EIS and for identifying the significant issues related to a proposed action" (40 CFR 1501.7). It is a means for early identification of important issues deserving of study in an EIS. The intent of scoping is to avoid overlooking important issues that should be analyzed in the EIS.

Comments are invited from any interested persons, including affected Federal, State, and local governmental agencies; any affected Native groups; conservation groups; and private industry. Information obtained from the scoping meetings and the Call is considered part of scoping.

Based on information gained through the scoping process--which includes staff evaluation and input--major issues, alternatives to the proposed action, and measures that could mitigate the effects of the proposed action are identified for analysis in the EIS.

For proposed Chukchi Sea Sale 126, MMS held a scoping meeting in Barrow on December 7, 1988. In addition, scoping comments for the proposed lease sale were requested from the public through newspaper, radio, and television advertisements in the North Slope Borough. Letters were sent to the Mayor of the North Slope Borough; the mayors, village coordinators, and representatives of the North Slope Borough Planning Commission for the communities of Barrow, Kaktovik, Nuiqsut, Point Hope, Point Lay, and Wainwright; and the Alaska Eskimo Whaling Commission informing them of the scoping process and requesting their comments. The results of the scoping process for this proposed lease sale are presented in Section I.D of this EIS. Section V lists individuals and organizations consulted prior to and during the preparation of this EIS.

5. Preparation of the Draft EIS (DEIS): As required by Section 102(2)(C) of the National Environmental Policy Act of 1969 (NEPA), an EIS must be prepared for any major Federal activity having the potential of significantly affecting the quality of the human, marine, and coastal environments. Offshore leasing is considered a major Federal activity for which an EIS must be prepared.

An integral part of preparing an EIS is the exchange of technical information that occurs during MMS-sponsored Information Update Meetings (IUM's) and Information Transfer Meetings (ITM's). The IUM's are held to provide an opportunity for MMS staff to discuss with investigators from the OCS Environmental Studies Program current results of studies in a lease-sale-specific area (for information about MMS-

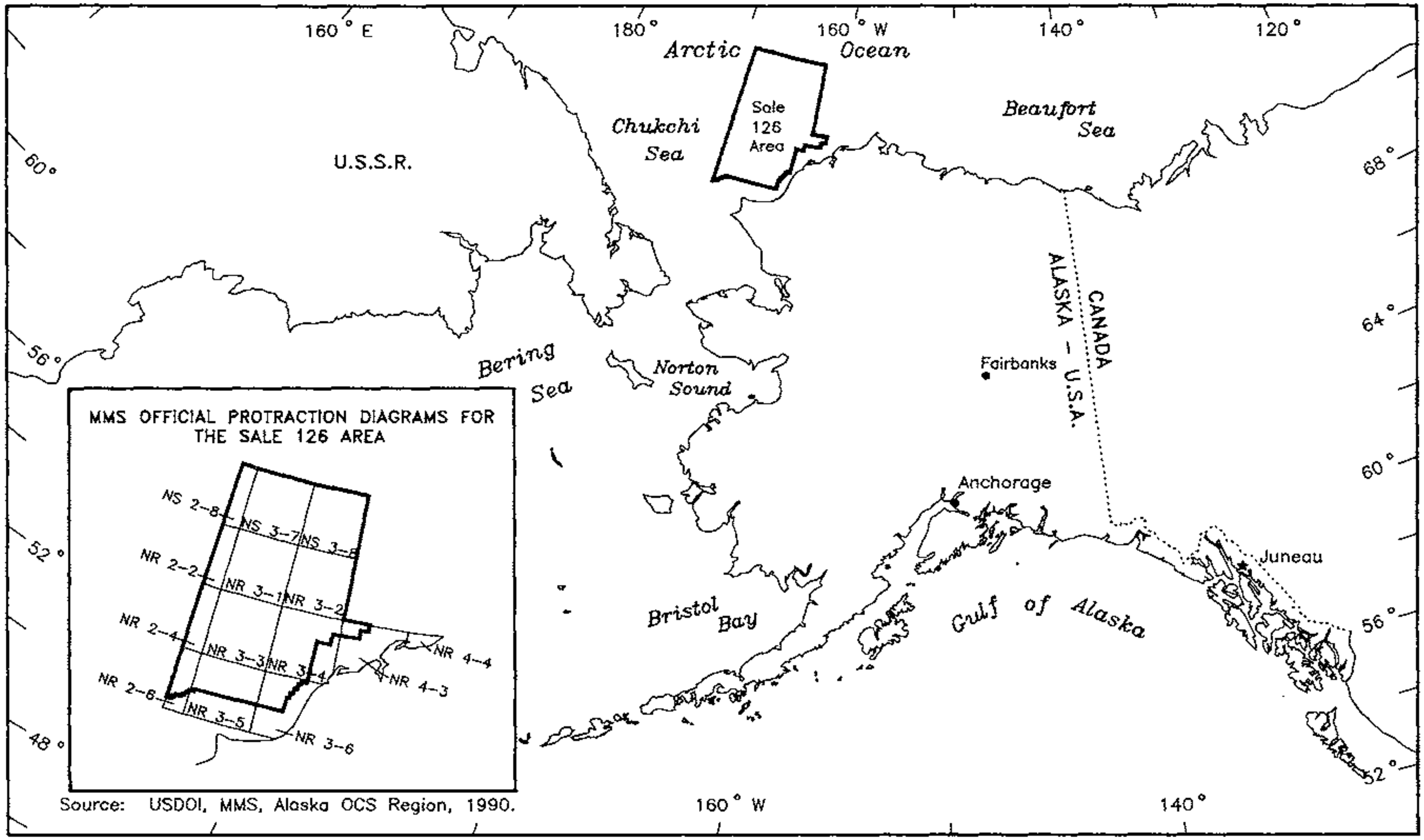


Figure I-1. Location of the Proposed Chukchi Sea Sale 126 Area

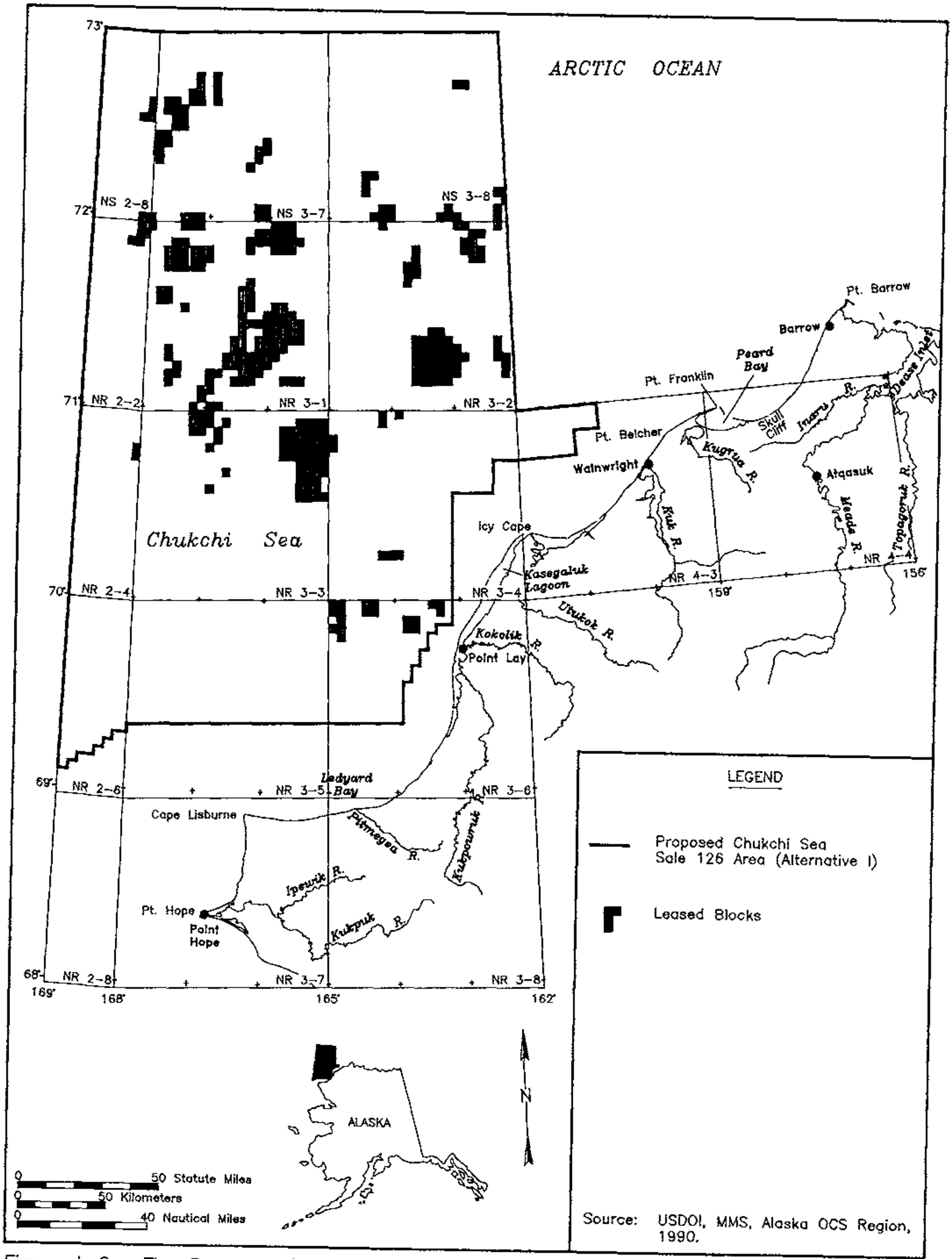


Figure I-2. The Proposal (Alternative I) sponsored studies and MMS Annual Environmental Studies Planning, see Appendix F). An IUM for the Chukchi Sea was held on March 27, 1986, in Anchorage, Alaska, to review the status of environmental knowledge and to discuss the implications of proposed oil and gas development for the Chukchi Sea Planning Area. The ITM's are public meetings held to present a general overview of regional knowledge. Participants at ITM's include researchers from public and private institutions; MMS staff; representatives of other Federal agencies, the State of Alaska, private industry, and regional organizations; and members of the MMS Alaska Regional Technical Working Group. An Arctic ITM was held on November 17-20, 1987, in Anchorage, Alaska. The most recent ITM meeting--held January 30-February 1, 1990, in Anchorage--addressed the distribution and migration of cetaceans in the U.S. and Soviet Chukchi Sea areas.

The DEIS describes the potentially affected marine and onshore environment, presents an analysis of potential adverse effects on this environment and the area's inhabitants, describes potential mitigating measures to reduce the adverse effects of offshore leasing and development, describes alternatives to the proposal, and presents a record of consultation and coordination with others during EIS preparation.

The document is filed with the Environmental Protection Agency (EPA), and its availability is announced in the Federal Register. Any interested party may request a copy of the DEIS by contacting the MMS office listed in the Federal Register. The public has 60 days to review and comment on the DEIS.

6. Endangered Species Consultation: Pursuant to Section 7 of the Endangered Species Act of 1973 (ESA), as amended, MMS consults with FWS and the National Marine Fisheries Service (NMFS), as appropriate, to determine whether a species that is listed as endangered or threatened may be jeopardized by the proposed action. Both formal and informal consultations are conducted on the potential effects of OCS leasing and subsequent activities on endangered and threatened species in the Chukchi Sea.

In accordance with the ESA, Section 7 regulations governing interagency cooperation, the MMS notified the NMFS and FWS on October 19, 1989, of the endangered and threatened species that would be included in a biological evaluation for Section 7 consultation. Both agencies responded on November 27, 1989, confirming that the species to be evaluated in the EIS were correctly specified.

On July 12, 1990, the MMS issued a request of the NMFS and FWS for formal consultation under Section 7 of the ESA. A response dated August 28, 1990, was received from NMFS stating that formal consultation was not necessary and that the Arctic Region Biological Opinion (ARBO) would apply to exploration in the Sale 126 area. The FWS responded in a memorandum dated October 31, 1990, indicating that the consultation process for the threatened arctic peregrine falcon began on August 27, 1990, and that leasing and exploration activities associated with Sale 126 are not likely to jeopardize the continued existence of the arctic peregrine falcon.

The MMS corresponded with the NMFS by letter dated July 26, 1990, regarding the potential effects of oil and gas leasing in Alaska on the Steller sea lion. By letter dated August 28, 1990, NMFS stated that there was no need to reinitiate consultation under Section 7 of the ESA for Lease Sale 126. A letter dated October 25, 1990, from the NMFS indicated agreement with the MMS determination that proposed Sale 126 is "not likely to affect the continued existence of the Steller sea lion."

See Appendix D for documentation of the Section 7 consultation process and a copy of the ARBO.

7. Public Hearings: Public hearings are held after release of the DEIS, and specific dates and locations for public hearings are announced in the Federal Register. Oral and written comments are obtained. Public hearings on the DEIS for Sale 126 were held in August 1990 in the following Alaska communities--Barrow on August 27, Wainwright on August 28, Point Lay on August 29, and Anchorage on August 31.

8. Preparation of the Final EIS (FEIS): Oral and written comments obtained on the DEIS

during the public comment period are addressed in the FEIS, which is then made available to the public and filed with the EPA. The availability of the FEIS is announced in the Federal Register.

9. Secretarial Issue Document (SID): The SID, which is based in part on the FEIS, includes a discussion of significant information connected with the proposed lease sale. The SID provides relevant environmental, economic, social, and technological information to the Secretary to assist him in making a decision on whether to conduct a lease sale and, if so, what terms and conditions should be applied to the sale and leases.

10. Proposed Notice of Sale: At least 90 days before the proposed lease sale, a proposed Notice of Sale (NOS) is prepared and its availability is announced in the Federal Register. A copy of the notice is furnished to the Governor of Alaska, pursuant to Section 19 of the OCSLA, so that he and any affected local governments may comment on the size, timing, and location of the proposed sale. Comments must reach the Secretary within 60 days after notice of the proposed lease sale.

11. Decision and Final Notice of Sale: The entire prelease process culminates in a final decision by the Secretary on whether to hold a lease sale and, if so, its size, terms, and conditions. The Secretary of the Interior has the option of deferring from the sale area any or all of the deferred area analyzed in the EIS or areas proposed for deletion after consultation with the Governor of Alaska, pursuant to Section 19 of OCSLA, as amended. The final NOS must be published in the Federal Register at least 30 days before the sale date. It may differ from the proposed NOS depending on the Secretary's final terms, i.e., size of lease sale, bidding systems, and mitigating measures. The Secretary is required by Section 19 to communicate to the Governor in writing the reasons for his determination to accept or reject the Governor's recommendations or to implement any alternative means in consultation with the Governor to provide for a reasonable balance between the national interest and the well-being of the citizens of the affected state.

12. Lease Sale: Chukchi Sea Sale 126 is tentatively scheduled to be held in late 1991. Sealed bids for individual blocks and bidding units (those listed in the NOS) are opened and publicly announced at the time and place of the sale. The MMS assesses the adequacy of the bids, and the Department of Justice--in consultation with the Federal Trade Commission--may review them for compliance with antitrust laws. If bids are determined to be acceptable, leases may be awarded to the highest bidders. However, the Secretary reserves the right to withdraw any blocks from consideration prior to written acceptance of a bid and the right to accept or reject bids, generally within 90 days of the lease sale.

13. Lease Operations: After leases are awarded, the MMS Field Operations Office is responsible for supervising and regulating operations conducted on the lease. Prior to any exploration activities on a lease, except preliminary activities, a lessee must submit an exploration plan, an Oil-Spill-Contingency Plan, and an Application for Permit to Drill (APD) to MMS for approval. The Office of Ocean and Coastal Resource Management, FWS, NMFS, EPA, NPS, U.S. Army Corps of Engineers (COE), USCG, the State of Alaska, and the public are provided an opportunity to comment on the exploration plan. The exploration plan must be approved or disapproved within 30 days, subject to the State of Alaska's concurrence or presumed concurrence with the lessee's coastal zone consistency certification (pursuant to the Federal Coastal Zone Management Act). The MMS' Environmental Studies program to meet MMS' legal mandate to monitor changes in human, marine, and coastal environments during and after oil exploration and development is contained in Section 20 (b) of the OCSLA: "Subsequent to the leasing and development of any area or region, the Secretary shall conduct such additional studies to establish environmental information as he deems necessary and shall monitor the human, marine, and coastal environments of such area or region in a manner designed to provide time-series and data trend information which can be used for comparison with any previously collected data for the purpose of identifying any significant changes in the quality and productivity of such environments, for establishing trends in the areas studies and monitored, and for designing experiments to identify the causes of such changes."

B. Leasing and Drilling History

This section summarizes and incorporates by reference Section I.B (Leasing History) of the Chukchi Sea Sale 109 FEIS (USDOI, MMS, 1987b). Additional updated information is included in this summary.

1. Previous Lease Sales: Sale 126 is the third OCS sale proposed for the Chukchi Sea Planning Area. The first sale, Sale 85, scheduled for February 1985, was deleted from the 5-year schedule "to provide for further assessment of operations in heavy ice conditions." There has been one Federal offshore lease sale conducted for the Chukchi Sea. Sale 109 was held in May 1988 and resulted in 350 leases (covering 1,976,912 acres) being issued for 10-year terms (see Fig. I-2).

The State of Alaska has not held a lease sale in the Chukchi Sea, and no lease sales are currently scheduled by the State for that area. In June 1989, the State of Alaska temporarily suspended its oil and gas leasing program as a result of the State Legislature's failure to sufficiently fund the operating budget for Fiscal Year (FY) 1990, which ended on June 30, 1990. A modified leasing program will be re-implemented in FY 1991.

2. Drilling: Drilling on Chukchi Sea OCS Federal leases began in 1989; one exploratory well has been drilled and abandoned, and two wells have been started and temporarily abandoned, and have been re-entered in 1990.

3. Litigation: The following information supplements information provided in Section I.B.3 of the Chukchi Sea Sale 109 FEIS.

a. Coastal Definition and Delineation: Controversies between the U.S. Government and the State of Alaska over jurisdiction of offshore lands resulted in United States v. State of Alaska, U.S. Supreme Court No. 84, Original (1979), to settle disagreements over the definition and delineation of the coastline. Hearings and the presentation of evidence on all of the issues in the case have been concluded. The Special Master assigned to the case has heard arguments on all of the issues and is expected to file his final report sometime in the summer of 1991.

b. Aboriginal Rights: In January 1981, the Inupiat community filed suit (Inupiat Community of the Arctic Slope v. United States, 746 F.2d 570 [9th Cir. 1984]) claiming aboriginal rights to the OCS in the Beaufort and Chukchi Seas. A district court ruling denying the aboriginal rights was affirmed by the U.S. Court of Appeals for the Ninth Circuit in November 1984. A petition filed by the Inupiat with the U.S. Supreme Court to hear their case was denied in October 1985. In June 1987, the Inupiat filed a motion to vacate the circuit court's judgment and consolidate the case for purposes of briefing and oral arguments with The People of the Village of Gambell, et al., v. Donald P. Hodel, 746 F.2d 572 (9th Cir. 1984), which, in part, also alleged that plaintiffs retained aboriginal title to OCS lands and that the Alaska Native Claims Settlement Act (ANCSA) did not extinguish those claims. The motion was denied in September 1987.

c. Seasonal Drilling Restriction: In July 1986, the North Slope Borough filed suit in response to the USDOI granting a one-time exception to the seasonal drilling restriction requested by Shell Western E&P, Inc., and Amoco Production Company for exploratory drilling on Sale 87 leases in the Beaufort Sea. In the suit, North Slope Borough v. Donald Hodel, et al., Civ. No. A86-393 (D. Alaska, filed July 31, 1986), the North Slope Borough alleged violations of the Endangered Species Act, the Marine Mammal Protection Act, the OCSLA, the Coastal Zone Management Act, the Alaska National Interest Land Claims Act, and the Alaska Coastal Management Act. A Motion for Temporary Restraining Order filed by the plaintiffs was denied, and a hearing for preliminary injunction was vacated at the request of the North Slope Borough because the Borough, Shell Western E&P, Inc., and Amoco Production Company had agreed upon terms of a settlement. In September 1986, the case was dismissed at the request of the parties.

d. Revenues: In September 1985, the State of Alaska filed suit (State of Alaska v.

United States of America, et al., Civ No. A85-502 [D. Alaska, filed September 3, 1985]), seeking an order effecting the fair and equitable division between the U.S. and the State of Alaska of revenues generated as a result of oil and gas leasing on the OCS. The State also alleged that from the time of passage of the 1978 amendments to the OCSLA until February 1985, the U.S. has violated 43 U.S.C. 1337(g)(1) by refusing to provide certain geological and geophysical data. In July 1986, the parties filed for dismissal. The dispute became moot with passage of the OCSLA amendments of 1985.

C. Legal Mandates, Authorities, and Federal Regulatory Responsibilities

OCS Report MMS 86-0003, "Legal Mandates and Federal Regulatory Responsibilities" (Rathbun, 1986), incorporated herein by reference, describes legal mandates and authorities for offshore leasing and outlines Federal regulatory responsibilities. This report contains, among other things, summaries of the OCS Lands Act, as amended, and related statutes, and a summary of the requirements for exploration and development and production activities. Also included are a discussion of authorities of other Federal agencies that affect OCS activities and a discussion of significant litigation affecting OCS leasing policy.

The MMS, Alaska OCS Region Reference Paper No. 83-1, "Federal and State Coastal Management Programs" (McCrea, 1983), incorporated herein by reference, describes the coastal management, legislation, and programs of the Federal Government and the State of Alaska. This paper highlights sections particularly pertinent to offshore oil and gas development and briefly describes some of the effects of the ANCSA and the Alaska National Interest Lands Conservation Act (ANILCA) on coastal management.

D. Results of the Scoping Process

The scoping process for the Chukchi Sea Sale 126 EIS consisted of an analysis of the responses to the Call for Information and Notice of Intent to Prepare an EIS on Sales 109 and 126; comments from the scoping meeting held in Barrow on December 7, 1988; reevaluation of the issues raised and analyzed in the EIS's for previous Chukchi Sea Planning Area lease sales (Sales 85 [cancelled] and 109); and staff input.

The responses to the Call for Information and Notice of Intent to Prepare an EIS are summarized as follows:

-- The United States Fish and Wildlife Service (FWS) expressed concern about: (1) environmental effects caused by pipeline landfalls; utility corridors within units of the Alaska Maritime National Wildlife Refuge; the barrier islands; and the combined effects of OCS activities and other onshore and offshore oil and gas developments--existing and potential; (2) effects of nearshore and onshore OCS development and production on migratory birds and anadromous fish stocks; (3) effects from increased air traffic over coastal areas during exploration and staging sites for activities in the planning area; (4) cumulative effects from various industrial activities on wildlife and water quality (fresh and marine) and aquatic food webs from various industrial activities (including chronic discharges of petroleum products, drilling effluents, and water-treatment chemicals); and (5) deletion of tracts immediately seaward of the following environmentally sensitive areas: Icy Cape to the eastern limit of the planning area and Point Hope to Cape Beaufort.

-- The National Park Service (NPS) was concerned with (1) effects on habitats for marine mammals and nationally and internationally significant archaeological resources within Cape Krusenstern National Monument; (2) effects on the resources of the Bering Land Bridge National Preserve; and (3) development and implementation of strategies to prevent or minimize the effects on cultural resources.

-- The National Oceanic and Atmospheric Administration (NOAA) expressed concern over (1) protection of the bowhead whale migration in the spring leads along the northwest coast of Alaska; and (2) the lack of very much new information since Sale 109 on marine mammal distribution and abundance along the summer-pack-ice edge, nearshore anadromous fish movements along the Chukchi Sea coast, summer belukha whale stock identity, and pelagic forage fish distribution and abundance.

-- The Environmental Protection Agency (EPA) recommended:

1. Protection of those sensitive habitat or biological resource areas from potential adverse effects associated with oil and gas activities, including Cape Lisburne and Cape Lewis, Ledyard Bay, Kasegaluk Lagoon, Peard Bay, and the Skull Cliff kelp beds. (The EPA recommended that the above areas be considered for deferral.)

2. Protection of migrating bowhead whales to include the Industry Site-Specific Bowhead Whale Monitoring Program Stipulation (Sale 109) will provide important information about bowhead whale behavioral response to drilling activities and noise and should be evaluated in the Sale 126 EIS; there must be a commitment to modify activities that are causing behavioral disturbance; the Marine Mammal Protection Act (MMPA) and the Endangered Species Act (ESA) have regulatory requirements that should be referenced in the stipulation; the stipulation should clarify which Federal agency has authority for determining effects and suspending activities if monitoring indicates behavioral disturbances; and if new technology or information cannot effectively eliminate or mitigate the jeopardy to the bowhead whale population from year-round development and production activities in the spring lead system, development and production could not occur in accordance with MMPA and ESA and this uncertainty should be clearly presented in a stipulation or as part of an Information to Lessee.

3. Conditional probabilities should be graphically presented in the oil-spill-risk analysis and greater emphasis on seasonal trajectories of oil slicks should be given in the environmental consequences analysis through the use of figures showing seasonal trajectories and more detailed discussion of seasonal conditional probabilities; and conditional probabilities should be presented in a format that is more usable to EIS reviewers (however, no specific format was suggested by the commenter).

4. Oil-spill response and cleanup: The EIS should include a discussion of the agencies and organizations that would be involved in oil-spill response and cleanup and a short description of their duties and responsibilities; a detailed and thorough analysis of oil-spill-containment and cleanup techniques also is needed and should provide information about the following: response time under a variety of weather conditions, availability of cleanup equipment, efficiency of cleanup equipment under a variety of meteorological and oceanographic conditions, rate at which spilled oil can be cleaned up by various recovery mechanisms, capability of containment and cleanup techniques to deal with major spills, and practicality of oil-spill cleanup on various shoreline types and open-water areas.

5. Information about the fate and effects of spilled oil should be included in the EIS: oil distribution to the atmosphere, water surface, water column, and sediments; oil distribution mechanisms; proportions of oil found in each environmental compartment; and changing physical, chemical, and toxicological properties of oil as it weathers under different seasonal and physical environmental conditions.

6. Information about the trophic relationships of the various species is needed and should include information about the food web, major prey organisms for each species or species group, opportunistic feeders that feed on a wide variety of prey, selective feeders that feed only on a limited number of species, and species having highly specialized food niches.

7. Information on oceanographic, meteorological, and climatological conditions should be presented so that seasonal trends relative to the oil-spill analysis can be understood, and to correlate with the discussion on mobilization time for oil-spill response and cleanup.

8. The life-cycle stage for each species evaluated in the EIS should be described and should include sensitivities to the various oil and gas effect-producing activities as well as non-OCS activities, population distribution for each life-cycle stage, and relationships between the various lifestage activities and habitats.

9. The population status of the various species, particularly those species that are decreasing, should be discussed and should include population trends and reason(s) for the decline in those species whose populations are declining.

10. The analysis of effects should evaluate the synergistic responses of the many species to exposure from multiple industrial activities.

11. The effects of causeways on fish and wildlife populations that inhabit the nearshore environment should be evaluated. Cumulative activities associated with onshore facilities and staging areas that would be located in the vicinity of the causeways could affect fish and wildlife populations. Vessel and aircraft traffic operating near causeways and vehicles operating on and in the vicinity of causeways should be evaluated.

12. Availability of pertinent information--to include the biological opinions on the effects and findings of the likelihood of jeopardy to endangered populations--should be included in the DEIS for public review and comment; and efforts to revise the EIS schedule should be made so that pertinent and relevant information germane to the leasing decision is available for public review and comment. (The commenter noted that (1) in a few instances the biological opinion has not been included in some DEIS's and (2) industry-funded studies of the effects of drilling noise and support activities on migrating whales and subsistence whaling were not completed until after publication of the Sale 97 FEIS and issuance of the Secretarial Issue Document for that sale.)

-- The State of Alaska (SOA) is concerned with (1) the lack of information sufficient to assess the effects of OCS oil and gas activities on wildlife populations (bowhead, belukha, and gray whales; walrus; and spotted seal): (a) bowhead whale arrival times, migration routes, and habitat-use areas in the fall have not been adequately determined; (b) belukha whale effects from noise and other disturbances and oil spills are not well known, and the relationship between a stock that summers in Kasegaluk Lagoon and the Kotzebue Sound stock is uncertain; (c) gray whale locations and intensity of feeding in the sale area have not been adequately studied; (d) increased potential for oil spills and disturbance from concurrent exploration resulting from Sales 109 and 126; and (e) effects on the nearshore ecosystem as a result of development of a system to transport the produced petroleum and the development of staging areas; and (2) the area identified in the Sale 109 EIS as the "Coastal Deferral" also should be deferred from Sale 126.

-- The North Slope Borough (NSB) expressed concern over the (1) effects of noise generated by industrial activities associated with offshore oil and gas exploration and development on bowhead whales; bowheads have exhibited strong avoidance responses to the noise produced by certain drilling-related activities at far greater distances than were previously indicated; protection of bowheads in migratory and feeding areas; protection of walrus, seal, bird, and polar bear populations; and protection of subsistence hunters in traditional hunting areas; and (2) the area deferred from Sale 109 should be deferred from Sale 126. The NSB also recommended (3) prohibition of any industrial activity during the bowhead whale migration, based upon current scientific information on the effects of noise, and to reduce the risk of a catastrophic oil spill and reduce the risk to other wildlife species and subsistence hunting.

1. Significant Issues Considered in the EIS: The significant issues listed below resulted from an evaluation of issues raised during the scoping process for this lease sale. The analyses in this EIS are focused on these issues.

a. Effects on subsistence-harvest patterns from

- oil spills
- industrial disturbance (including noise)
- reduced access to resources
- changes in subsistence practices related to oil and gas activities

(See Secs. III.C.2 and IV.B.11)

b. Effects on sociocultural systems from

- sale-related effects on subsistence uses and needs
- changes in traditions and cultural values

(See Secs. III.C.3 and IV.B.12)

c. Effects on lower-trophic-level organisms from

- oil spills
- construction
- drilling-mud discharges

(See Secs. III.B.1 and IV.B.3)

d. Effects on fishes from

- oil spills
- construction
- drilling-mud discharges

(See Secs. III.B.2 and IV.B.4)

e. Effects on marine and coastal birds from

- oil spills
- noise disturbance
- habitat loss

(See Secs. III.B.3 and IV.B.5)

f. Effects on marine mammals (including polar bear) from

- oil spills
- noise disturbance
- habitat loss (construction and siting)

(See Sec. III.B.4 and IV.B.6)

g. Effects on endangered whales from

- oil spills
- noise disturbance (during habitat use)
- habitat disturbance (including ships in ice leads)

(See Secs. III.B.5 and IV.B.7)

h. Effects on caribou from

- oil spills
- noise disturbance

- habitat alteration

(See Secs. III.B.7 and IV.B.9)

i. Cumulative effects on all resource categories from

- this sale in combination with other ongoing or proposed projects on the North Slope

(See Secs. IV.B through IV.D)

j. Oil-Spill-Containment and -Cleanup-Capability Issues:

- in open water
- in broken ice
- on or under ice
- along coastal areas
- during storms and winds

(See Sec. IV.A.1)

k. Fate and Behavior of Spilled Oil:

(See Sec. IV.A.2)

l. Oil-Spill-Risk Analysis:

(See Sec. IV.A.1)

m. Offshore-Technology Issues:

- capability of manmade structures such as offshore drilling units, production platforms, oil-storage facilities, or transportation systems to withstand the hazards of the Chukchi Sea

- major constraints on technology such as sea ice, waves and currents--particularly during storm surges--and superstructure icing

(See Sec. IV.A.3)

n. Archaeological Resources:

- effects of oil exploration and development on onshore-archaeological-resource sites at Point Hope, Cape Lisburne, Point Lay, Icy Cape, Wainwright, Point Belcher, and Point Franklin

(See Sec. IV.B.13)

o. Water Quality Issues:

- effects from oil spills, construction, and drilling muds and cutting discharges

(See Sec. IV.B.2)

p. Air Quality Issues:

- performance of a screening-level air quality-modeling analysis for all proposed sources

(See Sec.IV.B.1)

q. Economic Issues:

- effects on the local economy from increases in employment and population

(See Sec. IV.B.10)

r. Land Use Plans and Coastal Management Programs:

(See Secs. III.C.5 and IV.B.14)

2. Issues Not Considered in the EIS: The following issues raised during the scoping process are not analyzed in the EIS for the reasons indicated.

a. Earthquakes and Tidal Waves: Earthquake data indicate that the proposed Sale 126 and adjacent coastal areas historically are regions of low seismic activity. Thus, earthquakes and associated tsunamis are not expected to be significant hazards to petroleum industry operations.

b. The Effect of Oil and Gas Operations on a Limited Supply of Freshwater: Water is needed for drilling operations and for consumption. Supplies for offshore drilling and consumption are generated by desalinizing seawater. This process also could be used to meet onshore requirements if other options were not available to provide industry with an adequate independent water supply. One option currently used to supply onshore water for Prudhoe Bay operations relies on water that collects in the pits that remain after gravel has been extracted. Gravel-extraction processes that are used to support sale-related activities might generate a similar source of water. Either method of supplying water would preclude the occurrence of effects on the local water supply.

c. Completion of Land-Status and Compatibility Test on Refuge Lands Before Industrial Activities Are Permitted: Portions of the Chukchi Sea Unit of the Alaska Maritime Wildlife Refuge are in the vicinity of proposed Sale 126. Capes Lisburne and Thompson are particularly notable. The purposes for which the Alaska Maritime National Wildlife Refuge was established are to conserve fish and wildlife populations and habitats in their natural diversity, fulfill international fish and wildlife treaty obligations, provide for continued subsistence uses by local residents, provide for scientific research, and ensure water quality and quantity (ANILCA, Sec. 303[1][A][i] and [B]). This EIS examines the potential effects of Sale 126 on natural resources, water quality and quantity, and subsistence pursuits throughout the sale area--including Capes Lisburne and Thompson. As a result, the EIS should provide the information necessary for FWS refuge managers to address those elements of the Refuge Management Plan that might be affected by Sale 126.

d. The Statewide Economy: The economic effects of proposed Sale 126 would occur primarily in the North Slope Borough (NSB). The State of Alaska would receive an indeterminate amount of money from Section 8(g) blocks--those blocks lying within 3 to 6 miles offshore--for which the State receives a percentage of all revenues collected (Sec. 8[g] of the Act). This would only involve 3 or 4 of such blocks in this lease sale. Some sale-related and -induced employment effects would be experienced outside of the NSB, but the magnitude of these two effects is not expected to significantly affect the statewide economy. Therefore, this EIS does not describe the statewide economy or the statewide economic effects of the proposed sale.

e. Availability of Adequate Studies Information: Since the Chukchi Sea (Barrow Arch) Planning Area was first placed on the 5-year OCS oil and gas leasing program, over 100 studies pertinent to increasing our knowledge of this remote area have been completed. In addition, over 20 studies are ongoing or planned in the near future. Although more studies can be conducted in a sale area, it is the judgment of the MMS that the information base currently available is adequate for environmental assessment and for the Secretary of the Interior to make a decision concerning this lease sale. Ongoing and additional environmental studies will facilitate the decision-making process for future offshore oil and gas leasing activities in the Chukchi Sea region. (See Appendix F, MMS Alaska OCS Region Studies Programs, for a listing of Chukchi Sea environmental studies).

f. Eligibility of Archaeological Sites for Inclusion in the National Register of Historic Places: At this stage of the leasing process, the identification of previously recorded archaeological sites, an evaluation of the probability (high, medium, or low) of finding archaeological resources in a given area, and a determination of effect are included in the EIS. The MMS will not consider making a recommendation of eligibility for the National Register of Historic Places until site-specific exploration and development plans are submitted to the MMS.

g. Eskimo Curlew: The coastal area adjacent to the eastern boundary of the sale area is within the historic breeding range where the endangered Eskimo curlew nested on the open tundra. However, the Eskimo curlew has not been sighted in Alaska for decades (USDOI, FWS, 1980); therefore, the effects of oil and gas development associated with this sale area on the Eskimo curlew are not analyzed.

h. Potential for Fog and Ice-Fog Formation Caused by Onshore and Offshore OCS and Related Sources: Fog and ice fog are not considered to be pollutants under the air quality regulations and do not pose a significant hazard to oil and gas operations or human health.

i. Analysis of the Effects of Causeways on Nearshore Fish and Wildlife Populations: The effects of causeways are not analyzed in this EIS because causeways are not part of the development and production scenario for Sale 126. Hydrocarbons produced from the Sale 126 area are assumed to be transported to market by means of a pipeline which connects an offshore collector pipeline system with TAP.

3. Mitigating Measures Suggested During the Scoping Process: During the scoping process, the following suggestions for mitigating measures to protect certain resources were received and are discussed below. Section II.F.2 contains potential mitigating measures proposed by the MMS to mitigate the possible effects of proposed Sale 126. It should be noted that a Secretarial decision on these potential mitigating measures will not be made until the Notice of Sale is prepared. The analysis in this EIS does not assume that the measures are in place.

a. Stipulations:

(1) Protection of Archaeological Resources: This stipulation would reduce the possibility of damaging or destroying cultural resources through early detection and identification of archaeological sites.

(2) Orientation Program: This stipulation would require lessees to develop a program to inform all personnel involved in exploration or development and production activities (including personnel of the lessee's agents, contractors, and subcontractors) of the environmental, social, and cultural resources and values of the region.

(3) Protection of Biological Resources: This stipulation would provide a means to protect special biological populations and habitats that may occur in the proposed lease-sale area.

(4) Transportation of Hydrocarbons: This stipulation is intended to ensure that

the method to be used to transport hydrocarbons considers the social and environmental factors as well as the incremental financial costs of pipelines over alternative methods of transportation.

(5) Industry Site-Specific Bowhead Whale-Monitoring Program: This stipulation requires the lessees to conduct site-specific monitoring during exploratory-drilling activities occurring within the bowhead spring and fall migration periods to determine when whales are present and if they exhibit any behavioral disturbance due to the activities.

(6) Subsistence Whaling and Other Subsistence Activities: This stipulation requires all lessees to conduct exploration and development and production operations in a manner that minimizes any potential conflict between the oil and gas industry and subsistence hunters.

(7) Oil-Spill-Response Preparedness: This stipulation is intended to ensure that lessees are ready to respond to a platform oil spill that might occur as a result of their operations and have the appropriate equipment and trained personnel available to conduct cleanup operations.

b. Information to Lessees (ITL's):

(1) Bird and Marine Mammal Protection: This ITL recommends guidelines that would mitigate behavioral disturbances of wildlife from vessel and aircraft traffic.

(2) Areas of Special Biological and Cultural Sensitivity: This ITL advises the lessees that areas of biological and cultural importance should be considered in preparing their oil-spill-contingency plans.

(3) Arctic Peregrine Falcon: This ITL advises the lessees that threatened arctic peregrine falcons are present and that the lessees will need to consult with FWS on whether proposed onshore facility sites pose a conflict.

(4) Chukchi Sea Biological Task Force: This ITL advises lessees that the Regional Supervisor, Field Operations (RSFO), will consult with the Chukchi Sea Biological Task Force in implementing the Protection of Biological Resources Stipulation.

(5) Coastal Zone Management: This ITL advises the lessees that the Alaska Coastal Zone Management Program and approved regional coastal management programs may have policies pertinent to oil and gas activities.

(6) Endangered Whales and MMS Monitoring Program: This ITL advises the lessees that MMS intends to continue its areawide whale monitoring program in the Beaufort Sea during exploration activities. Further, the lessees are advised that the RSFO has the authority and intends to limit or suspend any operations on a lease whenever bowhead whales are subject to a threat of serious, irreparable, or immediate harm to the species.

(7) Development and Production Phase Consultation with National Marine Fisheries Services (NMFS) to Avoid Jeopardy to Bowhead Whales: This ITL advises the lessees that MMS will consult with NMFS before development, production will be allowed within the spring lead system of the Chukchi Sea, and specific options and alternatives to protect bowhead whales may be developed as a result of new information and technology.

(8) Oil-Spill-Cleanup Capability: This ITL is intended to remind lessees that oil-spill-contingency technology used to respond to an oil spill during broken-ice conditions must be the best available and that this technology must be in place and available prior to conducting drilling activities below threshold depth during broken-ice conditions.

c. Mitigating Measure Not Recommended for Further Study:

Seasonal Drilling Restriction (SDR): The NSB and SOA recommended that industrial activities--including drilling, seismic operations, and tug and icebreaker operations--be prohibited during the spring migration of bowhead whales to protect the traditional whale migratory and feeding areas and subsistence-hunting areas. There also is concern that industrial activities may have detrimental effects on other species.

The purpose of the SDR was to protect bowhead whales from what was then the unknown effects of an oil spill associated with activities (fall and spring) permitted by the MMS. Since that time, studies indicate that crude oil and industrial noise associated with such activities are likely to have only local, short-term effects on some cetaceans. Further, due to heavy ice conditions, industrial activities, including exploratory operations and seismic operations, are assumed not to occur during the spring bowhead migration. Consequently, in the light of what is now known concerning the effect of crude oil on whales and the extremely remote chance of an oil spill occurring during exploration, the continuation of the SDR is considered no longer necessary to protect the whales. Consultation will be reinstated with NMFS if and when production and development activities are contemplated. Nevertheless, in the interest of obtaining further effects-related information, potential whale monitoring ITL No. 6 was developed. Additionally, potential Stipulation No. 6 was developed to protect subsistence activities in the areas where bowhead whales are traditionally hunted.

Density Restriction for Protection of Bowhead Whales from Potential Effects of Noise: Stipulation No. 8 (Density Restriction for Protection of Bowhead Whales from Potential Effects of Noise) was described and analyzed as to effectiveness in the Sale 126 DEIS and subsequently deleted as a potential mitigating measure because it was inconsistent with recent NMFS regulations on incidental take of bowhead whale and not required by the Arctic Region Biological Opinion or the Sale 126 Biological Opinion.

d. Alternatives Suggested During the Scoping Process: Several alternatives were suggested during the scoping process on Sale 126. The Point Lay Deferral Alternative was developed by the MMS in response to these suggestions.

(1) The Point Lay Deferral Alternative (Alternative IV): The Point Lay Deferral Alternative would offer for leasing all of the area described for Alternative I except for a subarea located off Point Lay in the southeastern part of the proposed sale area. The subarea removed by the deferral alternative, the Point Lay Subarea Deferral, consists of 501 blocks (about 1.15 million hectares) located along the Chukchi Sea coast of northwestern Alaska from Cape Lisburne to Icy Cape (Fig. I-3). The subarea of the deferral is part of the areas that the SOA, NSB, NOAA, and EPA recommended for deferral for Sale 109. The other coastal areas they were concerned about were removed from future consideration at the area identification stage. The Point Lay Subarea Deferral was part of the Coastal Deferral Alternative analyzed in the Sale 109 EIS. The boundaries of the area to be deferred lie from 3 to 67 nautical miles offshore.

The Point Lay Deferral Alternative was developed to (1) include that part of the bowhead whale spring migration corridor that was not deleted from the planning area as a result of Area Identification; (2) include that part of the Chukchi polynya through which marine mammals migrate in the spring that was not deleted from the planning area as a result of Area Identification; (3) provide a protective buffer to the offshore subsistence-harvest area of Point Lay in addition to that provided by the deleted area; and (4) provide additional protection to important coastal habitats such as Kasegaluk Lagoon and the barrier island system and Ledyard Bay.

As a result of Sale 109, 22 blocks in the subarea of the deferral were leased; exploration drilling operations on these blocks require a site-specific bowhead whale monitoring program.

(2) Alternatives Not Selected for Inclusion in the EIS: Based on evaluations during the Area Identification phase of the leasing process, further deferral alternatives were not considered necessary to mitigate potential threats to coastal resources because a considerable number of nearshore

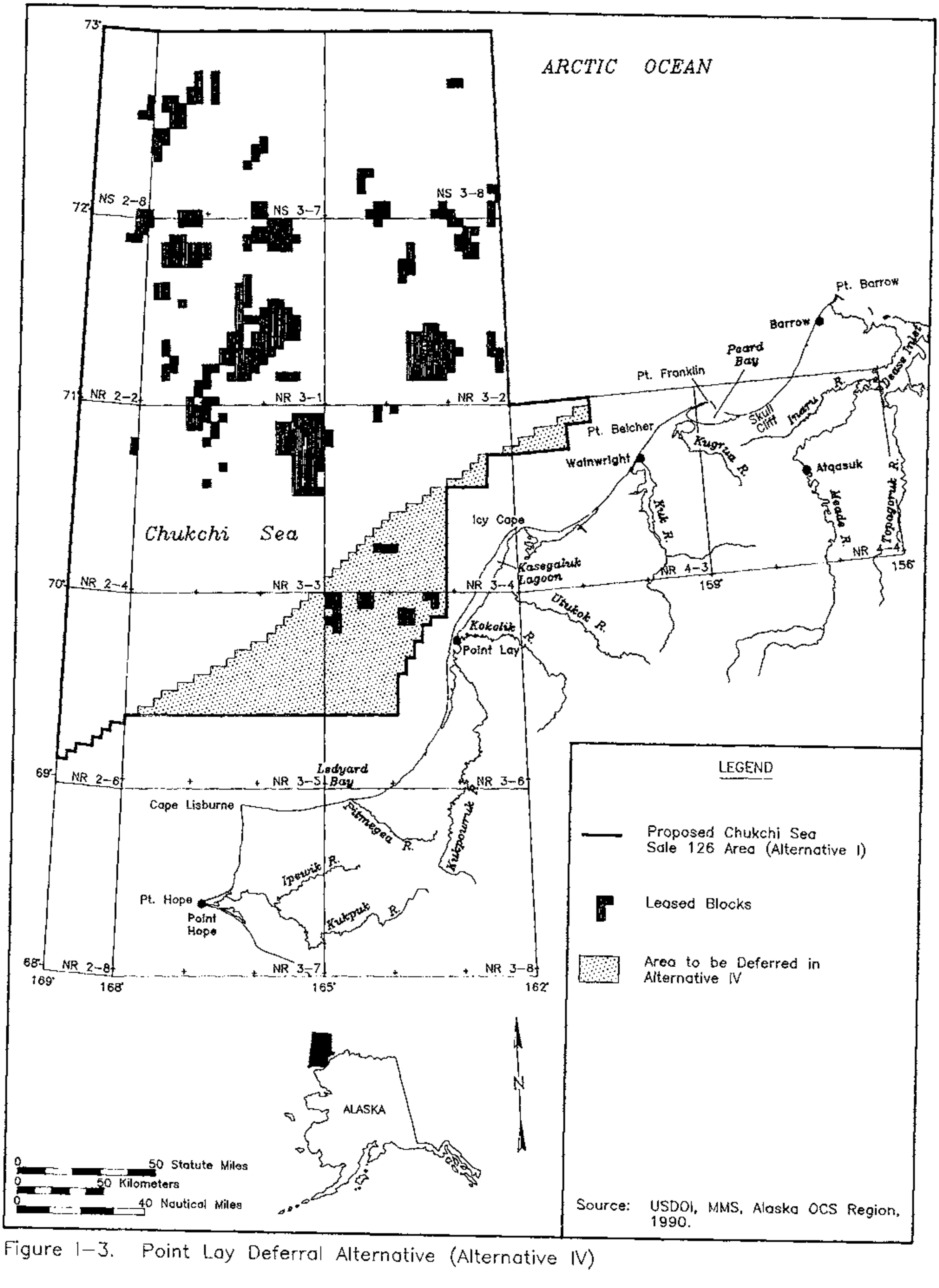


Figure 1-3. Point Lay Deferral Alternative (Alternative IV)

blocks in the Chukchi Sea planning area were deleted from further consideration (not to be offered for lease) and study in defining the Sale 126 sale area (see Fig. I-2).

The blocks that constituted the Sale 109 southern deferral alternative are not evaluated in this EIS because they are not part of the proposed sale area. The blocks that constituted the Sale 109 eastern deferral alternative either are not within the proposed sale area or are included within the blocks considered for deferral in the Point Lay Deferral Alternative. The northernmost boundary of the Sale 109 coastal deferral alternative coincides with the same boundary for the Point Lay Deferral Alternative; and, therefore, the nearshore blocks remaining after Area Identification are evaluated as part of the Point Lay Deferral Alternative.

(a) Buffer Area to Protect Coastal Areas: The deferral of blocks to provide a protective buffer around environmentally sensitive coastal areas also was proposed; the coastal areas include Cape Lisburne, Cape Lewis, Ledyard Bay, Kasegaluk Lagoon, Peard Bay, and Skull Cliff. As noted above, blocks along the coast from Peard Bay to Point Hope have been eliminated from the Sale 126 area. The deletion of these blocks should provide the proposed protective buffer.

(b) Suggestions for Other Deferral Alternatives: The following deferral alternatives were suggested during the scoping process for previous lease sales in the Chukchi Sea Planning Area:

-- There should be no leasing within 25 miles of the shore to protect subsistence hunting.

-- A 30- to 40-mile-wide buffer area off the coast should be deferred from leasing to protect resources and subsistence hunting.

-- There should be no leasing within 50 miles of shore to protect subsistence hunting.

-- The Peard Bay area should be deferred from leasing consideration because of its heavy use for subsistence purposes.

-- The entire area used by migrating bowhead whales should be deleted from the sale area.

-- Leasing should not occur in the flaw-lead zone.

-- Blocks within 12 miles of the Cape Lisburne bird rookery should be deleted.

-- The area within a 50-mile radius of Cape Lisburne should be deferred to protect the 35-mile-wide primary seabird feeding area, with a 15-mile-wide buffer area extending into the secondary seabird-feeding area.

-- The area from the 3-mile limit out to the western edges of the open-water lead system that recurs annually in the spring should be deferred to protect important coastal habitats and the Chukchi polynya.

-- The sale should be delayed for 2 to 3 years.

The areas recommended for deferral alternatives are included in the area of the Chukchi Sea Planning Area that was deleted from Sale 126 as a result of Area Identification or in the Point Lay Deferral Alternative that will be analyzed in the Sale 126 EIS. The effects of a time-delay alternative will be analyzed in Alternative III--Delay the Sale. A 3-year delay is considered in this analysis in order to accommodate a future time period comparable with the current time interval in Chukchi Sea lease sales, considering that Sale 109 was held in May 1988 and the subject lease sale is tentatively scheduled for late-1991.

II

ALTERNATIVES INCLUDING THE PROPOSED ACTION

II. ALTERNATIVES, INCLUDING THE PROPOSED ACTION

A. Introduction

1. Section Summary: This section contains (1) descriptions of Alternative I (low, base, and high cases)--the Proposed Action, Alternative II--No Lease Sale, Alternative III--Delay the Sale, and Alternative IV--the Point Lay Deferral Alternative; (2) summaries of the effects of Alternatives I and IV on physical and biological resources, social systems, and programs in and adjacent to the Sale 126 area; and (3) potential mitigating measures--including their purpose and effectiveness.

2. Resource Estimates: The methodology used for estimating resources is discussed in Appendix A (Resource Estimates). Differing assumptions regarding both economic and engineering factors will affect the estimate of recoverable resources. Economic factors include exploration and development costs, operating expenses, price and market value for oil and natural gas, taxes, depreciation, and royalty and production rates. Included among the engineering factors are reservoir thickness and area, properties of the hydrocarbon-bearing rocks, feasibility and effectiveness of pressure maintenance through secondary and tertiary recovery, well spacing, deviation in depth, climate, surficial geology, and other environmental factors affecting the design and technology of surface drilling, and development and production operations.

The undiscovered resources estimated to be leased in the Sale 126 area are reported by MMS for (1) a low case of 430 million barrels (MMbbl) of oil; (2) a base case of 1,610 MMbbl of oil; and (3) a high case of 3,540 MMbbl of oil (see Appendix A). These estimates (for the base and high cases) are conditional on the assumption that economically recoverable oil resources are present in the area. The marginal probability, estimated by MMS to be 0.21, indicates there is about a 21-percent chance of recoverable hydrocarbons being present in the unleased portion of the sale area.

The base case represents the most likely amount of unleased oil resources in the Chukchi Sea sale area estimated to be leased, discovered, and developed and produced as a result of Sale 126 if commercial quantities of hydrocarbons are discovered. As explained in Appendix A, this amount is derived from the unleased, conditional-mean estimate of 4,160 million barrels (MMbbl) of oil. The MMS estimates that about 39 percent of the 4,160 MMbbl of unleased oil are expected to be leased and developed in the Sale 126 area as a result of this lease sale. This represents approximately 1,610 MMbbl of oil available in the sale area. The low-case estimate is then derived by multiplying the 39-percent factor by the 95-percent conditional unleased estimate of 1,110 MMbbl. This amount, 430 MMbbl, is below the estimated minimum economic resource needed for development; therefore, only exploration activities are predicted for the low case. The high-case-resource estimate of 3,540 MMbbl represents a quantity of oil that is significantly higher than the base case; it is determined by multiplying the 5-percent conditional unleased estimate of 9,140 MMbbl by the 39-percent factor.

Sale 126 is the second OCS oil and gas lease sale in the Chukchi Sea; Chukchi Sea Lease Sale 109, was held on May 25, 1988. There are 350 active leases in the Chukchi Sea Planning Area, as a result of Sale 109, which comprise approximately 2.0 million acres (approx. 0.8 million hectares). To date, one exploration well has been completed and two exploration wells have been partially completed.

It is assumed that natural gas, if discovered, will not be economical to produce at this time or for the foreseeable future (see Appendices A and B). Several factors that make natural gas recovery prohibitively expensive include (1) the high cost of wellhead recovery associated with production; (2) the high cost to develop feeder and trunk pipelines; and (3) the high cost of infrastructure--including a liquefaction plant and shipping facilities, processing, and delivery to markets. However, in the unlikely event that gas does become economic, potential effects are described in Section IV.I, separate from the analysis of the effects of oil development and production elsewhere in Section IV.

The strategies used to explore, develop and produce, and transport the potential petroleum resources of the

Chukchi Sea area will vary. They will depend on many factors, any number of which may be unique to each leaseholder or operator. Because of these variables and because of the uncertainties with regard to the petroleum resources, there is no single development scenario possible. The strategies and technologies that are described in the exploration, development and production, and transportation scenarios (summarized in Table II-A-1) represent only some of the possible types of activities that might be used to exploit the petroleum resources of the Chukchi Sea. These strategies are used to identify characteristic activities and areas where these activities may occur; but they do not represent a recommendation, preference, or endorsement by the USDOI.

Appendix B provides an example of the degree of variability found in selecting developmental scenarios for the Chukchi Sea. Competing scenarios are described in Appendix B for both the base and high cases of the proposed action. In each case, scenarios are described for either constructing a pipeline to connect to the Trans-Alaska Pipeline (TAP) or constructing a pipeline to reach a marine terminal at Nome. The pipeline connection to TAP was chosen as a basis for analysis in both the base and high cases because (1) neither scenario showed a strong competitive advantage when analyzed purely on the basis of economic feasibility, and (2) the Nome scenario would require the acquisition of rights-of-way for a pipeline and accompanying service road through national-interest conservation lands as well as a variety of other land ownerships. Such noneconomic disadvantages of the Nome scenario prompted the choice of the TAP connection as the basic scenario for both the base and high cases of the proposal.

B. Alternative I - The Proposal

Alternative I would offer 4,319 blocks (approximately 9.58 million hectares or 23.68 million acres) of the Chukchi Sea Planning Area for leasing. This area represents the unleased part of the planning area that has been identified for further study. A total of 350 whole and partial blocks covering about 0.80 million hectares (about 1.98 million acres) in the study area have been leased as a result of the previous Chukchi Sea (Sale 109) oil and gas lease sale. Lease relinquishments received and approved by MMS prior to issuance of the NOS may result in additional areas being included in the lease sale. The blocks that comprise the proposed action are located about 3.5 to 200 nautical miles (about 6.5-370 km) offshore in water depths that range generally from about 98 to 263 feet (about 30-80 m). The MMS has estimated that the amount of oil expected to be discovered, and developed and produced, in Alternative I ranges from 430 MMbbl in the low case to 3,540 MMbbl in the high case, with a base case of 1,610 MMbbl. Natural gas also may be discovered; and, although it is not expected to be economical to produce for the foreseeable future, the effects of gas exploitation are discussed in Section IV.I.

1. Low Case:

a. Resource Estimates and Basic Exploration, Development and Production, and Transportation Assumptions for Effects Assessment: The resource estimate for the low case, 430 MMbbl, represents a quantity of oil that is less than an estimated minimum amount required to be discovered before development and production could occur. Because future recovery of resources estimated to be present in low quantities may depend on advances in technology and changes in economics, a considerable time interval might exist between exploration and future development and production of these resources. Therefore, only those activities associated with exploration would be undertaken. It is assumed that exploratory drilling would take place only during the open water season of the year. The levels of activities and timetable of events associated with the low case are shown in Table II-A-1 and Appendix B, Table 1.

Prior to drilling, the lessee/operator is required to conduct surveys to determine if shallow hazards are present at the proposed drill site; these surveys incorporate seismic profiling. The projected level of seismic activity is based on the nature and extent of the surveys that may be required (Notice to Lessees [NTL] 89-2, Minimum Requirements, Shallow Hazards Survey) and the predicted number of wells drilled. Seismic surveys of the exploration-well sites would be conducted during the open-water period. The seismic activity for the low case is estimated to cover a total of 368 km (227 statute mi).

Exploratory drilling is estimated to begin in 1992 with the drilling of two wells and end that same year. The amount of time required to drill and test each of the exploration wells is estimated to average about 90 days (Roberts, 1987) during the open water period. No exploratory drilling is anticipated during the spring, when the lead systems provide avenues for the northern migration of the bowhead whale. Upon completion of drilling and testing, the exploration wells will be plugged and abandoned in accordance with the requirements of 30 CFR Part 250.

Ice-strengthened floating drilling units with icebreaker support or arctic-class semisubmersibles are the most likely exploratory-drilling vessels to be used for Sale 126 (see Appendix B). With icebreaker assistance, the floating units are capable of operating in limited sea-ice conditions.

Drilling of each exploratory well will require the disposal of about 660 short tons (dry weight) of drilling muds and approximately 850 short tons (dry weight) of drill cuttings. The total amount estimated to be disposed for the 2 wells is about 1,320 short tons (dry weight) of drilling muds and about 1,700 short tons (dry weight) of cuttings. These materials will be disposed of primarily at the drill site under conditions prescribed by EPA's pollutant-discharge permit (see Rathbun, 1986; Clean Water Act of 1977, as amended [33 USC 1251 et seq.]).

Where possible, support and logistic activities will use, or upgrade, existing facilities. Major support for exploration drilling will be from Barrow, with additional support functions conducted from a shorebase facility located near the Wainwright airport. In 1992, a total of 3 barges are assumed to be located near the drill sites to supply materials that cannot be transported by helicopter. Helicopters are expected to be used to transport personnel and routine materials and supplies from the shorebase to the drilling units. It is estimated that a total of 180 helicopter flights will be flown in support of exploration drilling. This estimate is based on the assumption that there will be one flight per day for each drilling unit (the scenario assumes 2 drilling units operating simultaneously, with each unit drilling 1 exploratory well) during a 90-day operating window. A minimum of 3 helicopters is assumed to be employed while exploratory operations are being carried out.

The number of required support vessels for each drilling unit will depend, at least in part, on the type and characteristics of the unit and the sea-ice conditions. Exploratory drilling operations are assumed to be carried out only during the open-water season, which is assumed for analysis purposes to be represented by a 90-day drilling or operating period. Depending on ice conditions, 1 or more icebreaking vessels may be required to perform ice-management tasks for the floating units. Also, during the open-water season, it is estimated that there will be about 1 supply-boat trip per drilling unit per week; for exploration drilling, the total number of supply-boat trips is estimated (based on 90 days to drill a well) to be about 24. A total of 2 supply boats would be used in these operations. Estimates on the number of workmonths of direct OCS employment for each unit of work during the exploration phase are given in Appendix H, Table H-2.

b. Summary of Effects for the Low Case: The summaries presented in this section are based on the analyses in Section IV.B of this EIS. The types and levels of activities that might be associated with the low case for Alternative I are summarized in Table II-A-1 and described in the preceding section (Sec. II.B.1.a).

(1) Effects on Air Quality: Concentrations of criteria pollutants at the shoreline are expected to be ≤ 5 percent of available national standards or PSD increment. A very low effect on air quality is expected. Under the low case, operations and any accidental spills and emissions would be relatively small and well offshore. Air pollutants would be diffuse at the shoreline and unable to cause even local or short-term effects. Consequently, the effect of the low case on air quality is expected to be VERY LOW.

(2) Effects on Water Quality: The effects on water quality from exploration drilling and discharges associated with two wells would be minimal and temporary, occurring only during

actual drilling over a 1-year period. The effect of exploration discharges would persist only during actual discharge within the 100-m-radius mixing zone around each discharge point. Dissolved concentrations of trace metals would not exceed the acute marine- water quality criteria at the edge of the mixing zone. The effect on local and regional water quality is expected to be VERY LOW.

(3) Effects on Lower-Trophic-Level Organisms: The effects on lower-trophic-level organisms at the low-case level of exploration would be confined to the effects from placement of two different drilling rigs at two locations during a single year (1992). Seismic surveys needed for rig positioning would, based on test studies, have essentially no effect on this group of organisms. The limited volume and dispersal of drilling discharges would have a very low effect on lower-trophic-level-organism populations that are numerous and widely distributed over the Chukchi Sea Planning Area. The effect of the low case on lower-trophic-level organisms is expected to be VERY LOW.

(4) Effects on Fishes: The low case of oil exploration, wherein there is no development, could only marginally affect fishes through discharges associated with drilling operations. During a 1-year period, the two exploration wells would discharge drilling muds and fluids along with smaller volumes of other liquids and possibly formation waters. These discharges would not reach large areas of the marine environment, and their soluble components would be rapidly diluted and dissipated.

Seismic surveys required for rig siting have been tested on several fish species and found to have virtually no effect; therefore, further effects analysis is deemed to be unnecessary. The effect of the low case on fishes is expected to be VERY LOW.

(5) Effects on Marine and Coastal Birds: In the low case, effects on marine and coastal birds could result primarily from disturbance by aircraft and vessel operation during oil-exploration activities. Helicopter traffic between Barrow or Wainwright and drilling units would be the principal source of disturbance of waterfowl, shorebirds, and seabirds, especially during spring breakup and the open-water season when these bird populations occur in staging, migrating, or foraging concentrations in coastal and nearshore habitats. Such disturbance may affect survivorship by periodically disrupting the acquisition of energy reserves necessary for migration or breeding. Aircraft flights are not expected to pass over major seabird colonies at Capes Thompson and Lisburne. Operations during exploration are not expected to affect more than a few thousand birds or produce serious lasting effects. The overall effect of the low case on marine and coastal birds is expected to be LOW.

(6) Effects on Pinnipeds and Polar Bear: In the low case, effects on pinnipeds and polar bear could result from disturbance caused by operation of aircraft and vessels and by drilling activity. Most activity is likely to occur in the open-water season. Disturbance is not expected to result in significant injury or mortality, although increased stress may reduce survivorship of some individuals. Frequent aircraft flights are likely to displace most pinnipeds and polar bears from the vicinity of routinely traveled routes for the duration of the industrial activity. Vessel traffic coinciding with animal movements may interfere temporarily with local movements or migrations within a lead system, but there is no evidence that vessels would block or significantly delay migrations. The effect of the low case on pinnipeds and polar bear is expected to be LOW.

(7) Effects on Endangered and Threatened Species:

(a) Bowhead and Gray Whales: In general, the type and duration of any behavioral response from whales due to industrial noise and the specific distance at which this occurs are dependent on the activity of the whale, the activity of the vessel, the nature of the noise received, the time of year, the opportunities for space in which whales can move away, the individual differences in whale behavior, and the site-specific differences in underwater ambient noise and other factors associated with sound propagation. The specific response of any given whale and the distance at which it responds are dependent on how these factors combine to produce a perception of threat in the affected whale(s).

Exploratory operations are not anticipated to occur in the spring and thus would not affect bowhead whales, and only a small number of bowhead whales are likely to encounter noise during the fall bowhead migration because of their widespread distribution. Few gray whales are expected to encounter noise, since they tend to concentrate inshore of the Sale 126 area. Based on the assumptions discussed in Section IV.B.7, about 12.5 percent of the bowhead population could encounter exploration noise during the year when exploration occurs. The effect of industrial noise associated with exploration on bowhead and gray whales would be limited to local, short-term behavioral responses in only a portion of the whales that enter an industrial response zone. No changes in the overall distribution or the timing or route of the spring or fall bowhead or gray whale migrations are expected. Consequently, the effect of the low case on the bowhead and gray whale populations is expected to be very low.

(b) Arctic Peregrine Falcon: Due to the low level of activity associated with the low case and the very low level of expected interaction with oil and gas activities, the arctic peregrine falcon population is not likely to be affected by the low case. Consequently, the effect of the low case on the arctic peregrine falcon population is expected to be very low.

The effect of the low case on endangered and threatened species is expected to be VERY LOW.

(8) Effects on Belukha Whale: The effect of industrial noise associated with the low case on belukha whales is likely to be similar to that expected for other whales (local, short-term effects on a small percentage of the population). The expected rate of belukhas encountering exploratory noise in the low case is low. Consequently, the effect of the low case on the belukha whale population is expected to be VERY LOW.

(9) Effects on Caribou: In the low case, an onshore pipeline and road would not be built across the range of the Western Arctic herd to the TAP corridor, thereby removing virtually all potential disturbance from construction and vehicle traffic. Since relatively few caribou occur along the shoreline, helicopter-support traffic crossing the coast from a shore base to offshore drilling units is not likely to disturb a significant proportion of the herd. The effect of the low case on caribou is expected to be VERY LOW.

(10) Effects on the Economy of the North Slope Borough: In the low case, the gains in direct employment from Sale 126 would result from petroleum-exploration activities. These gains would be negligible relative to the NSB economy as a whole. Because of the low overall employment generated in this case, and because most of this employment would go to commuters from outside the region who would be living and working either offshore or at the Point Belcher enclave, the effect on employment in the NSB would be insignificant. The low-case projections are expected to have an insignificant effect on NSB property taxes and expenditures. No significant increases in onshore facilities related to oil exploration are expected. The NSB has the ability to tax only onshore facilities. The effect of the low case on the economy of the NSB is expected to be VERY LOW.

(11) Effects on Subsistence-Harvest Patterns: The low case of the proposed action uses an exploration-only scenario. Accordingly, the subsistence-use areas of the affected communities would not be exposed to large-scale construction activities. Further, exploratory-drilling activities are expected to occur during the open-water season (June-August); thus, drilling would occur only on the fringes of either the spring or fall bowhead migration. For this important subsistence resource--as for other aquatic and terrestrial resources--the effects of this sale are projected to be very low. Hence, the overall effect of the low case on the subsistence-harvest patterns of the affected communities also is expected to be VERY LOW.

(12) Effects on Sociocultural Systems: The sociocultural systems of the sale-affected area would suffer few effects as a result of the low case. Since this is an exploration-only scenario, the effects on subsistence-hunting patterns would be very low and the number of workers involved in field activities would be low. There would be no road connection between the Point Belcher support base and

Wainwright; and, in general, there would be little interaction between the migrant oil workers and community residents. Hence, the agents needed to change or even significantly affect the Inupiat sociocultural system could not be generated by this action. The overall effect of the low case on the cultural systems of the affected communities would be VERY LOW.

(13) Effects on Archaeological Resources: The effects of the low case would be due to (1) the low probability that offshore archaeological resources could survive the effects of the physical forces in the sale area in all but a few locations, and (2) the assumption that only exploration activities would occur for the low case. Archaeological resources in the sale area would be affected by low-case (no oil) offshore exploration, no construction of onshore support facilities, and no visits to archaeological-resource sites by OCS-related employees (employed directly by oil companies and indirectly by various types of support companies). The effect of the low case on archaeological resources is expected to be LOW.

(14) Effects of Land Use Plans and Coastal Management Programs: In the low case, no development is assumed within the NSB in order to support offshore-exploration activities. As a result, no conflict with land use or the NSB Land Management Regulations (LMR's) is anticipated. The statewide standards and NSB district policies of the Alaska Coastal Management Program apply to all activities that occur within the coastal boundaries of the NSB or directly affect the use or resources of the coastal zone. Noise and disturbance were identified in Sections IV.B.1 through IV.B.12 as the primary source of conflict in the low case. Horizontal and vertical buffers may be required to avoid conflict with the NSBCMP Policy 2.4.4(a). Noise also could disrupt the bowhead whale harvest. If the harvest for any of the communities were disrupted in a year when the whaling season was short due to weather, the possibility exists that the harvest would be unavailable for that season. However, conflict with this policy is unlikely because only exploration is anticipated in the low case, and exploration drilling in the Chukchi Sea most likely would occur during the open-water season. Subsistence hunting for bowhead whales should be completed by that time. Significant disturbance is not anticipated and conflict with NSB policies that address noise and subsistence (e.g., 2.4.3[b]) is not anticipated. For the low case, the potential for conflict with land use plans and coastal management programs is expected to be LOW.

(15) Effects on Wetlands: Under the low case, 25 to 30 hectares of wetlands would be filled in with gravel for the exploration-support base assumed to be developed and located at Wainwright. Neither oil development nor an onshore-pipeline-road corridor would be developed under the low case. The effect of the low case on wetlands is expected to be minimal.

2. Base Case:

a. Resource Estimates and Basic Exploration, Development and Production, and Transportation Assumptions for Effects Assessment: The base-case-resource estimate, 1,610 MMbbl, represents the most likely amount of oil resources estimated to be leased, discovered, and developed and produced in the Sale 126 area. The base-case-resource estimate was used to formulate the primary oil development scenario for the Sale 126 area.

(1) Timing of Activities: The level of activities and scheduling of events associated with the base case for Alternative I are shown in Table II-A-1 and Appendix B, Table 2. Exploratory drilling is estimated to begin in 1992 and continue through 1998. The first delineation well is expected to be drilled in 1993 (during the second drilling season). A total of 39 exploration and delineation wells are assumed to be drilled between 1992 and 1998. Production-platform installation and pipeline laying are estimated to begin in 2000 and continue through 2002. The drilling of production and service wells is assumed to begin in 2000 and continue through 2004, with a total of 214 wells being drilled. Production is anticipated to begin in 2002 and continue through 2020. Schedule assumptions are based on average conditions where large portions of the sale area can be ice-free for 90 days. However, the drilling season can be shortened considerably during years with heavy ice. Other factors that could affect the timing of activities include severe weather patterns that generate major wind or wave action and environmental regulations or

stipulations that affect drilling.

(2) Activities Associated with Exploration Drilling:

(a) Seismic Activity: In support of the proposed exploration and production activities, the lessee/operator is required to conduct surveys of sufficient detail to define shallow hazards or the absence thereof; these surveys should incorporate seismic profiling. The projected level of seismic activity is based on the nature and extent of the surveys that may be required (NTL 89-2, Minimum Requirements, Shallow Hazards Survey) and the predicted number of wells drilled. Surveys of the exploration- and delineation-well sites would be conducted in the ice-free seasons during the years of the exploration phase. Based on past experience, it is assumed that one-half of the well sites would be covered by a site-specific survey that generates 63 km (39 statute mi) of data; the remaining sites would be covered by a block-wide survey that generates 305 km (188 statute mi) of data. These surveys usually are conducted 1 year prior to drilling. Surveys would be done during the open-water period, probably concentrated in August and September. The average time needed to survey each site is 1 week, allowing downtime for bad weather and equipment failure. For the purposes of this EIS, site-specific surveys are assumed to be conducted for 20 of the exploration- and delineation-well sites; and block surveys are assumed for 19 exploration- and delineation-well sites. The total trackline distance would equal 7,055 km (4,352 statute mi).

(b) Exploration Drilling: Water depth will be a significant factor in selecting the appropriate drilling unit. The Sale 126 area is generally between 30 and 50 m deep, although depths of 80 m are present in a small portion of the northwest corner of the sale area (Truett, 1984). Existing bottom-founded units can be extended to reach a maximum depth of 22 to 30 m. Drillships can drill in deep water; their limitation is a minimum operating depth of 16 to 20 m (Alaska Oil and Gas Association [AOGA], 1987). The use of existing drillships would enable drilling to begin using systems that offer proven technology and procedures, and would allow exploration to proceed without construction delays.

Floating Drilling Units: Drillships can be used in waters deeper than 16 m (AOGA, 1987). The major disadvantage of the present class of ice-strengthened drillships is that they can operate for only a relatively short period of time because of ice conditions in the sale area. For the purpose of this scenario, it is assumed that ice presence would limit the average length of time that ice-strengthened drillships, typically supported by an icebreaker and 2 icebreaking supply vessels, could operate in the Chukchi Sea to about 90 days--primarily August, September, and October (Stringer, Zender-Romick, and Groves, 1982; Truett, 1984). The average time for operating could be reduced further if restrictions on downhole operations were imposed during the fall bowhead whale migration (September-November) or gray whale feeding periods (June-October). However, considerable differences exist in the duration of the open-water period between the southern and northern portions of the sale area; and conditions can vary from year to year. In average years, ice breakup in the southern Chukchi Sea begins in mid-June. Open-water conditions in the Chukchi Sea typically prevail by August. Freezeup in the northern Chukchi Sea usually begins in late October and rapidly continues southward (Truett, 1984) (see Sec. III.A.4 for details). Drilling, testing, and evaluating each well could require 1 to 2 drilling seasons.

The Kulluk, a Conical Drilling Unit (CDU), is another floating unit available for drilling in arctic waters 16 to 60 m deep (AOGA, 1987). It was designed to break ice up to about 1 m thick. With icebreaking capability and a conical shape, a CDU such as the Kulluk should be able to drill and test up to two wells during its expected operational period.

Ice-strengthened, floating drilling units would not overwinter in the sale area. Existing units are not designed to withstand the forces of thick, multiyear ice; and there are no harbors along the Alaskan Chukchi Sea coast where drillships or other relatively deep-draft vessels could move during the winter. To achieve the longest drilling season, drillships would enter and depart the sale area from the south. Breakup occurs earlier and freezeup later in the southern portion of the Sale 126 area. The presence of ice close to shore in the northern portion also is extended as a result of the convergence of the westward-drifting pack ice of the

Beaufort Sea at Point Barrow.

Bottom-Founded Drilling Units: Bottom-founded mobile drilling units rest either on the seafloor or on manmade berms. The Concrete Island Drilling System (CIDS) is placed directly on the seafloor in water depths of 10.5 to 18m (AOGA, 1987). A steel mat, permanently incorporated into the Single Steel Drilling Caisson (SSDC) in 1986, increased the operating depth to 23 m (AOGA, 1987). Operating depth can be further increased if the SSDC is placed on a gravel berm (Tenneco Oil, 1985). The SSDC has been used in the Canadian Beaufort Sea shear (stamukhi) zone, the CIDS in 15 m of water in the Alaskan Beaufort Sea. However, CIDS technology can be extended to water depths of 30 m. Both units use seawater as ballast; both have onboard monitoring systems to give an indication of sea-ice pressures and forces; and both can create grounded-ice barriers around the unit to dissipate the forces of moving sea ice. Drilling from these units can occur year-round. Crews for moving bottom-founded mobile drilling units to new locations could be onsite approximately 2.5 months during the ice-free season, depending upon the amount of time needed to prepare the site for the unit (Han-Padron, 1985). The actual move could take between 1 and 2 weeks.

(c) Drilling Muds and Cuttings: Drilling of each exploratory well will require the disposal of about 660 short tons (dry weight) of drilling muds and approximately 850 short tons (dry weight) of drill cuttings (see Appendix B). The total amount of muds and cuttings estimated to be disposed is about 25,740 short tons (dry weight) of drilling muds and 33,150 short tons (dry weight) of cuttings for the 39 exploration and delineation wells assumed to be drilled in the Sale 126 area. These materials will be disposed of primarily at the drill site under conditions prescribed by EPA's NPDES (see Rathbun, 1986; Clean Water Act of 1977, as amended [33 USC 1251 et seq.]).

(d) Support and Logistic Activities: The following assumptions for supporting exploration activities are speculative. They reflect what has been done in the past, but a number of factors could change in the future. Both types of exploratory-drilling units--drillships and bottom-founded units--store drilling supplies for one to three wells. It is assumed that drillships would be resupplied while in port during the winter season. Bottom-founded units are assumed to be resupplied during the open-water season; supplies would be offloaded from barges directly onto the drilling unit (see Table II-B-1 for details on barge requirements). In the Beaufort Sea, resupply typically occurs when drilling has been shut down during the whale migrations. Groceries and emergency supplies would be transported by helicopter. As a result, the requirement for supply boats to be maintained in the area probably would be quite limited and could be fulfilled by the ice-management vessels that support drillship operations. This would minimize the amount of onshore support activity and investment in permanent facilities and equipment (ERE Systems, Ltd., 1984).

One icebreaker and 2 ice-strengthened support/supply boats generally have been used in the Beaufort Sea to support each drillship operation; a comparable level of support has also been used in the Chukchi Sea. A total of 312 supply-boat trips are estimated to take place during exploration, based on the assumption of 1 supply-boat trip per drilling unit per week (of a 90-day drilling period). The number of annual supply-boat trips are estimated to range from 24 to 60 per year, depending on the number of drilling units in operation. Three to 6 tugs would be required to relocate bottom-founded units (AOGA, 1985); tugs assisting with the sealift probably could be used. Icebreaker assistance could be needed in years with unusual ice conditions. Between 1992 and 1998, up to 5 drilling units would be in use during any one year. Only 2 drillships are likely to be operating during any single season; the remaining units would be bottom-founded. At least 2 ice-management vessels would be present for each floating drilling unit during exploration (1992-1998) based on past experiences and commitments by lessees in the Beaufort and Chukchi Seas. These vessels are assumed to accompany a drillship into the lease area in August and depart in October, assuming typical ice conditions and the present class of drillships. Any unit used for year-round drilling would require extended support for personnel and equipment. Most of this support could be handled with helicopters. However, icebreaking work/supply boats, air-cushioned vehicles, and rolligons also could be used.

Air support would be used primarily for crew changes, delivery of perishable goods, and visits by inspection personnel. For most of the sale area, personnel and air freight are assumed to be transferred to helicopters at either the Barrow or Wainwright airport. Barrow's paved airport, equipped with a complete instrument-landing system, is owned and operated by the State and has regularly scheduled, daily jet service as well as air-taxi service. The airport has an FAA Flight Service Station , passenger terminal, cargo building, office buildings, and minor-repair services; fuel and oil are available. Wainwright's gravel airfield is owned and operated by the North Slope Borough.

The existing facilities at Barrow and Wainwright are adequate to handle the projected needs during exploration. Military airfields also are available in both communities. If the airfields at Barrow and Wainwright are too far north to support exploration, the abandoned airstrips at Icy Cape or Cape Beaufort could be upgraded; or the Kotzebue airport could be used. Like Barrow, Kotzebue is a trunk airport with regularly scheduled jet service and airport facilities. Arrangements also could be made to use the U.S. Air Force airstrip at Point Lay. Based on exploration practices elsewhere in Alaska, a minimum of 1 helicopter per drilling unit with a minimum of 1 additional helicopter for every 2 drilling units generally are assumed to be used to service drilling in the sale area (AOGA, 1985; ERA Aviation Center, Inc., 1985, oral comm.). Therefore, 3 to 7 helicopters are assumed to service the Sale 126 area. During the peak years of exploration effort (1992-1995), there could be a maximum of 150 flights per month, based on the assumption of 1 helicopter trip per day per platform (see Table II-A-1). A total of 2,340 helicopter flights are estimated to be flown in support of base-case-exploration drilling.

Portable housing and ancillary facilities for onshore support personnel and a workshop and warehouse would require approximately 10 hectares (Han-Padron, 1985). These facilities probably would be located near the Wainwright airport. Estimates on the number of workmonths of direct OCS employment for each unit of work during the exploration phase are given in Appendix H, Table H-3.

(3) Activities Associated with Development and Production: Assumptions associated with development and production strategies for the base case are highly speculative. Because of this, the scenario described here is meant to be characteristic of the type of development that could accompany production. Under this scenario, work on offshore and onshore production and transportation facilities would not begin until the engineering and economic assessments of the potential reservoirs have been completed and the conditions of all the permits have been evaluated. As shown in Appendix B, Table 2, the first delineation well is projected to be drilled in 1993; the first oil discovery in the Sale 126 leased blocks could be in 1993. Production is assumed to peak between 2003 and 2007 at 135 MMbbl a year and cease in 2020.

(a) Seismic Activity: A three-dimensional, multichannel seismic-reflection survey would be conducted for each of the 6 production platforms. Surveys for each platform are assumed to cover approximately 62 km^2 (38 mi^2), assuming an anticipated average drilling depth of 8,000 ft. Using a 76-m (250-ft) grid spacing pattern, each platform would require a survey of 1,658 km (about 1,023 statute mi) or a total of 9,948 km (about 6,138 statute mi) for the 6 platforms. Site-specific surveys required for siting each production platform would contribute an additional 379 km (234 statute mi), for a total seismic- survey distance of 10,329 km (6,372 statute mi). Individual platform sites may be surveyed several years prior to installation of the platforms; surveys would be conducted during the open-water period.

High-resolution seismic-reflection data (HRD) for shallow hazards would be collected prior to laying the offshore pipeline. The total trackline distance, estimated to be four times the length of the pipeline assumed for the scenario, would equal approximately 1,135 km (about 700 statute mi).

(b) Production Platforms: Assuming commercial discoveries in the sale area, production platforms most likely would be bottom-founded structures, such as inverted, cone-shaped, gravity-based concrete structures suitable for extreme ice conditions (see Appendix B). Construction and outfitting of the platforms would occur in ice-free harbors in the North Pacific Ocean. After staging, the platforms would be towed and installed during the open-water period. Drilling of development wells could begin after 50 percent of the facility hookup was complete and while production facilities were being readied for operation (AOGA, 1985;

Table II-A-1
Summary of Basic Scenario Assumptions Regarding Estimated
OCS-Related Activities in the Chukchi Sea Planning Area
and Arctic Region Planning Areas for Sale 126
(Page 1 of 2)

PHASE Facility or Event	Chukchi Sea Planning Area Alternative I Low Case[1] Number or Amount	Time-frame	Alternative I- Base Case[2] and Alternative IV[3] Point Lay Deferral Number or Amount	Time-frame	Alternative I High Case[4] Number or Amount	Time-frame	Arctic Region Planning Areas Cumulative Case[5] Number or Amount
EXPLORATION							
Total Annual Number of Barges			see Table II-B-1		see Table II-B-2		
Work Force--Direct OCS Employment (see Appendix H)							
Exploration- and Delineation-Well Drilling		1992		1992-1998		1992-2001	
Number of Wells - Total	2		39		53		68
Support Helicopter Flights	180		2,340		3,240		6,120
Supply Boat Trips	24		312		432		
Total Drilling Muds and Cuttings Disposed of							
Drilling Muds--Short Tons	1,320		25,740		34,980		42,840
Cuttings--Short Tons	1,700		33,150		45,050		55,760
Seismic Surveys							
Total Distance Covered--km (mi)	365 (227)		7,055 (4,352)		9,631 (5,941)		12,512 (7,718)
DEVELOPMENT AND PRODUCTION							
Total Annual Number of Barges			see Table II-B-1		see Table II-B-2		
Work Force--Direct OCS Employment (see Appendix H)							
Number of Platforms			6		12		11
Installation				2000-2002		2000-2002	
Production- and Service-Well Drilling				2000-2004		2001-2005	
Number of Wells			214		472		685
Production							
Total--MMbbl			1,610	2002-2020	3,540	2003-2021	5,480
Peak Yearly--MMbbl			135	2003-2007	297	2004-2008	
Support Helicopter Flights							
During Development Drilling			9,630		21,240		30,825
After Development Drilling			11,856		23,712		
Seismic Surveys							
Total Distance Covered--km (mi)			10,329 (6,372)		20,652 (12,744)		20,394 (12,675)

Table II-A-1
Summary of Basic Scenario Assumptions Regarding Estimated
OCS-Related Activities in the Chukchi Sea Planning Area
and Arctic Region Planning Areas for Sale 126
(Page 2 of 2)

	Chukchi Sea Planning Area						Arctic Region Planning Areas
	Alternative I Low Case[1/]		Alternative I-Base Case[2/] and Alternative IV[3/] Point Lay Deferral		Alternative I High Case[4/]		Cumulative Case[5/]
PHASE Facility or Event	Number or Amount	Time-frame	Number or Amount	Time-frame	Number or Amount	Time-frame	Number or Amount
Total Drilling Muds and Cuttings							
Disposed of							
Drilling Muds--Short Tons			23,540-149,800		51,920-330,400		102,750-465,800
Cuttings--Short Tons			197,950		436,600		808,300
TRANSPORTATION							
Oil Pipelines							
Installation				1999-2001		2000-2002	
Offshore Length--km (mi)			325 (200)		325 (200)		
Onshore Length--km (mi)			640 (400)		640 (400)		
Road Length[6/]--km (mi)			640 (400)		640 (400)		
OIL SPILLS							
Assumed for Analysis, ≥1,000 bbl							
Offshore Arctic	0		2		4		10
Prince William Sound and Gulf of Alaska	0		0		0		15
Assumed for Analysis, Offshore ≤1,000 bbl							
No. of Spills	0		380		830		
Total Oil--bbl	0		5,300		11,700		
Assumed for Analysis, Onshore[7/]							
No. of Spills 2-23 bbl (6-bbl avg.)			121		121		
Total Oil--bbl			730		730		
No. Spills 24-239 bbl (98-bbl avg.)			45		45		
Total Oil--bbl			4,410		4,410		
No. Spills >239 bbl (1,500-bbl avg.)			22		22		
Total Oil--bbl			33,000		33,000		

1/ Appendix B, Table 1.
2/ Appendix B, Table 2.
3/ Appendix B, Table 4.
4/ Appendix B, Table 3.
5/ Appendices A and B.
6/ The kilometers (mi) of road associated with the onshore pipeline is estimated to equal the length of the pipeline. Road construction would occur at about the same time as the pipeline is installed.
7/ Calculated from projected pipeline-spill statistics for the National Petroleum Reserve-Alaska (USDOI, BLM, NPR-A, 1983).

Exxon Company, U.S.A., 1985).

(c) Development Drilling: It is estimated that a total of 214 production and service wells would be drilled from 6 platforms from 2000 through 2004. Drilling of the production and service wells would use from 110 to 700 short tons (dry weight) of drilling muds per well. Some of the muds used in drilling production and service wells may be recycled through each subsequent well drilled on a particular platform. Depending on the quantity recycled, the amount of drilling muds disposed could range from 23,540 to 149,800 short tons (dry weight) for all wells drilled. Each well also is expected to produce approximately 925 short tons (dry weight) of drill cuttings, with the total amount of cuttings disposed of amounting to about 197,950 short tons (dry weight). The disposal of drilling muds and cuttings would be in accordance with approved EPA NPDES permits for development-well drilling; muds and cuttings also may be transported to shore and disposed of at approved sites.

(d) Support and Logistic Activities: As delineation drilling continues, support for the development of the field would shift to Point Belcher. The National Petroleum Council (NPC) identified Point Belcher as a likely site for a pipeline landfall (National Petroleum Council, 1981). It is assumed for this scenario that oil fields developed in the Chukchi Sea would be located so that Point Belcher would be a viable onshore location. An advantage to locating the landfall at Point Belcher is its proximity to Barrow, Wainwright, and the western portion of the proposed Beaufort Sea Sale 124 area. Airfields and facilities in these communities would provide alternatives in case of emergencies and also would enable the shift from existing to new infrastructure to occur more gradually, but in sufficient time to prevent overtaxing the infrastructure in those communities. A road connection between the support base and Wainwright would facilitate the shift.

The 25- to 30-hectare hypothetical service base at Point Belcher is assumed to provide base-camp facilities for development drilling and pipeline laying. A 1,900-m airstrip is assumed to be constructed to serve the facility. Gravel bases for all the facilities assumed in the scenario probably would require approximately 500,000 m^3 of gravel (Han-Padron, 1985). In addition to housing, the camp is assumed to have facilities for eating, recreation, health care, laundry, and offices. The service base is assumed to have storage for drilling, pipelaying, and other construction needs; facilities for maintaining onshore and offshore equipment and infrastructure; utilities; and onshore support for produced oil, such as pumping stations and storage. Prefabricated modules for the hypothetical shorebase would be delivered to Point Belcher by barges (see Table II-B-1). In 2003, the year of peak barge activity, 53 barges are assumed to be included in the Chukchi sealift. About one-half of these barges are assumed to offload directly onto a production platform.

If a shorebase were constructed at Point Belcher, barges could be offloaded either on the beach at Point Belcher or in Peard Bay. Use of Peard Bay is not assumed because of the potential that Peard Bay is underlain with permafrost; construction of marine facilities or moorage areas in Peard Bay is dependent upon deepening a channel across the sill to the center of the bay, where the water depth is adequate. Dredging in areas of permafrost may lead to subsidence along the shoreline; therefore, dredging of the channel would be possible only if the area to be dredged were free of permafrost. If Peard Bay were used for marine support, a road would be constructed between Peard Bay and Point Belcher.

Installation and hookup of the production platforms during the development stage would be supported by 2 supply boats and 1 helicopter per platform. Two platforms are scheduled to be installed during 2000, 2001, and 2002 (see Appendix B, Table 2), with heavy supplies being transported by barges (see Table II-B-1). During production, 2 icebreaker-support/supply boats and 2 helicopters would be dedicated to the sale area.

An additional support/supply boat and helicopter would be available for backup.
The number of helicopter flights to be flown in support of drilling 214 production and service wells is estimated to total 9,630 between 2000 through 2004, based on an average of 0.5 flights per well during the drilling period or 45 trips per well. The number of flights would range from 360 in 2000, when 8 wells would be drilled, to 3,600 in 2003, when 80 wells would be drilled. From 2002 to 2020, it is estimated that the number of helicopter flights to production platforms would average about 2 per week per platform, or 11,856

Table II-B-1
Barge Requirements for Exploration, Development, and Production
for the Chukchi Sea Sale 126 Base Case and the Point Lay Deferral Alternative

Year	Drilling Support[1/] Dry Goods	Drilling Support[1/] Fuel	Transporting Offshore Pipelines[2/]	Transporting Onshore Pipelines[3/]	Transporting Facility Modules[4/]	Total Annual Number of Barges
1991	0	0	0	0	0	0
1992	2	1	0	0	2	5
1993	4	3	0	0	4	11
1994	3	2	0	0	3	8
1995	3	2	0	0	3	8
1996	2	1	0	0	2	5
1997	1	1	0	0	1	3
1998	1	1	0	3	4	9
1999	0	0	4	3	7	14
2000	2	1	3	3	8	17
2001	10	7	3	0	13	33
2002	15	10	0	0	15	40
2003	20	13	0	0	20	53
2004	6	4	0	0	6	16
2005-2020	13/yr[5/]					13/yr

Source: USDOI, MMS, 1990.

1/ Barge requirements are based on an average barge capacity of 4,373 metric tons (4,820 short tons). Each exploration well is assumed to require 1,653 metric tons (1,822 short tons) of dry goods while each production well is assumed to require 1,092 metric tons (1,204 short tons). Fuel supplies require two-thirds the number of barges as dry goods.

2/ Assumes 250 tons of material per mile of pipeline with an average barge capacity of 4,373 metric tons.

3/ Barge requirements for delivering onshore pipe are based on the average barge capacity of 4,373 metric tons, typical of other barges loaded for onshore support activities (ERE Systems, Ltd., 1984). One-half the pipeline requirement for onshore pipelines would be delivered by barge. Pipelines for onshore construction would be delivered 1 year prior to installation (ERE Systems, Ltd., 1984).

4/ The number of barges historically needed for transporting prefabricated units has totaled the number used for dry drilling supplies, including pipelines (Berger, 1985, as cited by ERE Systems, Ltd., 1984).

5/ Limitations on maritime shipping are similar for the Beaufort and Chukchi Seas. Therefore, the split between marine and truck shipping is considered comparable. Once production began at Prudhoe Bay, barge traffic ranged from a low of 2 barges in 1979 to a high of 26 barges in 1983 and averaged about 13 per year. Therefore, the number of barges used during production in the Chukchi Sea is assumed to be 13.

flights.

Estimates on the number of workmonths of direct OCS employment for each unit of work during the development and production phase are given in Appendix H, Table H-3.

(4) Activities Associated with Oil Transportation: The transportation scenario for the base case assumes a pipeline connection to the Trans-Alaska Pipeline (TAP). This is the same scenario used for the earlier Chukchi Sea Sale 109 base case. The conditions for constructing such a pipeline--described in the Sale 109 FEIS (USDOI, MMS, 1987b)--are summarized here.

Use of the TAP has several advantages: (1) large quantities of oil could be transported; (2) under normal conditions, no produced oil would be stored offshore; (3) the technology for laying onshore pipelines in the Arctic is known; (4) current North Slope Borough (NSB) "best-efforts" land management policies prohibit development that accommodates petroleum transportation via marine tankers (NSB 19.80.031[j]); and (5) once the oil is onshore, future risks to arctic marine mammals would be virtually eliminated. Economic disincentives to use of the TAP typically are related to the assumption that a second pipeline would need to be constructed parallel to the existing pipeline, and that future tariffs would continue at current levels. This scenario assumes adequate capacity within the existing pipeline and relies on the fact that not all firms consider the TAP tariff to be a drawback to its use (Exxon Company, U.S.A., 1985). Construction costs for the pipeline to the TAP could be moderated if they were shared by companies also interested in transporting oil from the western Beaufort Sea and the National Petroleum Reserve-Alaska (NPR-A) to the TAP.

The total pipeline project of approximately 965 km (approx. 600 mi) is assumed to come onshore in the vicinity of Point Belcher and continue eastward to TAP Pump Station No. 2. Pipeline construction is assumed to begin in 1999 and end in 2001 (see Appendix B, Table 2). The project includes a 325-km (200-mi) offshore trunk and lateral gathering system and a 640-km (400-mi) onshore elevated pipeline.

The onshore pipeline would follow the best alignment from the landfall site to approximately the 200-m contour (generally north of the east-west segment of the Kigalik River and Maybe Creek), cross the Colville River near Umiat, and connect with the TAP at Pump Station No. 2. The pipeline route would vary if production within the NPR-A or the Beaufort Sea could be facilitated or gravel sources were better or more accessible with a different alignment. Gravel sources are fairly limited in the northern portion of the NPR-A. Potential sources of gravel would be abandoned stream channels above the flood stage, especially in the drainage of the Ikpikpuk River, and quarried bedrock, especially in the foothills. A potential gravel source near Point Belcher would be old beach deposits or old alluvial terraces around the Kuk River.

Approximately 10 rivers and large tributaries would be crossed. The road that would parallel the pipeline to Pump Station No. 2 is assumed to be maintained as a private road. Four onshore pump stations are assumed for the new pipeline, and one offshore booster station possibly would be required. Helipads typically would be located at each construction camp along the route (located about every 100 km) and at each pump station. Approximately 10 to 12 helipads are assumed to be built, and at least one helicopter flight a day to each active camp is assumed. These onshore-infrastructure facilities would produce the loss or alteration of wetlands and low- to medium-density-tundra habitat through gravel burial of tundra and changes in water drainage, such as through water impoundments created by road construction.

The offshore segment of the pipeline would be installed by bottom-tow or lay barges. Assuming that a lay barge is used, the period of time during which the barge could operate in the northeastern Chukchi Sea could be limited to about 70 days; but operations could be extended with icebreaker support (Dames and Moore, 1982; Han-Padron, 1985). The season also could be extended if large semisubmersible or ship-shaped lay barges were ice-strengthened and had a modified mooring system for operating in ice, a heat-recovery system, and enclosed work areas (Han-Padron, 1985). The shoreward end of the offshore pipeline could be laid during the winter from the ice in the landfast-ice zone. Pipe supplies for the offshore segment would arrive with the lay barge.

Subsidence along an offshore-pipeline route is not expected to be a major problem, since the soils of the Chukchi Sea tend to be well consolidated. However, during the seismic survey for the pipeline, if soils were found to be potentially susceptible to subsidence resulting from permafrost degradation, the pipeline probably would be coated with a layer of insulation to retard the subsidence (Swanson, 1986, oral comm.).

To protect the pipe from collisions with drifting ice masses, the pipeline is assumed to be laid in a trench cut into the seafloor. Pipeline placement below the level of ice gouging would be required in the areas where ice gouging could occur. If the trench were laid in unconsolidated sediments of the seafloor where ice scouring is evident, the pipeline might have to be covered with fill material. In areas where the sediment layer is thin or absent, the trench might have to be cut into the bedrock; a pipeline laid in a bedrock trench might not have to be covered.

Pipelines from the six platforms are assumed to converge offshore and come onshore at one landfall site. The onshore-pipeline section could be buried beneath the beach or in a berm, or it could rise over the shoreline on a truss structure supported by columns.

b. Summary of Effects for the Base Case: The summaries presented in this section are based on the analysis in Section IV.C of this EIS. The types and levels of activities that might be associated with the base case for Alternative I are summarized in Table II-A-1 and described in the preceding section (Sec. II.B.2.a).

(1) Effects on Air Quality: Concentrations of criteria pollutants at the shoreline are expected to be less than 5 percent of available national standards or PSD increments. A very low effect on air quality is expected. The effects of air pollutants--other than those addressed by air quality standards--could cause short-term, local effects on vegetation from a coating of soot. Consequently, a very low effect--other than with respect to standards--is expected. The effect of the base case on air quality as a result of exploration and development and production is expected to be VERY LOW.

(2) Effects on Water Quality: In the base case, water quality degradation could result from discharges, construction activities, and oil spills. Discharges of muds and cuttings are regulated by the EPA such that water quality criteria must be met at the edge of an EPA-established mixing zone. The effect of exploration- and production-drilling muds and cuttings discharges would persist only during actual discharge within the 100-m-radius mixing zone around each discharge point. Concentrations of trace metals would not exceed the acute marine-water quality criteria at the edge of the mixing zone. The effect on local and regional water quality is expected to be very low.

If formation waters were discharged, the effect on water quality would be local and would continue for the life of the field. The effect on local water quality is expected to be moderate, while the effect on regional water quality is expected to be very low.

Effects on water quality from dredging (and dumping) would be local and short-term. Turbidity would increase over a few square kilometers in the immediate vicinity of dredging operations only during actual dredging. Effects on local water quality are expected to be low, while the effect on regional water quality is expected to be very low.

Sustained degradation of water quality to levels above State and Federal criteria from hydrocarbon contamination is unlikely. Hydrocarbon concentrations from the two estimated oil spills of $\geq$ 1,000 bbl could exceed the chronic criterion of 0.015 ppm total hydrocarbons on at least several thousand square kilometers for a short period of time. Concentrations above the acute criterion are not anticipated. Effects of an oil spill on water quality are expected to be low both locally and regionally.

The overall effect of the base case on water quality as a result of exploration and development and production is expected to be MODERATE locally and LOW regionally.

(3) Effects on Lower-Trophic-Level Organisms: The lower-trophic-level organisms of the Sale 126 area could be affected by oil spills, drilling discharges, seismic disturbance, and offshore construction associated with the base case.

During the exploration phase of the base case, 39 exploration and delineation wells would be drilled using a maximum of 5 drilling rigs. This phase would occur during the period 1992 through 1998. Exploration-drilling discharges would total about 59,000 short tons. Any offshore construction during this period would occur in association with drilling rig placement and related seismic surveys.

Drilling discharges would affect only those lower-trophic-level organisms in close proximity to the discharge point. Any components toxic to lower-trophic-level organisms are rapidly diluted, limiting their effect to no more than a few tens of meters from the discharge point.

Construction and seismic surveys for exploration are limited for the former and with essentially no effect for the latter; therefore, both would have very low effect on lower-trophic-level organisms. The effect of the exploratory phase of the base case on lower-trophic-level organisms would be very low.

Oil spills are the major agent likely to cause effects on lower-trophic-level organisms during development and production. Oil spills, however, are expected to have very low effects on marine plants and invertebrates, since most of these organisms are distributed over much of the Chukchi Sea and the populations are large in number, with generally high reproduction rate and resulting high population numbers. Those organisms that inhabit nearshore, shallow environments are more at hazard from oil spills; however, the combined oil-spill-risk analysis does not show appreciable inshore areas as being contacted by oil spills.

Base-case-level effects from seismic exploration, drilling discharges, and offshore construction would be very localized during development production. Seismic-survey acoustic-energy devices now in use are essentially noninjurious to pelagic life, except for those few organisms in very close proximity to the point of energy discharge. Drilling discharges likewise have a limited spatial effect on marine life.

Offshore-construction activities (e.g., dredging and pipeline laying) could have a mixed effect on benthic communities--in the short term, damage to the organisms; in the long term, substrate changes may enhance habitat for some species.

Kelp beds in the Chukchi Sea may be limited in size and number and, therefore, more vulnerable to the effects of offshore oil and gas exploration and development. However, low effects from oil spills on this community are most likely since it is not likely that oil and gas activities would be sited where these kelp communities would be at risk. Drilling discharges and construction activities associated with the production phase of the base case are most likely to have very low effects on kelp beds since those communities currently identified are near the periphery of the sale area. The effect of the base case on lower-trophic-level organisms as a result of exploration and development and production is expected to be LOW.

(4) Effects on Fishes: The exploration phase of the base case could affect fish through drilling discharges, construction associated with rig placement, and seismic surveys.

The approximate 59,000 short tons of drilling muds and cuttings that would be discharged during the exploration phase of the base case would, due to their limited affected area from the discharge point, have only a very low effect on the few benthic and pelagic fishes that might inhabit this limited area. Similarly, construction and seismic surveys associated with placement of exploratory drilling rigs also would have a very low effect on fish. The effect of the exploration phase of the base case on fish is expected to be very low.

The fish of the Sale 126 area would very likely be affected by oil spills, drilling discharges, seismic disturbance, and construction activities associated with the development and production phase of the base-case level of petroleum hydrocarbon development; however, the magnitude and duration of these effects would vary for each of the causal agents.

Oil spills would produce a variety of lethal and sublethal responses in the fishes in the Sale 126 area. Offshore oil spills are expected to have a low effect on fishes, given the relatively broad distribution of fish, the low concentration of oil in water and the probabilities of offshore spills occurring and contacting important nearshore fish habitats. For example, for the base case, the Peard Bay Area, where subsistence-fishing activities are carried on has an 18-percent combined probability of an ≥ 1,000-bbl oil-spill occurring and contacting over 3-, 10-, and 30-day periods during both summer and winter (Appendix C, Tables C-13 and C-16). However, high effects are possible for anadromous fishes (salmon, rainbow smelt, and arctic char) and capelin if spawning-year individuals, aggregated multiage assemblages, or a year-class of young were affected by a spill in nearshore waters. A large spill (>239 bbl; see Table II-A-1) from the projected onshore pipeline is likely to have a very high effect on fish by affecting overwintering and rearing habitat, sensitive lifestages, and/or concentrations of fish; and a very high effect on fish is possible if the Colville River is contaminated.

Drilling discharges could affect fish in a limited area around the discharge point. Considering the low densities and the mobile behavior of fish, the low toxicities of drilling discharges, and the rapid dilution and dispersion of drilling fluids and cuttings, these effects on fishes in the Sale 126 area are expected to be very low.

Seismic disturbance by airguns or their equivalents could be injurious to fish eggs and larvae that are very near the energy release, but the effect of seismic disturbance on the fish resources of the Sale 126 area are expected to be very low because few fish would be exposed to these effects.

Offshore-construction activities in the Sale 126 area could raise sediments and be injurious to some adult, juvenile, and larval fish. Considering the low densities of fish and their high tolerance to suspended sediments, the effects of offshore-construction activities on the fish resources of the Sale 126 area are expected to be very low. The effect of the base case on fishes as a result of exploration and development and production is expected to be VERY LOW in marine habitats and VERY HIGH in freshwater habitats.

(5) Effects on Marine and Coastal Birds: The direct effects of two offshore oil spills and many small onshore-pipeline spills on marine and coastal birds may include the loss of several hundred to several thousand sea ducks and murres and small numbers of other birds over the 30-year life of the field. However, the chance of oil spills contacting coastal concentrations of tens of thousands of birds is very low--less than 3 percent--under the base case. The loss of several thousand oldsquaw, common eiders, and murres would represent a low effect because recruitment would replace lost individuals within 1 or 2 years or within one generation or less. Indirect oil-spill effects through loss of available food sources are very likely to be localized near the spill site and to last for one season or less (low effect). Oil contamination of sensitive habitats such as saltmarshes and tundra ponds from onshore spills may have long-term effects lasting several years, but the chance that any estimated spill would contact marine saltmarshes is <0.5 percent; and the local contamination of tundra ponds and wetlands near the spill sites is not expected to have any measurable effect on the availability of these habitats and food sources to marine and coastal birds due to the abundance of uncontaminated habitats.

The 150 (exploration phase), 100 (development), and 48 (production) helicopter trips per month to and from platforms, particularly low-altitude flights along the coast of the Sale 126 area, could be the greatest cause of disturbance to birds. Aircraft disturbance of large flocks of feeding waterfowl (such as oldsquaw, eiders, and Pacific brant) and shorebirds in the Kasegaluk Lagoon and Peard Bay habitats could displace these molting and migratory birds temporarily as they are acquiring the energy necessary for successful migration and may result in higher migration mortality and lower winter survival of affected birds. However, the frequency of aircraft-caused disturbance of birds in the sale area alone is not likely to have more than low effects, because most aircraft would fly directly to the platforms and not disturb coastal concentrations. Aircraft disturbance of large, nesting seabird colonies at Capes Lisburne and Lewis (over 150,000 birds, mostly murres and kittiwakes) is not likely to occur because aircraft traffic centered out of Barrow and Wainwright would fly directly to the offshore platforms and not pass near these or any other large colonies. Most disturbance of birds by vessel traffic is likely to be very brief and have an inconsequential effect on the well-being of birds involved (very low effects). Overall effects on marine and coastal birds of noise and disturbance from air and vessel traffic associated with the proposal are likely to be low, and are not expected to differ significantly between exploration and development/production phases due to the similar levels of these activities.

Offshore installation of 6 production platforms, trenching and burial of 325 km of offshore pipeline, and onshore construction--including a 25- to 30-hectare shorebase at Point Belcher, a 640-km onshore-pipeline corridor with a support road, and 10 to 12 gravel helicopter pads--are likely to temporarily disturb and displace some birds from local habitat areas that would be altered or destroyed by these activities. Offshore dredging, pipelaying, and platform construction would have local short-term, or low, effects on birds. Construction of the onshore-pipeline corridor to the TAP would alter approximately 64 km^2 of tundra habitat along the pipeline route and represent a small percentage of habitat available to bird populations. The overall effects of oil spills, noise disturbance, and habitat alteration due to construction activities associated with the base case on marine and coastal birds are likely to be low.

The overall effect of the base case on marine and coastal birds as a result of exploration and development and production is expected to be LOW.

(6) Effects on Pinnipeds and Polar Bear: In the base case, adverse effects on spotted, ringed and bearded seals; walrus; and polar bear could result from oil pollution, disturbance, and habitat degradation.

Analysis of oil-spill information suggests that there is a relatively high probability that these species occupying the drifting pack ice of the northwestern sale area and vicinity could encounter spilled oil, particularly in late spring and early summer as breakup is proceeding. During the summer season, the probability remains high in the northwestern sale area and is substantial in Migration Corridors A and B. Contact with substantial numbers of seals in the winter/spring period is unlikely because of their low-density occurrence and because any released oil is likely to be ice-entrained until breakup. In summer, ringed and bearded seals maintain similar densities and thus are not particularly vulnerable, while spotted seals concentrate at coastal haulout areas where the probability of oil-spill contact with most areas adjacent to the sale area is minimal. Oiling of adult seals is not likely to result in lethal effects; however, pups may die if oiled during their first few weeks. Overall seal mortality from oil spills is not expected to exceed a low level of effect.

An oil spill contacting the lead system/migration corridor in spring and early summer may contact up to a few thousand walrus, mainly cows with calves, migrating northward at this time. Although there is no evidence of walrus killed by oil contact, irritation of sensitive tissues might reduce survival of individuals experiencing other environmental stress. The death of small numbers of walrus would represent a low effect on the present population.

Contact with oil is likely to be fatal to polar bears, and any substantial spill-related mortality could have severe consequences in this slowly reproducing species. However, unless concentrated by a food supply their typically wide dispersion in the Chukchi region is likely to mitigate against significant mortality from oil spills and thus against effects exceeding a low level.

Frequent or sustained disturbance may cause pinnipeds and polar bears to avoid or abandon an area for the duration of the activity. This could have significant adverse consequences if involving a migration corridor, feeding area, or breeding area; for example, adult walrus may trample calves if startled, and female polar bears may abandon dens if disturbed. However, the low probability of fatalities from disturbance, and the generally small proportion of these populations likely to be disturbed, suggest that disturbance factors are not likely to exceed a low level of effect. Similar estimated levels of support air and vessel traffic suggest that disturbance will not differ significantly between exploration and development/production phases.

The overall effect of the base case on pinnipeds and polar bear as a result of exploration and development and production is expected to be LOW.

(7) Effects on Endangered and Threatened Species:

(a) Bowhead and Gray Whales: Studies to date indicate that industrial noise has from only a minor, short-term effect to no effect on whales. Exploratory operations would not affect bowhead whales in the spring since they would occur after bowheads have passed through the area. Also, since the sale area is believed to be outside of the spring-lead system, most bowheads are not likely to encounter noise associated with production operations. Some bowhead whales are likely to encounter exploration or production noise during their annual fall migration (September-November). Most gray whales are not likely to encounter industrial noise associated with the base case, since they tend to concentrate inshore of the Sale 126 area.

Based on the assumptions discussed in Section IV.C.7, during each year of the exploratory or production period, about 31 percent of the bowhead population could encounter exploration noise (from 5 exploration operations), and about 7 percent could encounter production noise (from 6 production operations). However, due to the conservative nature of the assumptions used, the more likely rate of bowheads encountering industrial noise in the base case ranges from zero to about 15 percent for exploration noise, and from zero to 2.5 percent for production noise. It is probable that some bowhead whales would encounter industrial noise associated with the base case; however, encounters with industrial noise are expected to be brief, since whales spend most of their time underwater and are often in a migratory mode.

The estimated probability of a spill occurring and contacting whale habitat in the base case ranges from 2 to 53 percent, although the probability of whales actually being contacted would be lower than this. If there were a large spill associated with the base case, it is likely that some bowhead or gray whales in localized areas would encounter crude oil. However, contact is expected to be brief; and the oil would be likely to have minimal effect on most whales. Consequently, the effect of the base case on the bowhead and gray whale populations is expected to be very low.

(b) Arctic Peregrine Falcon: A few arctic peregrine falcon nests have been reported along the bluffs along the Chukchi Sea coast, adjacent to the Sale 126 area. However, it is not expected that peregrine falcons in this area would be disturbed by aircraft or vessel operations associated with base-case exploration. The production phase involves a pipeline from Point Belcher to TAP Pump Station No. 2 that could pass within close proximity to some peregrine nesting locations. However, it is assumed that pipeline-construction activities in the vicinity of any peregrine falcon-nesting locations would occur during the fall and winter seasons, when falcons are not present. Effects from oil spills could occur from direct contact or via contaminated prey. However, Seabird Concentration Area I has a <0.5-percent probability of an oil spill occurring and contacting this area within 10 days. Further, since peregrines are not common in this area, effects due to reduced food availability would be minimal. Consequently, the effect of the base case on the arctic peregrine falcon population is expected to be very low.

The effect of the base case on endangered and threatened species as a result of exploration and development and production is expected to be VERY LOW.

(8) Effects on Belukha Whale: The effect of industrial noise, crude oil, and other activities associated with the base case on belukha whales is likely to be similar to that expected for other whales (local, short-term effects on a small percentage of the population). Due to the distance of spring/summer belukha habitat from the sale area and the dispersed nature of the fall belukha migration through the sale area, belukhas are not often likely to encounter industrial operations. Displacement of belukhas due to pipeline construction is likely to be very low. If there were a large spill associated with the base case, it is likely that some belukhas in localized areas would encounter crude oil. However, contact with oil is expected to last for only minutes, since whales spend most of their time underwater. Consequently, the effect of the base case on the belukha whale population as a result of exploration and development and

production is expected to be VERY LOW.

(9) Effects on Caribou: The primary source of disturbance to caribou of the Western Arctic herd on their summer range is vehicle traffic associated with the construction and presence of the 640-km onshore pipeline and support road from a shorebase facility at Point Belcher to TAP Pump Station No. 2. Cows and calves of the Western Arctic herd are particularly sensitive to disturbance during the calving and postcalving seasons and would be especially disturbed during periods of heavy traffic. Approximately 20 percent of the Western Arctic caribou herd that winters on the North Slope may be temporarily disturbed by vehicle traffic along the pipeline corridor during spring migration, while other caribou could be disturbed during summer movements.

Disturbance of caribou along the pipeline route would be most intense during the construction period (about 2 yr), when vehicle and air traffic would be most frequent, but would subside after construction is complete and over the remainder of the 30-year life of the field. Caribou movements across the pipeline corridor could be retarded or delayed--for perhaps a few hours or no more than a few days--during periods of heavy traffic, but caribou are likely to resume crossing the pipeline corridor with little restriction in movements after construction is complete. Vehicle and air traffic along the pipeline corridor are likely to cause flight reactions by some caribou. This would represent a low effect on caribou of the Western Arctic herd. Caribou distribution and/or abundance are not likely to be significantly affected by this development.

The onshore pipeline, support road, and 10 to 12 helicopter pads associated with the base case would alter or destroy about 64 km^2 of the Western Arctic herd's range, while the associated shorebase would cover 25 to 30 hectares near Point Belcher. The habitat altered or destroyed by these facilities represents less than 1 percent of the available range of the Western Arctic herd. Any offshore oil spill is likely to contaminate few caribou due to the 1-percent probability of spills occurring and contacting shoreline (very low probability) and low numbers of caribou in this habitat. The small onshore oil spills estimated for the base case would contaminate very local areas near the pipeline, unless entering a stream, and would not significantly affect the availability of caribou range.

The overall effect of the base case on caribou as a result of exploration and development and production is expected to be LOW.

(10) Effects on the Economy of the North Slope Borough: Employment and revenue effects in the North Slope region for the base case are expected to be moderate because the projected resident employment would increase above 10 percent for at least 5 years, and the average change in resident employment would be about 9 percent. Sale effects on Native- and non-Native-resident employment would be slightly higher and slightly lower, respectively. However, the unemployment rate for Native residents would still reach 50 percent by 2002, with or without the sale. In addition, NSB property taxes would increase an average 11 percent; and operating revenues would increase an average 9 percent. Economic benefits from new jobs, income, and taxes that could result from the proposed sale are expected to occur after the level of petroleum activities on the North Slope (e.g., Prudhoe Bay) has begun to decline. This decline would not be reversed by the projected effects of proposed Sale 126. The employment and revenue effects of the base case on the NSB region are expected to be moderate.

Effects on the subsistence harvest are expected to have significant adverse effects on the economy of the NSB. The value of subsistence resources can be translated into monetary units that reflect potential effects on household income in two ways. Firstly, they are a substitute for store-bought foods that allows cash to be used for other needs. Secondly, there is value derived from enjoyment of the use and value in the cultural aspects of these resources. These are real values that affect the economic well-being of NSB residents and are empirically quantifiable. Oil spills and industrial activities are expected to cause disruptions of the bowhead and belukha whale, walrus, fish, and caribou harvests in the communities of Barrow, Wainwright, and Atqasuk. To a lesser extent, harvests in Point Lay, Point Hope, and Nuiqsut would be affected. These disruptions would have a direct, measurable effect on residents in that they represent a loss of important sources of food and cultural values. This effect carries over throughout the region because of the extensive kinship/sharing networks. In addition, harvest disruptions could place a strain on the Borough government as it attempts to mitigate adverse effects. The effect of the base case on the NSB economy as a result of subsistence-harvest disruptions is expected to be high.

The overall effect of the base case on the economy of the NSB as a result of exploration and development and production is expected to be HIGH.

(11) Effects on Subsistence-Harvest Patterns: Under the base case, effects on subsistence-harvest patterns could occur as a result of oil spills and construction-related activities. Oil spills could cause multiyear suspensions or curtailments of subsistence activities for some marine mammal resources. Construction-related activities--pipeline emplacement, traffic noise, heavy-equipment movement, etc.--could hinder the harvest of subsistence resources. Because of the concentration of construction-related activities in the Point Belcher-Peard Bay area and the potential for this region to be affected by any oil spill incident that could occur over the life of the field, the communities that use this area heavily for their subsistence resources would be those most affected by sale-related activities. Conversely, the communities that lie at some distance from the Point Belcher area would be those that experience less sale-related effects on subsistence-related activities. Point Hope and Point Lay are expected to have lower effects as a result of the sale due to their distance from the principal location of construction and their lower probability of being affected by an oil spill. (Ten-day summer-and-winter-trajectory analysis indicates a <0.5% probability of an oil spill occurring and contacting the Point Hope Subsistence Area. The same trajectory analysis indicates a 1% chance of an oil spill occurring and contacting the Point Lay Subsistence Area. By contrast, the probability of an oil spill occurring and contacting the Wainwright Subsistence Area is 33% during summer.)

Barrow utilizes much of the Peard Bay area for the harvesting of fishes, birds, whales, walrus, and other marine mammal resources; any spillage of oil within the bay would diminish the quality of Barrow's subsistence harvest but would not eliminate it, even within the year the spill occurred. Barrow's subsistence-harvest area is extensive; therefore, the temporary loss of part of the Peard Bay range could be alleviated by a more intensive harvest in other locations of the community's harvest area. Therefore, moderate effects are expected on Barrow's subsistence harvest. Moderate sale-related effects also are expected for Atqasuk. Atqasuk's marine mammal subsistence harvests are conducted within and as a part of Barrow's marine-harvest zone. As an inland community, Atqasuk's caribou harvest may be affected by pipeline-emplacement activities; but such effects are expected to be very transient in duration. Nuiqsut's dependence on the Colville River system and its delta for fish and various land mammal resources marks it as being particularly vulnerable to a major upland oil spill. However, the likelihood of a major spill occurring on a critical tributary river and being undetected is remote. Point Belcher, the landfall for the Sale 126 pipeline, lies approximately 20 km north of Wainwright. The Wainwright Subsistence Area also is the most liable to be affected by an oil spill. Of all the communities analyzed for the base case, Wainwright is the most likely to experience substantial effects on its subsistence harvest. Virtually all of Wainwright's marine mammal harvests-particularly the bowhead whale harvest--could be affected by the proposed sale. The base case could result in high effects on Wainwright's subsistence harvests.

The overall effect of the base case on subsistence harvests as a result of exploration and development and production is expected to be HIGH for Wainwright; MODERATE for Barrow, Atqasuk, and Point Lay; and LOW for Nuiqsut and Point Hope.

(12) Effects on Sociocultural Systems: The effects analysis of the base case on the sociocultural systems of the six communities near the Sale 126 area is based on (1) industrial activity, (2) induced demographic changes, and (3) the degree and opportunity for interaction between industry work bases and existing communities. The effects of these agents were found to dissipate beyond the communities of Wainwright and Barrow. Both of these communities are forecast to receive the bulk of OCS-induced Native and non-Native employment, opportunities for ethnic interaction, and effects on subsistence hunting. These communities also may suffer an increase in the social pathologies (alcoholism, domestic violence, etc.)

that sometimes accompany industrial-development activities. Overall, sale-related activities are expected to continue the present population trend toward increased numbers of non-Native North Slope residents--especially in Barrow. The effect of the base case on sociocultural systems as a result of exploration and development and production is expected to be MODERATE.

(13) Effects on Archaeological Resources: The effects of the base case would be due mainly to (1) the low probability that offshore archaeological resources could survive the effects of the physical forces in the sale area in all but a few locations, (2) the assumption that both exploration and development activities would occur for the base case, (3) the approximately 1,610 MMbbl of estimated recovery, and (4) the modest disturbance to onshore resources. Archaeological resources in the sale area would be affected by base-case (1,610 MMbbl) offshore exploration, construction of onshore support facilities, construction of offshore pipelines to shore, recreational visits by OCS-related employees (employed directly by oil companies and indirectly by many types of support companies) to archaeological-resource sites, development, production, and other oil-related activities such as oil-spill cleanup. Therefore, the effect of the base case on archaeological resources as a result of exploration and development and production is expected to be MODERATE.

(14) Effects of Land Use Plans and Coastal Management Programs: Major changes in land use would result from development associated with Sale 126. The location of the shorebase and landfall at Point Belcher would be highly incompatible with the current use of the area as a base for subsistence hunting of bowhead whales and could lead to conflicts with the statewide standard for subsistence, and the NSBCMP policies and NSB LMR's that prohibit significant interference with the bowhead whale hunt and require access to subsistence resources. Because Point Belcher is the traditional site for launching for whaling, the potential also exists for effects on the cultural resources of the area; therefore, conflict with policies designed to protect these resources is possible. While the pipeline/road system assumed for this analysis could be constructed to conform to most NSB land use and CMP policies, access of Wainwright residents to the North American road system and vice versa via the pipeline/road to the Dalton Highway may generate additional social and economic problems and benefits that would need to be assessed if the road became public. Potential conflicts also are evident with the statewide standard for energy facilities if dredging activity occurs in Peard Bay and leads to long-term changes in biological distributions, for lagoon and river habitats in the event of an oil spill, and for water quality if formation waters are discharged into the Chukchi Sea. For the base case, the potential for conflict with land use plans and coastal management programs as a result of exploration and development and production is expected to abe HIGH.

(15) Effects on Wetlands: Wetlands encompass most of the North Slope coastal plain near the proposed sale area and include several hundred square miles of a mosaic of tundra-wetland-vegetation types that are important nesting and feeding habitat for millions of waterfowl, shorebirds, and land birds and that are habitat for a variety of freshwater fish and invertebrates. The base case could have local effects on wetlands from extraction of gravel fill along the pipeline-road corridor, from road-traffic dust along the corridor, from thermokarst (local melting of permafrost) along the road, and from onshore oil spills along the pipeline.

Along the 640-km-long pipeline road, an estimated 64 km^2 of wetlands are expected to be filled in. This wetlands loss is less than 1 percent of the wetlands on the coastal plain. However, the local effect on vegetation and topography is expected to persist for many years. Road-traffic dust deposited along the pipeline-road corridor is expected to have local effects on some plant communities along the road, with replacement of some moss species near the road. This local effect is expected to persist over the life of the field; but other plants are expected to benefit from nutrients leached from the road, and feeding birds would be attracted to early snowmelt areas created by the dust. Thermokarst along portions of the road is expected dto change local topography and have an aesthetic effect that will persist for many years but have no significant effect on plant or animal productivity. Several small (6- to 1,500-bbl average size) onshore oil spills are estimated to occur over the life of the pipeline and have local effects on plant and invertebrate communities for several years. Spill cleanup and rehabilitation (application of phosphorus fertilizer) would allow the plants to recover in a few years, but subtle effects on invertebrate communities in tundra ponds that become contaminated are expected to persist for several years.

The effect of the base case on wetlands from oil spills, road dust, thermokarst, and gravel-fill extraction is expected to be localized along the pipeline-road corridor, with less than 1 percent of the coastal tundra wetlands of the North Slope being severely damaged. Some effects on plant and invertebrate communities, topography, and visual aesthetics are expected to persist for many years due to dust and traffic.

3. High Case:

a. Resource Estimates and Basic Exploration, Development and Production, and Transportation Assumptions for Effects Assessment: The high-case-resource estimate, 3,540 MMbbl, represents the maximum resource volume likely to be present in commercial quantities. It represents a quantity of oil that is significantly higher than the base case, resulting in a correspondingly higher level of activities associated with exploration, development and production, and transportation. The level of activities and scheduling of events associated with the Sale 126 high case are shown in Table II-A-1 and Appendix B, Table 3. The basic structure of the high-case scenario is the same as for the base case; therefore, assumptions regarding the types of activities associated with the high case are comparable to the base case (Sec. II.B.2), including exploration-drilling activities (Sec. II.B.2.a(2)), development and production activities (Sec. II.B.2.a(3)), and transportation activities (Sec. II.B.2.a(4)). The levels of these activities involved, however, would be greater than in the base case due to the larger amount of oil being considered.

(1) Activities Associated with Exploration Drilling:

(a) Seismic Activity: Prior to drilling, the lessee/operator is required to conduct surveys to determine if shallow hazards are present or absent at the proposed drill site; these surveys should incorporate seismic profiling. Based on past experience, it is assumed that one-half the well sites would be covered by a site-specific survey that generates 63 trackline km (39 statute mi) of data; the remaining sites would be covered by a block-wide survey that generates 303 trackline km (188 statute mi) of data. These surveys usually are conducted 1 year prior to drilling during the open-water period. The average time needed to survey each site is 1 week, allowing downtime for bad weather and equipment failure. For the purposes of this EIS, site-specific surveys are assumed to be conducted for 27 of the exploration- and delineation-well sites; and block surveys are assumed to be conducted for 26 exploration- and delineation-well sites. The total trackline distance would equal 9,631 km (5,941 statute mi).

(b) Exploration Drilling: Drilling of the estimated 37 exploration and 16 delineation wells is anticipated to begin in 1992 and continue through 2001. Based on the water-depth ranges of the Sale 126 blocks, it is assumed that the exploration wells for the high case would be drilled from floating drilling units. Drilling of each exploratory well would require the disposal of about 660 short tons (dry weight) of drilling muds and about 850 short tons (dry weight) of drill cuttings. The total amount estimated to be disposed of is about 34,980 short tons (dry weight) of drilling muds and about 45,050 short tons (dry weight) of cuttings.

(c) Support and Logistic Activities: A total of about 3,240 helicopter flights are estimated to be flown in support of high-case exploration drilling. The number of flights per year ranges from 90 in 2001, when 1 drilling unit would be operating, to 540 in 1993, when 6 drilling units would be operating. Using a minimum of 1 helicopter per drilling unit, with 1 additional helicopter for every 2 drilling units, the total number of helicopters that would serve exploration drilling in the high case would not exceed the 9 used in peak year 1993 to service 6 drilling units.

Depending on ice conditions, two or more vessels may be required to perform ice-management tasks for the floating units during drilling operations in the open-water season. The potential number of drilling units that might be operating during the open-water season could range from 1 to 6 (see Appendix B, Table 3). It is estimated that there would be 1 supply-boat trip per drilling unit per week during the open-water season. For exploration drilling, the total number of supply-boat trips is estimated (based on 90 days to drill a well) to range from about 12 to 72, with a total number of trips estimated at 432 for the 36 drilling-unit operations carried out over a 10-year period.

(2) Activities Associated with Development and Production: The initial discovery of oil is projected to occur in the second or third year of the lease; the first delineation well is projected to be drilled in 1993. Of the 12 production platforms associated with the high case, 2 are estimated to be installed in 2000, 6 in 2001, and 4 in 2002.

(a) Seismic Activity: A three-dimensional, multichannel seismic-reflection survey would be conducted for each of the 12 production platforms. Surveys for each platform are assumed to cover approximately 62 km^2 (38 mi^2), assuming an anticipated average drilling depth of 8,000 ft. Using a 76-m (250-ft) grid spacing pattern, each platform would require a survey of 1,658 km (about 1,023 statute mi) or a total of 19,896 km (about 12,276 statute mi) for the 12 platforms. Site-specific surveys required for siting each production platform would contribute an additional 756 km (468 statute mi), for a total seismic- survey distance of 20,652 km (12,744 statute mi).

The HRD for shallow hazards would be collected prior to laying the offshore pipeline. The total trackline distance, estimated to be four times the length of the pipeline assumed for the scenario, would equal approximately 1,135 km (about 700 statute mi).

(b) Development-Well Drilling: It is estimated that a total of 472 production and service wells would be drilled between 2001 and 2005 (see Appendix B, Table 3). During drilling, some of the muds used for production and service wells may be recycled through each subsequent well drilled on a particular platform. Depending on the amount recycled, the amount of drilling muds disposed could range from 110 to 700 short tons (dry weight) for each well and from 51,920 to 330,400 short tons for all the production and service wells drilled. Each production and service well in the Sale 126 area is expected to produce approximately 925 short tons (dry weight) of drill cuttings; the total amount of cuttings disposed of would be about 436,600 short tons (dry weight).

Production of oil is forecast to begin in 2003 and continue through 2021. Peak production of 297 MMbbl per year would occur between 2004 and 2008.

(c) Support and Logistic Activities: The configuration of infrastructure used to support the high case is the same as for the base case (Sec. II.B.2.a(3)(d)), with the exception that activity levels are increased due to the increased volume of oil being considered.

Installation and hookup of production platforms during the development stage would be supported by 2 supply boats and 1 helicopter per platform (see Table II-A-1). Two platforms are scheduled to be installed during 2000, 6 in 2001, and 4 in 2002 (see Appendix B, Table 3), with heavy supplies being transported by barges (see Table II-B-2). During production, 2 icebreaker support/supply boats and 2 helicopters would be dedicated to the sale area. An additional support/supply boat and helicopter would be available for backup.

The number of helicopter flights to be flown in support of drilling 472 production and service wells is estimated to total 21,240 between 2001 through 2005, based on an average of 0.5 flights per well during the drilling period, or 45 trips per well. The number of flights would range from 1,800 in 2001, when 40 wells are drilled, to 6,300 in 2003 and 2004, when 140 wells are drilled each year. From 2003 to 2021, it is estimated that the number of helicopter flights to production platforms would average about 2 per week per platform, or 23,712 flights.

Estimates on the number of workmonths of direct OCS employment for each unit of work during the development and production phase are given in Appendix H, Table H-4.

Table II-B-2
Barge Requirements for Exploration, Development, and Production
for the Chukchi Sea Sale 126 High Case

Year	Drilling Support[1/] Dry Goods	Drilling Support[1/] Fuel	Transporting Offshore Pipelines[2/]	Transporting Onshore Pipelines[3/]	Transporting Facility Modules[4/]	Total Annual Number of Barges
1991	0	0	0	0	0	0
1992	2	1	0	0	2	5
1993	4	3	0	0	4	11
1994	3	2	0	0	3	8
1995	3	2	0	0	3	8
1996	2	1	0	0	2	5
1997	2	1	0	0	2	5
1998	2	1	0	0	2	5
1999	1	1	0	3	4	9
2000	1	1	4	3	8	17
2001	10	7	3	3	16	39
2002	20	13	3	0	23	59
2003	35	23	0	0	35	93
2004	35	23	0	0	35	93
2005	18	12	0	0	18	48
2006-2021	13/yr[5/]					13/yr

Source: USDOI, MMS, 1990.

1/ Barge requirements are based on an average barge capacity of 4,373 metric tons (4,820 short tons). Each exploration well is assumed to require 1,653 metric tons (1,822 short tons) of dry goods while each production well is assumed to require 1,092 metric tons (1,204 short tons). Fuel supplies require two-thirds the number of barges as dry goods.

2/ Assumes 250 tons of material per mile of pipeline with an average barge capacity of 4,373 metric tons.

3/ Barge requirements for delivering onshore pipe are based on the average barge capacity of 4,373 metric tons, typical of other barges loaded for onshore support activities (ERE Systems, Ltd., 1984). One-half the pipeline requirement for onshore pipelines would be delivered by barge. Pipelines for onshore construction would be delivered 1 year prior to installation (ERE Systems, Ltd., 1984).

4/ The number of barges historically needed for transporting prefabricated units has totaled the number used for dry drilling supplies, including pipelines (Berger, 1985, as cited by ERE Systems, Ltd., 1984).

5/ Limitations on maritime shipping are similar for the Beaufort and Chukchi Seas. Therefore, the split between marine and truck shipping is considered comparable. Once production began at Prudhoe Bay, barge traffic ranged from a low of 2 barges in 1979 to a high of 26 barges in 1983 and averaged about 13 per year. Therefore, the number of barges used during production in the Chukchi Sea is assumed to be 13.

(3) Activities Associated with Oil Transportation: Activities and routes in the high case associated with transporting oil via a pipeline connecting to the TAP are the same as for the base case.

b. Summary of Effects for the High Case: The summaries presented in this section are based on the analysis in Section IV.D of this EIS. The types and levels of activities that might be associated with the high case for Alternative I are summarized in Table II-A-1 and described in the preceding section (Sec. II.A.3.a).

(1) Effects on Air Quality: Concentrations of criteria pollutants at the shoreline are expected to be more than 5 percent but less than 20 percent of available national standards or PSD increments. The effect on air quality--with respect to standards--is expected to be low. The effects of air pollutants--other than those addressed by air quality standards--could cause short-term, local effects on vegetation from a coating of soot. Consequently, a very low effect--other than with respect to standards--is expected. The effect of the high case on air quality is expected to be LOW.

(2) Effects on Water Quality: In the high case, water quality degradation could result from discharges, construction activities, and oil spills. Discharges of muds and cuttings are regulated by the EPA such that water quality criteria must be met at the edge of an EPA-established mixing zone. The effect of exploration- and production-drilling muds and cuttings discharges would persist only during actual discharge within the 100-m-radius mixing zone around each discharge point. Concentrations of trace metals would not exceed the acute marine-water quality criteria at the edge of the mixing zone. The effect on local and regional water quality is expected to be very low.

If formation waters were discharged, the effect on water quality would be local and would continue for the life of the field. The effect on local water quality is expected to be moderate, while the effect on regional water quality is expected to be very low.

Effects on water quality from dredging (and dumping) would be local and short-term. Turbidity would increase over a few square kilometers in the immediate vicinity of dredging operations only during actual dredging. Effects on local water quality are expected to be low, while the effect on regional water quality is expected to be very low.

Sustained degradation of water quality to levels above State and Federal criteria from hydrocarbon contamination is unlikely. Hydrocarbon concentrations from the four estimated oil spills of $\geq$ 1,000 bbl could exceed the chronic criterion of 0.015 ppm total hydrocarbons on at least several thousand square kilometers for a short period of time. Concentrations above the acute criterion are not anticipated. Effects of an oil spill on water quality are expected to be low both locally and regionally.

The overall effect of the high case on water quality is expected to be MODERATE locally and LOW regionally.

(3) Effects on Lower-Trophic-Level Organisms: Exploratory drilling under the high case could affect lower-trophic-level organisms via drilling discharges, offshore construction, and seismic surveys. Drilling discharges under the exploration phase of the high case would approximate 80,000 short tons over a 10-year period. A number of toxic-effects studies of these discharges on various marine organisms have shown that their adverse effects are mostly limited to a few tens of meters from the discharge point. Offshore construction and seismic surveys associated with rig placement for exploratory drilling would affect only a very limited area over a very limited period, with resulting very low effects on lower-trophic-level organisms.

Oil spills can cause sublethal to lethal effects on marine plants and invertebrates. These effects range from reduction in growth and reproduction, behavioral changes, and possible eventual mortality. At the high-case level of oil development and production, the total volume of oil projected to be spilled is not significantly higher than for the base case; however, the probability of one or more oil spills occurring over the 19 years of development and production increases to 99 percent. The effect on marine plants and invertebrates, however, would not exceed low since this group is broad in distribution and large in population number, and most species usually reproduce at a relatively high rate. Those lower-trophic-level organisms that inhabit nearshore waters are more vulnerable to effects from oil spills; however, the high-case level of development and production does not show an appreciable increase in probability that an offshore oil spill would reach this zone.

The volume of material discharged from drilling locations also increases during the development and production phase of the base case but with a concurrent increase in the number of discharge locations. For this reason, the ultimate dispersal and dilution of these solids and liquids would not significantly increase their areal concentrations to a point where they would have a significant adverse effect on marine plants and invertebrates.

Due to the technology employed, seismic-survey effects--while increasing in scope--are not expected to increase from the virtually no-effect level of the base case. Construction activities--particularly nearshore or in bays--could have a moderate short-term effect on benthic invertebrates but only during the work.

Kelp beds could be adversely affected by drilling discharges and construction activities during development and production, if these activities occurred close to these communities (probably within 1,000 m). The known kelp beds, however, are located near the periphery of the Sale 126 area.

The effect of the high case on lower-trophic-level organisms is expected to be LOW.

(4) Effects on Fishes: Exploratory drilling under the high case could affect pelagic and benthic fish and their eggs and larvae through drilling discharges, offshore and onshore construction, and seismic surveys. Drilling discharges during the exploration phase of the high case total about 80,000 short tons. Studies have demonstrated that the effects of these discharges on fish are limited to the small area near the discharge point where toxic chemical concentrations are at high levels that have sublethal to lethal effects on fish, their eggs, and larvae. Offshore construction and seismic surveys associated with rig placement during exploration drilling would be limited in areal extent and time, with resulting very low effects on fish. Presently used seismic acoustic-energy sources essentially have no effects on fish.

Oil is the major substance that could have major effects on both the fish of the Chukchi Sea and onshore surface waters. Oil spills during development and production could have sublethal to lethal effects on a variety of benthic and pelagic (including) anadromous-fish species. At the development and production phase of the high case, the estimated number of oil spills is four. The effects of oil spills on fish, however, would be somewhat ameliorated by the limited areal extent of the average oil spill and the relatively rapid rate of dilution/weathering and subsequent reduction in toxicity.

Onshore-pipeline-oil spills could enter river-drainage and surface waters, where more restricted area and flow might increase toxic effects to resident and anadromous fishes that occupy these habitats. Calculations based on TAP operations show that there is a 95-percent probability of at least one spill of ≥ 2 bbl contacting a major river tributary. In this event, the effect on fish in that tributary could be very high; however, this limited areal effect would not affect other riverine-fish habitats.

Drilling discharges during development and production increase in weight and volume from the base case (Table II-A-1); however, these weights and volumes also increase over time and area. Therefore, the incremental effect would not change appreciably from the very low level of effect previously discussed at other levels of development. The effects of these drilling discharges usually are limited to no more than 100 m from the discharge point. This is a very small affected area of the total fish habitat of the Chukchi Sea. Adult benthic and pelagic fish have mobility to avoid conditions that might adversely affect them, while the relatively immobile eggs and larvae of these marine fish species are usually present in very large numbers but at relatively low densities to a point where only small, fractional numbers of the total population would be affected by the discharges.

While trackline kilometers of seismic surveys increase their level of effect on arctic fish species, effects would be limited to very temporary disturbance/displacement within the limited area and time for the surveys--for a very low effect on adult fish. Some injury to pelagic eggs and larvae might occur if these organisms were in very close proximity to the acoustic-discharge point. Only a few eggs and larvae would be affected.

Both offshore and onshore construction could cause displacement of fish from their habitat. Sedimentation would be the principal cause, with disturbance secondary in importance. Arctic-fish-population densities, however, are generally low; so only a few species would be subjected to these effects. Any eggs and larvae present in the discharge zone would not comprise any significant segment of their total regional populations. Since fish are mobile, they probably would move away from the area of disturbance. In addition, the effects of construction would be short-term. Therefore, this work would have a very low effect on fish. The effect of the high case on fishes is expected to be LOW in marine habitats and VERY HIGH in freshwater habitats.

(5) Effects on Marine and Coastal Birds: The principal result of elevated oil-spill risk at a higher resource level would be to increase the likelihood of potential effects, including multiple (4) oil-spill exposure, in coastal and offshore habitats used by marine and coastal birds. Oil-spill risk near large seabird colonies in the Cape Lisburne area or in sensitive coastal habitats where large numbers of birds could be vulnerable in summer and fall seasons, respectively, is only minimally greater than described for the base case. In nearshore and offshore waters (e.g., spring migration corridor), however, risk is considerably elevated. Risk is greatest in the summer, but bird densities are not particularly high during this season, so effects are not expected to be elevated significantly. During the spring migration period, when hundreds of thousands of migrant waterfowl are following the opening leads northward, substantially greater numbers of birds are vulnerable; but risk of oil-spill occurrence and contact is much less than in summer. Overall, several tens of thousands of birds could be lost in these areas over the life of the field; but their populations could respond with replacement within a generation. Thus, although there is a potential for bird populations to experience greater losses with the possibility of multiple spills, effects are expected to remain in the low range. The effect of the high case on marine and coastal birds is expected to be LOW.

(6) Effects on Pinnipeds and Polar Bear: The principal result of elevated spill risk at a higher resource level would be to increase the likelihood of potential effects, including multiple (4) oil-spill exposure, in coastal and offshore habitats used by walrus, seals, and polar bear. However, the increased number of spills is not likely to significantly elevate the numbers of individuals contacted, since relatively low densities of pinnipeds and polar bears would remain in loose ice or open water after spring breakup, when oil spilled or released from ice entrainment is likely to spread over extensive areas. Thus, although the effects of oil spills on these populations under the high resource case would be expected to exceed those of the base case, they are likely to remain in the low range. As a result of relatively low pinniped and polar bear densities, neither disturbance from operation of aircraft and vessels nor from drilling and construction activities are expected to disturb more than a small proportion of the respective populations or to result in overall effects exceeding a low level. The effect of the high case on pinnipeds and polar bear is expected to be LOW.

(7) Effects on Endangered and Threatened Species:

(a) Bowhead and Gray Whales: Studies to date indicate that industrial noise has only a local, short-term effect on some whales. Exploratory operations are not expected to affect the bowhead whale population in the spring, since operations would occur after bowheads have passed through the area. Also, since the sale area is believed to be outside of the spring-lead system, most bowheads are not likely to encounter noise associated with production operations. A number of bowhead whales are likely to encounter exploration or production noise during their annual fall migration (September-November). Most gray whales are not likely to encounter industrial noise associated with the high case, since they tend to concentrate inshore of the Sale 126 area.

Based on the assumptions discussed in Section IV.D.7, during each year of the exploratory or production period about 37.5 percent of the bowhead population could encounter exploration noise (from 6 exploration operations); and about 30 percent could encounter production noise (from 12 production operations). However, due to the conservative nature of the assumptions used, the more likely rate of bowheads encountering industrial noise in the high case would range from zero to about 15 percent of the bowhead population for exploration noise, and from zero to 2.5 percent of the population for production noise. It is probable that a number of bowhead whales would encounter industrial noise associated with the high case. However, encounters with industrial noise are expected to be brief, since whales in the sale area are typically in a migratory mode.

The estimated probability of an oil spill occurring and contacting whale habitat in the high case ranges from 1 to 81 percent, although the probability of whales actually being contacted would be less than this. If there were a large spill associated with the high case, it is likely that a number of bowhead or gray whales in localized areas would encounter crude oil. However, contact is expected to be brief since whales spend most of their time underwater and are often in a migratory mode. If whales were contacted by crude oil, the oil would be likely to have no effect on most whales and only a minor, short-term effect on others. Consequently, the effect of the high case on bowhead and gray whale populations is expected to be very low.

(b) <u>Arctic Peregrine Falcon</u>: Effects on the arctic peregrine falcon due to the high case are expected to be similar to those discussed for the base case. However, the high case involves an increased level of activity over that estimated for the base case and thus an increased probability of disturbance. This could result in more nesting peregrine falcons being disturbed in the vicinity of the pipeline to TAP Pump Station No. 2. However, at this time, only a hypothetical corridor has been identified. Consultation with the USFWS will likely be reinitiated at the time of actual pipeline-corridor planning. At this time, it is assumed that pipeline-construction activities in the vicinity of any peregrine falcon-nesting locations would occur during the fall and winter seasons, when falcons are not present. As a result, pipeline construction should not often disturb peregrine falcon-nesting or -foraging activities. The probability of crude oil associated with the high case occurring and contacting seabird-concentration areas is <0.5 percent; hence, effects due to reduced food availability are expected to be minimal. Consequently, the effect of the high case on the arctic peregrine falcon population is expected to be low.

The effect of the high case on endangered and threatened species is expected to be VERY LOW on the bowhead and gray whale populations and LOW on the arctic peregrine falcon population.

(8) <u>Effects on Belukha Whale</u>: The effect of industrial noise, crude oil, and other activities associated with the high case on belukha whales is likely to be similar to that expected for other whales (local, short-term effects on a small percentage of the population). The high case involves more exploration and production activity than the base case and about twice the amount of crude oil produced. However, due to the distance of spring/summer belukha habitat from the sale area and the dispersed nature of the fall belukha migration through the sale area, belukhas are not likely to interact often with industrial operations. Displacement of belukhas due to pipeline construction is not likely to occur. Consequently, the effect of the high case on the belukha whale population is expected to be VERY LOW.

(9) <u>Effects on Caribou</u>: In the high-resource case, the elevated level of development activity would result in increased numbers of aircraft overflights of coastal habitats used by caribou, thereby increasing the likelihood and frequency of disturbance effects described under the base case. However, the primary proposal-related source of disturbance remains the construction of an onshore pipeline across range of the Western Arctic herd from Point Belcher to the TAP corridor, and vehicle traffic on the accompanying road for the duration of the field. Although vehicle traffic could temporarily delay caribou

movements across the pipeline corridor, they are likely to resume crossing within a short period of initial interaction (a few hours to a few days). Traffic volume is not expected to be significantly greater than for the base case.

The 1-percent (extremely low) probability of shoreline contact by oil spills would result in contamination of few caribou. The relatively small amount of caribou habitat contaminated by onshore spills, plus that removed by pipeline, road, and shorebase construction, is likely to represent less than 1 percent of the available range.

The overall effect of the high case on caribou is expected to be LOW.

(10) Effects on the Economy of the North Slope Borough: Employment and revenue effects in the North Slope region as a result of the high case are expected to be moderate because the projected resident employment would increase above 20 percent for greater than 5 years. Sale effects on Native- and non-Native-resident employment would be slightly higher and slightly lower, respectively. However, the unemployment rate for Native residents should still reach 50 percent by 2002--with or without the sale. In addition, NSB property taxes would increase an average 18 percent and operating revenues would increase an average 14 percent. Economic benefits from new jobs, income, taxes, etc., that could result from the proposed sale are expected to occur after the level of petroleum activities on the North Slope (e.g., Prudhoe Bay) has begun to decline. This decline would not be reversed by the projected effects of proposed Sale 126. The effects of the high case on revenues and employment for the NSB region are expected to be very high.

Effects on the subsistence harvest are expected to have significant adverse effects on the economy of the NSB. The value of subsistence resources can be translated into monetary units that reflect potential effects on household income in two ways. Firstly, they are a substitute for store-bought foods that allows cash to be used for other needs. Secondly, there is value derived from enjoyment of the use and value in the cultural aspects of these resources. These are real values that affect the economic well-being of NSB residents and are empirically quantifiable. Oil spills and industrial activities are expected to cause disruptions of the bowhead and belukha whale, walrus, fish, and caribou harvests in the communities of Barrow, Wainwright, and Atqasuk. To a lesser extent, harvests in Point Lay, Point Hope, and Nuiqsut would be affected. These disruptions would have a direct, measurable effect on residents in that they represent a loss of important sources of food and cultural values. This effect carries over throughout the region because of the extensive kinship/sharing networks. In addition, harvest disruptions could place a strain on the Borough government as it attempts to mitigate adverse effects. The effect of the high case on the NSB economy as a result of subsistence-harvest disruptions is expected to be high.

The effect of the high case on the economy of the NSB is expected to be VERY HIGH.

(11) Effects on Subsistence-Harvest Patterns: In the high case, effects on subsistence-harvest patterns could occur as a result of oil spills and construction-related activities. Oil spills could cause multiyear suspensions or curtailments in subsistence activities for some marine mammal resources. Construction-related activities--pipeline emplacement, traffic noise, heavy-equipment movement, etc.--could hinder the harvest of subsistence resources. Because of the concentration of construction-related activities in the Point Belcher-Peard Bay area and the potential for this region to be affected by any oil-spill incident, which could occur over the life of the proposal, those communities that utilize this area heavily for their subsistence resources would be those most affected by sale-related activities. Conversely, those communities that lie at some distance from the Point Belcher area would experience fewer sale-related effects on subsistence-related activities. Point Hope and Point Lay are expected to have low effects as a result of the sale due to their distance from the principal location of construction and their lower probability of being affected by an oil spill (10-day summer- and winter-trajectory analysis indicates a <0.5% probability of a spill occurring and contacting the Point Hope Subsistence Area). The same trajectory analysis indicates a 17-percent chance of an oil spill occurring and contacting the Point Lay Subsistence Area during winter.

By contrast, the probability of an oil spill occurring and contacting the Wainwright Subsistence Area is 59 percent during winter.

Barrow utilizes much of the Peard Bay area for the harvesting of fishes, birds, whales, walrus, and other marine mammal resources. Any spillage of oil within the bay would diminish the quality of Barrow's subsistence harvest but would not eliminate it--even within the year during which the spill occurred. Barrow's subsistence-harvest area is extensive. The temporary loss of part of the Peard Bay range could be alleviated by a more intensive harvest in other locations of the community's harvest area. Therefore, moderate effects are projected for Barrow's subsistence harvest. Moderate sale-related effects are also projected for the community of Atqasuk. Atqasuk's marine mammal subsistence harvests are conducted within and as a part of Barrow's marine-harvest zone. As an inland community, Atqasuk's caribou harvest may be affected by pipeline-emplacement activities; but such effects are expected to be very transient in duration. Nuiqsut's dependence on the Colville River system and its delta for fish and various land mammal resources marks it as being particularly vulnerable to any type of upland oil spill. However, the likelihood of a major spill occurring on a critical tributary river and being undetected is remote. Point Belcher, the landfall for the Sale 126 pipeline, lies approximately 20 km north of Wainwright. The Wainwright Subsistence Area is also the most liable to be affected by an oil spill. Of all the communities analyzed under the high case, Wainwright is the most likely to experience substantial effects on its subsistence harvest. Virtually all of Wainwright's marine mammal harvests--particularly the bowhead whale harvest--could be affected by the proposed sale. The high case could result in high effects on Wainwright's subsistence harvests.

The overall effect of the high case on subsistence harvests is expected to be HIGH for Wainwright; MODERATE for Barrow, Atqasuk, and Point Lay; and LOW for Nuiqsut and Point Hope.

(12) Effects on Sociocultural Systems: The effects analysis of the high case on the sociocultural systems of the six communities near the Sale 126 area is based on (1) industrial activity, (2) induced demographic changes, and (3) the degree and opportunity for interaction between industry work bases and existing communities. The effects of these agents were found to dissipate beyond the communities of Wainwright and Barrow. Both of these communities are forecast to receive the bulk of OCS-induced Native and non-Native employment, opportunities for ethnic interaction, and effects on subsistence hunting. These communities also may suffer an increase in the social pathologies (alcoholism, domestic violence, etc.) that sometimes accompany industrial-development activities. Overall, sale-related activities are expected to continue the present population trend toward increased numbers of non-Native North Slope residents--especially in Barrow. The effect of the high case on sociocultural systems is expected to be MODERATE.

(13) Effects on Archaeological Resources: The effects of the high case would be due to (1) the probability of a transportation spill occurring and affecting offshore resources, (2) the probability of oil entering the water column and affecting bottom sediments that have a low probability of containing surviving offshore archaeological resources, (3) the large amount of oil resources expected to be discovered, and (4) the winter ice in the Arctic and its effect on lengthening the duration of a spill. Therefore, the effect of the high case on archaeological resources is expected to be MODERATE.

(14) Effects of Land Use Plans and Coastal Management Programs: Doubling the offshore activity and estimated number of oil spills in the high case accentuates the effects on coastal resources and uses identified in the base case. However, the levels of effects for coastal resources and uses vary only slightly from the base case. Therefore, the potential for significant conflicts between effects on resources and uses noted in the high case and the NSB LMR's and the statewide standards and NSB district policies of the Alaska Coastal Management Program (ACMP) remain the same as those identified for the base case (see Sec. IV.C.14). Conflict is most likely with the ACMP statewide standard for subsistence and with the NSBCMP policies and LMR's that prohibit significant interference with the bowhead whale hunt and require access to subsistence resources. Potential conflicts also are evident with the statewide standard for energy facilities if dredging activity occurs in Peard Bay and leads to long-term changes in biological distributions, for lagoon and river habitats in the event of an oil spill, and for water quality if formation

waters are discharged into the Chukchi Sea. For the high case, the potential for conflict with land use plans and coastal management programs is expected to be HIGH.

(15) Effects on Wetlands: Under the high case, the same amount of wetland is expected to be lost or affected as under the base case because the same amount of onshore development is expected to occur with construction of the 640-km-long pipeline-road corridor from Point Belcher to TAP Pump Station No. 2. Wetlands would be covered (<1% of any wetland type available on the coastal plain) by gravel fill on the road location and along the pipeline corridor; and wetlands would be affected by thermokarst, oil spills, and road dust within 100 m along the pipeline/road, as described under the base case (see Sec. IV.C.15). The effect of the high case on wetlands from oil spills, road dust, thermokarst, and gravel-fill extraction is expected to be localized along the pipeline-road corridor, with less than 1 percent of the coastal tundra wetlands of the North Slope being severely damaged. Some effects on plant and invertebrate communities, topography, and visual aesthetics are expected to persist for many years due to dust and traffic.

C. Alternative II - No Lease Sale: This alternative would eliminate the entire area proposed for leasing from further consideration. Table II-C-1 shows the amount of energy needed from other sources to replace the oil production anticipated from the base case. If this alternative were adopted, there would not be any exploration and development and production activities. The effects estimated to occur as a result of Alternative I would not occur. Even without Sale 126, however, the environment would still change; there would be effects to the environment from other natural and manmade factors.

D. Alternative III - Delay the Sale: This alternative would delay the proposed sale for up to a 3-year period--1991 to 1994. The effects estimated to occur as a result of Alternative I would be delayed for 3 years. Additional research pertinent to the Chukchi Sea area could also be carried out during this period of delay. Table II-D-1 shows studies pertinent to the Chukchi Sea area that may be conducted by MMS during a 3-year delay of sale.

E. Alternative IV - Point Lay Deferral Alternative: The Point Lay Deferral Alternative would offer 3,818 blocks (approx. 8.43 million hectares) of the Chukchi Sea Planning Area for leasing. The area of the Point Lay Deferral Alternative is the result of the deferral from leasing of 501 blocks (approximately 1.15 million hectares), of which 22--located along the Chukchi Sea coast from Cape Lisburne to Icy Cape--were leased during the previous Chukchi Sea Sale 109.

1. Resource Estimates and Basic Exploration, Development and Production, and Transportation Assumptions for Effects Assessment: The Point Lay Deferral Alternative is estimated to produce 1,610 MMbbl of oil, an amount equal to the estimated total amount of oil production under the base case. Consequently, the assumed scenario activities associated with exploration, development and production, and transportation as well as levels of activity under the deferral alternative are the same as for the base case. The level of activities and scheduling of events associated with the deferral alternative are shown in Table II-A-1 and Appendix B, Table 4. The following is derived from the description of the base case (Sec. II.B.2.a) as a means of describing activities assumed to be associated with the deferral alternative.

a. Activities Associated with Exploration Drilling:

(1) Seismic Activity: Prior to drilling, the lessee/operator is required to conduct surveys to determine if shallow hazards are present or absent at the proposed drill site; these surveys should incorporate seismic profiling. Based on past experience, it is assumed that one-half the well sites would be covered by a site-specific survey that generates 63 trackline km (39 statute mi) of data; the remaining sites would be covered by a block-wide survey that generates 303 trackline km (188 statute mi) of data. These surveys usually are conducted 1 year prior to drilling during the open-water period. The average time needed to survey each site is 1 week, allowing downtime for bad weather and equipment failure. For the purposes of this EIS, site-specific surveys are assumed to be conducted for 20 of the exploration- and delineation-well

Table II-C-1
Energy Needed from Other Sources to
Replace Anticipated Oil Production from
Proposed Chukchi Sea Sale 126

Alternative Energy Sources	Amount of Resource
Oil[1/]	1.61×10^{8} bbl
Gas[2/]	8.74×10^{12} cf
Coal	
Anthracite[3/]	3.55×10^{8} tons
Bituminous[4/]	3.44×10^{8} tons
Subbituminous[5/]	4.75×10^{8} tons
Lignite[6/]	6.73×10^{8} tons
Oil Shale[7/]	2.30×10^{9} tons
Tar Sands[8/]	2.15×10^{9} tons
Nuclear (Uranium Ore)[9/]	1.50×10^{6} tons

Source: USDOI, MMS, 1990.

1/ 5.60×10^{6} BTU/bbl.
2/ 1,031 BTU/cf.
3/ 25.4×10^{6} BTU/ton (Williams and Meyers, 1976).
4/ 26.2×10^{6} BTU/ton (Williams and Meyers, 1976).
5/ 19.0×10^{6} BTU/ton (Williams and Meyers, 1976).
6/ 13.4×10^{6} BTU/ton (Williams and Meyers, 1976).
7/ .7 bbl/ton (Science and Public Policy Program, 1976).
8/ 4.2×10^{6} BTU/ton (Science and Public Policy Program, 1975).
9/ 100,000 tons of ore = 3 million tons of coal at 10,000 BTU/lb (Science and Public Policy Program, 1975).

Table II-D-1
Studies Pertinent to the Chukchi Sea Area
That May Be Conducted by the Minerals Management Service
during a 3-Year Delay of Sale, 1991-1994

Year	Study Title
1991-1994	Remote-Sensing-Data Acquisition and Analysis (ongoing)
1991-1994	Circulation Model and Oil-Spill-Risk Analysis (ongoing)
1991	Revision of the Alaska OCS Oil-Weathering Model
1991-1992	Physical and Chemical Characteristics of Emulsified Oil in Turbulent Sea Water
1991-1993	Fisheries Oceanography in Areas of Oil and Gas Activities in the Arctic (ongoing)
1991	Potential Impacts of Human Activities on Feeding Behavior, Energetics, and Habitats of Molting Pacific Black Brant in the Teshekpuk Lake Special Area, Alaska (ongoing)
1991	Use of Kasegaluk Lagoon by Marine Mammals and Birds (ongoing)
1991	Delineation, Faunal Composition, and Repeated Use of Benthic Feeding Areas by Walrus and Endangered Gray Whales in the Northern Chukchi and by Walrus in Norton Sound
1991-1993	Monitoring Distribution of Arctic Whales (ongoing)
1991-1993	Application of Remote Methods of Large Cetacean Tracking (ongoing)
1991-1993	Stable Isotope Analysis of Bowhead Whale and Zooplankton Tissues (ongoing)
1991	Model Verification: Site-Specific Interaction of Acoustic Stimuli (ongoing)
1991	Importance of Leads to Bowhead Whales
1991	Potential Influence of Environmental and Industrial Factors on Bowhead Whale Hunting
1991-1993	Acquisition and Curation of Alaskan Marine Mammal Tissues for Determining Levels of Contamination Associated with Offshore Oil and Gas Development (ongoing)
1991-1993	Information-Update Meetings and Report Publication (ongoing)
1991-1993	Conferences and Reports on MMS Results (ongoing)
1991-1994	Risk Perception of the Sociocultural Consequences of Alaskan OCS Activities (ongoing)
1992	The Consequences of OCS Development on Community Service Infrastructure
1993	Subsistence and Cultural Practices of Native Alaskans

Source: USDOI, MMS, Alaska OCS Region, Environmental Studies Section, 1990.

sites; and block surveys are assumed to be conducted for 19 exploration- and delineation-well sites. The total trackline distance would equal 7,055 km (4,352 statute mi).

(2) Exploration Drilling: Drilling of the estimated 28 exploration and 11 delineation wells is anticipated to begin in 1992 and continue through 1998. Based on the water-depth ranges of the Sale 126 blocks, it is assumed that the exploration wells would be drilled from floating drilling units. Drilling of each exploratory well would require the disposal of about 660 short tons (dry weight) of drilling muds and about 850 short tons (dry weight) of drill cuttings. The total amount estimated to be disposed of is about 25,740 short tons (dry weight) of drilling muds and about 33,150 short tons (dry weight) of cuttings.

(3) Support and Logistic Activities: A total of about 2,340 helicopter flights are estimated to be flown in support of exploration drilling. Using a minimum of 1 helicopter per drilling unit, with 1 additional helicopter for every 2 drilling units, the total number of helicopters that would serve exploration drilling would not exceed the 7 used in the peak years of 1993 and 1994 to service 5 drilling units.

Depending on ice conditions, 2 or more vessels may be required to perform ice-management tasks for the floating units during drilling operations in the open-water season. The potential number of drilling units that might be operating during the open-water season could range from 2 to 5 (see Appendix B, Table 4). It is estimated that there would be 1 supply-boat trip per drilling unit per week during the open-water season. For exploration drilling, the total number of supply-boat trips is estimated (based on 90 days to drill a well) to range from about 24 to 60, with a total number of trips estimated at 312 for the 26 drilling-unit operations carried out over a 7-year period.

b. Activities Associated with Development and Production: The initial discovery of oil could occur in the second or third year of the lease; the first delineation well is projected to be drilled in 1993. The six production platforms associated with the deferral alternative are estimated to be installed (2/yr) between 2000 and 2002.

(1) Seismic Activity: A three-dimensional, multichannel seismic-reflection survey would be conducted for each of the 6 production platforms. Surveys for each platform are assumed to cover approximately 62 km^2 (38 mi^2), assuming an anticipated average drilling depth of 8,000 ft. Using a 76-m (250-ft) grid spacing pattern, each platform would require a survey of 1,658 km (about 1,023 statute mi) or a total of 9,948 km (about 6,138 statute mi) for the 6 platforms. Site-specific surveys required for siting each production platform would contribute an additional 379 km (234 statute mi), for a total seismic survey distance of 10,329 km (6,372 statute mi).

The HRD for shallow hazards would be collected prior to laying the offshore pipeline. The total trackline distance, estimated to be four times the length of the pipeline assumed for the scenario, would equal approximately 1,135 km (about 700 statute mi).

(2) Development-Well Drilling: It is estimated that a total of 214 production and service wells would be drilled between 2000 and 2004 (see Appendix B, Table 4). During drilling, some of the muds used for production and service wells may be recycled through each subsequent well drilled on a particular platform. Depending on the amount recycled, the amount of drilling muds disposed could range from 110 to 700 short tons (dry weight) for each well and from 23,540 to 149,800 short tons for all the production and service wells drilled. Each production and service well is expected to produce approximately 925 short tons (dry weight) of drill cuttings; the total amount of cuttings disposed would be about 197,950 short tons (dry weight).

Production of oil is forecast to begin in 2002 and continue through 2020. Peak production of 135 MMbbl per year would occur between 2003 and 2007.

(3) Support and Logistic Activities: Installation and hookup of production

platforms during the development stage would be supported by 2 supply boats and 1 helicopter per platform (see Table II-A-1). Two platforms per year are scheduled to be installed during 2000, 2001, and 2002 (see Appendix B, Table 4), with heavy supplies being transported by barges (see Table II-B-2). During production, 2 icebreaker support/supply boats and 2 helicopters would be dedicated to the sale area. An additional support/supply boat and helicopter would be available for backup.

The number of helicopter flights to be flown in support of drilling 214 production and service wells is estimated to total 9,630 between 2000 through 2004, based on an average of 0.5 flights per well during the drilling period, or 45 trips per well. The number of flights would range from 360 in 2000, when 8 wells are drilled, to 3,600 in 2003, when 80 wells are drilled. From 2002 to 2020, it is estimated that the number of helicopter flights to production platforms would average about 2 per week per platform, or about 11,856 flights.

Estimates on the number of workmonths of direct OCS employment for each unit of work during the development and production phase are the same as for the base case and are given in Appendix H, Table H-2.

c. Activities Associated with Oil Transportation: Activities and routes associated with transporting oil via a pipeline connecting to the TAP are the same as for the base case.

2. Significance of the Proposed Area to Be Deferred: As shown in Figure I-3, the Point Lay Deferral Alternative would offer for leasing all of the area described for Alternative I, except for selected blocks located off Point Lay in the southeastern part of the proposed sale area. (A list of blocks within the area to be deferred is available from the Alaska OCS Region, Leasing Activities Office.) The area to be deferred (not offered for lease) by the deferral alternative is part of the area that the State of Alaska, North Slope Borough, NOAA, and EPA recommended for deferral in the previous Chukchi Sea Sale 109. The other coastal areas they were concerned about were removed from future consideration at the area identification stage. The area to be deferred was part of the Coastal Deferral Alternative analyzed in the Sale 109 FEIS. The boundaries of the area to be deferred lie between about 3 and 67 statute mi offshore.

The area to be deferred contains important biological resources, habitats for subsistence resources, and cultural values for residents of the nearby areas. More specifically, the deferral alternative was developed to (1) include that part of the bowhead whale spring-migration corridor that was not deleted from the planning area as a result of Area Identification; (2) include that part of the Chukchi polynya through which marine mammals migrate in the spring that was not deleted from the planning area as a result of Area Identification; (3) provide a protective buffer to the offshore subsistence-harvest area of Point Lay in addition to that provided by the area deleted from the proposed lease-sale area; and (4) provide additional protection to important coastal habitats such as Kasegaluk Lagoon and the barrier-island system and Ledyard Bay.

As a result of Sale 109, 22 blocks located in the area to be deferred were leased. Exploration-drilling operations on these blocks require a site-specific bowhead whale monitoring program (see Sec. II.F.2).

3. Summary of Effects for the Deferral Alternative: The summaries presented in this section are based on the analysis in Section IV.G of this EIS. The types and levels of activities that might be associated with the Point Lay Deferral Alternative are summarized in Table II-A-1 and described in Section II.E.1.

a. Effects on Air Quality: Concentrations of criteria pollutants at the shoreline due to development and production are expected to be less than 5 percent of available national standards or PSD increments. A very low effect on air quality is expected. Under the Point Lay Deferral Alternative, operations and any accidental spills and emissions would be relatively small and well offshore. Air pollutants would be diffuse at the shoreline and unable to cause even local or short-term effects. Consequently, effects on air quality--other than those addressed by standards--are expected to be very low. The effect of the Point

Lay Deferral Alternative on air quality as a result of exploration and development and production is expected to be VERY LOW.

b. Effects on Water Quality: Under the Point Lay Deferral Alternative, water quality in the Chukchi Sea would be affected only by platform discharges (muds and cuttings and formation waters), construction activities (drilling, and platform and pipeline placement), and oil spills. Discharges of muds and cuttings are regulated by the EPA such that water quality criteria must be met at the edge of an EPA-established mixing zone. The effect of exploration- and production-drilling muds and cuttings discharges would persist only during actual discharge within the 100-m-radius mixing zone around each discharge point. Concentrations of trace metals would not exceed the acute marine-water quality criteria at the edge of the mixing zone. The effect on local and regional water quality is expected to be very low.

If formation waters were discharged into the water column rather than reinjected, the effect on water quality would be local and would continue for the life of the field. The effect on local water quality is expected to be moderate, while the effect on regional water quality is expected to be very low.

Effects on water quality from dredging (and dumping) would be local and short-term. Turbidity would increase over a few square kilometers in the immediate vicinity of dredging operations only during actual dredging. Effects on local water quality are expected to be low, while the effect on regional water quality is expected to be very low.

Sustained degradation of water quality to levels above State and Federal criteria from hydrocarbon contamination is unlikely. Hydrocarbon concentrations from the two estimated oil spills of ≥ 1,000 bbl could exceed the chronic criterion of 0.015 ppm total hydrocarbons on at least several thousand square kilometers for a short period of time. Concentrations above the acute criterion are not anticipated. Effects of an oil spill on water quality are expected to be low both locally and regionally.

The effect of the Point Lay Deferral Alternative on water quality is expected to be MODERATE locally and LOW regionally.

c. Effects on Lower-Trophic-Level Organisms: Oil spills, drilling discharges, offshore construction, and seismic surveys could affect lower-trophic-level organisms. Oil spills would be the principal agent that could have an adverse effect on this group of organisms; however, no oil spills are estimated to occur during the 7 years of exploration drilling. Drilling discharges, as analyzed in Sections IV.C.3 and IV.D.3 are shown to have little effect on lower-trophic-level organism populations, since affected habitat is limited to that immediate to the discharge point. The quantities discharged are only a small increment to the natural sediment load of the Chukchi Sea. Rig placement may temporarily displace/disturb some lower-trophic-level organisms; however, the structure itself may enhance habitat for members of this group. Seismic surveys required for well siting would likely use airguns or equivalent acoustic-energy sources. These devices essentially have no significant adverse effect on lower-trophic-level organisms. Lower-trophic-level organisms, marine plants, and invertebrates could be affected by drilling discharges, seismic surveys, and construction activities associated with the Point Lay Deferral Alternative.

Exploration drilling would discharge about 59,000 short tons of muds and cuttings from a total of 39 exploration and delineation wells over a period of 8 years. Only 5 rigs would be present at any one time. Development and production would increase these weights to a range of 23,540 to 149,800 short tons of drilling muds and to 197,950 short tons of cuttings. These materials would be discharged from 6 different platforms, in conjunction with the drilling of 214 production and service wells, over a 5-year period (Table II-A-1). Additional information regarding drilling discharges can be found in Section IV.B.2.a. The quantities discharged are small compared to natural-nearshore-sediment loads of the Chukchi Sea. Less than 0.1 km^2 around each drilling rig would be affected by discharged material, but any marine plants and invertebrates within this area would be affected.

The broad distribution, large population number, and relatively rapid rate of reproduction would limit adverse effects on the lower-trophic level organisms of the Chukchi Sea Planning Area to a very low level, even though those within the area influenced by the discharges would probably sustain a very high-level effect. The affected organisms would comprise only a minute fraction of the total populations.

Seismic surveys would affect only those organisms in close proximity to the acoustic-energy source. The surveys would have a very low overall adverse effect on the populations within the Point Lay Deferral Alternative. The temporary placement of drilling rigs could cause some disturbance to the benthos and to sessile organisms there, although the rig structure itself may enhance habitat and afford protection for some organisms.

The effect of the Point Lay Deferral Alternative on lower-trophic-level-organisms is expected to be VERY LOW.

d. Effects on Fishes: Oil spills of large volume that contact fish habitats, especially where the habitats are discrete and somewhat restricted in area, would be the major factor affecting this group of organisms. Arctic fish populations (including anadromous species) also could be affected by drilling discharges, seismic surveys, and any construction activities associated with the Point Lay Deferral Alternative.

Exploration drilling would discharge about 53,000 short tons of muds and cuttings from 35 exploration and delineation wells during a period of 7 years. Only 5 rigs would be present at any one time. The quantities discharged are small compared to the natural-nearshore-sediment loads of the Chukchi Sea. Less than 0.1 km^2 around each drilling rig would be affected by discharged material, but any fish within this area would be affected. The normally mobile fish would probably move outside the limited area affected by the drilling discharges; but broad distribution of fish in the Point Lay Deferral area would result in a very low effect on fish from drilling discharges.

Seismic surveys have been found to have little or no effect on fish. Pelagic eggs and larvae of some species may sustain sublethal to lethal effects if they are within very close proximity to the seismic-energy-discharge point. The placement of drilling rigs might temporarily disturb fish, but the presence of the structure in itself might afford habitat for some species.

The effect of the Point Lay Deferral Alternative on fishes is expected to be VERY LOW in marine habitats and VERY HIGH in freshwater habitats.

e. Effects on Marine and Coastal Birds: Under the Point Lay Deferral Alternative, development and any resulting adverse effects on marine and coastal birds are expected to be essentially as described for the base case, except that those effects associated with the deferred blocks in the southeastern sale area are less likely to occur. Deferral of these blocks would remove hypothetical spill sites from which spilled oil could contact the spring-migration corridor and coastal lagoons. Contact probabilities for these important habitats decline somewhat under this alternative, but hypothetical pipeline-spill points would still remain in the vicinity of the deferred blocks. Deferral of these blocks is inconsequential in reducing risk to nearshore habitats, and the probability of a spill occurring and contacting any environmentally important areas is unchanged. Thus, this alternative produces a minor reduction in oil-spill risk to some marine and coastal bird habitats.

Disturbance of marine and coastal birds under this alternative is not expected to differ substantially from the base case, since some vessels would pass through and helicopters would overfly the deferred blocks enroute to leased blocks. The overall effect of the Point Lay Deferral Alternative on marine and coastal birds is expected to be LOW.

f. Effects on Pinnipeds and Polar Bear: Under the Point Lay Deferral Alternative, development and any resulting adverse effects on pinnipeds and polar bear are expected to be essentially as described for the base case, except that those effects associated with the deferred blocks in the southeastern sale area are less likely to occur. Deferral of these blocks would remove hypothetical spill sites from which spilled oil could contact the spring-migration corridor and coastal lagoons. Contact probabilities for these important habitats decline somewhat under this alternative, but hypothetical pipeline spill points would still remain in the vicinity of the deferred blocks. Deferral of these blocks is inconsequential in reducing risk to nearshore habitats, and the probability of a spill occurring and contacting any environmentally important area is unchanged. Thus, this alternative produces a minor reduction in oil-spill risk to some marine mammal habitats.

Disturbance of pinnipeds and polar bear under this alternative is not expected to differ substantially from the base case, since some vessels would pass through and helicopters would overfly the deferred blocks enroute to leased blocks. The effect of the Point Lay Deferral Alternative on pinnipeds and polar bear is expected to be LOW.

g. Effects on Endangered and Threatened Species:

(1) Bowhead and Gray Whales: Studies indicate that industrial noise is likely to have from only a local, short-term effect on the whales that encounter it. Contact with oil is expected to be brief and would be likely to have a minimal effect on most whales. The Point Lay Deferral Alternative consists of the same number of exploration and production operations as that of the base case. Hence, bowhead and gray whales are expected to encounter these agents at the same rate discussed for the base case. The deletion of the eastern portion of the sale area would further reduce the likelihood of spring bowhead encounters with industrial noise but would not substantially reduce the probability of crude oil contacting the spring-migratory corridor. Since fall-migrating bowheads do not use the deferred area and gray whales are concentrated shoreward, the Point Lay Deferral Alternative would provide minimal benefit over the base case.

(2) Arctic Peregrine Falcon: Since the amount of exploration and production activity associated with the Point Lay Deferral Alternative is the same as for the base case, the effect of this alternative also is expected to be the same. Consequently, the effect of the Point Lay Deferral Alternative on the arctic peregrine falcon population is expected to be very low.

The effect of the Point Lay Deferral Alternative on endangered and threatened species is expected to be VERY LOW.

h. Effects on Belukha Whale: The effect of industrial noise and crude oil associated with the Point Lay Deferral Alternative on belukha whales in or near the Sale 126 area is expected to be essentially the same as that discussed for bowhead and gray whales (local, short-term effects on some animals), although belukhas are likely to respond to industrial noise of higher frequencies. The estimated rate of belukhas encountering exploratory noise and crude oil in the Point Lay Deferral Alternative would be similar to the rate expected for the base case, although spring migrating belukhas may experience slightly less noise due to the more offshore location of the sale area. Displacement of belukhas due to pipeline construction is unlikely. Consequently, the effect of the Point Lay Deferral Alternative on the belukha whale population is expected to be VERY LOW.

i. Effects on Caribou: Under the Point Lay Deferral Alternative, development and effects thereof are expected to be essentially as described for the base case, except that those effects associated with deferred blocks in the southeastern sale area may be less likely to occur. The effect of the Point Lay Deferral Alternative on caribou is expected to be LOW.

j. Effects on the Economy of the North Slope Borough: The employment and revenue effects of the Point Lay Deferral Alternative are expected to be moderate because the projected resident employment would increase above 10 percent for at least 5 years, and the average change in resident employment would be about 9 percent. Sale effects on Native- and non-Native-resident employment would be slightly higher and slightly lower, respectively. However, the unemployment rate for Native residents would still reach 50 percent by 2002, with or without the sale. In addition, NSB property taxes would increase an average 11 percent; and operating revenues would increase an average 9 percent. Economic benefits from new jobs, income, and taxes that could result from the proposed sale are expected to occur after the level of petroleum activities on the North Slope (e.g., Prudhoe Bay) has begun to decline. This decline would not be reversed by the projected effects of proposed Sale 126. The employment and revenue effects of this alternative on the NSB region are expected to be moderate.

The value of subsistence resources can be translated into monetary units that reflect potential effects on household income. The use of these resources by NSB residents enters into household income in two ways. Firstly, they are a substitute for store-bought foods that allows cash to be used for other needs. Secondly, there is value derived from enjoyment of the use and value in the cultural aspects of these resources. These are real values that affect the economic well-being of NSB residents and are empirically quantifiable. Subsistence-harvest disruptions could result from oil spills and industrial activities. The importance of the subsistence resources to the NSB economy could mean that subsistence-harvest disruptions would cause high effects. Construction activities could disrupt the bowhead whale harvest for both Barrow and Wainwright for more than 1 year. Low-level effects are expected on caribou, walrus, and seals. An oil spill could prevent bowhead whale harvests for at least 1 year. The economic well-being of NSB residents would be significantly affected by these events, representing a real loss in income.

The effect of the Point Lay Deferral Alternative on the economy of the NSB is expected to be HIGH.

k. Effects on Subsistence-Harvest Patterns: The effects of the Point Lay Deferral Alternative on the communities near the Sale 126 area would be similar to those for the base case. The Alternative IV development scenario is essentially the same as that for the base case in terms of estimated recoverable hydrocarbons and the levels of industry activity needed for hydrocarbon recovery. The 501 blocks deferred from leasing would not significantly alter the effects concluded for the base case. Wainwright, Barrow, and Point Hope hunters do not take bowheads or other resources from that portion of the sale area comprised of these 501 blocks. Also, Point Lay hunters do not harvest bowheads. This alternative could reduce effects on the Point Lay harvest of belukha whales by reducing the potential level of OCS activities in and around the Point Lay area. However, such a reduction of effects on the belukha whale harvest would not be sufficient to reduce the overall moderate effect on Point Lay or to change the effect levels concluded under the base case for the other communities near the Sale 126 area. The overall effect of Alternative IV on subsistence-harvest patterns is expected to be HIGH for Wainwright; MODERATE for Barrow, Atqasuk, and Point Lay; and LOW for Nuiqsut and Point Hope.

l. Effects on Sociocultural Systems: The effects of the Point Lay Deferral Alternative on sociocultural systems would not be significantly different from those of the base case. The agents that change or significantly affect the Inupiat sociocultural system would be essentially the same as for the base case. Resource and industry activity levels would be very nearly the same as for the base case, and the oil-transportation scenario is virtually identical to that of the base case. The block deletions that characterize this alternative could enhance the cultural well-being of Wainwright by reducing the potential effect of OCS activities on the belukha whale harvest. However, no other communities or resources would be appreciably affected by the block deletions; and the effect of this alternative on sociocultural systems would be the same as for the base case--MODERATE.

m. Effects on Archaeological Resources: The effects of the Point Lay Deferral Alternative would be due mostly to the crossing of an offshore pipeline from lease areas farther out on the OCS through the deferral area to the shorebase at Point Belcher. Because there are archaeological sites and shipwrecks in the deferral area, the pipeline would endanger those resources located both offshore in the deferral area and onshore. Therefore, the effect of the Point Lay Deferral Alternative is expected to be MODERATE.

n. Effects of Land Use Plans and Coastal Management Programs: The Point Lay Deferral Alternative does not alter significantly either the offshore activity and estimated number of oil spills or the effects on coastal resources and uses identified in the base case. Therefore, the potential for significant conflicts between effects on resources and uses and the NSB LMR's and the statewide standards and NSB district policies of the Alaska Coastal Management Program (ACMP) remain the same as those identified for the base case (see Sec. IV.C.14). Conflict is most likely with the ACMP statewide standard for subsistence and with the NSBCMP policies and LMR's that prohibit significant interference with the bowhead whale hunt and require access to subsistence resources. Potential conflicts also are evident with the statewide standard for energy facilities if dredging activity occurs in Peard Bay and leads to long-term changes in biological distributions, for lagoon and river habitats in the event of an oil spill, and for water quality if formation waters are discharged into the Chukchi Sea. For the Point Lay Deferral Alternative, the potential for conflict with land use plans and coastal management programs is expected to be HIGH.

o. Effects on Wetlands: Under the Point Lay Deferral Alternative, onshore development is expected to be the same as under the base case, with local effects on wetlands occurring along the 640-km-long pipeline-road corridor due to gravel fill, thermokarst, oil spills, and road dust. Less than 1 percent of the wetlands on the coastal plain of the North Slope are expected to be severely changed or affected by this alternative. The effect of the Point Lay Deferral Alternative on wetlands is expected to be the same as described for the base case.

F. Mitigating Measures

1. Mitigating Measures That Are Part of the Proposed Action and the Alternatives: Laws, regulations, and orders that provide mitigation are considered part of the proposal. Examples include the OCS Lands Act, which grants broad authority to the Secretary of the Interior to control lease operations and, where appropriate, undertake environmental monitoring studies (see Appendix F); the Consolidated Offshore Operating Regulations (which rescinded and replaced Alaska OCS Orders effective May 31, 1988); and the Fisherman's Contingency Fund. Incorporated by reference in Section I.C is OCS Report MMS 86-003, "Legal Mandates and Federal Regulatory Responsibilities" (Rathbun, 1986). Permit requirements, engineering criteria, testing procedures, and information requirements also are outlined. These requirements are developed and administered by the MMS. The mitigating effect of these measures has been factored into the environmental-effects analysis. Incidental take regulations now in effect do not permit any activity in the spring lead system while the whales are migrating.

2. Potential Mitigating Measures: The following mitigating measures are offered to reduce or eliminate potential adverse effects identified in Section IV. A Secretarial decision on these mitigating measures has not occurred; they are noted here as potential measures that could further mitigate the effects of this proposed lease sale. The Secretary has imposed similar measures in previous Federal oil and gas lease sales; use of these measures is likely to continue unless more effective mitigating measures are identified. If any of these measures are adopted, they will appear in the Notice of Sale. The analysis in this EIS does not assume that the following mitigating measures are in place; however, they are evaluated in the discussions of the effectiveness of stipulations or information to lessees that follow each of the potential measures.

a. Potential Stipulations: Stipulations are specific requirements placed on the lessee by the USDOI to reduce or eliminate potential adverse effects. The following stipulations will be considered for Chukchi Sea Sale 126:

No. 1	Protection of Archaeological Resources
No. 2	Protection of Biological Resources
No. 3	Orientation Program
No. 4	Transportation of Hydrocarbons
No. 5	Industry Site-Specific Bowhead Whale-Monitoring Program

No. 6 Subsistence Whaling and Other Subsistence Activities
No. 7 Oil-Spill-Response Preparedness

NOTE: Stipulation No. 8, Density Restriction for Protection of Bowhead Whales from Potential Effects of Noise, as described in the DEIS, has been deleted as a potential mitigating measure because it is inconsistent with recent NMFS regulations on incidental take of bowhead whale and not required by the Arctic Region Biological Opinion or the Sale 126 Biological Opinion.

Stipulation No. 1--Protection of Archaeological Resources

(a) "Archaeological resource" means any prehistoric or historic district, site, building, structure, or object (including shipwrecks); such term includes artifacts, records, and remains which are related to such a district, site, building, structure, or object (16 U.S.C. 470w(5)). "Operations" means any drilling, mining, or construction, or placement of any structure for exploration, development, or production of the lease.

(b) If the Regional Supervisor, Field Operations (RSFO), believes an archaeological resource may exist in the lease area, the RSFO will notify the lessee in writing. The lessee shall then comply with subparagraphs (1) through (3).

(1) Prior to commencing any operations, the lessee shall prepare a report, as specified by the RSFO, to determine the potential existence of any archaeological resource that may be affected by operations. The report, prepared by an archaeologist and a geophysicist, shall be based on an assessment of data from remote-sensing surveys and of other pertinent archaeological and environmental information. The lessee shall submit this report to the RSFO for review.

(2) If the evidence suggests that an archaeological resource may be present, the lessee shall either:

(i) Locate the site of any operation so as not to adversely affect the area where the archaeological resource may be; or

(ii) Establish to the satisfaction of the RSFO that an archaeological resource does not exist or will not be adversely affected by operations. This shall be done by further archaeological investigation, conducted by an archaeologist and a geophysicist, using survey equipment and techniques deemed necessary by the RSFO. A report on the investigation shall be submitted to the RSFO for review.

(3) If the RSFO determines that an archaeological resource is likely to be present in the lease area and may be adversely affected by operations, the RSFO will notify the lessee immediately. The lessee shall take no action that may adversely affect the archaeological resource until the RSFO has told the lessee how to protect it.

(c) If the lessee discovers any archaeological resource while conducting operations in the lease area, the lessee shall report the discovery immediately to the RSFO. The lessee shall make every reasonable effort to preserve the archaeological resource until the RSFO has told the lessee how to protect it.

Purpose of Stipulation No. 1: The purpose of this measure is to protect prehistoric and historic archaeological resources and shipwrecks that are known or may be discovered in a lease area from any petroleum-industry activity that would disturb the area.

Effectiveness of Stipulation No. 1: Stipulation No. 1 provides a positive method to determine if archaeological resources are present in the lease area prior to the start of any operations associated with petroleum-development activities and ways to develop effective measures to protect known or subsequently discovered archaeological resources. Therefore, the effects of industry operations on archaeological resources in the base case would be reduced from MODERATE to LOW with the adoption of this stipulation; and effects in the other cases would likewise be reduced by one level of effect.

Stipulation No. 2--Protection of Biological Resources

If biological populations or habitats that may require additional protection are identified in the lease area by the Regional Supervisor, Field Operations (RSFO), the RSFO may require the lessee to conduct biological surveys to determine the extent and composition of such biological populations or habitats. The RSFO shall give written notification to the lessee of the RSFO's decision to require such surveys.

Based on any surveys which the RSFO may require of the lessee or on other information available to the RSFO on special biological resources, the RSFO may require the lessee to:

(1) Relocate the site of operations;

(2) Establish to the satisfaction of the RSFO, on the basis of a site-specific survey, either that such operations will not have a significant adverse effect upon the resource identified or that a special biological resource does not exist;

(3) Operate during those periods of time, as established by the RSFO, that do not adversely affect the biological resources; and/or

(4) Modify operations to ensure that significant biological populations or habitats deserving protection are not adversely affected.

If any area of biological significance should be discovered during the conduct of any operations on the lease, the lessee shall immediately report such findings to the RSFO and make every reasonable effort to preserve and protect the biological resource from damage until the RSFO has given the lessee direction with respect to its protection.

The lessee shall submit all data obtained in the course of biological surveys to the RSFO with the locational information for drilling or other activity. The lessee may take no action that might affect the biological populations or habitats surveyed until the RSFO provides written directions to the lessee with regard to permissible actions.

Purpose of Stipulation No. 2: Important biological populations and habitats in addition to those already identified in the Information to Lessees on Areas of Special Biological and Cultural Sensitivity may exist in the proposed sale area. Such populations and habitats may require additional protection. If critical biological resources are identified, measures could be developed to reduce possible adverse effects on them from oil and gas activities. These measures could include shifts in operational sites, modifications in drilling procedures, and increased consideration of the areas during oil-spill-contingency planning.

Effectiveness of Stipulation No. 2: This stipulation provides a formal mechanism for identifying important or unique biological populations or habitats that require additional protection because of their sensitivity and/or vulnerability. If these populations or habitats are found to exist in the lease area, the stipulation provides a means for developing measures to reduce possible adverse effects from oil and gas activities. For example, although kelp-bed communities are known to occur in the northeastern Chukchi Sea, extensive surveys for them have not been made; and, at present, only two have been reported. This stipulation could result in the identification and protection of kelp-bed communities. By regulating the siting of drilling and construction activities, effects on kelp beds could be avoided. Avoidance of such effects could also provide some local benefits to invertebrates, fishes, birds, and marine mammals. Through identification of biological populations or habitats requiring special protection, this stipulation also could provide data for the environmental report required for exploration and development plans that must be reviewed and approved according to 30 CFR 250.33 and 250.34. Stipulation No. 2 is not likely to change the overall effect levels of the proposal on biological resources, although local reductions in habitat effects or effects on specific, vulnerable populations may occur.

Stipulation No. 3--Orientation Program

> The lessee shall include in any exploration or development and production plans submitted under 30 CFR 250.33 and 250.34 a proposed orientation program for all personnel involved in exploration or development and production activities (including personnel of the lessee's agents, contractors, and subcontractors) for review and approval by the Regional Supervisor, Field Operations. The program shall be designed in sufficient detail to inform individuals working on the project of specific types of environmental, social, and cultural concerns which relate to the sale and adjacent areas. The program shall be formulated by qualified instructors experienced in each pertinent field of study and shall employ effective methods to ensure that personnel are informed of archaeological and biological resources and habitats, including endangered species, fisheries, bird colonies, and marine mammals, and to ensure that personnel understand the importance of not disturbing archaeological resources and of avoidance and nonharassment of wildlife resources. The program shall also be designed to increase the sensitivity and understanding of personnel to community values, customs, and lifestyles in areas in which such personnel will be operating. The orientation program shall also include information concerning avoidance of conflicts with subsistence activities. The program also shall include presentations and information about all pertinent lease sale stipulations and information to lessees provisions.
>
> The program shall be attended at least once a year by all personnel involved in onsite exploration or development and production activities (including personnel of the lessee's agents, contractors, and subcontractors) and all supervisory and managerial personnel involved in lease activities of the lessee and its agents, contractors, and subcontractors.
>
> The lessee shall maintain a record of all personnel who attend the program. This record shall include the name and date(s) of attendance of each attendee and shall be kept onsite for so long as the site is active, not to exceed 5 years.

Purpose of Stipulation No. 3: The purpose of this potential stipulation, which addresses the concerns of residents expressed during the scoping process and for other Alaska sales, is to provide increased protection to the environment. The orientation program would promote an understanding of, and appreciation for, local community values, customs, and lifestyles of Alaskans without creating undue costs to the lessee. It would also provide necessary information to industry personnel about the biological resources used for commercial and subsistence activities, about archaeological resources of the area and appropriate ways to protect them from adverse effects, and about the concerns for reducing industrial noise and disturbance effects on marine mammals and marine and coastal birds.

Effectiveness of Stipulation No. 3: This measure provides positive mitigating effects in that it would make all personnel involved in petroleum-industry activities aware of the unique environmental, social, and cultural values of Chukchi Sea Inupiat residents and their environment. There is concern that uninformed workers and subcontractors could unknowingly destroy or damage the biological environment, be insensitive to local historical or cultural values, or unnecessarily disrupt the local economy. This stipulation also would minimize conflicts between subsistence-hunting activities and activities of the oil and gas industry. Overall, the Orientation Program Stipulation would reduce effects somewhat but not enough to change the levels of effects identified for the proposal.

Stipulation No. 4--Transportation of Hydrocarbons

> Pipelines will be required: (a) if pipeline rights-of-way can be determined and obtained; (b) if laying such pipelines is technologically feasible and environmentally preferable; and (c) if, in the opinion of the lessor, pipelines can be laid without net social loss, taking into account any incremental costs of pipelines over alternative methods of transportation and any incremental benefits in the form of increased environmental protection or reduced multiple-use conflicts. The lessor specifically reserves the right to require that any pipeline used for transporting production to shore be placed in certain designated management areas. In selecting the means of transportation, consideration will be given to any recommendation of the Regional Technical Working Group, or other similar advisory groups with participation of Federal, State, and local governments and industry.
>
> Following the development of sufficient pipeline capacity, no crude oil production will be transported by surface vessel from offshore production sites, except in the case of emergency. Determinations as to emergency conditions and appropriate responses to these conditions will be made by the Regional Supervisor, Field Operations.

Purpose of Stipulation No. 4: This stipulation provides a formal way of selecting a means of transporting petroleum from a sale area. It also informs the lessee that (1) MMS reserves the right to require the placement of pipelines in certain designated management areas and (2) pipelines must be designed and constructed to withstand the hazardous conditions that may be encountered in the sale area. This stipulation is intended to ensure that the decision on which method to use in transporting hydrocarbons considers the social, environmental, and economic consequences of pipelines.

Effectiveness of Stipulation No. 4: The analysis of the effects of Sale 126 Alternative I on the physical, biological, and socioeconomic resources of the sale and adjacent areas considers pipelines as the method of transporting produced oil in the sale area. Because of this, Stipulation No. 4 is not expected to significantly reduce the overall effect levels identified for the resources analyzed in Section IV. However, implementation of this stipulation would reinforce two policies of the NSB Coastal Management Program--(1) NSBCMP 2.4.4(h), which requires pipelines to be specifically designed to withstand sea ice and other hazards, and (2) NSBCMP 2.4.5.1(h), which discourages development that accommodates movement of produced hydrocarbons by tankers.

Stipulation No. 5--Industry Site-Specific Bowhead Whale-Monitoring Program

> Lessees shall conduct a site-specific monitoring program during exploratory drilling activities to determine when bowhead whales are present in the vicinity of lease operations and the extent of behavioral effects on bowhead whales due to these activities. The lessee shall provide its proposed monitoring plan to the Regional Supervisor, Field Operations (RSFO), for review and approval no later than 60 days prior to commencement of drilling activities. Information obtained from this site-specific monitoring program shall be provided to the RSFO in accordance with the approved monitoring plan. This stipulation will remain in effect until termination or modification by the Department of the Interior after consultation with the National Marine Fisheries Service.

This stipulation applies to the following blocks for the following time period:

Migration Area
April 1 to May 31

Official Protraction Diagram	Blocks Included
NR 3-4	243, 244, 284, 327, 328, 370-372, 412-416, 454, 455, 497-499, 539-543, 581-587, 624-631, 667-675, 710-719, 753-763, 796-807, 839-851, 882-895, 925-939, 969-983
NR 3-5	25, 26, 68-70, 111-114, 154-158, 197-202, 240-246, 282-290, 324-334, 367-378, 409-422, 451-466, 493-510, 535-554, 578-598, 620-642
NR 3-6	1-15, 45-59, 89-103, 133-145, 177-188, 221- 232, 265-275, 309-319, 353-362, 397-406, 441-449, 485-493, 529-537, 573-581, 617-625
NR 4-3	54, 55, 96-99, 137-140, 179-184, 221-228

Purpose of Stipulation No. 5: The purpose of this stipulation is to provide information on when whales are present in the vicinity of exploratory operations and the extent of behavioral responses caused by these activities.

Effectiveness of Stipulation No. 5: This stipulation, in conjunction with ITL No. 6 (Information on Endangered Whales and MMS Monitoring Program), is intended to provide additional scientific information concerning endangered bowhead whales during their spring migration during exploratory activities. Should the information obtained from the MMS' or the lessees' monitoring programs indicate that there is potential harm to the species, the RSFO will require the lessee to suspend operations, in accordance with 30 CFR 250.10. Some endangered bowhead whales may interact with the activities associated with exploratory drilling, but it is more likely that interaction would be minimal. The timing of the migration is such that it should be finished in the Chukchi Sea by the time exploratory operations would be expected to begin. Exploration in the sale area is generally limited by ice into July, whereas the bowhead whale migration almost always occurs much earlier. As a result, the stipulation would be minimally effective in providing information on the interaction of the spring bowhead whale migration and offshore drilling operations and would not alter the effect of the proposal without the stipulation.

Stipulation No. 6--Subsistence Whaling and Other Subsistence Activities

All exploration, and development and production operations shall be conducted in a manner that minimizes any potential for conflict between oil and gas industry and subsistence activities, particularly the subsistence bowhead whale hunt.

Prior to submitting an exploration plan or development and production plan to the lessor for activities proposed during the bowhead whale migration period, the lessee shall contact potentially affected subsistence whaling communities, such as Wainwright, Barrow, Point Hope, and Point Lay, and the Alaska Eskimo Whaling Commission (AEWC) to discuss potential conflicts with the siting, timing, and methods of proposed operations. Through this consultation, the lessee shall make reasonable efforts to assure that exploration, development, and production activities are compatible with whaling and other subsistence hunting activities and will not result in undue interference with subsistence harvests.

A discussion of resolutions reached during this consultation process and any unresolved conflicts shall be included in the exploration plan or the development and production plan. In particular, the lessee shall show in the plan how mobilization of the drilling unit and crew and supply boat routes will be scheduled and located to minimize conflicts with subsistence activities. Communities, individuals, and other entities who were involved in the consultation shall be identified in the plan.

The lessee shall send a copy of the exploration plan or development and production plan to the potentially affected whaling communities and the AEWC at the same time they are submitted to the lessor to allow concurrent review and comment as part of the lessor's plan approval process.

Subsistence whaling activities occur generally during the following period:

April to June: Barrow whalers use lead systems off Point Barrow and west of Barrow in the Chukchi Sea. Wainwright whalers use lead systems between Wainwright and Peard Bay. Point Hope and Point Lay whalers use the lead systems south of Point Hope.

Purpose of Stipulation No. 6: The activities and attitudes that surround subsistence form the core of Native culture in the Chukchi and Beaufort Sea areas. Local concerns about effects on subsistence are a major scoping issue. The intent of this stipulation is to encourage lessees to conduct themselves in a responsible manner with regard to Native subsistence needs and thus avoid adverse effects on local subsistence harvests and cultural values.

Effectiveness of Stipulation No. 6: Lessee awareness of, and sensitivity to, Inupiat subsistence whaling and other subsistence activities could reduce adverse effects on local subsistence harvests and sociocultural systems. The direct measurement of effects will, in the instance of Sale 126, be pointedly difficult to measure because the boundaries of the sale area do not include those areas where bowhead whale harvests are traditionally concentrated.

For subsistence harvests, the expected effects would be high for Wainwright; moderate for Barrow, Atqasuk, and Point Lay; and low for Point Hope and Nuiqsut. High effects in Wainwright would be due primarily to oil-spill effects, traffic noise, and offshore construction activities. Moderate effects expected for Barrow, Atqasuk, and Point Lay would be due primarily to oil-spill effects. With this stipulation, the high effects expected for Wainwright could be reduced to moderate effects. However, effects would not be expected to change for the remaining communities, since potential oil-spill effects would not be affected by this stipulation.

Through cooperation and coordination, potential effects that noise and disturbance might have on the bowhead whale harvest could possibly be reduced. The Oil/Whalers Cooperative Programs for the Beaufort Sea (in effect from 1986-1989) between Nuiqsut and Kaktovik whalers and oil industry companies is an example of such cooperation and coordination. Although this program has expired, similar cooperation and coordination efforts have been required for Sales 97 and 109 as part of the lease stipulations.

Stipulation No. 7--Oil-Spill-Response Preparedness

Lessees must be prepared to respond to oil spills, which includes training of personnel for familiarization with response equipment and strategies, and conducting drills to demonstrate readiness. Prior to approval of exploration or development and production plans, lessees shall submit for review and approval Oil-Spill- Contingency Plans (OSCP's) in accordance with 30 CFR 250.42. The OSCP must address all aspects of oil-spill-response readiness, including an analysis of potential spills and spill-response strategies, type, location and availability of appropriate oil-spill equipment, and response times and equipment capability for the proposed activities. The plan must also address response drills and training requirements. The lessee shall conduct drills under realistic conditions, without endangering the safety of personnel, to the extent necessary to demonstrate continued readiness and response capability for appropriate environmental conditions: e.g., solid ice, open water, and broken ice conditions. For production operation, drills shall be conducted at least semiannually. Additional drills will be required if drilling operations continue into new seasonal environmental conditions. Drills shall include deployment of onsite response equipment, and additional equipment, available from a cooperative or other sources identified in the OSCP, to the extent necessary to demonstrate adequate response preparedness for the type, location, and scope of proposed activities and anticipated environmental conditions.

Purpose of Stipulation No. 7: The purpose of this stipulation is to ensure that lessees are (1) ready to respond to a platform oil spill that might occur as a result of their operations and (2) have the appropriate equipment and trained personnel available to conduct cleanup operations. Response readiness is addressed in the oil-spill-contingency plans (OSCP's) that are submitted to MMS for approval and demonstrated, to a limited extent, by oil-spill-response drills conducted under appropriate environmental conditions. Readiness also would be demonstrated in cleaning up an actual oil spill.

Effectiveness of Stipulation No. 7: The requirements of this stipulation reinforce the oil-spill-response-preparedness requirements contained in 30 CFR 250.42, Oil Spill Contingency Plans, and 250.43, Training and Drills. Lessees are required to submit OSCP's for MMS approval either with or prior to submitting Exploration Plans or Development and Production Plans; approved OSCP's are to be reviewed and updated annually.

To assure a prompt response in the event of a platform oil spill, OSCP's must address items such as (1) various spill-response strategies; (2) types, capabilities, and local and regional inventories of various types of response equipment, material, and supplies; and (3) training of personnel, including conducting drills. (The drills are to be realistic and include the deployment of equipment.) Knowledge of the response strategies and the training of personnel in the use of the response equipment ensures a more rapid and efficient response to an oil spill.

Response strategies are based in part on the source of the spilled oil, including the anticipated size of spill. The flow rate of oil from OCS wells ranges from 10 to more than 8,000 bbl/day--the average flow rate is about 180 bbl/day. The average flow rate for Sale 126 wells is estimated to be 1,800 bbl/day. Thus, strategies to clean up crude oil from a well blowout might be based on volumes of ten to several thousand barrels of oil per day. In contrast, tanker spills sometimes involve the release of large volumes of oil in a relatively short time. As a result of the grounding of the Exxon Valdez, about 260,000 bbl of oil were released into Prince William Sound within several hours.

The procedures taken in advance to respond to a platform oil spill help provide for a more effective response. However, as noted in Appendix L (Sec. I.D), the effectiveness of oil-spill cleanup at sea is quite variable and depends on (1) sea, weather, and ice conditions; (2) time of response; (3) type of cleanup procedure used; and (4) type of oil spilled. With so many variables, recovery of most of the spilled oil is unlikely.

As noted in Section II.F.1, laws and regulations that provide mitigation are considered part of the proposed lease sale; the mitigating effects of these laws and regulations are considered in the analyses of the effects of Sale 126 (Sec. IV). Because the requirements reiterate existing regulations, the mitigating effects of this stipulation have been considered in the analyses of the effects of Sale 126. Thus, adoption of the stipulation would not be expected to reduce the effects on any of the resources that might be affected by a platform or other type of oil spill.

NOTE: Stipulation No. 8, Density Restriction for Protection of Bowhead Whales from Potential Effects of Noise, as described in the DEIS, has been deleted as a potential mitigating measure because it is inconsistent with recent NMFS regulations on incidental take of bowhead whale and not required by the Arctic Region Biological Opinion or the Sale 126 Biological Opinion.

b. Potential Information to Lessees: The mitigating measures considered as information to lessees (ITL's) either (1) state MMS policy and practices that are carried out and enforced, (2) inform lessees about special concerns in or near the lease area or, (3) advise or inform lessees of the existing legal requirements of MMS and other Federal agencies. These measures provide positive mitigation by creating greater awareness of these issues on the part of the lessees.

The following ITL's are proposed for Chukchi Sea Sale 126:

No. 1	Information on Bird and Marine Mammal Protection
No. 2	Information on Areas of Special Biological and Cultural Sensitivity
No. 3	Information on Arctic Peregrine Falcon
No. 4	Information on Chukchi Sea Biological Task Force
No. 5	Information on Coastal Zone Management
No. 6	Information on Endangered Whales and MMS Monitoring Program
No. 7	Information on Development and Production Phase Consultation with NMFS to Avoid Jeopardy to Bowhead Whales
No. 8	Information on Oil-Spill-Cleanup Capability

ITL No. 1--Information on Bird and Marine Mammal Protection

Lessees are advised that during the conduct of all activities related to leases issued as a result of this sale, the lessee and its agents, contractors, and subcontractors will be subject to, among others, the provisions of the Marine Mammal Protection Act (MMPA) of 1972, as amended (16 U.S.C. 1361 et seq.); the Endangered Species Act (ESA), as amended (16 U.S.C. 1531 et seq.); and applicable International Treaties.

Lessees and their contractors should be aware that disturbance of wildlife could be determined to constitute harm or harassment and thereby be in violation of existing laws and treaties. With respect to endangered species and marine mammals, disturbance could be determined to constitute a "taking" situation. Under the ESA, the term "take" is defined to mean "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in such conduct." Under the MMPA, "take" means "harass, hunt, capture, collect, or kill or attempt to harass, hunt, capture, or kill any marine mammal." Violations under these Acts and applicable Treaties may be reported to the National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service (FWS), as appropriate.

Incidental taking of marine mammals and endangered and threatened species is allowed only when the statutory requirements of the MMPA and/or the ESA are met. Section 101(a)(5) of the MMPA allows for the taking of small numbers of marine mammals incidental to a specified activity within a specified geographical area. Section 7(b)(4) of the ESA allows for the incidental taking of endangered and threatened species under certain circumstances. If a marine mammal species is listed as endangered or threatened under the ESA, the requirements of both the MMPA and the ESA must be met before the incidental take can be allowed.

Under the MMPA, the NMFS is responsible for species of the order Cetacea (whales and dolphins) and the suborder Pinnipedia (seals and sea lions) except walrus; the FWS is responsible in Alaskan waters for polar bears, sea otters, and walrus. Procedural regulations implementing the provisions of the MMPA are found at 50 CFR Part 18.27 for FWS, and at 50 CFR Part 228 for NMFS.

Lessees are advised that specific regulations must be applied for and in place and the Letters of Authorization must be obtained by those proposing the activity to allow the incidental take of marine mammals whether or not they are endangered or threatened. The regulatory process may require one year or longer.

Of particular concern is disturbance at major wildlife concentration areas, including bird colonies, marine mammal haulout and breeding areas, and wildlife refuges and parks. Maps depicting major wildlife concentration areas in the lease area are available from the Regional Supervisor, Field Operations. Lessees are also encouraged to confer with the FWS and NMFS in planning transportation routes between support bases and leaseholdings.

Behavioral disturbance of most birds and mammals found in or near the lease area would be unlikely if aircraft and vessels maintain at least a 1-mile horizontal distance and aircraft maintain at least a 1,500-foot vertical distance above known or observed wildlife concentration areas, such as bird colonies and marine mammal haulout and breeding areas.

For the protection of endangered whales and marine mammals throughout the lease area, it is recommended that all aircraft operators maintain a minimum 1,500-foot altitude when in transit between support bases and exploration sites. Lessees and their contractors are encouraged to minimize or reroute trips to and from the leasehold by aircraft and vessels when endangered whales are likely to be in the area. Human safety should take precedence at all times over these recommendations.

Purpose of ITL No. 1: The purpose of this measure is to minimize behavioral disturbance of wildlife, particularly at known concentration areas. The Chukchi Sea is an important habitat for endangered and nonendangered marine mammals, marine birds, and waterfowl.

Effectiveness of ITL No. 1: The Chukchi Sea area is an important habitat for endangered and nonendangered marine mammals and marine birds. Of particular concern are: (1) bowhead whale populations that migrate through the Chukchi Sea from April through June and from September through November; (2) gray whales that spend the summer feeding in the area (June-October); (3) other endangered whale species (fin and humpback) that occasionally occur in the sale area during the summer; (4) large groups of Pacific walrus hauled out along the pack-ice front; (5) large numbers of bearded and ringed seals occurring throughout the sale area, especially along the ice front; (6) concentrations of spotted seals hauled out along the barrier islands of Kasegaluk Lagoon and Icy Cape; (7) polar bears that sometimes congregate along the coast near Cape Lisburne, Icy Cape, and Point Franklin; (8) large seabird colonies at Capes Lisburne and Thompson; (9) waterfowl and shorebird concentrations at Kasegaluk Lagoon and Peard Bay; and (10) other areas identified in ITL No. 2 as areas of special biological sensitivity.

Due to the advisory nature of this measure and the characteristics of the aircraft and vessel controls, it is likely that some marine mammals and birds would interact with the activity associated with platforms and all attendant exploration, development, and production traffic over the life of the field (30 years). It cannot be assumed that inadvertent conflict can be avoided completely or that incidental "taking" would not occur. If this measure is adopted, effects on whales, walrus, seals, and seabirds are expected to be the same as for the proposal.

ITL No. 2--Information on Areas of Special Biological and Cultural Sensitivity

Lessees are advised that certain areas are especially valuable for their concentrations of marine birds, marine mammals, fishes, or other biological resources or cultural resources. Identified areas and time periods of special biological and cultural sensitivity include the spring lead system from April through July, the area from Icy Cape to the northern boundary of the sale area east of 162°W. longitude, Peard Bay, Ledyard Bay, Kasegaluk Lagoon, and the open water within 12 miles of the major bird colonies of Cape Lisburne and Cape Thompson. These areas are among areas of special biological and cultural sensitivity to be considered in the oil-spill-contingency plan required by 30 CFR 250.42. Lessees are advised that they have the primary responsibility for identifying these areas in their oil-spill contingency plans and for providing specific protective measures. Additional areas of special biological and cultural sensitivity may be identified during review of exploration plans and development and production plans.

Consideration should be given in oil-spill-contingency plans as to whether use of dispersants is an appropriate defense in the vicinity of an area of special biological and cultural sensitivity. Lessees are advised that prior approval must be obtained before dispersants are used.

Purpose of ITL No. 2: The purpose of this ITL is to help protect birds, marine mammals, fishes, and other biological resources from oil spills in those areas that have been identified by Federal and State agencies and public-interest groups as important to the continued well-being of the biological resources.

Effectiveness of ITL No. 2: Consideration in oil-spill-contingency plans of the identified areas of special biological sensitivity would help protect these, as well as other, areas from oil spills. Protection of special biological areas would reduce the effects on the biological resources of the areas. This may reduce oil-spill effects on some coastal-wetland habitats of birds and reduce the chance of caribou encountering oil along the coast; but the overall level of effects on caribou and marine and coastal birds--as well as effects on pinnipeds, polar bears, and belukha whales--would not be reduced by this ITL. However, any local reduction of the effects on birds, marine mammals, and fishes should also reduce any adverse effects on subsistence-hunting activities. With the ITL in place, Peard Bay and Kasegaluk Lagoon would be considered during oil-spill-contingency planning. This would lessen the chance of oil reaching these areas and reduce the probability of a MODERATE effect on fish resources in these sensitive areas. Potential effects on kelp-bed communities in nearshore waters might be ameliorated by this ITL. The area within a 3-mile radius of Point Belcher is an important feeding area for gray whale cow/calf pairs. Identification of this area in the oil-spill-contingency plan will focus the need for more protection in this area, which will decrease the potential of a gray whale/oil-spill interaction. Overall, if this measure is adopted and observed, the effect of sale-related activities on the biological resources of the area would remain the same as for the proposal.

ITL No. 3--Information on Arctic Peregrine Falcon

Lessees are advised that the arctic peregrine falcon (Falco peregrinus tundrius) is listed as threatened by the U.S. Department of the Interior and is protected by the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.).

Peregrines are generally present in Alaska from mid-April to mid-September and are most disturbed by human activities in the vicinity of nest sites. The conduct of Outer Continental Shelf exploration or development and production activities will not conflict with arctic peregrine falcons if onshore facilities are located away from known nest sites. The lessee should contact the Fish and Wildlife Service (FWS) for information on locations of known nest sites of peregrine falcons. Aircraft should maintain at least a 1-mile horizontal and 1,500-foot vertical distance from known or potential peregrine nest sites to avoid conflict.

Lessees are advised that the FWS will review exploration plans and development and production plans submitted by lessees to the Minerals Management Service (MMS). The FWS review may determine that certain restrictions could apply to further protect arctic peregrine falcon habitats. Lessees and affected operators should establish regular communication with MMS and FWS. Human safety should take precedence at all times over these recommendations.

Purpose of ITL No. 3: The purpose of this measure is to prevent noise or human disturbance from OCS exploration activities from adversely affecting peregrine falcons adjacent to the sale area. This protection is accomplished by advising the lessees of (1) minimum distances that aircraft should maintain from known or potential peregrine nest sites and (2) the role of the FWS in reviewing exploration plans and development and production plans and determining what restrictions, if any, may be applied.

Effectiveness of ITL No. 3: Compliance by lessees with the recommendations described in this ITL should decrease the adverse effects of aircraft traffic on peregrines. Likewise, it is believed that noise-disturbance effects from onshore facilities could be eliminated if such facilities are located away from known nest sites. However, the proposed onshore pipeline may not avoid all peregrine nest sites. Consequently, effects of sale-related activities under this ITL would be the same as under the proposal.

ITL No. 4--Information on Chukchi Sea Biological Task Force

> Lessees are advised that in the enforcement of the Protection of Biological Resources stipulation, the Regional Supervisor, Field Operations (RSFO), will consider recommendations from the Chukchi Sea Biological Task Force (BTF), composed of designated representatives of the Minerals Management Service, Fish and Wildlife Service, National Marine Fisheries Service, and Environmental Protection Agency. Personnel from the State of Alaska and local communities are invited and encouraged to participate in the proceedings of the BTF. The RSFO will consult with the Chukchi Sea BTF on the conduct of biological surveys by lessees and the appropriate course of action after surveys have been conducted.

Purpose of ITL No. 4: The purpose of this ITL is to establish a formal means of advising the RSFO about matters regarding enforcement of the Protection of Biological Resources stipulation. The recommendations of the Chukchi Sea BTF should provide for better decision making concerning biological resources and increased protection of these resources from possible adverse effects.

Effectiveness of ITL No. 4: Biological task forces have proven helpful in providing technical guidance to the RSFO on decisions concerning many Alaskan OCS lease sales. The BTF for Sale 126 in the Chukchi Sea should be no exception. Although effects levels of the proposal on biological resources could be reduced by this ITL, the overall level of effects would remain the same.

ITL No. 5--Information on Coastal Zone Management

> Lessees are advised that the Alaska Coastal Management Program (ACMP) may contain policies and standards that are relevant to exploration and development and production activities associated with leases resulting from this sale.
>
> In addition, the North Slope Borough Coastal Management Program has been incorporated into the ACMP and contains more specific policies related to transportation corridors; energy facility siting; geologic hazards; and protection of subsistence areas and resources, habitats, and historic or prehistoric resources.
>
> Relevant policies are applicable to ACMP consistency reviews of postlease activities. Lessees are encouraged to consult and coordinate early with those involved in coastal management review.

Purpose of ITL No. 5: The purpose of this ITL is to inform lessees of pertinent policy areas contained in the ACMP and to alert lessees to the fact that the State reviews exploration plans and development and production plans, including the siting of energy-related facilities, for consistency with these policies. Furthermore, it informs the lessee of local coastal management programs that may have policies supplementing the statewide standards of the ACMP.

Effectiveness of ITL No. 5: This ITL could help to alleviate potential conflicts with both land use regulations and coastal management policies by alerting lessees that Alaska has an approved CMP that is amended by the North Slope Borough district program. Policies included in the ACMP are designed to prevent or mitigate environmental and social problems that may be associated with development. Although the application of ACMP policies is not expected to modify the levels of effect that result from accidental oil spills, conformance with these standards and policies would help to alleviate some potential adverse effects, especially those identified for subsistence. Moreover, the process of achieving consensus and obtaining final approval of projects could be substantially eased and potential conflicts with the ACMP reduced if lessees coordinate early with those involved in coastal management reviews.

ITL No. 6--Information on Endangered Whales and MMS Monitoring Program

Lessees are advised that the Minerals Management Service (MMS) intends to continue its areawide endangered whale monitoring program in the Chukchi Sea during exploration activities. The program will gather information on whale distribution and abundance patterns and will provide the Regional Supervisor, Field Operations (RSFO), with additional assistance to determine the extent, if any, of adverse effects to the species.

The MMS will perform a National Environmental Policy Act review for each proposed exploration plan and development and production plan, including an assessment of cumulative effects of noise on endangered whales. Should the review conclude that activities described in the plan will be a threat of serious, irreparable, or immediate harm to the species, the Regional Supervisor, Field Operations (RSFO), will require that activities be modified, or otherwise mitigated before such activities would be approved.

Lessees are further advised that the RSFO has the authority and intends to limit or suspend any operations, including preliminary activities, as defined under 30 CFR 250.3l, on a lease whenever bowhead whales are subject to a threat of serious, irreparable, or immediate harm to the species. Should the information obtained from MMS or lessees' monitoring programs indicate that there is a threat of serious, irreparable, or immediate harm to the species, the RSFO will require the lessee to suspend operations causing such effects, in accordance with 30 CFR 250.10. Any such suspensions may be terminated when the RSFO determines that circumstances which justified the ordering of suspension no longer exist. Notice to Lessees No. 86-2 specifies performance standards for preliminary activities.

Incidental taking of marine mammals and endangered and threatened species is allowed only when the statutory requirements of the MMPA and/or the ESA are met. Section 101(a)(5) of the MMPA allows for the taking of small numbers of marine mammals incidental to a specified activity within a specified geographical area. Section 7(b)(4) of the ESA allows for the incidental taking of endangered and threatened species under certain circumstances. If a marine mammal species is listed as endangered or threatened under the ESA, the requirements of both the MMPA and the ESA must be met before the incidental take can be allowed.

Information regarding endangered whales will be reviewed annually by the MMS in consultation with the NMFS and the State of Alaska until it is determined that annual reviews are no longer necessary. The sources of information include: the MMS monitoring program; the industry site-specific monitoring required by Stipulation No. 5 (including data obtained within 90 days of completion of a drilling season); pertinent results of the MMS environmental studies and other applicable information. The purpose of the review will be to determine whether existing mitigating measures adequately protect the endangered whales. Should the review indicate the threat of serious, irreparable, or immediate harm to the species, the MMS will take action to protect the species, including the possible imposition of a seasonal drilling restriction, or other restrictions if appropriate.

Purpose of ITL No. 6: The purpose of this measure is to provide additional scientific information concerning endangered whales that may interact with activities associated with oil and gas exploration.

Effectiveness of ITL No. 6: ITL No. 6, in conjunction with Stipulation No. 5 on the industry monitoring program, will help provide additional scientific information concerning bowhead whales from activities associated with exploration and production. If the monitoring programs indicate a threat of adverse effects, the RSFO will require the lessee to limit or suspend operations causing such effects, in accordance with 30 CFR 250.10.

It is likely that some endangered whales could interact with activities associated with exploratory drilling and that this interaction could result in minor, short-term effects on some whales. If this measure is adopted, the overall effect level is not expected to change and would be the same as for the proposal.

ITL No. 7--Information on Development and Production Phase Consultation with NMFS to Avoid Jeopardy to Bowhead Whales

> The Minerals Management Service (MMS) has been advised by the National Marine Fisheries Service (NMFS) that, based on currently available information and technology, NMFS believes that development and production activities in the spring lead system used by bowhead whales along the Chukchi Sea coast would likely jeopardize the continued existence of the bowhead whale population. The NMFS has advised that they will reconsider this conclusion when new information, technology and/or measures become available or are proposed that would effectively eliminate or otherwise mitigate this potential jeopardy situation. Lessees are advised that specific options, alternatives, and/or mitigating measures may be developed for production and development activities during MMS consultation with NMFS as new information or technology is developed for specific development plans, but that the possibility exists that development and production on leases in this area may be constrained or precluded.

Purpose of ITL No. 7: This ITL addresses the NMFS' position that development and production within the spring lead system would likely jeopardize the continued existence of the bowhead whale population. The lessees are advised that consultation will be conducted with the NMFS before development and production will be allowed within the spring lead system, and that specific options and alternatives to protect the bowhead whale may be developed as a result of new information and technology.

Effectiveness of ITL No. 7: ITL No. 5 (Information on Endangered Whales and MMS Monitoring Program), along with Stipulation No. 5 (Industry Site-Specific Bowhead Whale-Monitoring Program), will provide additional biological information over at least the next 5 years (minimum time before development). Studies to date (Richardson et al., 1984, 1985, 1990; Malme et al., 1983, 1984, 1985, 1986; Ljungblad et al., 1985; Wartzok et al., 1989) indicate that industrial noise has only a local, short-term effect on some whales. Studies involving crude oil indicate that crude oil has only a minor, short-term effect on cetaceans (Geraci and St. Aubin, 1980, 1982, 1985; Fishman, Caldwell, and Vogel, 1985; and Goodale, Hyman, and Winn, 1981). However, if a significant effect were to occur or become likely from industrial noise or oil, this additional information would aid the MMS in developing measures that would effectively preclude any effect from continuing or occurring. This additional information, and any subsequent mitigating measures developed by the MMS would be made available to the NMFS, and would be useful during future Section 7 consultations concerning the bowhead whale. Section 7 consultation will be accomplished prior to any production and development activity. While this ITL will assist by providing additional information, the overall effect level of sale-related activities on the bowhead whale population is expected to be the same as for the proposal.

ITL No. 8--Information on Oil-Spill-Cleanup Capability

> Exploratory drilling, testing, and other downhole activities may be prohibited in broken ice conditions unless the lessee demonstrates to the Regional Supervisor, Field Operations (RSFO), the capability to detect, contain, clean up, and dispose of spilled oil in broken ice. The adequacy of such oil-spill response capability will be determined within the context of Best Available and Safest Technologies requirements, and will be considered at the time the oil-spill-contingency plans are reviewed. The adequacy of these plans will be determined by the RSFO prior to approval of exploration or development and production plans.

Purpose of ITL No. 8: The intent of this measure is to remind lessees that oil-spill-contingency technology used to respond to an oil spill during broken-ice conditions must be the best available and that this technology will be in place and available prior to conducting drilling activities below threshold depth during broken-ice conditions.

Effectiveness of ITL No. 8: The information contained in this ITL supplements the requirements for oil-spill-response-preparedness as contained in 30 CFR 250.42, Oil Spill Contingency Plans (OSCP). Lessees are required to submit OSCP's for approval by MMS with or prior to submitting Exploration Plans or Development and Production Plans.

To assure a prompt response in the event of an oil spill, OSCP's must address items such as (1) various spill-response strategies; (2) types, capabilities, and local and regional inventories of various types of response equipment, material, and supplies; and (3) training of personnel, including conducting drills. (The drills are to be realistic and include the deployment of equipment.) Knowledge of the response strategies and the training of personnel in the use of the response equipment ensures a more rapid and efficient response to an oil spill.

The procedures taken in advance to respond to an oil spill help to provide for a more effective response. However, as noted in Appendix L (I.D), the effectiveness of oil-spill cleanup at sea is quite variable and depends on (1) sea, weather, and ice conditions; (2) time of response; (3) type of cleanup procedure used; and (4) type of oil spilled. With so many variables, recovery of most of the spilled oil is unlikely. As noted in Section II.F.1, laws and regulations that provide mitigation are considered part of the proposed lease sale; the mitigating effects of these laws and regulations are considered in the analyses of the effects of Sale 126 (Sec. IV). Because the information supplements existing regulations, the mitigating effects of this ITL have been considered in the analyses of the effects of Sale 126. Thus, adoption of the ITL would not be expected to reduce the effects on any of the resources that might be affected by an oil spill.

G. Summary and Comparison of Effects of Alternatives

Table II-G-1 presents a summary and comparison of potential effects for Alternatives I and IV. See Sections IV.B through IV.G for a comprehensive analysis of the potential effects of Sale 126; it is particularly important to refer to these analyses rather than use only this summary table as the indicator of potential effects. Terms that indicate levels of effect (i.e., VERY LOW, LOW, MODERATE, HIGH, and VERY HIGH) are defined in Table S-2 (located in the front of this EIS).

Table II-G-1
Summary of Effects[1] for Alternatives I and IV[2]
Chukchi Sea Lease Sale 126

Resource Category	Alternative I Low Case	Alternative I Base Case	Alternative I High Case	Alternative IV Point Lay Deferral Alternative
1. Air Quality	VERY LOW	VERY LOW	LOW	VERY LOW
2. Water Quality				
Local	VERY LOW	MODERATE	MODERATE	MODERATE
Regional	VERY LOW	LOW	LOW	LOW
3. Lower-Trophic-Level Organisms	VERY LOW	LOW	LOW	VERY LOW
4. Fishes (except Pacific Salmon)				
Marine Habitats	VERY LOW	VERY LOW	LOW	VERY LOW
Freshwater Habitats		VERY HIGH	VERY HIGH	VERY HIGH
5. Marine and Coastal Birds	LOW	LOW	LOW	LOW
6. Pinnipeds and Polar Bear	LOW	LOW	LOW	LOW
7. Endangered and Threatened Species				
Bowhead Whale	VERY LOW	VERY LOW	VERY LOW	VERY LOW
Gray Whale	VERY LOW	VERY LOW	VERY LOW	VERY LOW
Arctic Peregrine Falcon	VERY LOW	VERY LOW	LOW	VERY LOW
8. Belukha Whale	VERY LOW	VERY LOW	VERY LOW	VERY LOW
9. Caribou	VERY LOW	LOW	LOW	LOW
10. Economy of the North Slope Borough	VERY LOW	HIGH	VERY HIGH	HIGH
11. Subsistence-Harvest Patterns				
Barrow	VERY LOW	MODERATE	MODERATE	MODERATE
Wainwright	VERY LOW	HIGH	HIGH	HIGH
Point Lay	VERY LOW	MODERATE	MODERATE	MODERATE
Atqasuk	VERY LOW	MODERATE	MODERATE	MODERATE
Nuiqsut	VERY LOW	LOW	LOW	LOW
Point Hope	VERY LOW	LOW	LOW	LOW
12. Sociocultural Systems	VERY LOW	MODERATE	MODERATE	MODERATE
13. Archaeological Resources	LOW	MODERATE	MODERATE	MODERATE
14. Land Use Plans and Coastal Management Programs	LOW	HIGH	HIGH	HIGH
15. Wetlands	[3]	[3]	[3]	[3]

Table II-G-1
Summary of Effects[1] for Alternatives I and IV[2]
Chukchi Sea Lease Sale 126
(Continued)

[1] Refer to Table S-2 for the definitions of levels of effect for each resource category.

[2] Alternative II (No Lease Sale)--The effects associated with Alternative I or other alternatives would not occur with this alternative. Alternative III (Delay the Sale)--The effects associated with this alternative would be the same as those of Alternative I, except the sale could be delayed for up to 3 years.

[3] Effects on wetlands from infrastructure construction, especially the onshore pipeline to the TAP, are discussed in Sections IV.B.15, IV.C.15, IV.D.15, and IV.G.15.

III

DESCRIPTION OF THE AFFECTED ENVIRONMENT

III. DESCRIPTION OF THE AFFECTED ENVIRONMENT

A. Physical Considerations

The physical considerations described in Section III of the Sale 109 FEIS (USDOI, MMS, 1987b) are incorporated by reference, summarized, and augmented with additional material as cited.

1. Geology:

a. Physiography: Within the proposed Sale 126 area, the continental shelf is broad, has low relief, and is gently inclined to the north (Fig. III-A-1). The range of water depths is from 6 m to approximately 80 m. Approximately 80 percent of the shelf lies between the 30- and 60-m isobaths (Grantz et al., 1982). Bathymetric highs within or contiguous to the Sale 126 area are: (1) the western flank of Hanna Shoal, (2) Herald Shoal, (3) a spit-like shoal defined by the 30-m isobath northwest of Point Hope, and (4) Blossom Shoals (Fig. III-A-1). Two unnamed subsea valleys dissect the shelf in the northwestern and northeastern parts of the sale area.

b. Petroleum Provinces: The structural province classification used by Thurston and Theiss (1987; Fig. III-A-2) describes the geological framework and hydrocarbon potential of the Sale 126 area. Figure III-A-3 shows the geologic ages, the names of stratigraphic formations onshore, and the equivalent seismic sequence stratigraphy of the Sale 126 area. Provinces with high hydrocarbon potential are in the northwestern, central, and western portions of the sale area: North Chukchi Basin, Central Chukchi Basin, and Chukchi Platform (Thurston and Thiess, 1987). Both structural and stratigraphic traps are present in the Sale 126 area. Prospective reservoirs are in seismic units probably equivalent to the Lisburne Group, the Sadlerochit Group, the Shublik Formation, and the Sag River Formation. Potential source rocks probably are seismic units equivalent to the Shublik Formation, the Kingak Shale, and the Pebble Shale (Thurston and Theiss, 1987).

c. Other Geological and Environmental Considerations:

(1) Marine Sediments: Two to 5 m of unconsolidated sediment overlies most of the central Chukchi shelf. Thicker sediment accumulations occur in paleochannels in the northern sale area. Potential geohazards in channel-fill deposits include permafrost and gas-charged sediments; and liquifaction may occur if the channel fill contains thick sequences of volcanic ash (Phillips, 1987).

Migrating bedforms indicate active sediment transport on the Chukchi shelf. Gravel bedforms, aligned north-south, on the outer shelf are produced by storm-generated currents in combination with shelf currents (Fig. III-A-4; Phillips, 1987). Storm-generated currents may pose the greatest potential hazard because they rapidly erode and scour the seabed as well as transport sediment.

Gravel lags and large- and small-scale sand bedforms are found beneath the Alaska Coastal Current (ACC). Large-scale sandwave fields migrating to the northeast are found: (1) directly off Icy Cape, (2) north of Wainwright, and (3) north of Point Franklin (Phillips, 1987). As evidenced by the bedforms, scour and erosion under the ACC is a potential geohazard.

The distribution of gravel, sand, and mud (silt- and clay-size particles) in the surface sediments of the Sale 126 area is shown in Figure III-A-4. Mud is generally found in the deeper parts of the shelf and is also abundant in protected bays and lagoons along the coast (Lewbel, 1984).

(2) Permafrost: Subsea permafrost occurs either in response to negative sea-bottom temperatures is formed in now-submerged coastal areas that were previously exposed to air temperatures below 0°C. Much of the ice-bonded permafrost that has been found beneath the sea bottom has been inferred from acoustic geophysical surveys, and the term "accoustically defined permafrost" has been

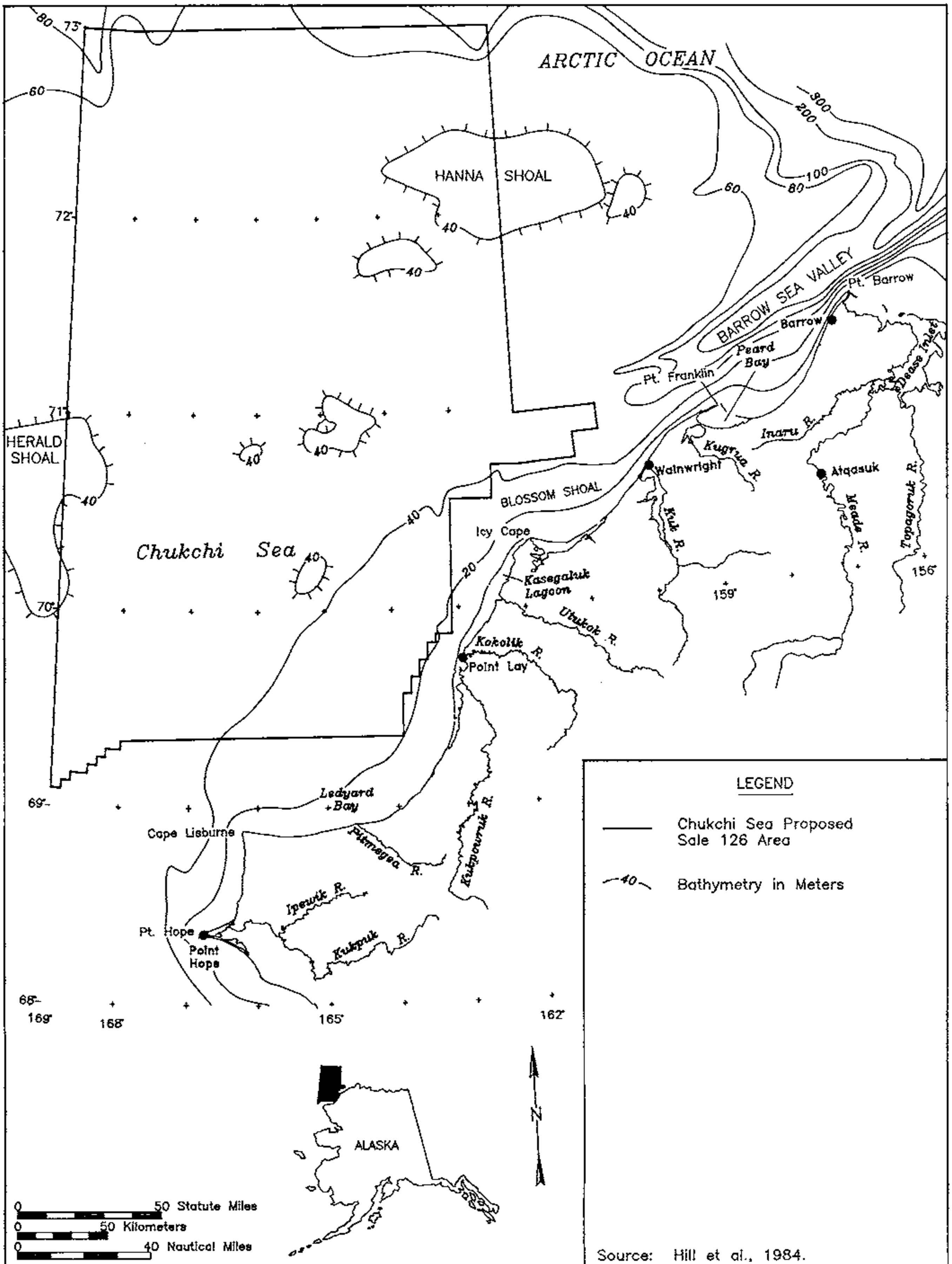


Figure III–A–1. Generalized Chukchi Sea Bathymetry

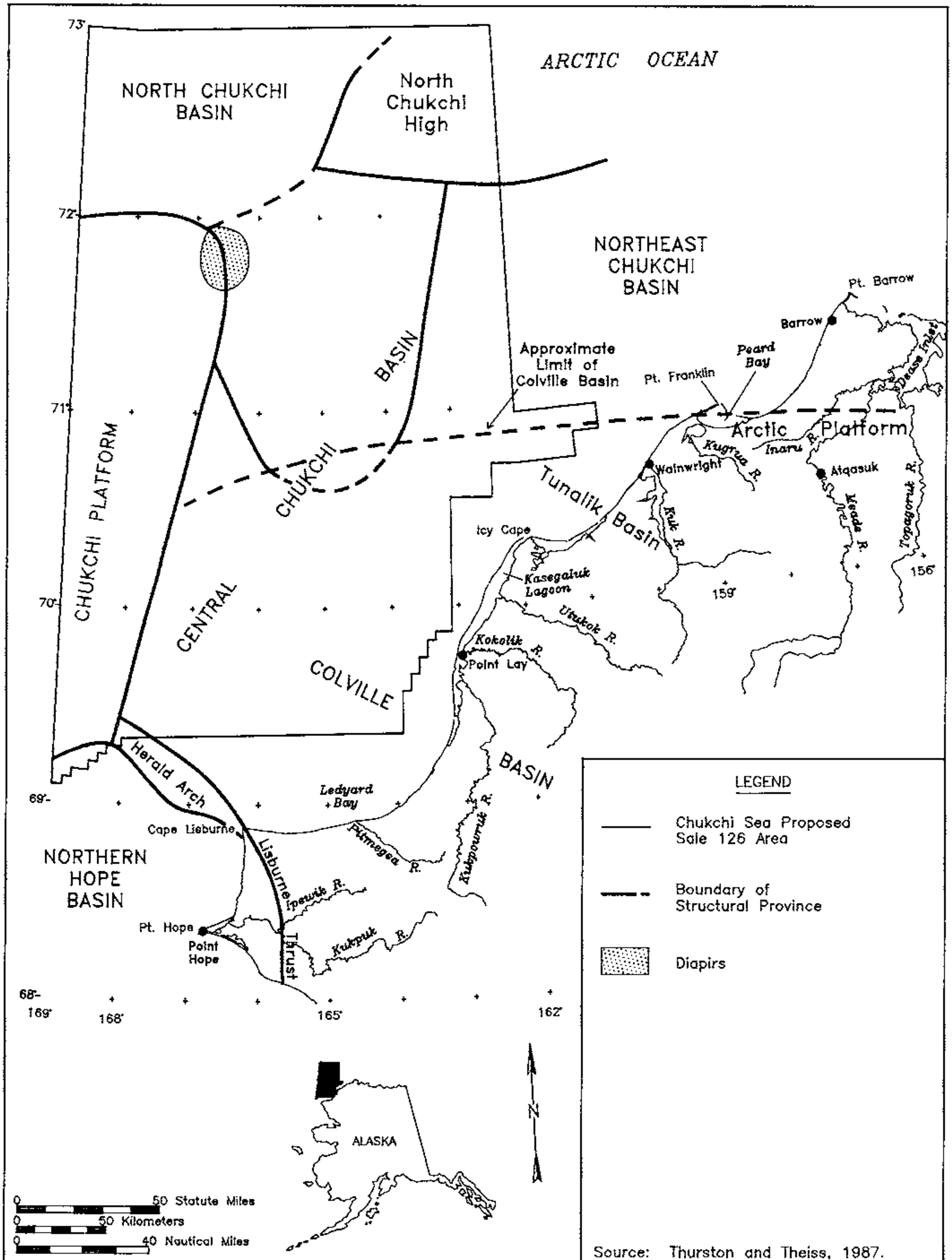


Figure III-A-2. Major Structural Provinces and Sedimentary Basins of the Proposed Sale 126 Area

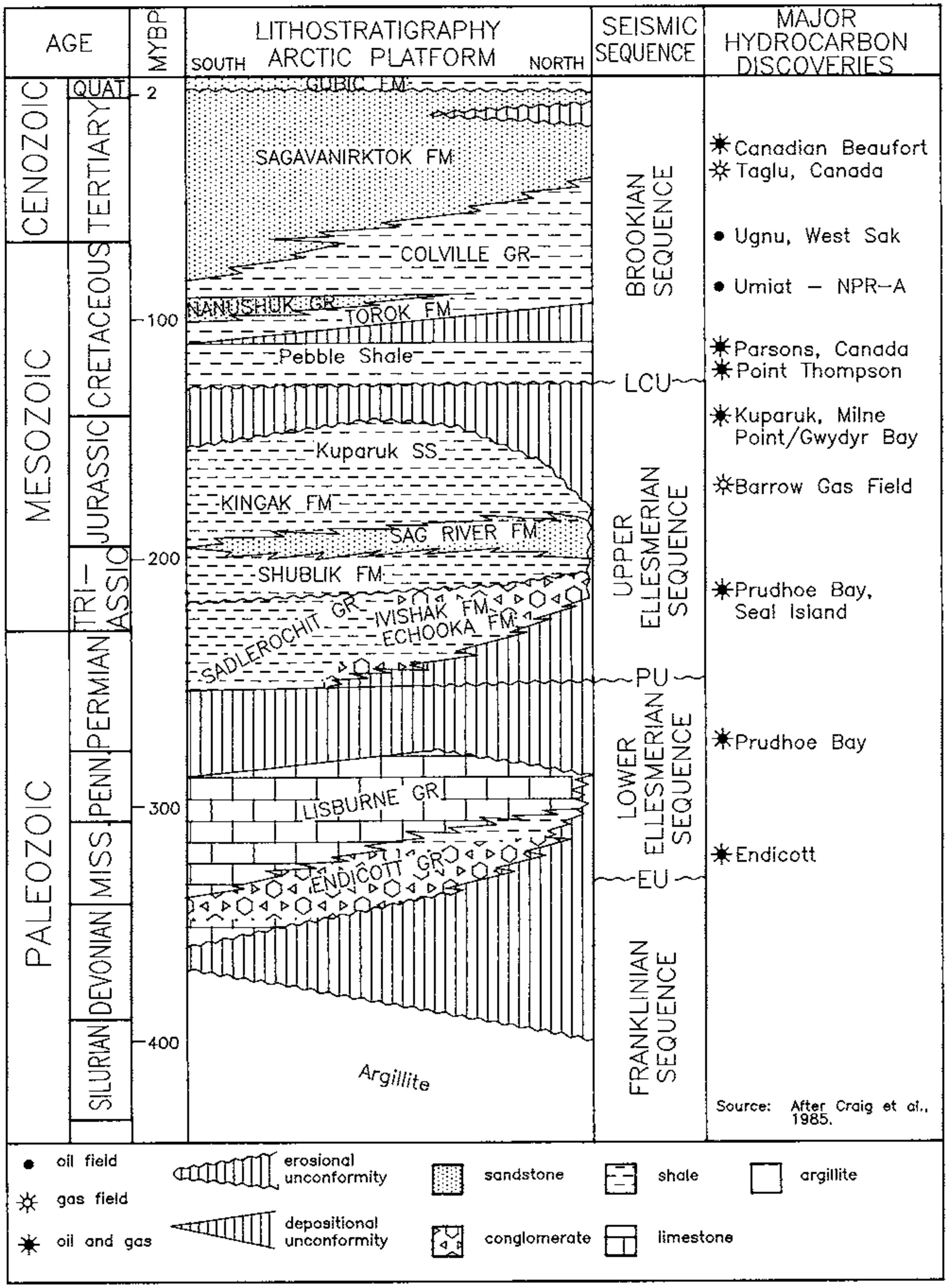


Figure III–A–3. Generalized Lithostratigraphic Column Showing the Relationship of Northern Alaska Stratigraphic Sequences to Seismic Sequences Recognized in the Proposed Sale 126 Area

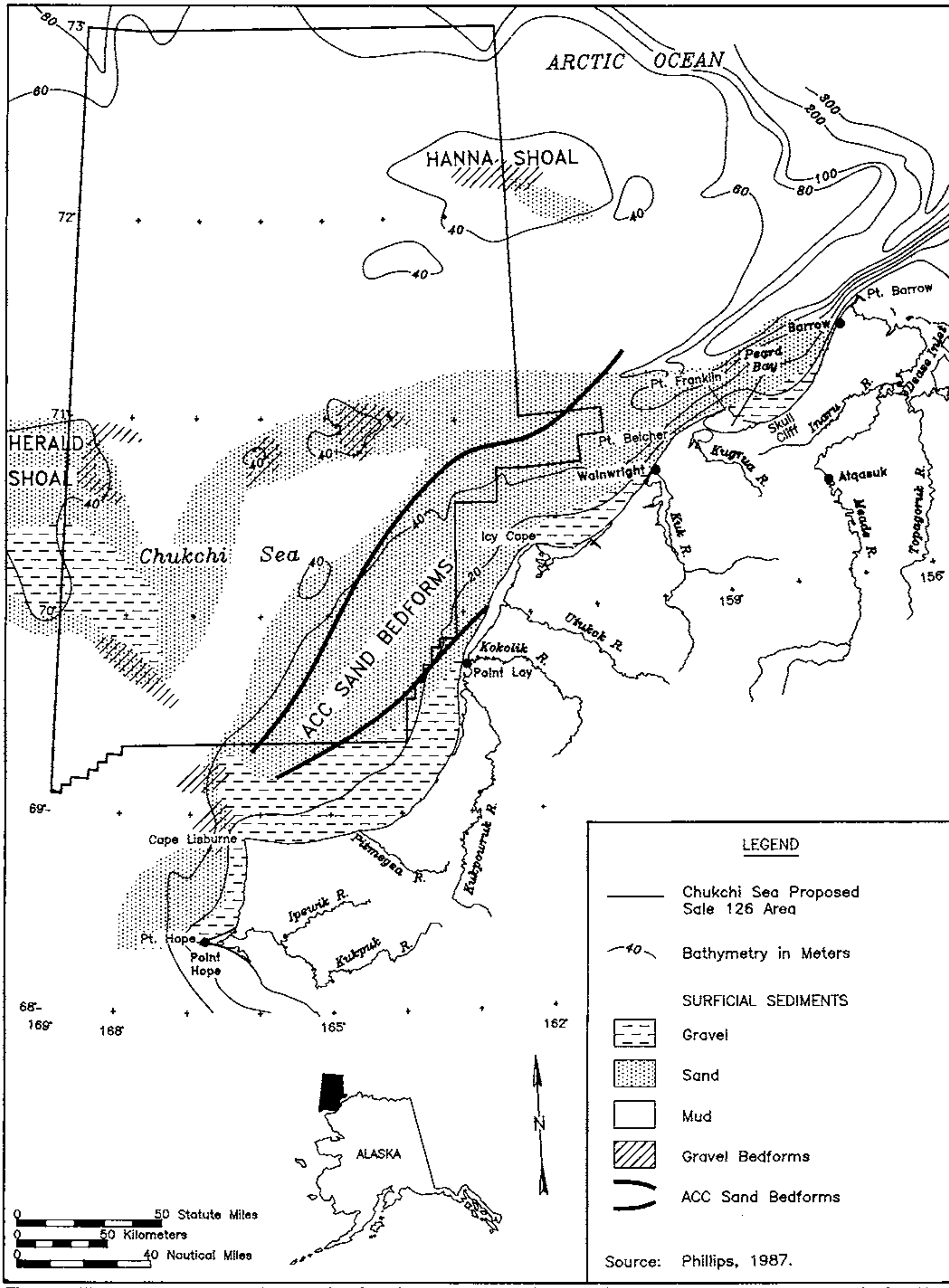


Figure III–A–4. Generalized Distribution of Surficial Sediments and Bedforms within the Chukchi Sea used to describe such permafrost found in other areas where temperature records or visual confirmation of ice bonding are not available (Mackay, 1972; Hunter et al., 1976).

Subsea permafrost can present a set of engineering challenges to potential development. In the Sale 126 area, the presence and distribution of subsea permafrost is largely unknown (Grantz et al., 1982). Subsea permafrost is not yet recognized in most seismic data from the Chukchi Sea (Sellman and Hopkins, 1984). Rogers and Morack (1982) recognized ice-bonded material from seismic data collected in 5 m of water north of Icy Cape. Sub-zero temperatures observed in shallow nearshore boreholes indicate that ice-bearing subsea permafrost becomes thin or absent at approximately 1 km offshore (Osterkamp and Harrison, 1982). However, verifying the above conclusion would require additional temperature measurements offshore.

(3) Natural Gas Hydrates: To date, seismic profiles do not show any definite areas of gas hydrates.

(4) Shallow Gas: Acoustic anomalies were mapped from high-resolution seismic data (Grantz et al., 1982; Thurston and Theiss, 1987; Fig. III-A-5). These acoustic anomalies may represent overpressured biogenic or thermogenic gas depending on their burial depth, trapping mechanism, and the presence of an effective seal.

(5) Earthquakes: Seismic activity is historically low in the northeastern Chukchi Sea (Fig. III-A-5a).

(6) Mudslides: Slumping may be a potential geohazard in the northernmost parts of the Sale 126 area. However, the northern shelf margins are not extensively investigated and the distribution of slump deposits is not known at this time.

2. Meteorology: The general climatic conditions along the northeastern Chukchi coast are characterized by strong winds, cold temperatures during the winter and summer, and small annual precipitation (Searby and Hunter, 1971). In the Chukchi Sea, the climate is transitional between a polar oceanic climate and a high-contrast polar climate.

The general air circulation is dominated by a region of high pressure generally located over the Beaufort Sea. The Siberian High is south and west of the Beaufort High. Eastward-moving western-Pacific storm centers remain south of 60^0N. latitude. Low-pressure systems, with strong southeasterly winds, occasionally move northeasterly through the Bering and Chukchi Seas into the Arctic basin, bringing unseasonably warm air to the region.

Summer atmospheric-pressure patterns are more numerous and varied than the winter patterns (Barry, 1979). Western-Pacific low-pressure systems are more common north of 60^0N. latitude. These systems move northeasterly through the Bering Sea into the Chukchi Sea, where they follow the northwestern Alaska coast. Low-pressure systems generally bring cloudy skies, frequent precipitation, and southwesterly winds. Low-pressure systems also may develop over northern Siberia (Reed and Kunkel, 1960).

Surface winds along the coast between Point Lay and Barrow commonly blow from the east and northeast; at Cape Lisburne, winds from the east and southeast prevail (Brower et al., 1988). The coastal wind range is generally from 4 to 8 m per second (m/sec). Winds greater than 8 m/sec occur less than 4 percent of the time (Wise, Comiskey, and Becker, 1981). Sustained winds of 26 to 29 m/sec, with higher gusts, have been recorded (Wilson et al., 1982).

Along the Chukchi Sea coast north of Point Hope, the average summer temperature range is from -2^0 to 12^0C, and the average winter temperature is from -33^0 to -6^0C; the extreme temperature range is from -49^0 to 27^0C (Selkregg, 1975). The average precipitation range is from 13 centimeters per year (cm/yr) in the north to 38 cm/yr in the south.

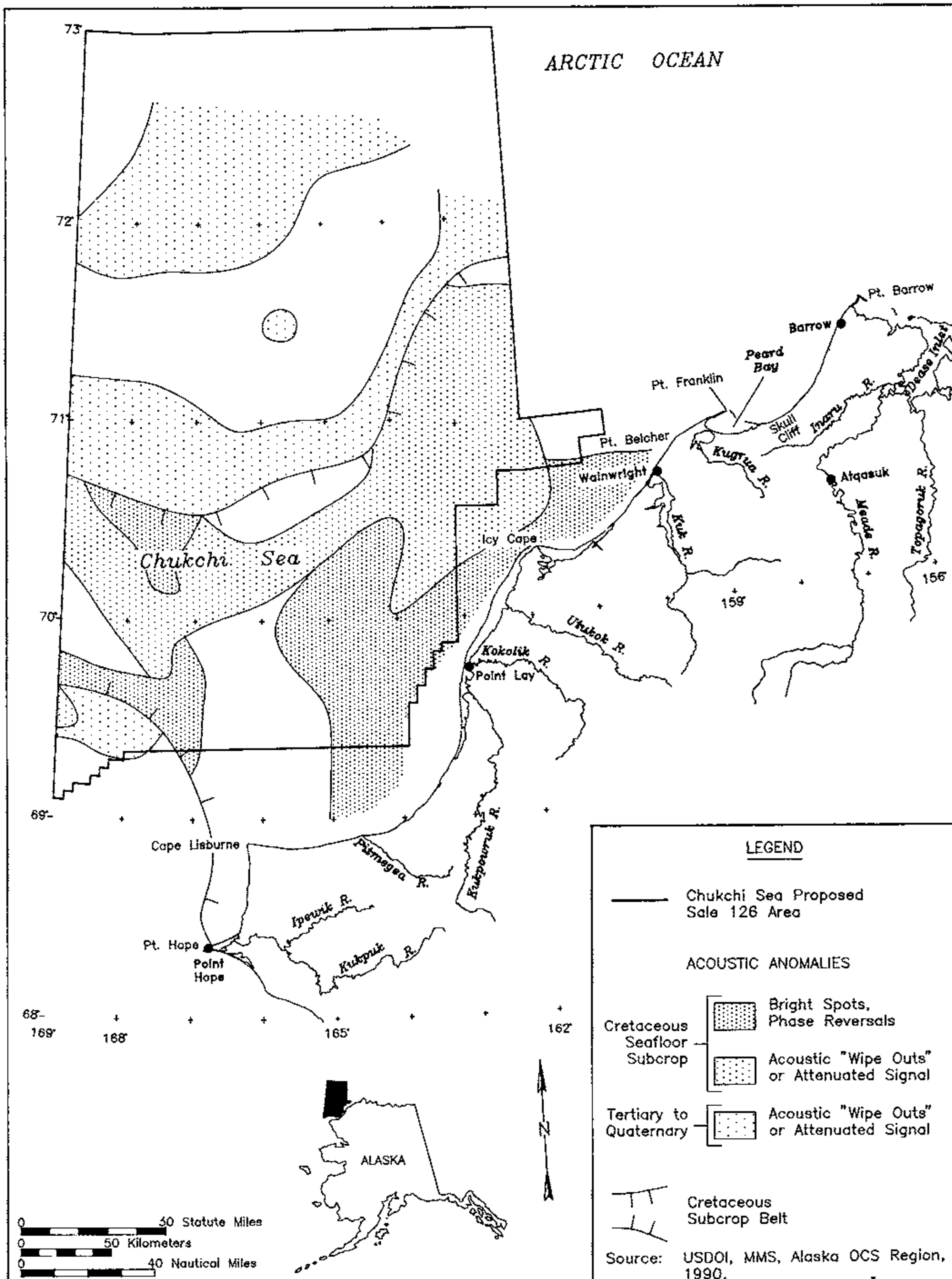
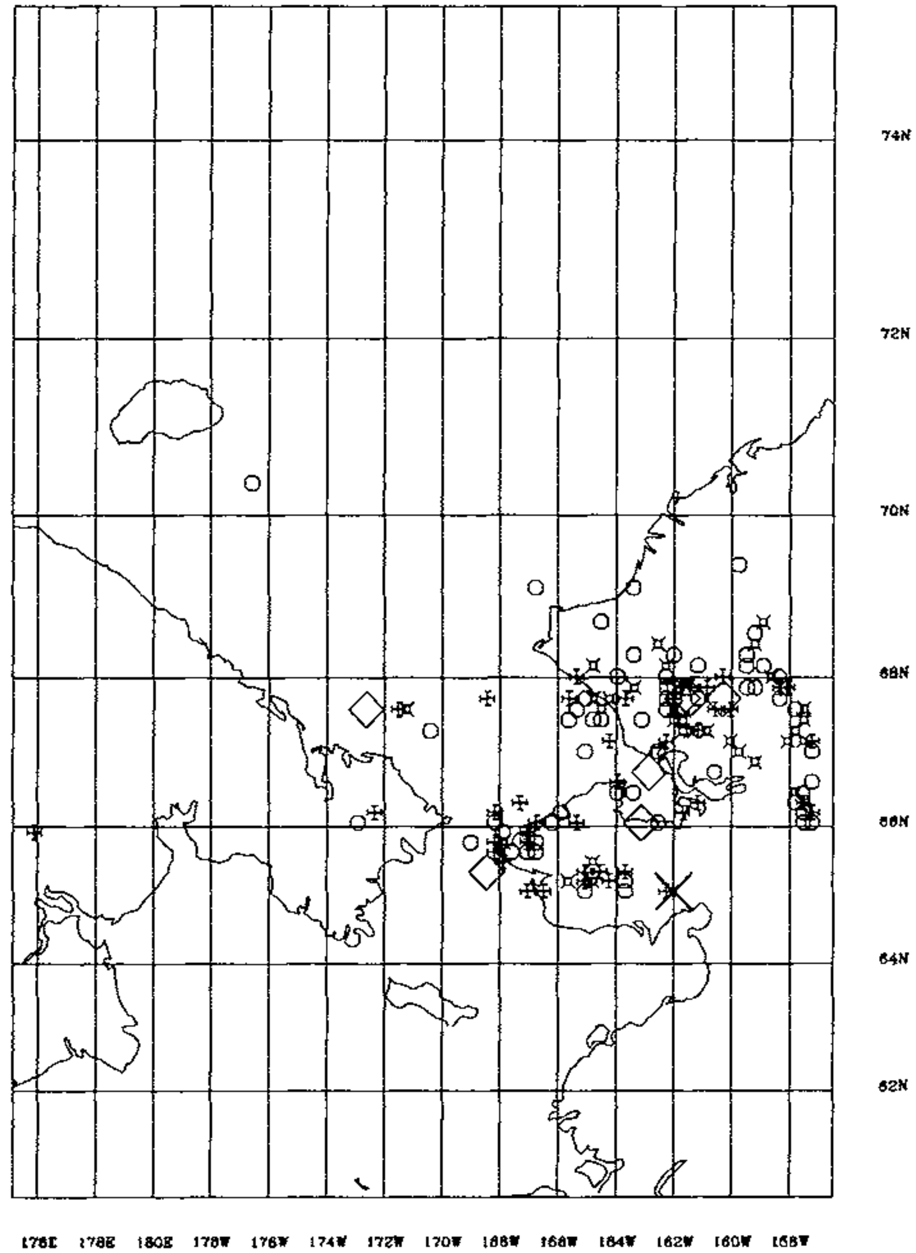


Figure III-A-5. Distribution of Near-Surface Acoustic Anomalies Possibly Related to Shallow Gas



LEGEND

Approximate Magnitudes
on the Richter Scale
of Earthquakes Recorded
from 1854 to Nov. 17, 1989

? ○ 1 □ 2 + 3 ¤

4 ⊕ 5 ◇ 6 ╳

Source: USGS, National Earthquake Information Center, 1990.

Figure III-A-5a. Seismic Activity in the Chukchi Sea Area

In the Sale 126 area, fog may be present at any time (Brower et al., 1988). When sea ice covers the Chukchi Sea, fog occurs about 10 percent of the time. During open-water periods, fog becomes more common, occurring between 20 and 30 percent of the time.

3. Physical Oceanography: The Chukchi Sea is a shallow epicontinental sea. The oceanography is influenced by: (1) the flow of water from the Bering Sea, (2) the atmospheric-pressure system, (3) surface-water runoff, and (4) seasonal ice cover.

From the Bering Sea, water moves north through the Chukchi Sea into the Arctic Ocean (Coachman and Aagaard, 1988). The flow through the Bering Strait is driven by a mean sea-level slope (approximately 10^{-6}) down to the north. Annual transport shows seasonal cyclicity, with winter transport averaging a third of the summer transport (Coachman and Aagaard, 1988). Annual mean transport is 0.8 ±0.2 Sverdrups ("Sverdrup": a unit of volume transport equal to 1,000,000 cubic meters per second [m^3/sec]). The flow through the Bering Strait can reverse under strong northerly winds.

The CTD data collected in 1986 indicated that the ranges of temperatures and salinities are consistent with those observed earlier (Feder et al., 1990). Two watermasses, the Bering Sea Water (BSW) and the Alaska Coastal Water (ACW), enter the Chukchi Sea through the Bering Strait. These two watermasses are distinguished by salinity differences (Aagaard, 1987). The BSW is more saline, forms in the northern Bering Sea, and flows northward through the western Bering Strait parallel to the bathymetry. Near the latitude of Point Hope, the BSW flows northwesterly following the Hope Sea Valley to Herald Canyon and into the Arctic Ocean. The BSW generally does not flow through the Sale 126 area.

The ACW is less saline and warmer, develops in the eastern Bering Sea, and--following the bathymetry--flows through the eastern Bering Strait and along the western coast of Alaska through the Chukchi Sea (Aagaard, 1987).

The third major watermass in the Chukchi Sea is the resident Chukchi Water (RCW). The RCW has temperatures near freezing and salinities equal to or greater than the ACW. The RCW is shelf water from the previous winter, when the water columns are homogenous and incursions of upper Arctic Ocean water infringe on the shelf (Aagaard, 1987).

The influence of Kotzebue Sound on the Chukchi Sea may be significant. Feder et al. (1990) suggest that the input of water runoff into Kotzebue Sound reinforces the Alaska Coastal Current. Kotzebue Sound is also significant in the role it plays in modifying watermass properties. The bottom water formed in Kotzebue Sound during winter flows out of the sound during most of the year along the coast (Feder et al., 1990). The horizontal gradients between watermasses on the inner and outer shelf maintain a front of variable strength (Feder et al., 1990). This front represents a boundary between the Bering Shelf/Anadyr Water (BSAW) and the ACW.

Acoustic Doppler Current Profiles taken during a 1986 oceanographic cruise reproduced many of the features of earlier descriptions of the flow (Feder et al., 1989). North of Cape Lisburne, the ACW forms a narrow, fast-moving current flowing northeasterly approximately parallel to the 20-m isobath (Paquette and Bourke, 1974); this current is the ACC (Figs. III-A-6 and III-A-7). Current speeds of 20 to 30 cm/sec are characteristic of the eastern Chukchi Sea (Mountain, Coachman, and Aagaard, 1976). Grantz et al. (1982) noted reports of coastal-current velocities of 50 cm/sec near Cape Lisburne, 51 to 87 cm/sec south of Icy Cape, and 55 cm/sec north of Wainwright; on occasion, velocities up to 200 cm/sec have been reported north of Wainwright.

From Wainwright to Point Barrow, the coastal current flows parallel to the Barrow Sea Valley. North of Point Barrow, the ACC turns and flows southeasterly parallel to the coastline.

The Barrow Sea Valley/Barrow Canyon provides a channel for water exchange between the Chukchi Sea and

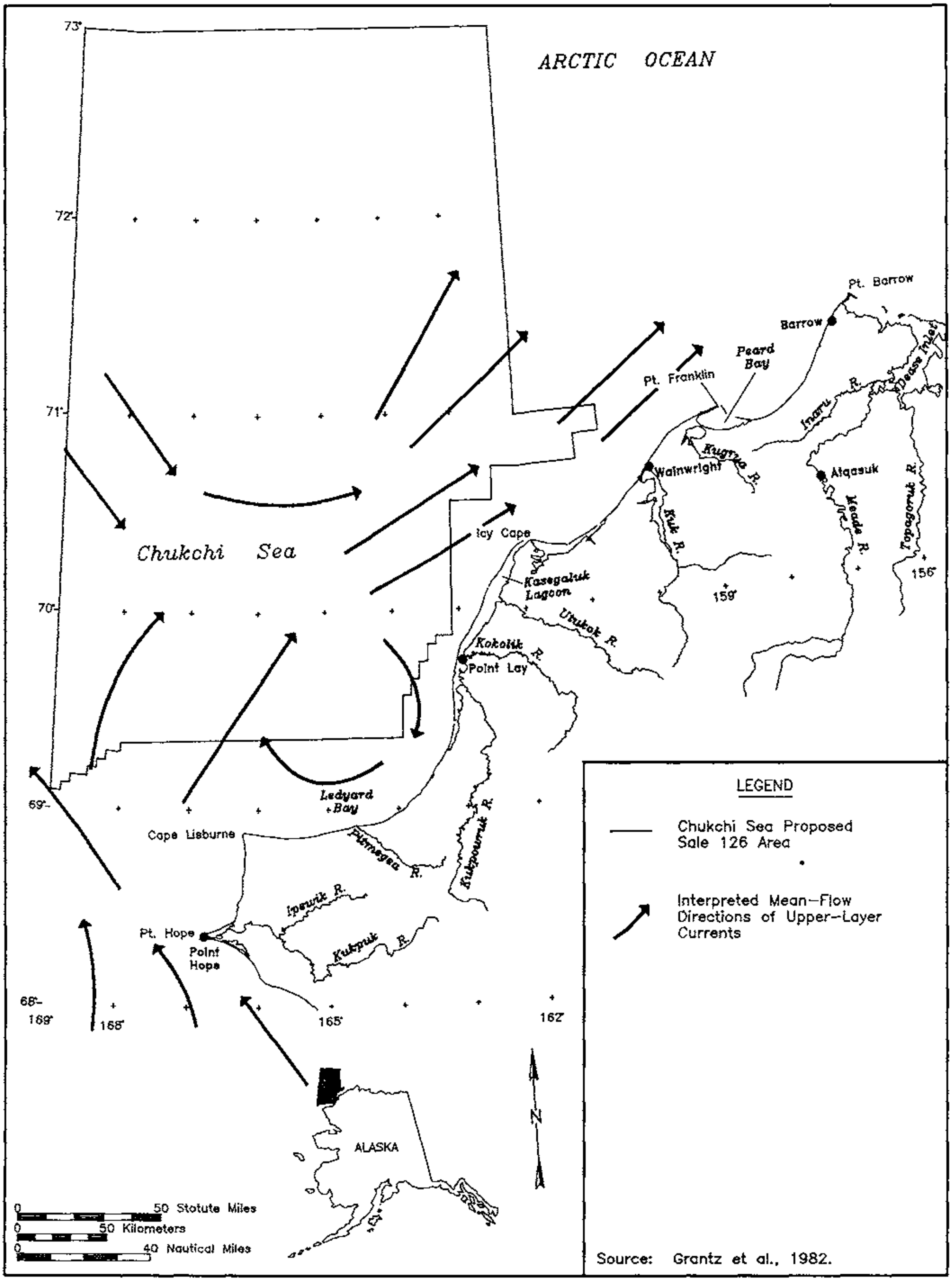


Figure III-A-6. Upper-Layer Currents in the Chukchi Sea

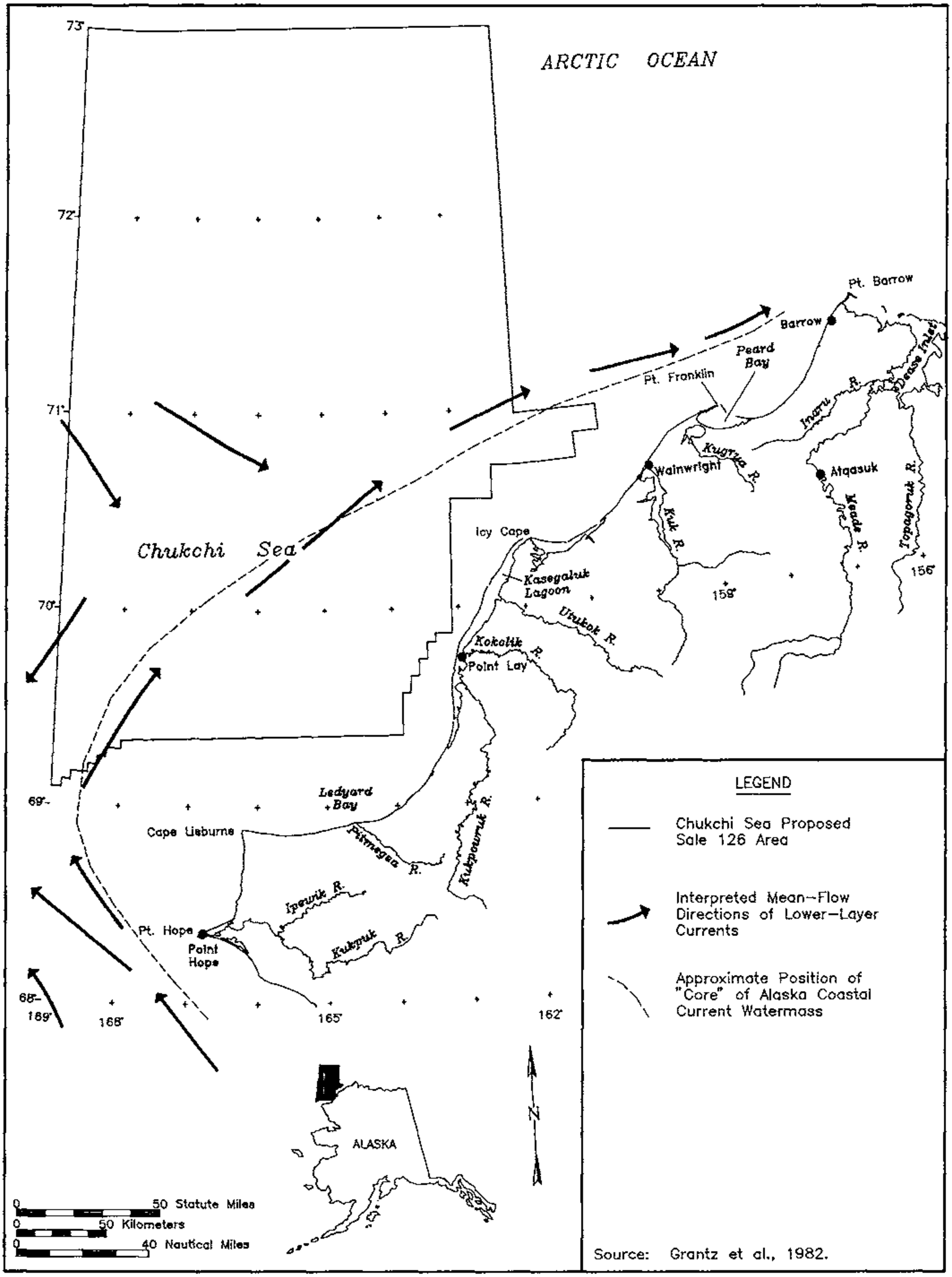


Figure III-A-7. Lower-Layer Currents in the Chukchi Sea the deeper waters of the Beaufort Sea and Arctic Ocean (Mountain, Coachman, and Aagaard, 1976). At times, the flow of water in the Barrow Canyon is southwest from water depths of 150 to 300 m in the Arctic Ocean into the Chukchi Sea (Mountain, Coachman, and Aagaard, 1976). These reversals are related to the same atmospheric-pressure conditions that cause a southerly flow of Chukchi Sea water through the Bering Strait.

The ACC flow is variable and directional reversals can persist for several weeks (Wilson et al., 1982b; Aagaard, 1984); a large part of the flow variability is wind-driven. Thus, during the summer, the ACW may be absent from some parts of the Chukchi Sea coastal area because of prolonged (southerly) flow reversal or offshore diversion (Aagaard, 1984). Feder et al. (1989) determined that the coastal region of the northeast Chukchi Sea responds rapidly (within 6 hr) to wind forcing nearly as a unit from Point Barrow to Point Hope.

During northeasterly flow, anticyclonic (clockwise) eddies can separate the nearshore circulation from the ACC, between Cape Lisburne and Icy Cape (Fig. III-A-6) (Wiseman and Rouse, 1980); off Icy Cape (Hufford, Thompson, and Farmer, 1977); and in Peard Bay (Hachmeister and Vinelli, 1985).

During the open-water period, the onshore and offshore flow of nearshore surface water is controlled by the local windfields (Hachmeister and Vinelli, 1985). Northeasterly winds promote upwelling that brings cooler bottom water into the nearshore area. Southwesterly winds establish a warm coastal jet in the nearshore region and remove the cooler bottom water. Easterly winds shift the ACC offshore, centering it approximately 20 km from the coast. Westerly winds shift the ACC closer to the coast.

During the summer, pressure gradients can produce light- to calm-wind conditions that blow landward along the coast. These winds affect a zone 20 km wide seaward of the shore and push water and sea ice, if present, toward the coast.

In the spring and summer, the Bering Sea shelf is diluted with freshwater runoff and heated from solar radiation and runoff. Water in the eastern Bering Sea receives a larger proportion of the runoff than does water in the western Bering Sea. The discharge from arctic rivers flowing into the Bering and Chukchi Seas is greatest between May/June and August, and the major discharge comes from the Yukon River (Coachman and Aagaard, 1981).

Wind-generated waves are limited to the open-water period. Waves with heights of less than 1 m and periods of less than 6 seconds are the most frequently observed (Brower et al., 1988). However, the potential for generating larger waves occurs near the end of the open-water season, when storm frequencies are highest and there is more open water. Waves with heights greater than 6 m have been observed, but they occur less than 1 percent of the time.

The area most susceptible to storm-surge flooding is north of Point Lay. Storms moving from the west or southwest can develop surges up to 3 m during the open-water period.

Tides are small in the Chukchi Sea, and the range is generally less than 0.3 m.

Winter temperature and salinity properties in the Chukchi Sea are acquired by cooling and sea-ice formation. Winter water is characterized by nearly vertical homogeneity. Sea ice covers the Chukchi Sea for nearly 8 months and remains north of 71°N. latitude for 10 or 11 months. Melting of ice in the Bering Strait begins in late June and--under the influence of northward-flowing warm water--proceeds to the north. The change from winter to summer oceanographic conditions occurs rapidly. In September, the ice reaches its maximum retreat somewhere between 72° and 75°N. latitude (Paquette and Bourke, 1981). Sea-ice conditions in the Sale 126 area are described in Section III.A.4.

During fall and winter, salt rejection during the formation of sea ice in the nearshore area increases the density of the underlying water and causes a seaward flow of the denser water; this mechanism preferentially occurs along coasts with offshore winds, as is frequently the case in the eastern Chukchi Sea during winter.

4. Sea Ice: In the Sale 126 area, sea ice generally begins forming in late September or early October, covering most of the sale area by mid-November or the beginning of December (Webster, 1982; LaBelle et al., 1983; Stringer and Groves, 1985). The general seasonal characteristics of ice in the nearshore area are summarized in Table III-A-1a; the timing of freezeup at several locations along the Chukchi Sea coast is shown in Table III-A-1b. Polar pack ice moves southward in late September and, by mid-October, may be found near Barrow (Webster, 1982).

By about mid-May, the nearshore ice and thin ice begin to melt; by July, the pack ice in the sale area begins retreating northward (Tables III-A-1a and III-A-1b). Even in September, when there is maximum open water, ice may be present in the northern sale area (Stringer and Groves, 1985). The southern sale area, south of 70°N. latitude, will be ice-free between the beginning of August and the end of October (Stringer and Groves, 1986); within this area, the ice will return once it has retreated in the spring--and may retreat once it has formed in the fall--less than 50 percent of the time. The relative locations of the ice edge during the time of maximum ice-free water in the Chukchi Sea are shown in Figure III-A-8 for the period 1972 through 1983.

a. Winter Conditions: Based on dynamic behavior and differences in the types of sea-ice features, the winter-sea-ice regime of the Sale 126 area can be divided into the landfast-ice zone, the stamukhi (shear or flaw) zone, and the pack-ice zone (Fig. III-A-9). These zones vary spatially and temporally and are strongly influenced by the bathymetry and location of offshore shoals.

(1) Landfast-Ice Zone: By March or April, the landfast-ice zone extends from the shore out to water depths that may vary from 20 to 30 m (Barry, 1979; Wilson et al., 1982b). The width of this zone tends to be narrowest around exposed capes and headlands and widest in protected embayments and shoals (Mellor, 1981). North of Icy Cape, the thickness of the landfast ice ranges from 1.8 to 2.4 m; south of the cape, normal winter-ice thickness ranges from 0.6 to 1.2 m.

In the inner part of the landfast zone, the ice freezes to the seafloor; in the outer part, the ice floats. Movement of ice in the landfast zone is intermittent and may occur at any time but is more common during freezeup and breakup; ice motion is caused primarily by winds and currents. As a first approximation, wind-driven sea ice moves at a rate of about 3 percent of the windspeed. Extreme rates of ice movement--up to 2.3 m/sec--were reported in the Chukchi Sea off Barrow during a storm in December 1973 (Shapiro, 1975); the ice was about 0.6 m thick, and the winds blew at about 26 m/sec, with gusts up to 52 m/sec.

The movement of ice toward the shore may result in pileups and rideups on the beaches and offshore islands. In the Beaufort Sea, where these phenomena have been studied more extensively, shore-ice pileups and rideups appear to be relatively frequent events. These nearshore and onshore pileups frequently extend up to 20 m inland from the shoreline over both gentle and sloping terrain and up steep coastal bluffs (Kovacs, 1982). In April 1981, a large shore pileup that was 20 m high at its peak was observed on Icy Cape. A summer storm subsequently smoothed over the beach and removed any traces that the pileup might have left in the sediments (Kovacs and Kovacs, 1982).

Ice rideups--where an entire ice sheet slides in a relatively unbroken manner over the ground surface for more than 50 m--are not very frequent; rideups that extend more than 100 m are relatively infrequent (Kovacs, 1982). Some of the low-lying barrier islands in the Beaufort Sea have been completely overridden by ice sheets as thick as 0.9 m (Kovacs and Sodhi, 1979). Pileups and rideups may occur at any time of the year, but they are most frequent in the fall and spring.

(2) Stamukhi Zone: The ice zone that lies seaward of the landfast ice has been referred to as the stamukhi (shear or flaw) zone. This zone is a region of dynamic interaction between the

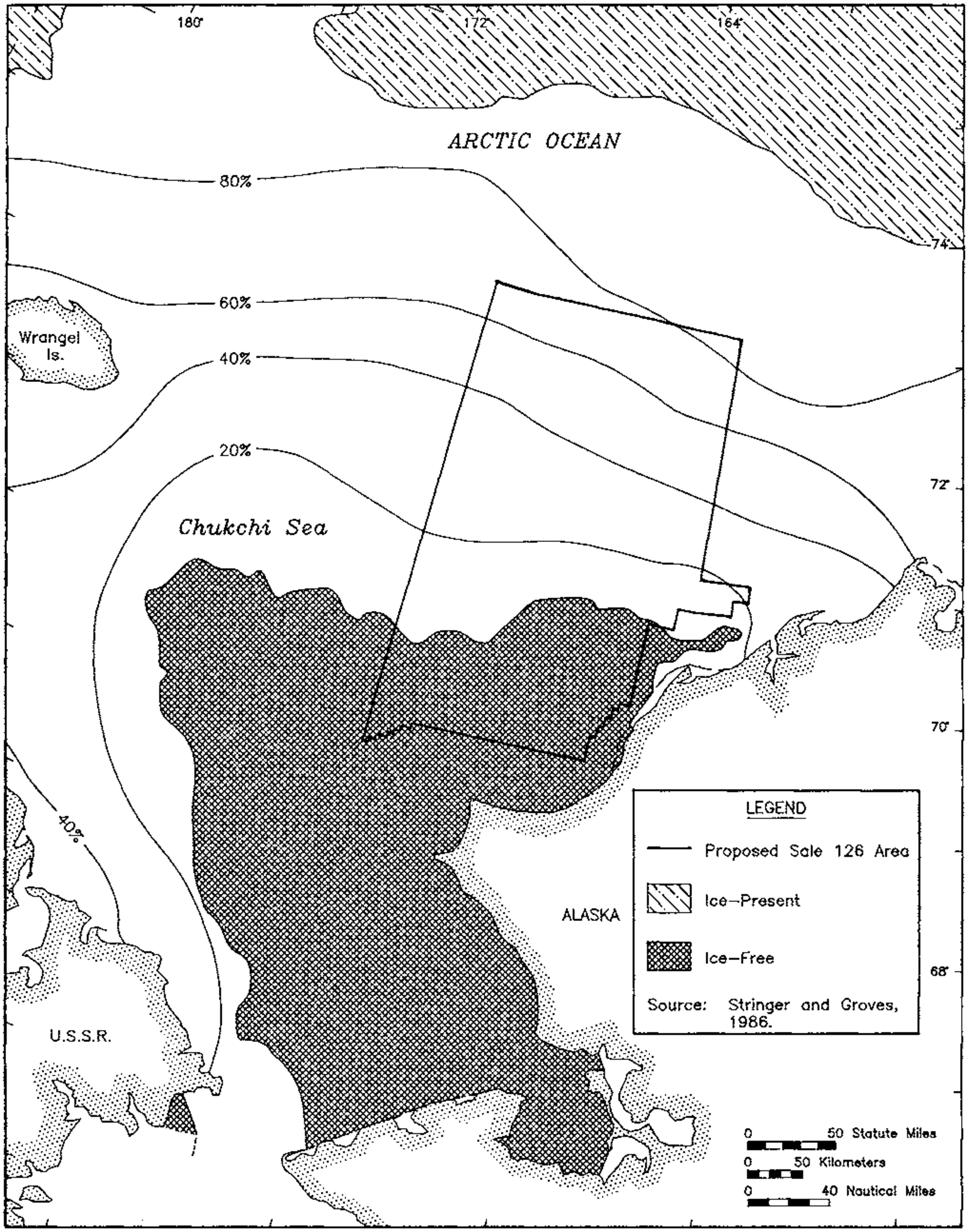


Figure III–A–8. Chukchi Sea Ice–Edge Frequency Map for October 5–11, 1972 to 1983

NOTE: The isopleths on this map define the relative frequency with which oceanic locations have been within the ice edge during this period. The Ice–Free area was free of ice in all years studied (1972–1983), while the Ice–Present area had ice present in all years.

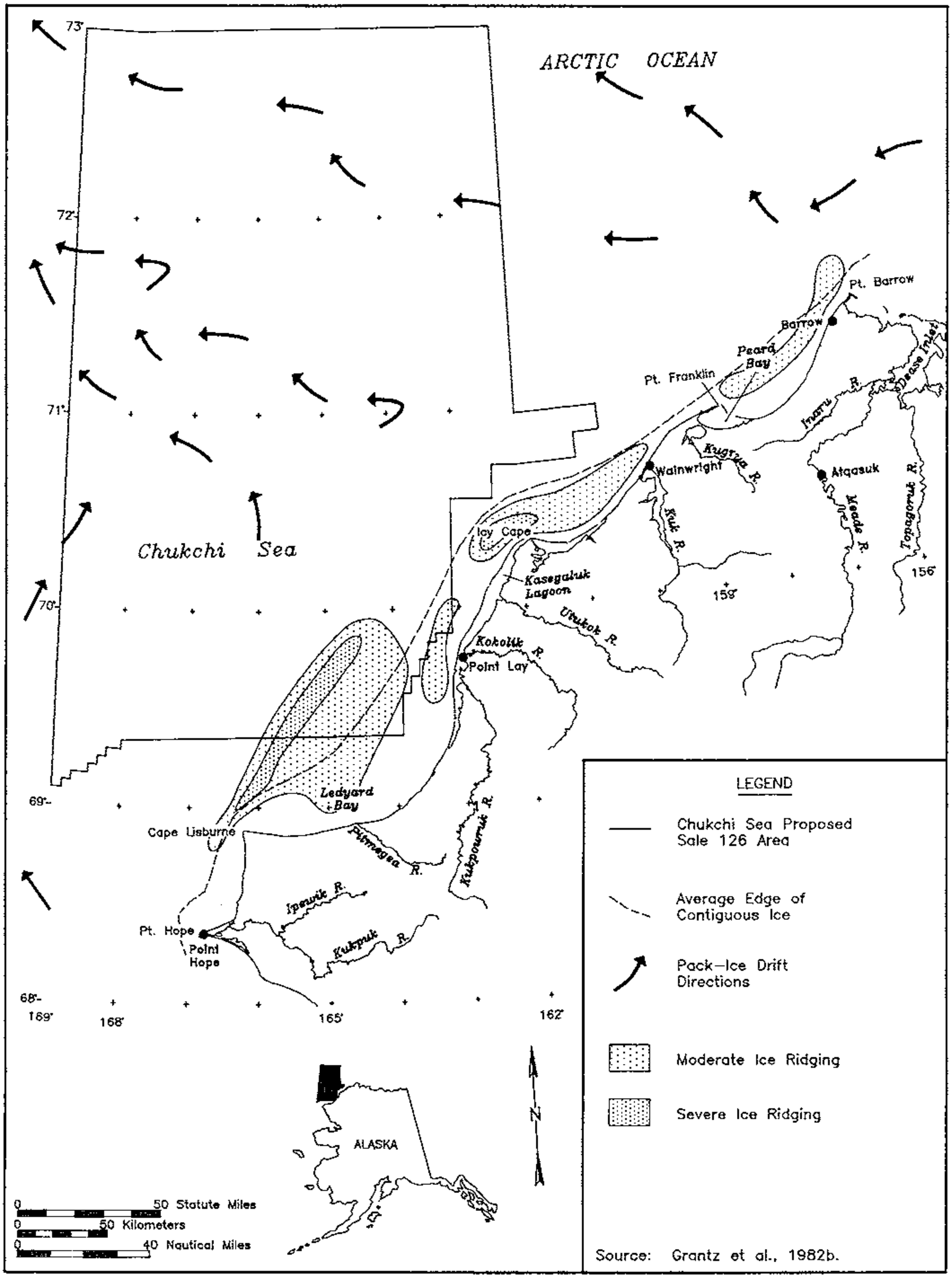


Figure III-A-9. Coastal-Ice Zonation, Areas of Ice Ridging, and Direction of Pack-Ice Movement in the Chukchi Sea

Table III-A-1a
Average Seasonal Landfast-Ice Regimes in the Chukchi Sea[1/]

Ice Phase	Central Chukchi[2/] Sea Coast
New ice forms	Oct. 10
First continuous fast ice	Early Nov.
Extension/modification of fast ice	Nov./Dec. - Jan./Feb.
Stable ice sheet inside 15-meter isobath	Feb. - Apr./May
Rivers flood the fast ice	May 1
First melt pools	May 10
First openings and movement	June 10
Nearshore area largely free of fast ice	July 5

Source: Barry, 1979.

1/ These dates are based on available Landsat imagery for 1973-1977. An identifiable event may occur anywhere between the dates of available clear frames that bracket the latest date of recognized nonoccurrence and the earliest date of its identified occurrence; the average of these dates is used here.

2/ The ice may not achieve any prolonged local stability, given data ± 7 to 10 days.

Table III-A-1b
Ice-Breakup and -Freezeup Data for Points Along the Chukchi Sea Coast

	BREAKUP			FREEZEUP			Years
	Earliest	Latest	Average	Earliest	Latest	Average	of Data
Point Barrow	June 15	Aug. 22	July 22	Aug. 31	Dec. 19	Oct. 3	31
Wainwright	June 7	July 26	June 29	Sept. 26	Oct. 9	Oct. 2	7
Point Lay	June 1	July 10	June 24	Oct. 12	Nov. 27	Nov. 4	4
Point Hope	May 30	July 8	June 20	Oct. 6	Dec. 19	Nov. 11	8

Source: LaBelle et al., 1983.

relatively stable ice of the landfast-ice zone and the mobile ice of the pack-ice zone that results in the formation of ridges, leads, and polynyas (large areas of open water). In the Chukchi Sea, the region of most intense ridging occurs in waters that vary in depth from 15 to 40 m deep (Fig. III-A-10); moderate ridging extends seaward and shoreward of these regions. Grounded ridges help to stabilize the seaward edge of the landfast-ice zone.

Ridges are formed by the differential movement of adjacent ice floes or sheets. If the movement is essentially normal to the boundary that separates the floes, a pressure ridge is formed. On the other hand, if the motion is essentially parallel to the boundary, a shear ridge is formed. Pressure ridges are sinuous, composed of blocks with dimensions related to the thickness of the ice being incorporated into the ridge at the time of movement, and may be associated with large (tens of meters) over- and underthrusting of interacting ice sheets. Extensive rafting usually occurs in the vicinity of pressure ridges, and ice thicknesses of 2 to 4 times the sheet thickness may be found within a few hundred meters of the ridge. Shear ridges are straighter, usually have one vertical side, and are composed of granulated-ice particles that range in size from a few centimeters in diameter up to rounded blocks that have dimensions comparable to the thickness in the ice that formed the ridge.

At depths shallower than 60 m, linear depressions have been gouged into the seafloor by the keels of drifting ice masses. Ice-gouge densities in the sale area are shown in Figure III-A-10.

Along the coast, areas of high ice-gouge density include the steep slopes of the seafloor in the Barrow Sea Valley or ice-push-sediment ridges, the stamukhi zone, and the shoals adjacent to the capes (Lewbel, 1984). The orientation of the gouges is usually parallel to the isobaths on the steep slopes and shoals, but in water less than 15 m deep the orientation may be random. Between Point Barrow and Icy Cape, the maximum observed gouge-incision depth generally increases slightly from 2.4 m at 12 m of water depth to 2.8 m at 24 m of depth. Below 28 to 30 m, the gouge-incision depth decreases with increasing depth; this decrease may reflect the thin sediment cover, about 1 to 2 m in waters deeper than 30 m, or the presence of bedrock at or near the surface, which would prevent gouges from forming. Reworking of sediments by currents in the stamukhi zone may also eliminate the traces of many ice gouges.

Contemporary ice gouging may be occurring in water at least 43 m deep. In the central part of the Sale 126 area, beneath the ACC in water depths of 43 to 45 m, ice gouges were observed cutting across sand-ripple fields that may be active under present-day current regimes. The currents also transport the sediments that partially or completely fill in the gouges. The reoccurrence interval of ice gouging on the seafloor of the Chukchi Sea is unknown at this time.

The system of leads and polynyas that develops between the landfast- and pack-ice zones extends the length of the Chukchi coast from Point Hope to Barrow during the winter and spring (Stringer, 1982). Between February and April, the average lead-system width is less than 1 km (the extreme widths range from a few km in February to 20 km in April) and is open about 50 percent of the time. The overall behavior of the Chukchi Sea open-water system from late spring to early fall is summarized as follows: (1) during May and June, the average width is about 4 km at the northern end but widens to about 58 km at the southern end (there are, however, large variations in the width and the system is a more or less permanent feature); (2) through July and August, the average width increases dramatically (extreme widths of several hundred km can occur), but the open-water system in the vicinity of Point Barrow and Wainwright may be closed; (3) September is the period of maximum open water, but the pack ice is occasionally held against the coast at Point Barrow; and (4) the freezeback process begins in October.

Anchor ice may be an important geologic agent in the sedimentary regime of the shallow Arctic seas (Reimnitz, Kempema, and Barnes, 1986). In the Beaufort Sea, anchor ice has been observed in waters shallower than 5 m--other information suggests that it may form at depths out to about 15 to 20 m. Anchor ice is underwater ice formed in supercooled water. Frazil ice consists of small, disk-shaped crystals that form in turbulent, slightly supercooled water. When turbulence carries frazil ice to submerged, supercooled

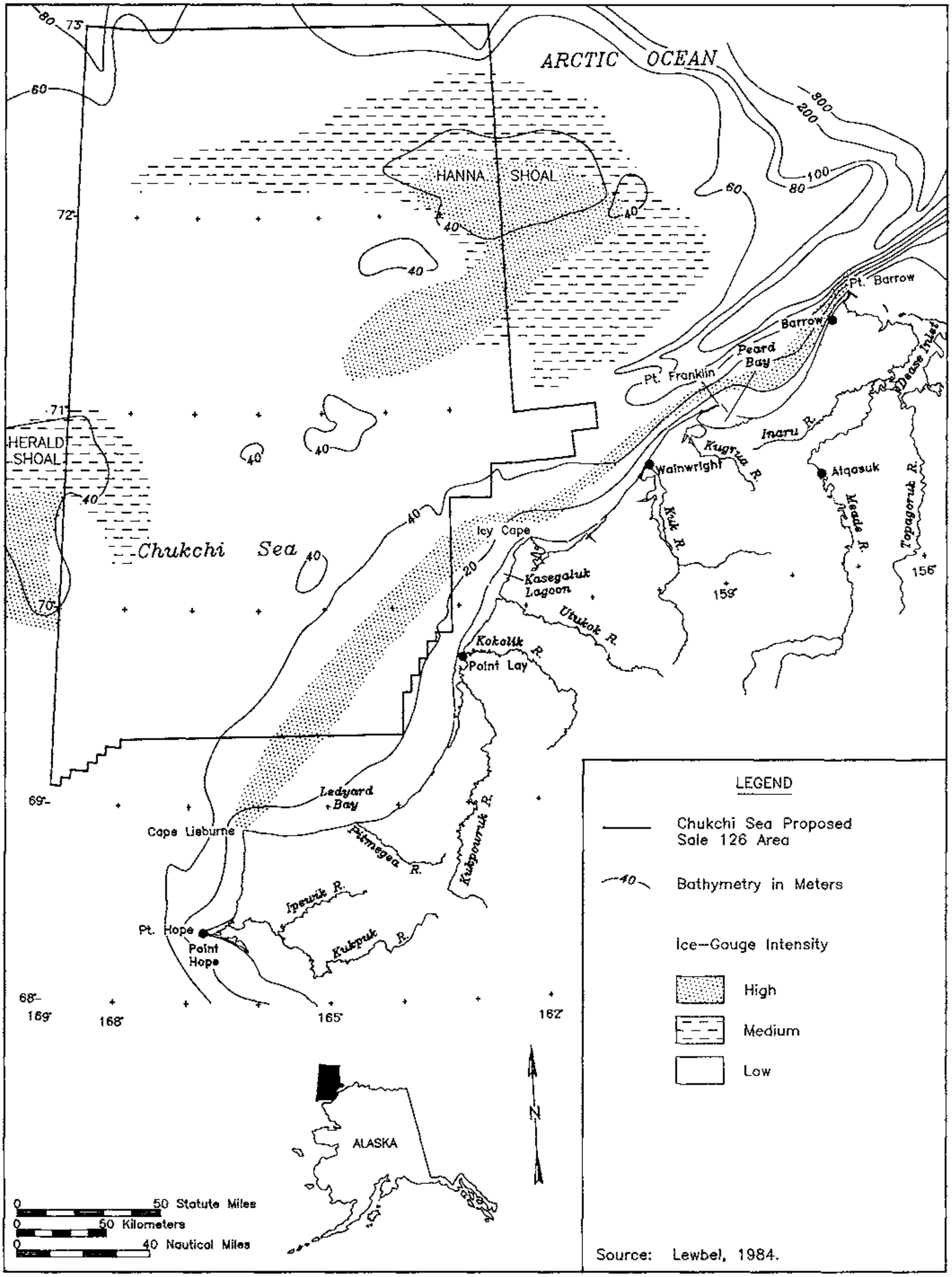


Figure III–A–10. Ice–Gouge Intensity in the Chukchi Sea objects on the bottom, the frazil may adhere to the substrate (sediments)--forming anchor ice. Once anchor ice is formed, it may grow rapidly by free growth in the supercooled water or by trapping other frazil crystals from the water column. When dislodged, the buoyant force of the anchor ice generally transports some components of the substrate to the surface.

The short-lived nature of storm-generated anchor ice makes study of related sediment transport and bedform dynamics extremely difficult. Near the seabed, sediment movement with anchor ice during a storm probably is more important for overall sediment transport than is ice rafting on the sea surface (Reimnitz, Kempema, and Barnes, 1986).

(3) Pack-Ice Zone: The pack-ice zone lies seaward of the stamukhi zone and includes the following morphologically different sea-ice types: (1) first-year ice; (2) multiyear floes, ridges, and floebergs; and (3) ice islands. The first-year ice that forms in open-water fractures, leads, and polynyas varies in thickness from a few centimeters to more than a meter. The ice within a refrozen opening generally is thinner and weaker than the surrounding ice. Multiyear ice is simply defined as ice that has survived one or more melt seasons. Ice islands are tabular icebergs that have calved (broken away) from ice shelves on Ellesmere and Axel Heiberg Islands.

During the winter, the pack ice in the northern part of the Chukchi Sea generally moves in a westerly direction (Fig. III-A-9); however, there may be short-term perturbations from the basic trend due to the passage of low- and high-atmospheric-pressure systems across the arctic. Pack ice in the southern part of the Chukchi Sea is usually transported to the north or northwest. The movement of the pack ice during the spring and summer of 1977 and 1978 was determined from buoys deployed on and drifting with the pack ice (Pritchard, 1978; Colony, 1979). The data from the buoys showed that the direction of movement was generally to the northwest, but the ice drifted slightly toward the southwest in March.

Sea-ice-motion studies in the Chukchi Sea during 1981 to 1982 showed that in the central part of the sale area, (1) ice more than 150 km offshore moved in a generally northwesterly direction, and (2) ice from an area 50 to 100 km offshore showed both northeasterly and southwesterly directions of movement--the distances covered in either direction were up to 100 km long during time periods of 3 to 10 days (Pritchard and Hanzlick, 1987). The velocities of the ice movement nearer the coast ranged from about 5 to 25 cm/sec, and ocean currents appeared to be more important than wind in determining the direction of ice movement. Ocean currents flowing parallel to the shoreline reached a maximum velocity of about 35 cm/sec.

Strong, driving forces acting over a relatively long period of time will gradually move the sea ice southward in a band that is 100 or more km wide and extends from the Bering Strait northward along the Alaskan coast past Point Barrow (Kovacs, Sodhi, and Cox, 1982). This band includes sea ice of the flaw-lead system along the northwestern Alaska coast. As the ice attempts to move through the Bering Strait, an arch (or ice bridge) is formed across the strait (Pritchard, Reimer, and Coon, 1979). If the combination of wind and current forces acting on the ice behind the blockage exceeds the strength of the arch, the arch will fail and the jammed-up ice will move rapidly into the Bering Sea; such an event is termed a breakout. Breakouts may occur about two to four times a season and last for several (2-4) days (Lewbel, 1984).

A breakout event in January 1977 resulted in an estimated 62,000 km^2 of Chukchi Sea ice flowing through the Bering Strait with a speed of about 4.1 km per hour (km/h); in March 1978, approximately 64,000 km^2 of ice moved through the strait at 2.8 km/h (Ahlnas and Wendler, 1979).

First-year floes off the Chukchi Sea coast have a thickness of about 1.2 to 1.5 m (Barry, 1979). Multiyear floes are 3 to 5 m thick. Large floes with diameters that range from 0.5 to 10 km have been observed in the vicinity of the 30- to 40-m isobaths between Barrow and Cape Lisburne (Dickins Engineering Consulting, 1979).

Sea ice that is thicker than 5 m is common in the Arctic Ocean pack ice and is generally believed to consist of pressure ridges and rubble fields that were formed by the deformation of thinner ice (Weeks and Mellor, 1983). The sizes of multiyear ridges are described principally in terms of sail height and, to a lesser extent, keel depth or ridge length. Based on a limited number of concurrent measurements, the ratio of sail height to keel depth is about 1:3.2 for floating ridges that are in equilibrium. To date, measurements of these parameters indicate that there are many low ridges and very few high ridges.

Seasonal and geographic variations in the ice roughness were determined from data obtained in 1976 during laser-profilometer flights in the northeastern part of the Chukchi Sea (Tucker, Weeks, and Frank, 1979). Seasonal variations in the ridge heights showed that average ridge heights in the fall and early winter (1.2 m) are lower than in late winter and early spring, when the ice is thicker (1.5 m). Over 75 percent of the late-winter and early spring ridges were less than 2 m high; several ridges were about 5 m high. The average ridge density of about 3.6 ridges/km was also greater in February and April than in August and December, when about 1.8 ridges/km were observed.

As a result of melting and refreezing, multiyear ridges are stronger than first-year ridges. During the summer, the ice in the sail portion of the ridge melts and displaces the more saline water in the voids of the keel. When this meltwater freezes, it gives the ridges a strong core with no voids.

Ships operating in sea ice report that first-year ridges do not offer significant resistance beyond that needed to force the large volume of ice aside, but multiyear ridges are extremely difficult to break (Weeks, 1981). Other thick masses of sea ice include floebergs and ice islands. Floebergs are hummock or rubble fields that are frozen together. They form principally in the zone between the drifting pack ice and the landfast ice (Toimil and Grantz, 1976).

Ice islands are large, tabular icebergs with areal sizes ranging up to 1,000 or more km^2 and thicknesses up to 60 m (Sackinger et al., 1985). They calve from the ice shelves located along the northern coasts of Ellesmere and Axel Heiberg Islands and drift into the Arctic Ocean, where they slowly circulate in a clockwise direction for many years. During an observation period from 1963 through 1986, 1,053 km^2 of ice were lost from the Ellesmere and Axel Heiberg ice shelves. The amount of ice lost in any year varied from zero to 569 km^2. The ice-shelf observations and ice-island sightings indicate that it may take 10 or more years for ice islands to reach locations to the east within the Beaufort Sea. Large ice islands have been observed only in the northern part of the Chukchi Sea.

Hanna Shoal is a site for the accumulation of ice features such as ice-island fragments or floebergs that have drafts greater than 25 m (Toimil and Grantz, 1976). Recurrent groundings of ice islands or floebergs result in the seasonal growth of this field.

The northern, eastern, and southeastern flanks of Hanna Shoal are extensively gouged (Lewbel, 1984). The ice-gouge densities reflect the pack-ice-drift patterns around the shoal. On the northern flank of Hanna Shoal out to a depth of about 48 m, ice-gouge-incision depths seldom exceed 2 m; but between the water depths of 48 and 52 m, incision depths of 3 to 4 m have been observed. Ice gouges are shallow and sparse beyond the 54-m isobath. Shallow, solitary ice gouges have been found east of Hanna Shoal in water as deep as 64.5 m and may be expected of equivalent water depths in the northernmost part of the Sale 126 area. Ice gouges also are abundant on Herald Shoal.

Within the central part of the Chukchi Sea shelf, the ice-gouge density appears to decrease to the south and with depth.

b. Summer Conditions: The edge of the retreating pack ice is quite variable. In midsummer, the Chukchi Sea pack ice is usually composed of a mixture of broken, eroded blocks and small floes. Depending upon the wind velocity, the concentration of ice at the edge may be less than one-eighth or greater than six-eighths. Winds or currents moving away from the ice tend to scatter individual floes and form a broad zone; winds and currents moving toward the ice compact the zone. However, even when individual pieces of sea ice are scattered, the edge tends to be well defined (Paquette and Bourke, 1981).

The shape of the ice edge is irregular and includes embayments of various sizes that are produced by the melting action of warm water. Some of the larger embayments appear to reoccur from year to year, in approximately the same places. One of the embayments occurs in the western Chukchi Sea between 170° and 175°W. longitude; another embayment is centered at about 168°W. longitude; and a third lies west to west-northwest of Point Barrow. These embayments are closely correlated with bathymetric troughs and support the concept that the flow of warm water from the Bering Sea is controlled, at least in part, by the bathymetry.

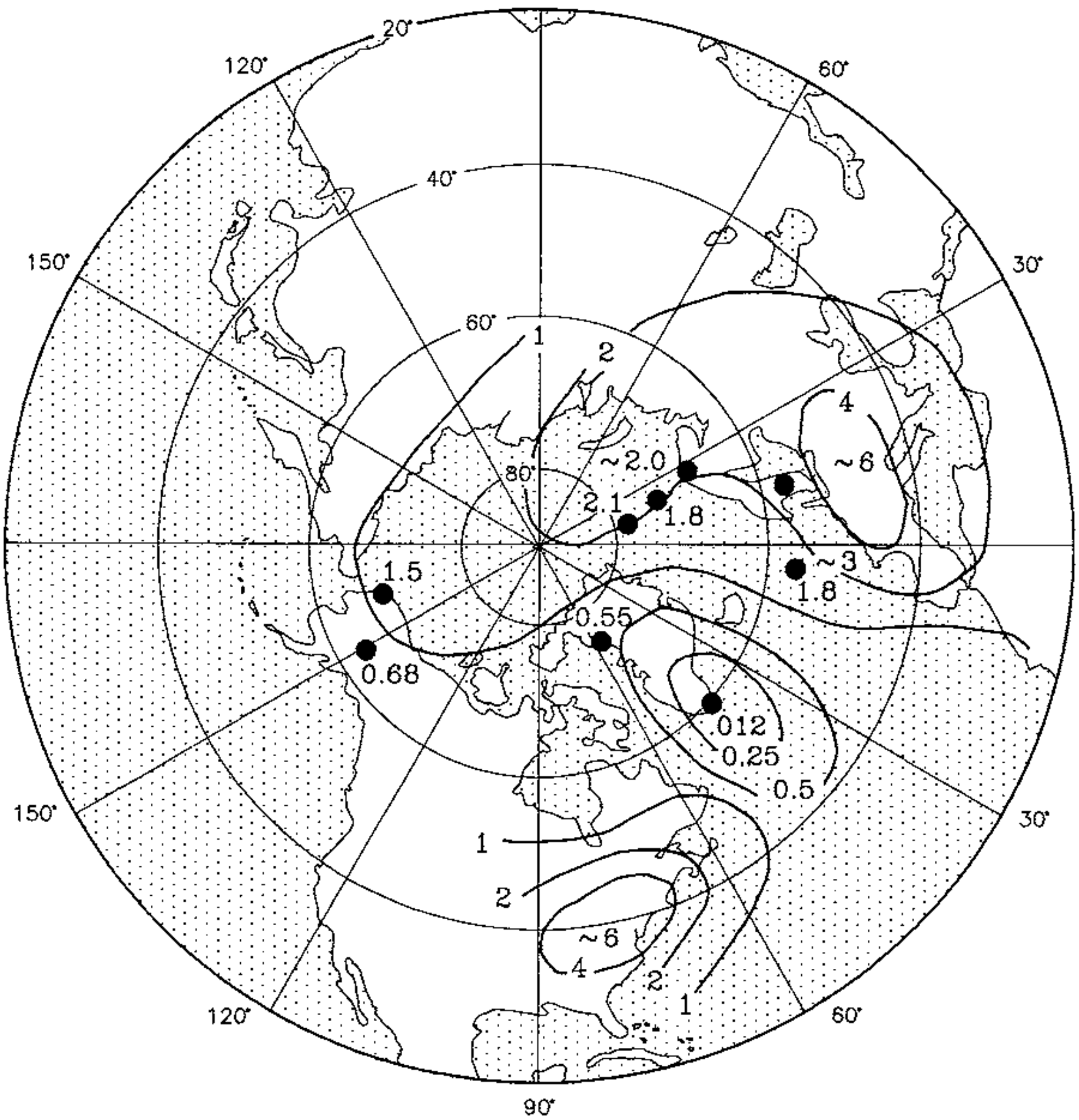
The general characteristics of sea-ice decay along the coast during the summer are as follows (Barry, 1979) (see Table III-A-2 for the timing): (1) over-ice flooding at the river mouths in spring, (2) meltpools forming on the ice surface, (3) openings in previously continuous ice sheets, (4) movements in previously immobile nearshore ice, and (5) nearshore areas largely free of fast ice. Because there are no major rivers along the Chukchi Sea coast, nearshore over-ice flooding is not a dominant component of the sea-ice-decay process.

5. Air Quality: The existing onshore air quality adjacent to the Chukchi Sea Sale 126 area is considered to be relatively pristine, with concentrations of regulated air pollutants that are far less than the maxima allowed by the National Ambient Air Quality Standards (national standards) and State air quality statutes and regulations designed to protect human health. Under provisions of the Prevention of Significant Deterioration (PSD) Program of the Clean Air Act, existing air quality superior to the national standards is protected by additional limitations on nitrogen dioxide, sulfur dioxide, and total suspended particulate matter. Areas in Alaska are currently designated as PSD Class I or II. The Class I air quality designation is the most restrictive and applies to certain national parks, monuments, and wilderness areas. There are no Class I areas in or near the proposed lease-sale area; the entire area is designated Class II. The applicable standards and maximum allowable PSD Class I, II, and III increments are listed in Table III-A-2.

Emissions consist of widely scattered small sources, principally from residences, refuse disposal, and small-village diesel-electric generators. The EPA (USEPA, 1978) prepared emissions inventories and ambient air quality estimates for areas in Alaska with relatively small populations. These estimates were derived from general emission-factor relationships with the local economic base and demographic data and indicate compliance with existing air quality requirements. Since 1978, the increase in emissions sources in the area (principally from activities in Barrow) has not been significant. However, there is little available air quality monitoring information from the area with which to quantify ambient pollutant concentrations. The State of Alaska (State of Alaska, DEC, 1987) recently prepared a Preliminary Technical Analysis Document in support of a proposed air quality permit for the proposed Red Dog Mine project, which is located approximately 100 km south of the lease-sale area. Based primarily on experience and limited information from other similar remote sites, the analysis anticipates that concentrations of most background pollutants will be at or less than the level detectable by air quality monitoring instruments, and that the ambient annual average 1-hour concentration for ozone is approximately 50 $\mu g/m^3$, while the standard is 235 $\mu g/m^3$.

During the winter and spring, pollutants are transported across the Arctic Ocean, from industrial Europe and Asia to arctic Alaska (Rahn, 1982). These pollutants cause a phenomenon known as arctic haze. Pollutant sulfate due to arctic haze in the air at Barrow--that in excess of natural background--averages 1.5 $\mu g/m^3$. The concentrations of vanadium--a combustion product of fossil fuels--then averages up to 20 times the background levels in the air and snowpack. Concentrations of aerosol haze during winter and spring at Barrow are similar to those over large portions of the continental U.S. (see Fig. III-A-11), but considerably higher than levels south of the Brooks Range of Alaska. Despite this seasonal long-distance transport of pollutants into the Arctic, regional air quality still is far better than specified by standards.

6. Water Quality: The water quality of the Sale 126 area is generally pristine; most impurities occur at low levels. These impurities are introduced into the marine environment through river runoff, coastal erosion, and inflow from the Bering Sea. The rivers that flow into the sea remain relatively



Source: After Rahn, 1982.

Figure III-A-11. Mean Winter Concentrations of Pollutant Sulphate ($\mu g/m^3$) in Surface Aerosol of the Arctic and its Environs

Table III-A-2
Ambient Air Quality Standards Relevant to Chukchi Sea Sale 126 ($\mu g/m^3$)

	Averaging Time					
Criteria Pollutant[1/]	Annual	24 hr	8 hr	3 hr	1 hr	30 min
Total Suspended Particulates[2/]	60[3/]	150	*	*	*	*
Class I[4/]	5[3/]	10	*	*	*	*
Class II[4/]	19[3/]	37	*	*	*	*
Class III[4/]	37[3/]	75	*	*	*	*
Carbon Monoxide	*	*	10,000	*	40,000	*
Ozone[5/]	*	*	*	*	235[6/]	*
Nitrogen Dioxide	100[7/]	*	*	*	*	*
Class I[4/]	2.5[7/]	*	*	*	*	*
Class II[4/]	25[7/]	*	*	*	*	*
Class III[4/]	50[7/]	*	*	*	*	*
Inhalable Particulate Matter (PM10)[8/]	50[9/]	150[10/]	*	*	*	*
Lead	1.5[11/]	*	*	*	*	*
Sulfur Dioxide	80[7/]	365	*	1,300	*	*
Class I[4/]	2[7/]	5	*	25	*	*
Class II[4/]	20[7/]	91	*	512	*	*
Class III[4/]	40[7/]	182	*	700	*	*
Reduced Sulfur Compounds[2/,12/]	*	*	*	*	*	50

Sources: State of Alaska, Dept. of Environmental Conservation, 1982; 80 18 AAC 50.010, 80 18 AAC 50.020; 40 CFR 52.21 (43 FR 26388), 40 CFR 50.6 (52 FR 24663), 40 CFR 51.166 (53 FR 40671).

NOTE: An asterisk (*) indicates that no standards have been established.

1/ All averaging times cannot be exceeded more than once each year, except that annual means may not be exceeded.
2/ State of Alaska air quality standard (not national standards).
3/ Annual geometric mean.
4/ Class II standards refer to the PSD Program. The standards are the maximum increments in pollutants allowable above previously established baseline concentrations.
5/ The State ozone standard compares with national standards for photochemical oxidants, which are measured as ozone.
6/ The 1-hour standard for ozone is based on a statistical, rather than a deterministic, allowance for an "expected exceedance during a year."
7/ Annual arithmetic mean.
8/ PM10 is the particulate matter less than 10 μm in aerodynamic diameter.
9/ Attained when the expected annual arithmetic mean concentration, as determined in accordance with 40 CFR 50, subpart K, is $\leq 50\ \mu g/m^3$.
10/ Attained when the expected number of days per calendar year, with a 24-hour average concentration above 150 $\mu g/m^3$, as determined in accordance with 40 CFR 50, subpart K, is ≤ 1.
11/ Calendar-quarter arithmetic mean.
12/ Measured as sulfur dioxide.

unpolluted by the activities of man.

a. Turbidity: Satellite imagery and analyses of suspended-particulate matter indicate that turbid waters are confined to nearshore lagoons, inlets, and breaks in offshore bars (Sharma, 1979). However, because of the absence of major rivers and lower rates of shoreline erosion along the Chukchi Sea coast, these nearshore waters should be clearer than the nearshore waters of the neighboring Beaufort Sea.

Offshore, in the southern portion of the sale area, suspended-particulate loads in the water column range between 1 and 5 parts per million (ppm). In the northern portion, surface concentrations are usually less than 1 ppm, with somewhat higher concentrations at depth.

b. Dissolved Oxygen: In general, oxygen concentrations are at or above saturation (Fleming and Heggarty, 1966). Because the cold temperature of the water increases solubility of oxygen, oxygen concentrations are high--about 8 to 11 milliliters per liter (ml/l) (Kinney et al., 1970). However, concentrations as low as 6 ml/l have been found in the deeper waters offshore of Point Hope.

c. Trace Metals: Trace-metal concentrations are low and show no indication of pollution (Table IV-B-3). Concentrations within the sediment are similar to those for other coastal seas. Existing water concentrations of sampled trace metals are two orders of magnitude lower than those required by Federal saltwater-quality criteria.

d. Hydrocarbons: Background hydrocarbon concentrations also are very low. In the water they average less than 1 part per billion (ppb) and appear to be mostly biogenic (Shaw, 1977; Katz and Cline, 1980). Pelagic tars were not present in the two surface tows (740 m^2 each) made in the OCSEAP program. A plume of low-molecular-weight hydrocarbons in deeper water (although still less than 1 ppb) extends toward Point Hope from the west. Cline, Feely, and Young (1978) speculated on two possible sources for this plume: (1) hypothesized seeps along the Siberian Shelf or (2) an artifact of slower decomposition of biotic hydrocarbons in cold, less oxygenated water derived from the Siberian Shelf.

Concentrations of hydrocarbons in the sediment have not been measured but would be expected to be at least as low as the (low) parts-per-million levels found in the more developed Beaufort and northern Bering Seas (see Proposed Diapir Field Lease Offering [June 1984] FEIS [USDOI, MMS, 1984a]; Norton Basin Sale 100 FEIS [USDOI, MMS, 1985]; and Beaufort Sea Sale 97 FEIS [USDOI, MMS, 1987a]).

B. Biological Resources:

1. Lower-Trophic-Level Organisms: Lower-trophic-level organisms in the Chukchi Sea Sale 126 area can be categorized as pelagic (living in the water column), epontic (living on the underside of or in sea ice), or benthic (living on or in the sea bottom). The abundance and spatial and seasonal distribution of these organisms are strongly influenced by the physical environment. In particular, the currents moving north through the Bering Strait have a strong effect on primary production, in addition to transporting detritus and larval forms of invertebrates and fishes from the Bering Sea into the Chukchi Sea. Seasonal ice regimes also strongly influence the pattern and timing of productivity and the distribution patterns of higher-order consumers (e.g., walrus).

a. Pelagic Community: This section concentrates on planktonic organisms that live in the water column (pelagic fishes are discussed in Sec. III.B.2). Planktonic organisms are those organisms occurring in the water column that are subject to the vagaries of the water's movements; they are unable to swim very effectively against currents. Two basic groups comprise the plankton: (1) phytoplankton, the primary producers or plants of the plankton; and (2) zooplankton, the animal component of the plankton.

Primary production, via the process of photosynthesis, is the formation of organic compounds (like carbohydrates), from inorganic carbon sources (e.g., carbon dioxide) using solar energy, and with chlorophyll as a catalyst. The entire food chain can be based on this process. In the southern Chukchi Sea, primary production is enhanced by the transport of upwelled nutrient-rich water from the Gulf of Anadyr in the northwestern Bering Sea through the Bering Strait and into the Chukchi Sea. The very high concentrations of phytoplankton supported by this water in the Bering Strait region have been estimated to fix 324 grams of carbon per square meter per year (g $C/m^2/yr$) over 2.12 x 10^4 km^2 (Sambrotto, Goering, and McRoy, 1984). This is nearly twice the production of the southeastern Bering shelf and is higher than figures reported for any arctic area (Subba Rao and Platt, 1984). Initial data from the ISHTAR (Inner Shelf Transfer and Recycling in the Bering and Chukchi Seas) Project suggest that the various watermasses (Alaska Coastal Water, Bering Shelf Water, and Anadyr Water) entering the Chukchi Sea have distinct productivity regimes.

The intense productivity of the region near St. Lawrence Island and northward through the Bering Strait produces a great deal of organic matter, some of which supports a high zooplankton biomass, plus excess material that may, at least in part, be deposited in sediments of the Chukchi Sea. This enriched sediment supports a high biomass of benthic invertebrates (see Sec. III.B.1.c, Benthic Communities).

Patterns in annual primary productivity in the Chukchi Sea have been estimated by Schell (1986) (Fig. III-B-1). Primary productivity tends to decrease as one moves north from the Bering Strait. Light, as influenced by ice regimes, and nutrients are both important in determining levels of primary production. Hameedi (1978) found that nutrients (primarily nitrogen) were the major factor limiting primary production in the photic (lighted) zone of the Chukchi Sea during July. Light was not limiting at his stations during the summer. Hameedi also felt that sea-ice algae might contribute substantially to the total chlorophyll a content in the Chukchi Sea, although the residence time of these cells in the water column might not be long.

The phytoplankton species reported from the Chukchi and Beaufort Seas generally have widespread distributions in high latitudes (Carey, 1978). Most algal species predominate in either the open-water or epontic (under-ice) communities, with only one species, Nitzschia cylindrus, a major component of both epontic and pelagic habitats (Horner and Schrader, 1982). Long-chain diatoms such as Chaetoceros were found by English (1966) to be abundant components of phytoplankton samples in the Chukchi Sea.

Watermasses moving northward through the Bering Strait and into the Chukchi Sea transport not only nutrients and phytoplankton, but also zooplankton from the Bering Sea. Similar species of zooplankton are found in the Bering and Chukchi Seas (Stepanova, 1937; Johnson, 1953, 1956; Brodsky, 1957; English, 1966; Wing, 1974; Coyle, 1981). Differences in the species composition of nearshore- and more oceanic-zooplankton assemblages within the Chukchi also are similar to patterns observed in the Bering Sea (Brodsky, 1957). Samples from coastal environments generally had smaller volumes of zooplankton, with predominances by the copepods Eurytemora pacifica and Acartia clausi and the cladoceran Evadne nordmani. Offshore areas were characterized by copepods like Metridia lucens, Calanus plumchrus, and Eucalanus bungii (English, 1966). In sampling by Wing (1974), the hydromedusa, Aglantha digitale, was the predominant zooplankter, both in numbers and biomass. The second-most abundant zooplankters were calanoid copepods, although meroplankters (larval forms of benthic animals) equaled or exceeded copepods in numbers at half of the stations. The calanoid copepods had their highest densities off Cape Lisburne. Wing compared data from the most similar stations sampled by himself (in 1970) and Johnson (in 1947). Major differences (besides those that were apparently due to season of sampling) were: (1) calanoid copepods dominated the zooplankton in 1947, but not in 1970; (2) greater numbers of Aglantha, Clione (a pteropod), and crab larvae occurred in 1970; and (3) lesser numbers of Pseudocalanus were found in 1970. Coyle (1981) found calanoid copepods, mainly Pseudocalanus spp. and Oithonia similis, to predominate. However, he remarked that zooplankton abundances were much lower in the Chukchi Sea than in more southerly areas, and that the species represented were generally small, inefficient phytoplankton grazers that are poor sources of food for whales and other consumers of zooplankton (in contrast to the large zooplankton found in the Beaufort Sea that are apparently efficient grazers and also are fed on extensively by bowhead whales).

Figure III-B-1a depicts Chukchi Sea zooplankton productivity relative to the proposed Sale 126 area.

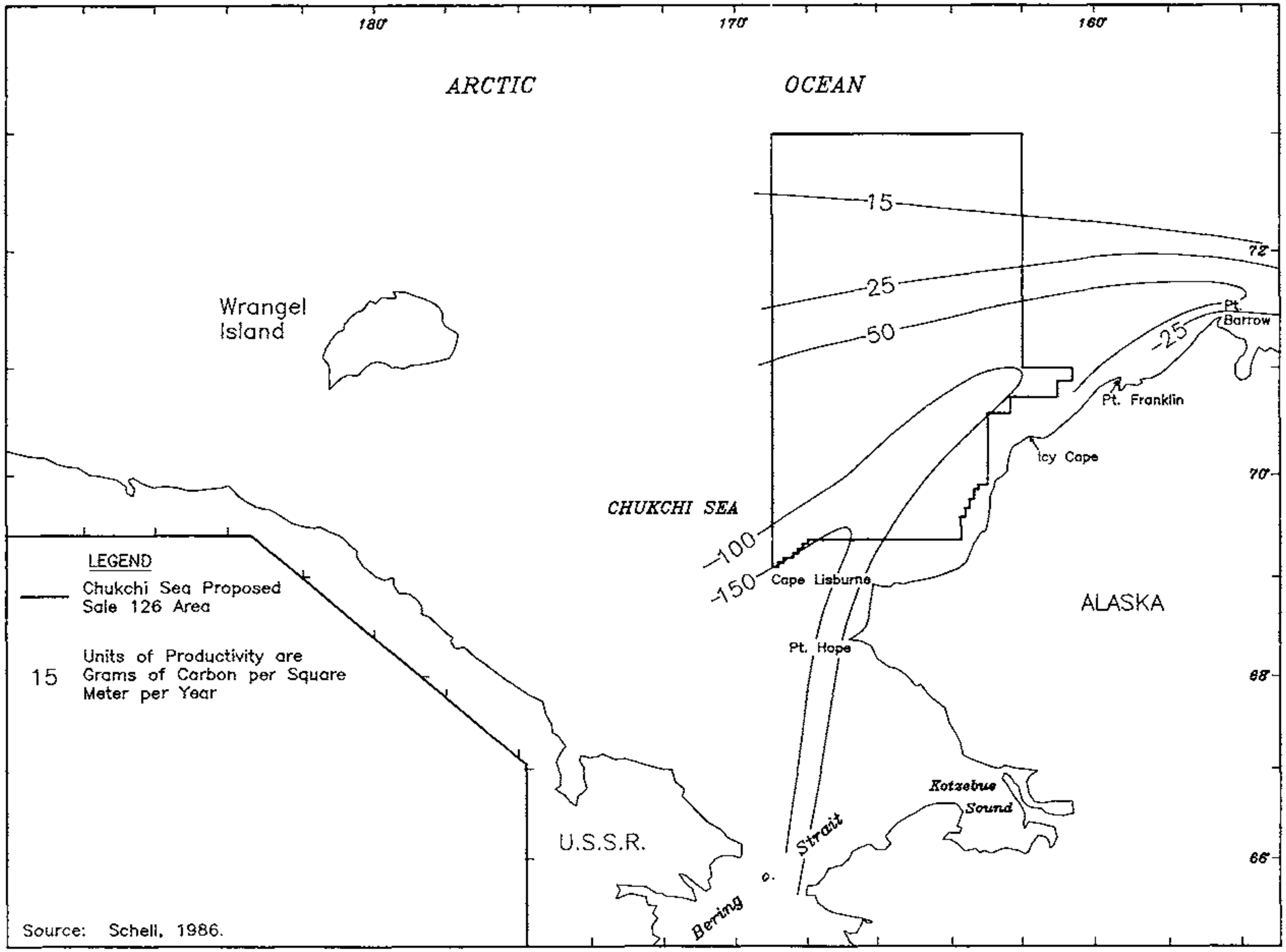


Figure III--B-1. Contours of Annual Primary Production

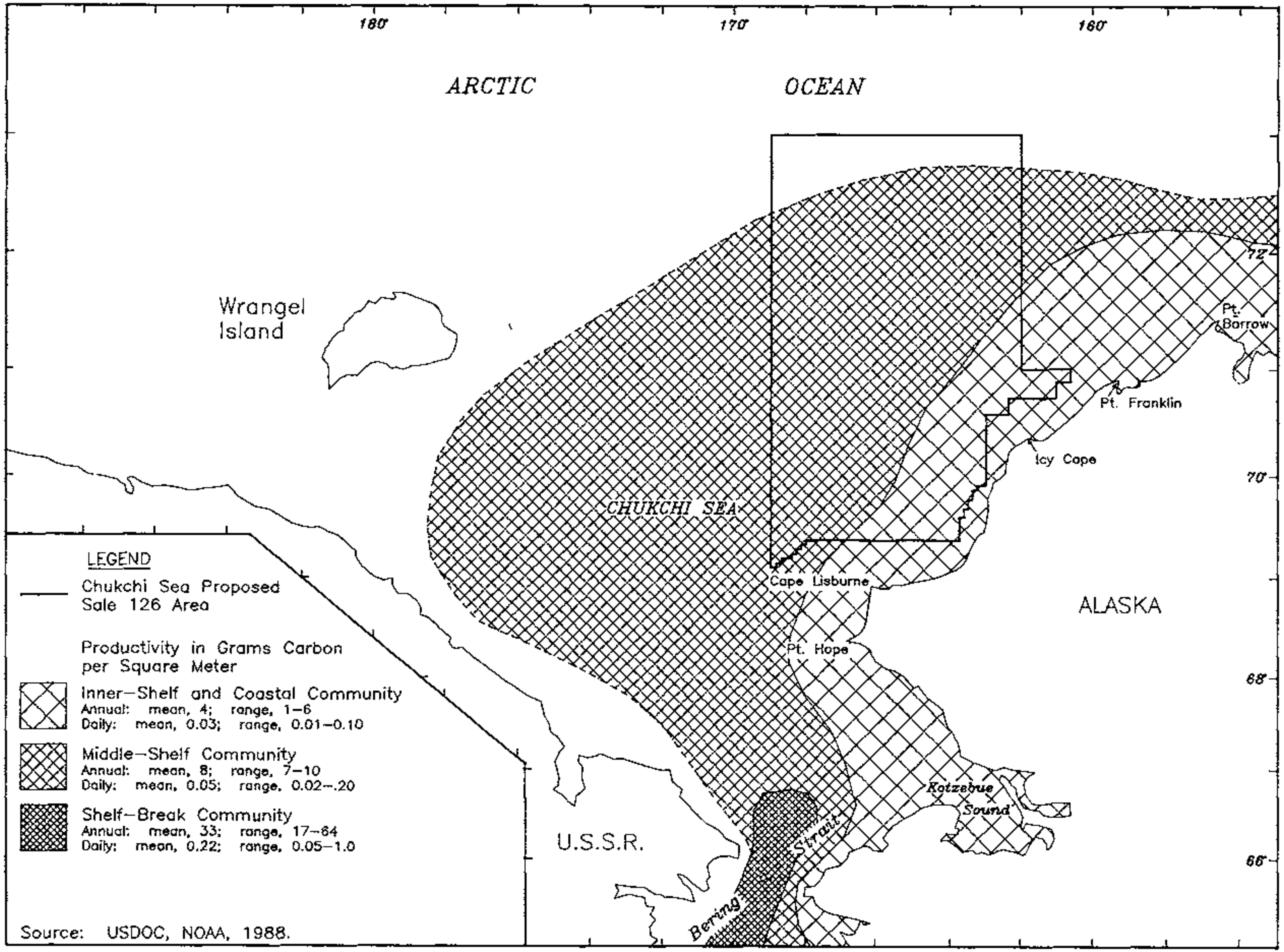


Figure III-B-1a. Zooplankton Productivity in the Sale 126 Area

(USDOC, NOAA, 1988).

Zooplankton samples in the Beaufort Sea also have included coelenterates, nematodes, annelids, mollusks, tunicates, decapod crustaceans, and barnacles.

Wing and Barr (1977) sampled midwater invertebrates in offshore areas of the Chukchi Sea ranging from near Icy Cape to somewhat southwest of Cape Lisburne. They found 103 species of invertebrates, with amphipods comprising the most species (35), followed by decapod crustaceans with 14 species. Scyphozoans and hydrozoans contributed most to the volume of the catches. After the scyphozoans and hydrozoans were removed, euphausids and mysids were the most abundant invertebrates and became the major contributors to the biomass.

Euphausiid distribution relative to the Sale 126 area is depicted in Figure III-B-1b.

b. Epontic Community: The epontic community in the Sale 126 area is an assemblage of plants, small invertebrates, with a group of fish (cryopelagic fish) that are distinctly associated with the undersurface of sea ice. The primary producers in this community are ice algae, which form a concentrated food source for a variety of animals, including amphipods, copepods, ciliates, various worms, and juvenile and adult fishes. The algae are dominated by diatoms and are present on the undersurface of the ice or within the bottom few centimeters. Ice-algal distribution tends to be patchy on both small and large scales.

In the Chukchi Sea, near Barrow, the ice-algal bloom and the spring bloom in the water column are clearly separated by species composition and time. The ice community is composed primarily of pennate diatoms (Horner and Alexander, 1972; Alexander, Horner, and Clasby, 1974), while the spring phytoplankton bloom consists primarily of centric diatoms (Horner, 1969). Only one diatom species, Nitzschia cylindrus, is abundant in both the ice and water-column communities. The ice-algal bloom usually occurs in April and May, although it sometimes extends into early June, while the phytoplankton bloom does not start until ice breakup is underway and light is available to the cells in the water column.

Although approximately 200 diatom species have been identified from arctic sea ice, only a few species predominate. Nitzschia frigida was usually found by Horner and Alexander (1972) to be the most abundant species at Barrow, but Meguro, Ito, and Fukushima (1966, 1967) apparently did not find it farther offshore. Navicula marina was also a predominant member of the community at Barrow and was often the most abundant species (Alexander, Horner, and Clasby, 1974).

Microalgae are found in sea ice as it forms in the fall, but the origin of the cells is not known (Horner and Schrader, 1982). One possibility is that those species that eventually thrive in the ice may be present in low numbers in the water column and may be incorporated into the ice as it forms (Horner and Schrader, 1982).

Light appears to be the major factor controlling the distribution, development, and production of the ice-algal assemblage. Productivity increases with increasing light. Attenuation of light by turbid ice (ice with incorporated sediments) or by snow cover can greatly reduce or eliminate the productivity of the ice algae (Alexander, Horner, and Clasby, 1974; Schell, 1980a,b; Horner and Schrader, 1982; Dunton, 1984).

Algal biomass in the spring bloom near Barrow showed a bimodal pattern, with an early peak during late April-early May, and a later maximum peak at the end of May-early June (Alexander, Horner, and Clasby, 1974). Primary-production levels near Barrow were 5 grams of carbon per square meter (g C/m^2) for the bloom period. In the eastern Chukchi Sea, Parrish (1982, unpubl. data cited by Schell, 1987, oral comm.) has calculated a yearly estimate of 13 g C/m^2. This value is higher than estimates for the Chukchi Sea near Barrow and for the coastal Beaufort Sea (Alexander, Horner, and Clasby, 1974). Other sources of primary production include phytoplankton, benthic microalgae, and--in some areas--benthic macroalgae.

Although the contribution of ice algae to annual productivity may be relatively small, these cells may be an

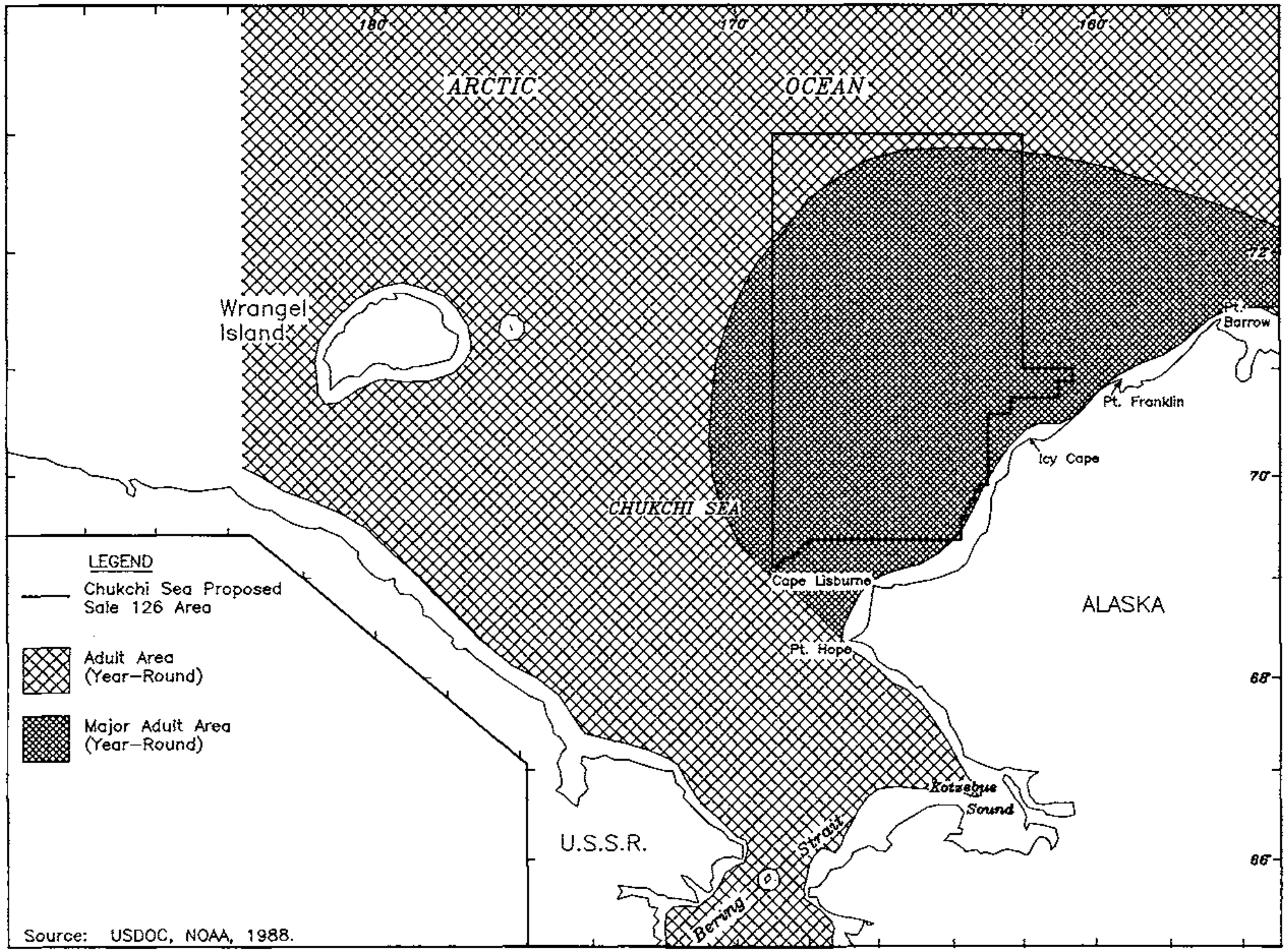


Figure III-B-1b. Euphausiids in the Sale 126 Area important source of food during early spring when food is presumably in short supply. It has been hypothesized that incomplete grazing of the ice algae and algae at the ice edge may allow a significant portion of the algal-cell population to remain intact. These cells may then serve as a direct food source or may enhance nutrient supplies in the benthic environment by sinking as detritus or living, photosynthetically active cells (Alexander and Chapman, 1981; Niebauer, Alexander, and Cooney, 1981).

c. Benthic Communities: The benthic communities in the Chukchi Sea can contain macroscopic algae (large seaweeds), benthic microalgae, and benthic invertebrates.

(1) Macroscopic Algae: Although systematic surveys for macroscopic algae, especially kelp beds, have not been undertaken in the northeastern Chukchi Sea, records from a variety of sources indicate the presence of at least two kelp beds along the nearshore coast. One first described by Mohr, Wilimovsky, and Dawson (1957) and confirmed by Phillips et al. (1982) is located about 20 km northeast of Peard Bay, near Skull Cliff. Another was reported by Phillips and Reiss (1985a) approximately 25 km southwest of Wainwright in water depths of 11 to 13 m. Even without detailed surveys, it appears that kelp beds are not frequently encountered in the Chukchi Sea. Mohr, Wilimovsky, and Dawson (1957) remarked that kelp were found at only one of 18 stations sampled by the Arctic Research Lab's LCM William E. Ripley as it traveled from Point Barrow to Wainwright; the one station where it found algae was near Skull Cliff. The predominant alga at this station was the kelp, Phyllaria dermatodea. Two other known algae, Laminaria saccharina and Desmarestia viridis, also were abundant; and seven species of red algae were sampled. Other macroscopic algae have been noted in Peard Bay, as drift algae, and when fouling anchors (see Truett, 1984). The areal extent and the inherent possibility of variability in areal extent have not been determined.

Macroscopic-algal growth in nearshore areas of the Chukchi Sea is probably limited by the availability of appropriate substrates (rock, cobble, and gravel). The existent kelp beds and stands of green sea lettuce (Ulva) in Peard Bay are additional sources of primary production. Kelp beds provide a three-dimensional environment that, in some areas, increases the diversity of organisms living in an area. However, Mohr, Wilimovsky, and Dawson (1957) recorded that relatively few invertebrates (all polychaetous annelids and arthropods) were taken, plus six species of fishes in conjunction with the algae near Skull Cliff.

(2) Benthic Microalgae: Benthic-microalgal assemblages, consisting primarily of diatoms, have been studied in the Chukchi Sea in the nearshore area off Barrow (Matheke and Horner, 1974). The relationship of the species found in sediments with those found in the ice-algal assemblage is unclear, although some species occur in both assemblages. Primary productivity of the benthic microflora ranged from less than 0.5 milligrams $C/m^2/hr$ in winter (when the sampling area was covered with ice), to almost 57.0 mg $C/m^2/hr$ in August. This peak-productivity value was about eight times the peak value for ice-algal production and approximately twice that of the phytoplankton (Matheke and Horner, 1974). The productivity of these various assemblages peaked at different times: ice-algal productivity peaked in May, phytoplankton productivity peaked in the first half of June, and productivity of the benthic microalgae peaked during late July and August. Therefore, in nearshore environments benthic microalgae may be a significant source of primary productivity.

(3) Benthic Invertebrates: The benthic-invertebrate fauna of the northeastern Chukchi Sea appears to contain components of both the Bering Sea biota and that of the Beaufort Sea. Currents flowing northward from the bering Sea through the Bering Strait carry larval forms of some benthic invertebrates (meroplankton). With increasing distance from the Bering Strait, the influence of such transport should decrease, although only for those species that, once established in the Chukchi Sea, are unable to successfully reproduce. Although the benthic-invertebrate fauna of the southeastern Chukchi has been characterized as primarily boreal Pacific in nature, both Broad et al. (1978) and Kinney (1985) have noted the similarity of nearshore, littoral, and/or lagoonal invertebrates found in the northeastern Chukchi Sea to those of the Beaufort Sea. Kinney (1985) attributes this to the similarity of the major physical conditions in the northern Chukchi and Beaufort Seas, and to occasional current reversals along the coast

that bring larvae and food from the Beaufort Sea.

The offshore benthos in the northeastern Chukchi Sea has not been extensively studied. Stoker (1981) examined benthic infauna in this region as part of a large study that extended from the southeastern Bering Sea to the northern Chukchi Sea. Even this study had only about 10 of its 176 quantitative sampling stations within the Sale 126 area (Figs. III-B-1c and III-B-1d, and Table III-B-1). In his study, Stoker statistically compared the infaunal compositions of the stations, ranging in location from the southeastern Bering Sea to north of Point Barrow, and recognized the recurring pattern of eight major faunal assemblages (Fig. III-B-1d and Table III-B-1). Two of these species groupings occurred in the northeastern Chukchi Sea--Groups VI and VIII (Fig. III-B-1d and Table III-B-1). Group VI was predominated by the polychaete Maldane sarsi, the brittle star Ophiura sarsi, the sipnuculid (peanut worm) Golfingia margariticea, and the bivalve Astarte borealis. The major species in Group VIII were the bivalves Macoma calcarea, Nucula tenuis, and Yoldia hyperborea, and the amphipod Pontoporeia femorata. Stoker felt that the type of sampling gear used did not adequately sample large, deep-burrowing bivalves in the genera Mya and Spisula. The major predators of the infauna, walrus and bearded seal, have diets containing higher percentages of burrowing bivalves than did Stoker's study (Lowry, Frost, and Burns, 1980a). In the case of the bearded seal, diets were dominated by clams in the genera Spisula and Serripes. Walrus diets in the Chukchi Sea may be similar (Lowry, Frost, and Burns, 1980a). Figure III-B-2 depicts distribution of infaunal invertebrate biomass in relation to the Sale 126 area.

Stoker also latitudinally compared the species diversity and biomass of samples. Within the Sale 126 region, biomass was far greater in the most southerly region; however, species diversity increased with increasing latitude. The differences in benthic standing stocks (biomass) on the Bering/Chukchi shelf were felt to be determined by levels of primary productivity, current structure and velocity (both affecting food availability), and predation by benthic-feeding fishes and marine mammals. Depth, sediment type, and latitude were viewed as being only coincidentally involved. In examining species distributions, sediment type was the environmental variable most directly correlated with distributions (Stoker, 1981).

The epifauna in offshore regions of the northeastern Chukchi Sea benthos has been investigated to varying extents by Wing and Barr (1977), Frost and Lowry (1983), Sparks and Pereyra (1966), and Phillips and Reiss (1985a,b). In general, organisms seem to be broadly distributed, although they frequently seem to segregate by sediment type. Figure III-B-2 depicts distribution of epifaunal invertebrate biomass relative to the Sale 126 area.

Ten of 36 stations sampled by Frost and Lowry (1983) occurred in the northeastern Chukchi Sea, with the remainder ranging eastward to the U.S./Canada demarcation line. The major break in epifaunal communities seemed to occur at about 154°W. longitude. West of this meridian, in areas with muddy substrates, brittle stars (usually Ophiura sarsi) predominated. Other associated species included soft corals (Eunephthya spp.) and sea cucumbers (Psolus sp. and Cucumaria sp.). Stations in this western area that had rocky substrates had different species compositions. Ophiura sarsi was also one of the species found by Stoker (1981) to predominate in the Chukchi Sea (Group VI, Fig. III-B-1d). Echinoderms, primarily brittle stars and crinoids, were the most abundant invertebrates at 26 of 33 stations sampled by Frost and Lowry, usually comprising more than 75 percent of the total trawl biomass.

Sparks and Pereyra (1966) sampled primarily south of Point Hope, but found, in their samples to the north of that point, various echinoderms (starfish, echinoids, brittle stars, and sea cucumbers, gastropods, annelids, barnacles, decapod crustaceans, and tunicates to be relatively abundant.

Wing and Barr (1977) sampled the benthos at one station in the northeastern Chukchi Sea off Point Lay and found 3 species of gastropods, 4 bivalves, 2 mysids, 2 isopods, 12 amphipods, 9 decapod crustaceans, and 1 ascidian species.

Phillips (1986, oral comm.) found some association of invertebrate types with substrate and water depth.

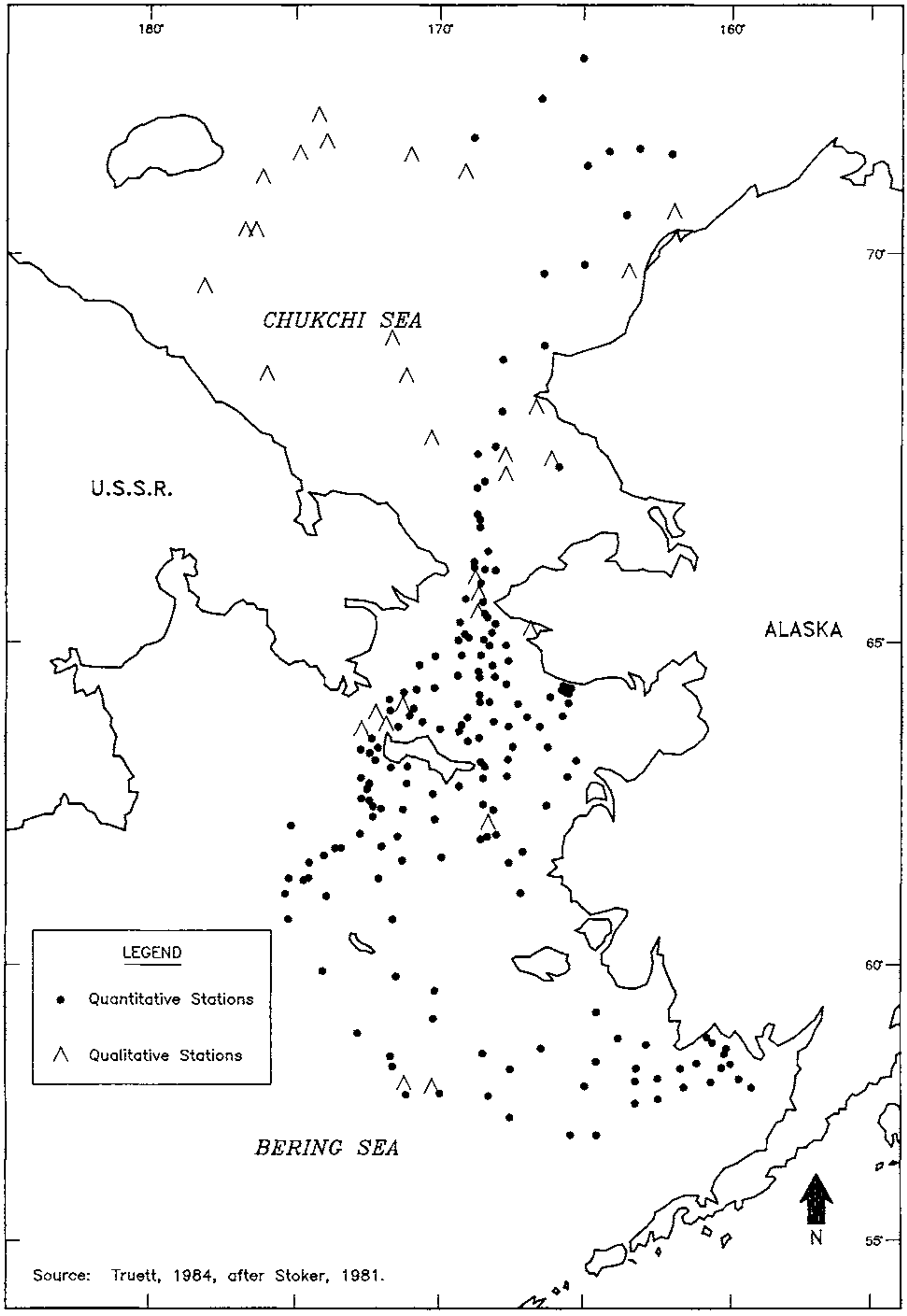


Figure III-B-1c. Infaunal Stations Sampled by Stoker

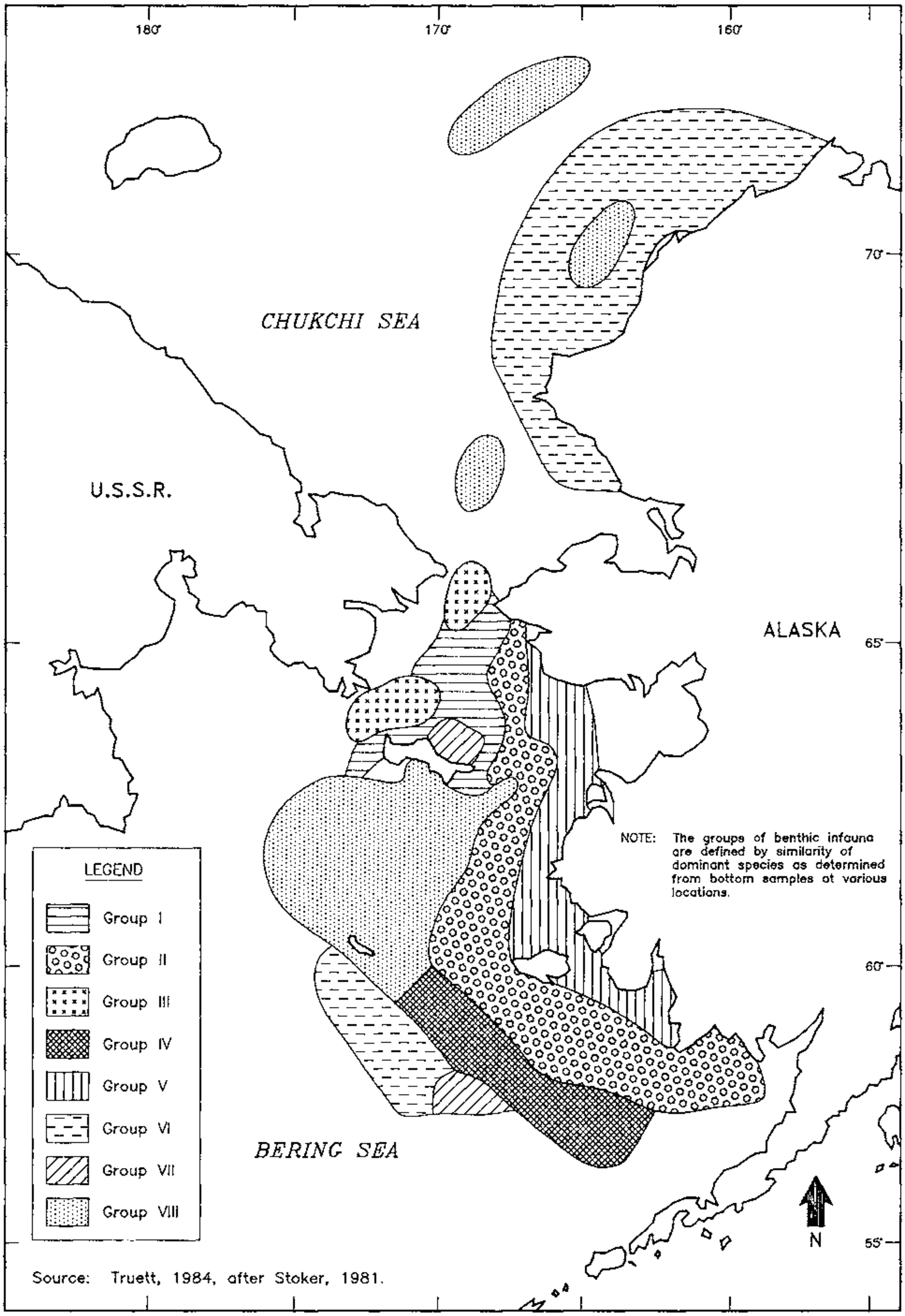


Figure III–B–1d. Patterns of Similarity of Benthic Faunal Groups

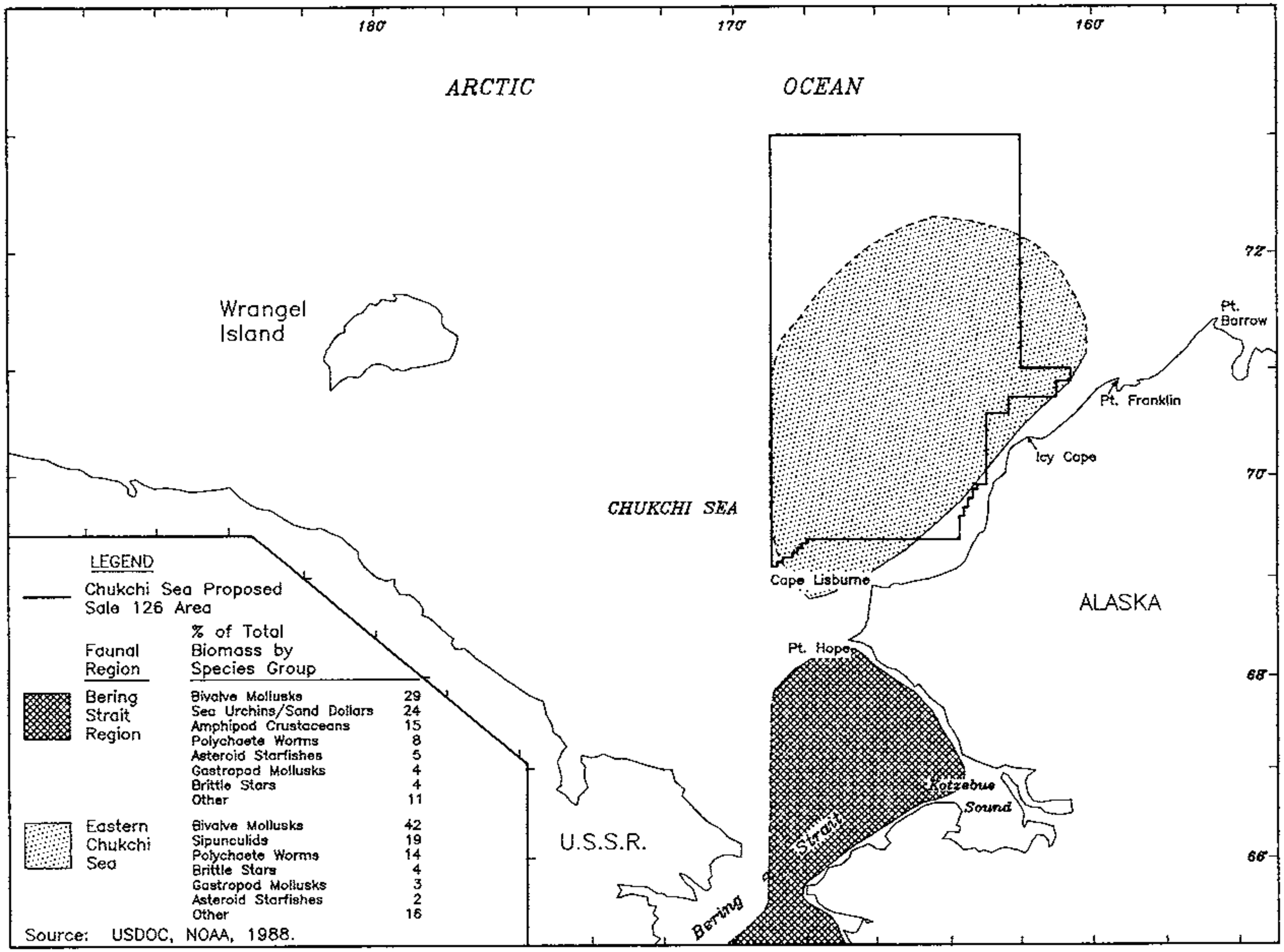


Figure III-B-2. Infaunal Invertebrate Biomass in the Sale 126 Area

Table III-B-1
Descriptions of Benthic Faunal Groups Shown in Figure III-B-3

Dominant Species	Common Name
CLUSTER GROUP I	
Ampelisca macrocephala	amphipod
Byblis gaimardi	amphipod
Ampelisca birulai	amphipod
Macoma calcarea	clam
Astarte borealis	clam
CLUSTER GROUP II	
Tellina lutea	clam
Echinarachnius parma	sand dollar
CLUSTER GROUP III	
Ophiura maculata	brittle star
Strongylocentrotus droebachiensis	sea urchin
Cistenides granulata	poylchaete worm
CLUSTER GROUP IV	
Haploscoloplos elongatus	polychaete worm
Protomedeia fasciata	amphipod
Yoldia hyperborea	clam
CLUSTER GROUP V	
Serripes groenlandicus	bivalve - cockle
Myriochele heeri	polychaete worm
Sternaspis scutata	polychaete worm
Diamphiodia craterodmeta	brittle star
Gorgonocephalus caryi	basket star
CLUSTER GROUP VI	
Maldane sarsi	polychaete worm
Ophiura sarsi	brittle star
Golfingia margariticea	sipunculid - peanut worm
Astarte borealis	clam
CLUSTER GROUP VII	
Macoma calcarea	clam
Chone duneri	polychaete worm
CLUSTER GROUP VIII	
Macoma calcarea	clam
Nucula tenuis	clam
Yoldia hyperborea	clam
Ponteporeia femorata	amphipod

Source: Stoker, 1981.

Depth of the substrate also could influence the survival of various organisms. In some gravel-dominated areas, live anemones and soft corals were found down to depths of 30 to 40 centimeters; in some places, a layer of dead barnacles was found buried in the gravel. The latter observation suggests that large-scale movements of gravel beds might be caused by storms. Wave forms in sandy substrates also suggests disturbance of the bottom by physical forces.

Feeding by gray whale and walrus could be correlated with different substrates, as evidenced by sidescan-sonar images of feeding traces (Phillips, 1986, oral comm.). Gray whales fed most intensively between Point Franklin and Wainwright, in areas of pebbly sand containing abundant amphipods. Walrus, on the other hand, fed intensively to depths of 58 m at the edge of the pack ice north and west of Point Franklin. Substrates showing walrus traces were a finer sand with a mud veneer that contained some bivalves.

Although Phillips (1986, oral comm.) observed signs of ice gouging down to depths of 69 m in the Chukchi Sea, the nearshore and littoral zones are much more likely to be seasonally disturbed by ice. In a study of the nearshore and littoral areas of the Beaufort and Chukchi Seas, Broad et al. (1978) concluded that the fauna of the Beaufort littoral and nearshore (0-20 m depths) and the northeastern Chukchi littoral (0-2 m depths) are similar in species, diversity, and biomass. Principal invertebrates sampled in the northeastern Chukchi littoral include oligochaete worms, isopods, mysids, amphipods, bivalves, priapulids, chironomid larvae, dipterans, and hermit crabs (Broad et al., 1978).

Investigation of the Peard Bay Lagoon by Kinney (1985) revealed that the predominant epibenthic species were the isopod Saduria entomon, the mysid Mysis litoralis plus many juvenile Mysis sp., and the amphipods Gammaracanthus loricatus, juvenile Gammarus sp., and Onisimus litoralis. The type and distribution of infaunal invertebrates appeared to be influenced by physical factors such as sediment composition, water depth, currents, etc. In the deeper, central section of Peard Bay, two species of bivalves predominated, while in the shallower surrounding areas such as the entrance to the more interior Kugrua Bay, several species of polychaetes predominated. The shallow center of Kugrua Bay was predominated by oligochaetes. Comparison of the faunas of the littoral and lagoonal environments of the northeastern Chukchi Sea with those of the Beaufort Sea, plus the occurrence of several arctic-zooplankton species just outside of Peard Bay, suggest that the predominant species in these areas are polar forms rather than boreal Pacific species.

d. Trophic Interactions: In a highly seasonal environment like that of the Chukchi Sea, extremes and patterns in the physical environment affect the interaction of organisms with the environment and interactions among organisms. In the Chukchi Sea, currents moving north through the Bering Strait have a strong effect on primary production in addition to transporting detritus and larval forms of invertebrates and fishes from the Bering Sea into the Chukchi Sea. Seasonal ice regimes also strongly influence the pattern and timing of productivity and the distribution patterns of higher-order consumers (e.g., walrus).

Dynamics within the pelagic community will be influenced most by transport of nutrients, productivity, and consumers from the Bering Sea, plus the seasonal retreat of ice and subsequent bloom of open-water phytoplankton. Other primary producers such as kelp, benthic microalgae, or ice-algae may be locally or temporally important sources of carbon (the ice algae providing a burst of production before the open-water phytoplankton bloom). Zooplankton in the Chukchi Sea are thought to be similar to those of the middle Bering Sea shelf in species composition and as small, inefficient grazers of phytoplankton. Thus, much of the local production, as well as plankton and detritus transported into the Chukchi Sea, may sink to the benthos and support the organisms there. It has been suggested that the epibenthic community is dependent on detritus (Stoker, 1981). Both the epifauna and infauna figure importantly in the diets of the higher-order consumers (see Fig. III-B-3). The major predators of the infauna are walrus and bearded seal (Lowry, Frost, and Burns, 1980a), while the epifauna are of particular importance to bearded seal (shrimps, brachyuran crabs); ringed seal (amphipods, shrimps); gray whale (ampeliscid amphipods); and arctic cod (benthic amphipods, shrimps, mysids (Lowry and Frost, 1981).

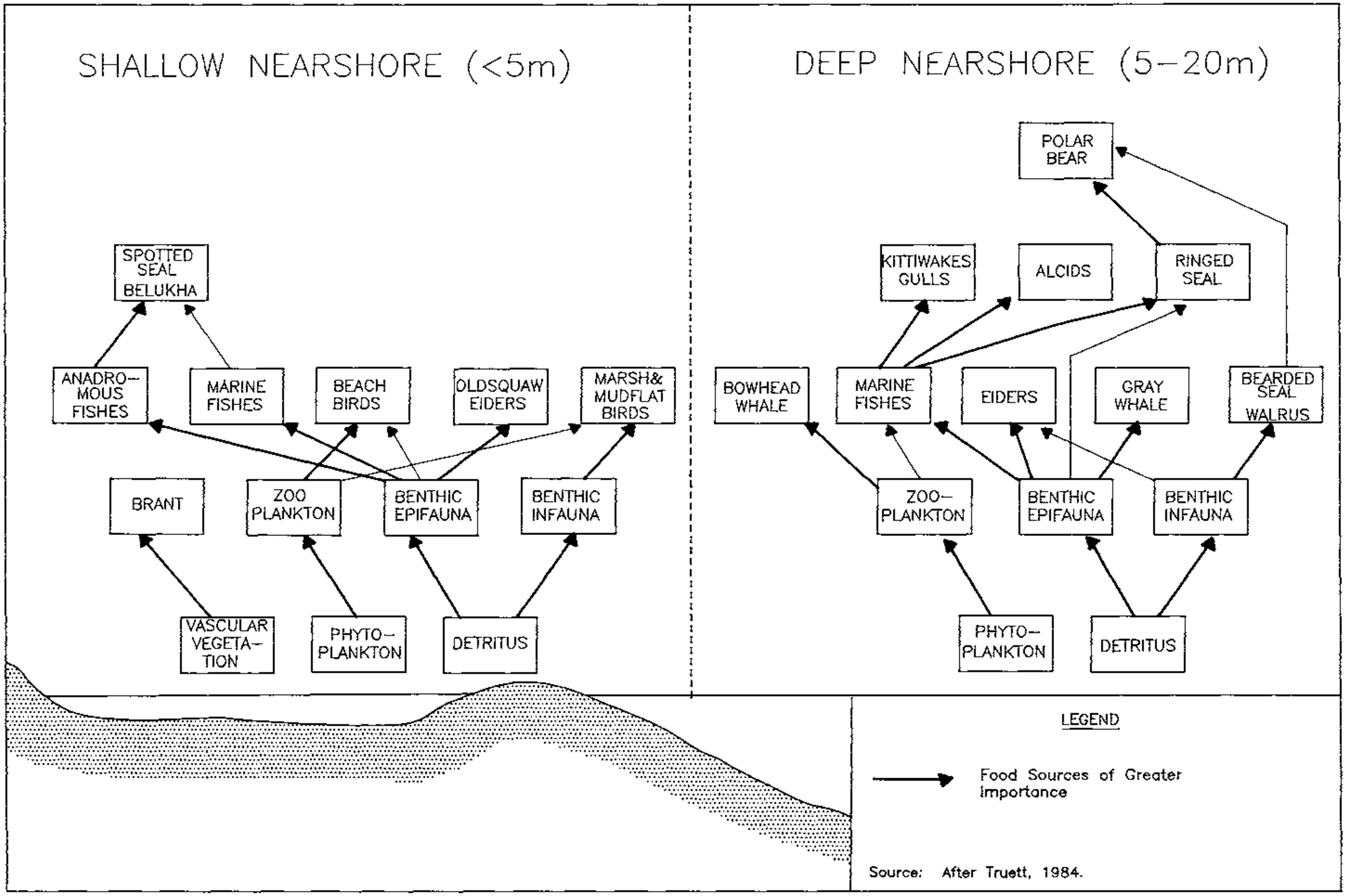


Figure III-B-3. Simplified Food Web of the Chukchi Sea Coastal Ecosystem

The distribution of epifaunal biomass relative to the Sale 126 area is shown in Figure III-B-4.

More generally speaking, epifauna are important prey of some marine mammals, marine and anadromous fishes, and birds. Fishes--especially arctic cod but also saffron cod, sand lance, and sculpins--are important prey of other organisms, including marine mammals, birds, and other fishes. Swartz (1966) estimated that 25 million arctic cod may be consumed annually by seabirds at Cape Thompson. Changes in the abundance of these major fish prey may lead to fluctuations in the distribution and reproductive success of seabirds and marine mammals (Springer, Roseneau, and Johnson, 1979; Lowry, Frost, and Burns, 1980a). Springer et al. (1984) extended the correlation to interannual changes in water temperature and sea ice. Spatial variation in currents also can affect primary productivity and related food webs in an area. For example, the area near Cape Lisburne, where copepod abundance is very high and nesting birds forage extensively, may be an area of high primary productivity, resulting possibly from the formation of a front between Alaska Coastal Water and Arctic Ocean Water (Springer et al., 1984). Upwelling may occur in this region. Thus, physical-oceanographic parameters may affect primary productivity and its transport into the Chukchi Sea, which in turn may affect the abundance of fishes (and other prey of higher-order consumers), and finally may affect the abundance of birds or marine mammals.

2. Fishes: This discussion incorporates by reference the discussion of fishes contained in the Beaufort Sea Sale 97 FEIS (USDOI, MMS, 1987a) and the Norton Basin Sale 100 FEIS (USDOI, MMS, 1985), with augmentation by additional information, as cited. Overviews of the fish resources of the proposed Sale 126 area have been provided by Morris (1981a), Moulton and Bowden (1981), Craig (1984), and Maynard and Partch/Woodward-Clyde Consultants (1984). Craig and Skvorc (1982) provided an analysis of research on the fish resources of this region. Since these reviews, two more studies were completed in the northeastern Chukchi Sea (Fechhelm et al., 1984; Kinney, 1985); and a moderate amount of research was completed in the vicinity of Kotzebue Sound to the south and in the Beaufort Sea to the northeast. From this sampling, 72 species of fishes were reported for the northeastern Chukchi Sea. Studies in this area generally followed marine fishes because they appear to be more abundant than anadromous species. The populations of anadromous species tend to be small and widely distributed.

a. Anadromous Fishes: Twenty-five species of fishes were reported to occur in the freshwaters of the Chukchi Sea coast (Morrow, 1980). Thirteen of these species are anadromous and can be found in the open waters of offshore areas, estuaries, and freshwater systems during part of their life cycles. The anadromous fishes of the Chukchi Sea include Pacific salmon, arctic char (Dolly Varden), ciscoes, whitefishes, and rainbow smelt. Of the Pacific salmon species, only pink and chum salmon are found throughout the sale area; sockeye, coho, and king salmon are occasionally caught in coastal waters, but they generally reach their northern spawning boundary in the Point Hope/Point Lay coastal sector at Cape Lisburne. King salmon are infrequently taken by subsistence fishermen at Point Lay (Schneider and Bennett, 1979). As juveniles, some anadromous species undertake extensive migrations from freshwater to mature at sea in the offshore areas; as adults, they return to freshwater to spawn. Among this group are the arctic lamprey, the five salmon species (pink, chum, sockeye, king, and coho), and rainbow smelt (Maynard and Partch/Woodward-Clyde Consultants, 1984). The remainder of the anadromous species seasonally enter the brackish or offshore-marine environment in the summer and spend most of their lives in freshwater lakes and rivers. During the summer open-water season, anadromous species range throughout the Chukchi Sea in offshore coastal waters; brackish estuaries and river mouths; and freshwater rivers, streams, and lakes. Most of the anadromous-fish species spawn in the fall in lakes or streams.

A recent study by Craig and Skvorc (1982) on the status of existing fisheries information for the Chukchi Sea region recognized that limited research has been conducted on the anadromous fishes that inhabit the coastal streams and estuaries north of Point Hope. The available information is the result of a few brief reconnaissance surveys, and virtually all of the data on anadromous fishes were collected during the open-water season. Fechhelm et al. (1984) and Kinney (1985) studied fish in Kasegaluk Lagoon and Peard Bay as well as offshore during the open-water season, but few anadromous fishes were caught. In March 1983, no anadromous fish were caught under the ice in Peard Bay, Wainwright Inlet, or Ledyard Bay (Fechhelm et al.,

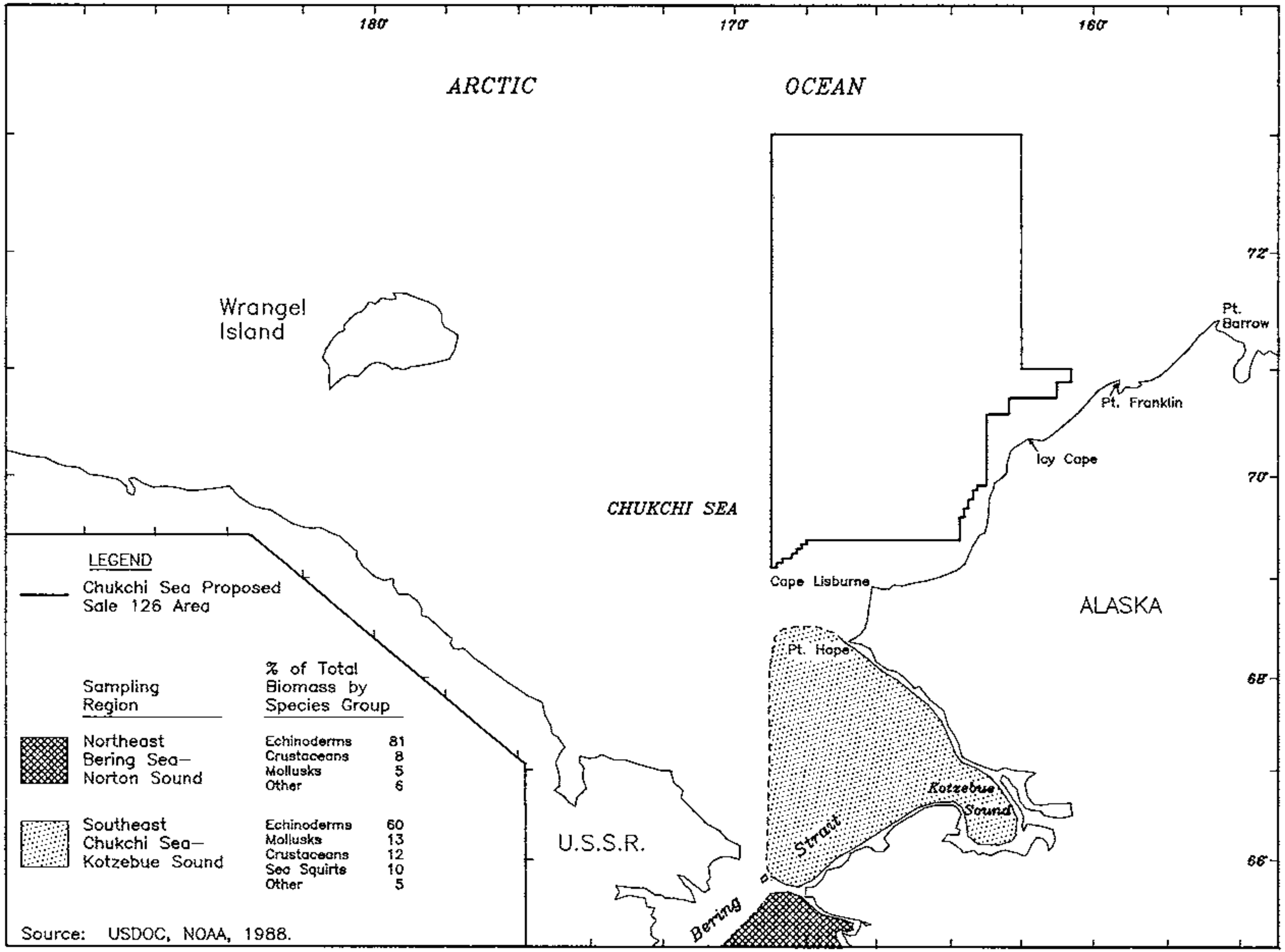


Figure III–B–4. Epifaunal Invertebrate Biomass in the Sale 126 Area

1984). Much of the knowledge regarding species occurrence has been collected from subsistence harvests by coastal inhabitants. In the southeastern Chukchi Sea south of Point Hope, the knowledge of anadromous-fish populations, life-history information, and habitat use has been augmented by studies directed at commercial fish stocks and detailed investigations conducted during the 1960's for Project Chariot in the Cape Thompson area (Maynard and Partch/Woodward-Clyde Consultants, 1984). A number of studies that included anadromous fishes were conducted in relation to oil and gas activity in the Beaufort Sea (Craig and McCart, 1976; Bendock, 1977; Hablett, 1979; Craig and Haldorson, 1981; Gallaway et al., 1982; Schmidt, McMillan, and Gallaway, 1983; and Cannon and Hachmeister, 1986).

Craig (1984) summarized the importance of relatively warm and brackish nearshore waters to the dispersal and welfare of the anadromous fishes of the Beaufort Sea coast. Wolotira, Sample, and Morin (1977) characterized the anadromous fishes of the southeastern Chukchi Sea as using only estuarine and other nearshore marine environments. Recent studies indicate that there are physiological advantages, and probably requirements, for anadromous species to remain in these nearshore waters (Fechhelm and Gallaway, 1982). However, Craig and Skvorc (1982) caution that extrapolation of fisheries data from the Beaufort Sea or Norton Sound may not be valid because of differences in oceanography, fish populations, and presumed use of coastal habitats. When the catch per fyke-net-day in the Chukchi Sea is compared to the Beaufort Sea studies (Craig and Haldorson, 1981; Griffiths and Gallaway, 1982; Griffiths et al., 1983; Fechhelm et al., 1984; and Kinney, 1985), the virtual absence of anadromous fishes is the most prominent feature of the Chukchi Sea catches (Table III-B-2). Nearshore currents, or the discharge of freshwater from streams along the Chukchi Sea coast, may be inadequate to establish a narrow and significantly distinct body of warm, brackish water along the shoreline, except in enclosed areas such as Wainwright Inlet or Kasegaluk Lagoon. Anadromous fishes consequently may use offshore habitats, since the temperature and salinity gradients between nearshore and offshore are not great; or the fishes may congregate in the few protected coastal areas where waters are warmest and brackish (i.e., Kasegaluk Lagoon) (Craig, 1984). At this time, the importance of offshore-marine habitats to the anadromous-fish species of the Chukchi Sea has not been determined. In August and September of 1983, no rainbow smelt or salmon were caught with gill nets and otter trawls farther than 1.5 km offshore. Fyke and gill nets at Point Lay caught 320 rainbow smelts, 34 pink salmon, 3 arctic char, 2 least ciscoes, 2 Bering ciscoes, and 1 chum salmon out of a total of 14,437 fish (Fechhelm et al., 1984). In Peard Bay, fyke nets caught 18 least ciscoes, 9 rainbow smelts, 3 Bering cisco, and 1 pink salmon out of a total of 11,896 fish (Kinney, 1985).

Rainbow smelt were the most common anadromous fish caught at Point Lay, but they were caught not far offshore. The smelt appeared to prefer the bottom of the water column, at least when traveling seaward. The presence of apparently young-of-the-year fish in August, the report of a sexually ripe female in mid-June, the lack of extensive coastal migrations by rainbow smelt, and an apparent postspawning gonadal recovery make it likely that the Kokolik, Utukok, and Kukpowruk Rivers are spawning sites for smelt. The rainbow smelt and pink salmon around Point Lay consumed from 65 to 75 percent fish--mostly arctic cod (Fechhelm et al., 1984).

Some investigators have suggested that the main rivers of the Chukchi coastline may be unsuitable for colonization by king, sockeye, and coho salmon because the juvenile lifestages of these species exhibit a marked intolerance to low water temperatures (Salonius, 1973; McLean and Delany, 1977). Pink and chum salmon have been able to colonize streams farther north because of their relative independence from the freshwater lifestages (i.e., outmigration to marine environments immediately after emergence from the stream gravel). The principal stocks of pink salmon are found in the Kugrua, Kuk, Utukok, Kokolik, Kukpowruk, Pitmegea, and Kukpuk Rivers. Although they may be small, chum salmon stocks are found in the Kugrua, Kuk, and Pitmegea Rivers (Craig, 1984). Craig and Skvorc (1982) speculated that the extremely low diversity and numbers of anadromous and resident freshwater fishes along the Chukchi coast may be related to the limited availability of suitable overwintering areas.

Although few arctic char were caught by Fechhelm et al. (1984) at Point Lay, and none were caught by Kinney (1985) at Peard Bay, arctic char are reported to be one of the main fish species caught along the

Table III-B-2
Fyke-Net-Catch Summary for Fish Species
Caught During Nearshore Summer Surveys in the Beaufort and Chukchi Seas[1]

	Beaufort Sea								Chukchi Sea			
	Simpson Lagoon				Prudhoe Bay		Sagavanirktok Delta		Point Lay		Peard Bay	
	1977		1978		1981		1982		1983		1983	
Arctic cod	7.6	(6.5)[2]	77.9	(1607.1)	49.2	(179.8)	27.9	(147.7)	39.0	(183.1)	69.5	(413.5)
Fourhorn sculpin	69.6	(59.2)	17.9	(369.3)	23.7	(86.4)	27.7	(146.9)	19.8	(93.0)	23.7	(140.8)
Arctic cisco	14.7	(12.5)	0.8	(16.5)	15.0	(54.7)	29.1	(154.4)	0.0	(0.0)	0.0	(0.0)
Least cisco	2.3	(1.9)	1.2	(24.8)	6.6	(24.0)	2.3	(12.5)	0.01	(0.07)	0.15	(0.9)
Arctic char	3.8	(3.2)	0.9	(18.6)	2.3	(8.5)	5.1	(27.8)	0.01	(0.01)	0.0	(0.0)
Broad whitefish	0.1	(0.8)	0.2	(3.1)	0.9	(3.1)	5.6	(29.7)	0.0	(0.0)	0.0	(0.0)
Others	1.9		1.1		2.3		2.3		41.2		6.65	

Sources: Craig and Haldorson, 1981 (Simpson Lagoon); Griffiths and Gallaway, 1982 (Prudhoe Bay); Griffiths et al., 1983 (Sagavanirktok Delta); Fechhelm et al., 1984 (Point Lay); Kinney, 1985 (Peard Bay).

[1] Values are presented as a percentage of total catch.
[2] Figures in parentheses present catch per fyke-net-day.

coastal beaches by Wainwright residents (Nelson, 1981). Recent genetic studies of Beaufort Sea arctic char have suggested that separate stocks with distinctive genetic makeups occur in different river drainages (Everett and Wilmot, 1987). These genetic studies are currently being extended into streams bordering the northeastern Chukchi Sea.

Subsistence fishing is an important activity at Wainwright, Point Lay, and Point Hope. During the summer, fishing occurs along the shore for salmon and varying proportions of arctic char, ciscoes, sculpins, flounders, saffron cod, and whitefishes. During the fall, more fishing occurs inland along the rivers for anadromous and freshwater fish. During the winter, Wainwright Inlet is often fished for smelt (Craig, 1984). For a detailed discussion of the subsistence harvest of fish, see Section III.C.2.

b. Marine Fishes: The Chukchi Sea represents a transition zone between the fish communities of the Beaufort and Bering Seas. The fauna is basically arctic, with continual input of southern species through the Bering Strait (Craig, 1984). The marine fishes of this area include arctic staghorn; fourhorn, shorthorn, and twohorn sculpins; arctic cod; Canadian eelpout; arctic flounder; and saffron cod.

The distribution of marine-fish species in the Chukchi Sea appears to be influenced by temperature and salinity. Yellowfin sole and saffron cod occupy the shallower, seasonally warmer waters, while arctic cod, arctic staghorn sculpin, and Bering flounder are usually found in deeper, colder waters. Arctic flounder, starry flounder, and fourhorn sculpin frequent the low-salinity waters near estuaries and river mouths. Higher-salinity waters are apparently preferred by most of the other marine-fish species that occur throughout the broad marine-coastal shelf (Morris, 1981a). Fourhorn sculpin and arctic flounder were caught in increased numbers in nearshore coastal areas when temperature increased and salinity decreased (Fechhelm et al., 1984). In the Sagavanirktok River Delta in the Beaufort Sea, the numbers of arctic cod increased as the salinity increased (Griffiths, 1983; Cannon and Hachmeister, 1986).

Until recently, the marine fishes of the Chukchi Sea received little attention from investigators. Most trawl surveys concentrated on the region south of Cape Lisburne. Trawl samples taken in the northern Chukchi Sea were described by Frost and Lowry (1983a) and Fechhelm et al. (1984). Fyke- and gill-net samples of the coastal areas were described by Fechhelm et al. (1984) and Kinney (1985). In addition, food-habit studies of the seabird colonies at Capes Thompson and Lisburne contributed to the knowledge of marine fishes in offshore areas (Springer and Roseneau, 1979). Comprehensive information concerning the life history, population dynamics, distribution, and ecological relationships of most of these species is lacking (Maynard and Partch/Woodward-Clyde Consultants, 1984).

Relatively few fish species have accounted for a large percentage of the fish caught during surveys conducted in this region. During otter-trawl surveys conducted in the northeastern Chukchi and Beaufort Seas in early August 1977, 3 species accounted for 65 percent of all fishes caught: arctic cod, 37 percent; Canadian eelpout, 15 percent; and twohorn sculpin, 13 percent (Frost and Lowry, 1983a). In the late summer of 1983, otter-trawl and fyke- and gill-net surveys conducted primarily in the Sale 126 area showed that 5 species accounted for 93 percent of all fishes caught: arctic staghorn sculpin, 52 percent; arctic cod, 21 percent; shorthorn sculpin, 8 percent; hamecon, 7 percent; and saffron cod, 5 percent. Arctic cod made up 54 percent of the adjusted catch biomass (Fechhelm et al., 1984). During trawl surveys conducted in 1976 in the southeastern Chukchi Sea, arctic cod ranked fifth in biomass although they were the dominant marine fish in numbers and in frequency of occurrence (Wolotira, Sample, and Morin, 1977).

In Peard Bay in July and August 1983, 4 marine species accounted for 99.16 percent of the total fyke-net catch: arctic cod, 69.5 percent; fourhorn sculpin, 23.7 percent; saffron cod, 5.7 percent; and arctic flounder, 0.7 percent (Kinney, 1985). Fyke-net surveys in Kasegaluk Lagoon (Fechhelm et al., 1984) showed that arctic cod, fourhorn sculpin, and arctic flounder accounted for 36 percent, 20 percent, and 12 percent, respectively, of the total catch in this coastal area. In March 1983, winter fish sampling was conducted with fyke and gill nets under the ice in Peard Bay, Wainwright Inlet, and Ledyard Bay. Out of the 205 fish caught in the fyke nets, there were 204 arctic cod and 1 sculpin species. No fish were caught in the gill nets (Fechhelm et al., 1984).

The majority of the marine fishes of the Chukchi Sea are demersal as adults; Pacific herring, capelin, and Pacific sand lance are considered to be pelagic fishes as adults. It has been suggested that many of the marine-fish populations are maintained by recruitment of eggs and larvae that are transported north from the Bering Sea by the Alaska Coastal Current (Pruter and Alverson, 1962, as cited by Morris, 1981a). Fishes that probably maintain their populations by resident breeding stock include arctic cod, saffron cod, sand lance, capelin, sculpins, and some of the flounders. These resident spawners tend to lay large, yolky eggs in shallow water, with larvae becoming planktonic during the summer and some eventually sinking to deeper water to mature (Morris, 1981a).

Marine fish in this region are generally smaller than those in areas farther south, and densities are much lower (Bowden and Moulton, 1981; Frost and Lowry, 1983a). Arctic cod in the northern part of the Sale 126 area weighed significantly less per unit-length than arctic cod of the same length from the southern part of the sale area (Fechhelm et al., 1984). Both the average and maximum sizes of flatfishes taken during a study of the southeastern Chukchi Sea were below the sizes accepted by U.S. commercial-fishery markets (Alverson and Wilimovsky, 1966). The same investigators also suggested that the physical climate of the Chukchi Sea (see Sec. III.A) may be responsible for limiting the population sizes and depressing the growth patterns of some marine fishes.

Arctic cod young-of-the-year are normally found in the upper 50 m of water, in the same zone where the greatest abundance of their food (plankton) is found. Quast (1974) estimated that more than 46 million pounds of juvenile arctic cod were present between Cape Lisburne and Icy Cape in 1970. In many bottom trawls, adult arctic cod are found in association with the bottom. They can also be found around ice, which may provide shelter from predators and food in the form of ice-associated invertebrates. Arctic cod are most often found around pressure ridges and rafted ice, where the undersurface of the ice is rough. The crevices, holes, caverns, and small ice cracks are commonly used. No large concentrations of adult arctic cod have been found in these habitats (Sekerak, 1982). Although arctic cod are known to spawn in the winter under the ice, most of their spawning areas are unknown (Morris, 1981a). A known arctic cod spawning ground is located in the nearshore waters of Stefansson Sound in the Beaufort Sea (Craig and Haldorson, 1981). It is reported that arctic cod spawn only once (Nikolskii, 1961, as cited by Morrow, 1980).

During the summer, large schools of Pacific sand lance are reported in Ledyard Bay, north of Cape Lisburne. Marine-bird-feeding studies suggest a major downcoast movement of these fish during late July and August (Roseneau and Springer, 1977). Sand lance spawn from November to February on sandy bottoms at depths of 50 to 75 m (Morris, 1981b).

Capelin are poorly sampled by trawl surveys, and little is known of their areal abundance and distribution along the Chukchi Sea coast. Capelin generally prefer smooth sand and gravel beaches for spawning; they have been observed spawning from early to mid-July along the sandy seaward beaches of barrier islands (Seaman, 1982, oral comm.). On August 1-3, 1983, 3,358 capelin caught off Point Lay were part of a spawning population. Only two more capelin were caught during the rest of the study. Since no capelin were taken in Kasegaluk Lagoon, spawning may have been restricted to the seaward shoreline of the barrier islands (Fechhelm et al., 1984).

The bulk of the Pacific herring population lies south of the Bering Strait, and the density of the Chukchi Sea is too low to develop a commercial fishery. In the spring, Pacific herring spawn in high-energy, nearshore environments, depositing eggs on vegetation or on bottom substrate that is free from silting. There was some evidence by gonadal weights and egg sizes that herring may have spawned in Kasegaluk Lagoon in the early summer of 1983; however, no trace of young-of-the-year herring was found throughout the end of the summer (Fechhelm et al., 1984).

Arctic flounder are shallow-water flatfishes whose spawning usually takes place in shallow coastal areas during late fall or winter (Morrow, 1980). During midwinter, fourhorn sculpin spawn on the bottom in nearshore habitats (Craig and Haldorson, 1981). Saffron cod are marine fish that generally inhabit nearshore areas and often enter rivers. They spawn annually during the winter in nearshore waters (Morrow, 1980).

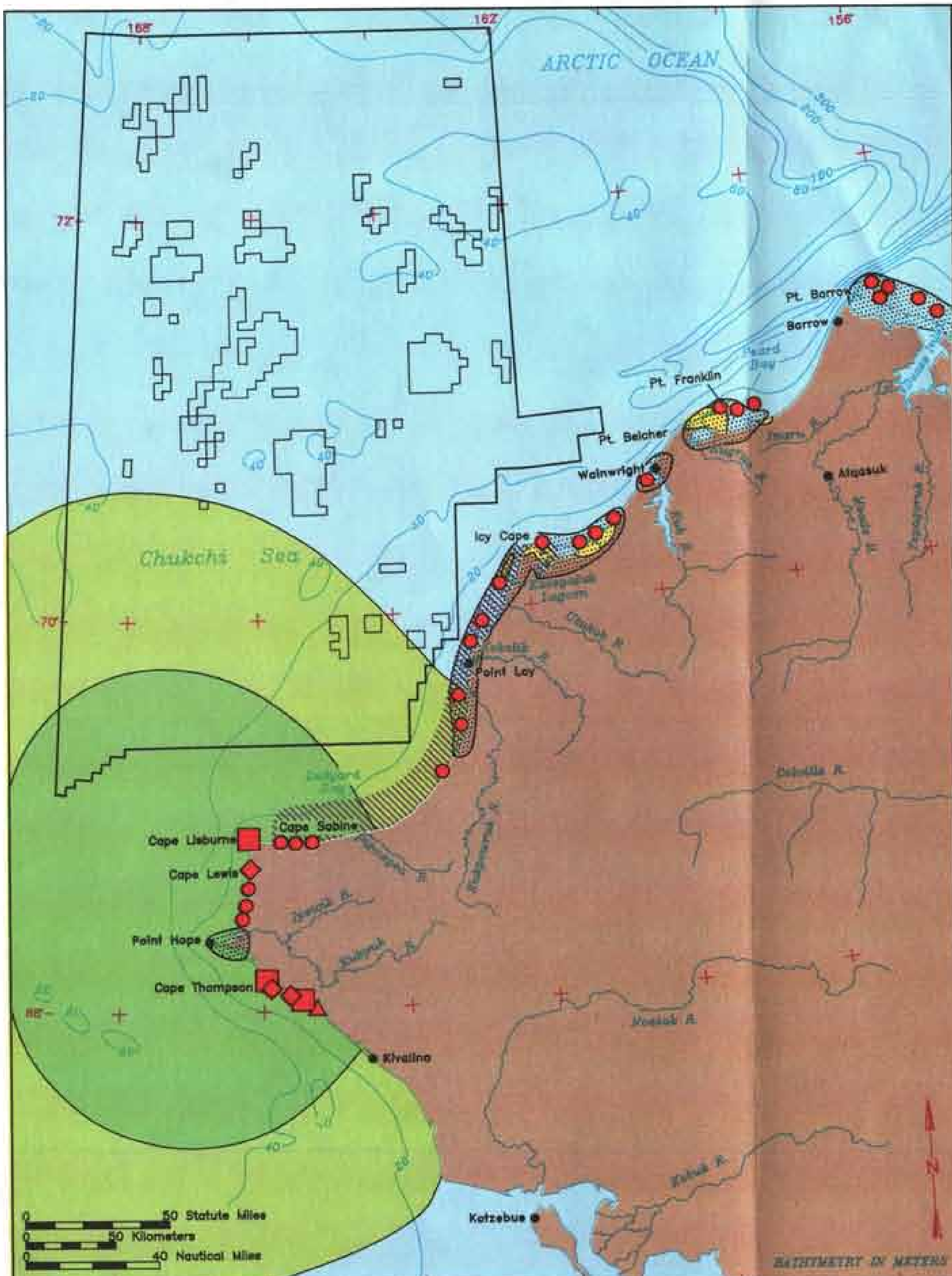
Arctic cod are an important, early-season food source for the murres and kittiwakes at Capes Thompson and Lisburne, with peak numbers of cod taken by these marine seabirds during ice breakup (Springer and Roseneau, 1979). Swartz (1966) estimated that as many as 250 million arctic cod are consumed annually by the Cape Thompson seabird colonies. Lowry, Frost, and Burns (1979) identified arctic cod as a key prey species for spotted and ringed seals and belukha whales in the Chukchi Sea. Summer distributions of arctic cod are unknown; however, large schools reportedly form in the fall and approach the coast and warm waters near river mouths. Large numbers of this species are occasionally stranded on beaches because of storms or possibly because of attempts to escape predation by whales (Sekerak, 1982). Other marine fishes that are important prey of marine mammals and seabirds in the Chukchi Sea include Pacific sand lance, capelin, Pacific herring, saffron cod, sculpins, and smelt (Jangaard, 1974; Lowry, Frost, and Burns, 1979; Springer and Roseneau, 1979; Seaman and Burns, 1981).

Fechhelm et al. (1984) studied the food habits of various fish species caught during their study in the northeastern Chukchi Sea. Capelin and Pacific herring ingested mostly Mysis littoralis. During the summer, arctic cod also ate mysids, but their diet varied from place to place and included copepods and amphipods. During the winter in Ledyard Bay, Wainwright Inlet, and Peard Bay, copepods were the principal food item for arctic cod. Saffron cod caught near Kotzebue and St. Lawrence Island ate fish (saffron cod and sculpin species) and gammarid amphipods. Fourhorn sculpin ate mostly isopods in both the lagoon and ocean environments. Arctic flounder ate polychaetes and unknown worms (Fechhelm et al., 1984). Sand lance fed primarily on small planktonic crustaceans (Morris, 1981b). Euphausiids are small (to 30 mm), epipelagic to epibenthic crustaceans, circumpolar in distribution, and common to the Chukchi Sea Planning Area. These crustaceans exhibit diel movement to deeper waters during day, rising toward the surface at night. Eggs and early larvae are in shallow, surface waters later; older larvae occur at deeper depths. Population size is unknown, but density ranges from 10 to 100 individuals per square meter. Euphausiid distribution in the Chukchi Sea and Arctic Ocean is shown in Figure III-B-1b.

3. Marine and Coastal Birds: Several million birds comprising about 85 species of seabirds, waterfowl, shorebirds, and raptors occupy or migrate through marine and coastal habitats in or adjacent to the proposed Sale 126 area. Nearly all of these species are seasonal residents of the arctic from May through September. Among the more abundant species that may be affected by the proposal are yellow-billed, Pacific and red-throated loons; king and common eiders; Pacific black brant; oldsquaw; northern pintail; glaucous gull; black-legged kittiwake; arctic tern; common and thick-billed murres; red phalarope; and four Calidris sandpipers (Divoky, 1987). Other species notable for their variable occurrence, low numbers, or little known distribution include short-tailed shearwater, Ross' gull, ivory gull, Sabine's gull, black guillemot, auklets, and horned puffin. A major proportion of the world Ross' gull population occurs along the pack-ice edge in the Chukchi Sea in September and October (Divoky et al., 1988). Gyrfalcon and snowy owl are two of the more common raptor species in arctic coastal areas.

Large concentrations of foraging seabirds occur within the southern portion of the sale area near Capes Thompson, Lewis, and Lisburne, where over 0.5 million nest (Graphic No. 1). The majority of individuals in these northernmost Alaskan colonies are murres and kittiwakes; small numbers of gulls and puffins are present and also nest on various bluffs and headlands along the coast adjacent to the sale area. Small numbers of gulls, arctic terns, and black guillemots, together with larger numbers of common eiders, nest on barrier islands and spits, especially those associated with Kasegaluk Lagoon and Peard Bay (Divoky, 1978) and some river deltas. Capes Thompson and Lisburne, the Kasegaluk Lagoon barrier islands, Icy Cape, Point Franklin, and the Peard Bay barrier islands shown on Graphic No. 1 are part of the Alaska Maritime National Wildlife Refuge.

Spring migration to the North Slope and the northern Chukchi Sea areas generally occurs from late May



MINERALS MANAGEMENT SERVICE
ALASKA OCS REGION

CHUKCHI SEA (Sale 126)

GRAPHIC NO. 1

IMPORTANT HABITATS OF MARINE AND COASTAL BIRDS

LEGEND

- Chukchi Sea Proposed Sale 126 Area
- Leased Blocks (Sale 109)
- Seabird Colonies*
  - >100,000–1,000,000
  - >10,000–100,000
  - >1,000–10,000
  - <1,000
- Waterfowl and Shorebird Feeding and Staging Areas
- Important Waterfowl Feeding and Molting Areas
- Primary Seabird Foraging Area
- Secondary Seabird Foraging Area
- Saltmarsh Habitats for Brant and Shorebirds in Summer and Fall

** Capes Thompson and Lisburne, the Barrier Islands of Kasegaluk Lagoon and Peard Bay, and Point Franklin are units of the Alaska Maritime National Wildlife Refuge.*

Sources: Divoky, 1978; Sowls et al., 1978; State of Alaska, ADF&G, 1981; Springer et al., 1982; Roseneau and Herter, 1984; Stevenson and Gill, 1987.

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through June (Lehnhausen and Quinlan, 1981). Migration to and through the sale area probably occurs along a broad front, as it does along the Beaufort Sea coast, with offshore, coastal, and inland migration routes used by various species. Coastal and offshore migration routes are influenced by spring ice conditions, and the timing of migration varies with wind direction and availability of open-water leads (Divoky, 1983). Offshore leads are followed by perhaps one million king eiders and tens of thousands of common eiders and oldsquaw. Substantial numbers of waterfowl, primarily Pacific brant and pintails, use saltmarshes in the Icy Cape area for feeding and resting during spring migration. Murres and kittiwakes appear in the Cape Lisburne area by mid-May; and concentrations of murres raft in ice leads near the Cape Thompson, Cape Lisburne, and Cape Lewis colonies at this time.

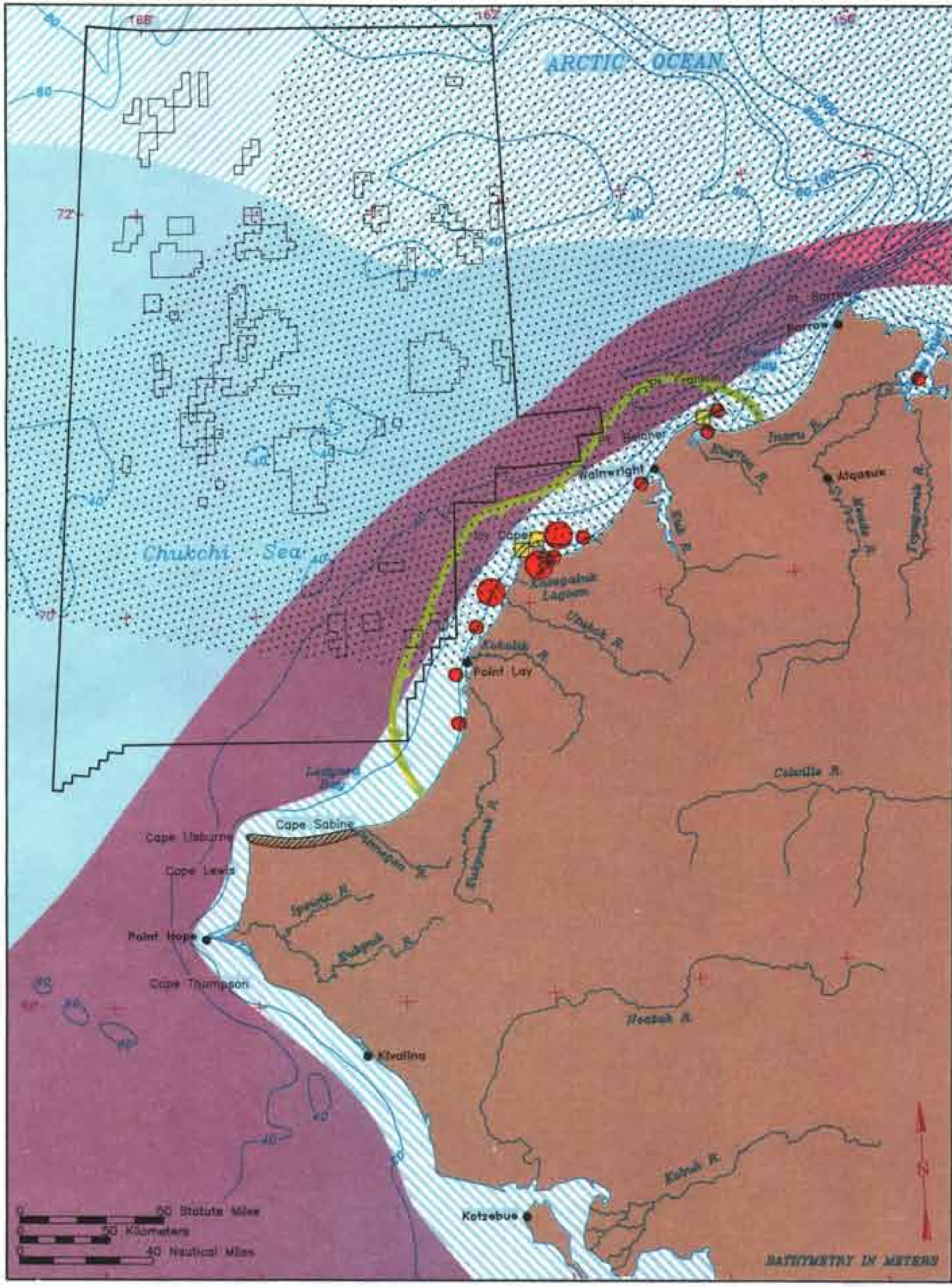
Shortly after spring migration, most shorebird and waterfowl populations disperse to nesting grounds primarily on moist tundra and marshlands of the arctic slope. Semipalmated sandpipers and red phalaropes were reported as the most abundant tundra-nesting shorebirds in the Icy Cape area, while pintails and oldsquaw were the most common waterfowl recorded (Lehnhausen and Quinlan, 1981).

Along the coast adjacent to the sale area, large concentrations of feeding and staging waterfowl and shorebirds are present from late June through September in Kasegaluk Lagoon, at the mouth of the Kuk River, and in Peard Bay (Connors, Connors, and Smith, 1981; Lehnhausen and Quinlan, 1981; Gill, Handel, and Connors, 1985) (Graphic No. 1). Beginning in late June, soon after spring migration has ceased, there is a substantial northward movement of molt-migrant oldsquaw from more southerly areas. Large numbers of these molting birds are present in lagoons and along barrier islands from mid-July until late August. In early July, hundreds of thousands of molt-migrant king eiders move south along the Chukchi coast; some remain until mid-November as long as open water persists.

Saltmarshes along the mainland coast of the sale area are important foraging habitat, particularly for waterfowl and shorebirds. In the saltmarshes of the Icy Cape area, waterfowl densities greater than 100 to more than 600 ducks/km^2 have been observed from June through August, with Pacific brant, pintails, and eiders reported as the most abundant waterfowl species, and dunlins and red phalaropes the most abundant shorebirds (Lehnhausen and Quinlan, 1981). Fall migration in late August and September is much more focused along the coast than the spring migration, with numerous staging concentrations of birds occurring in the lagoons and river mouths and on the barrier islands. Ledyard Bay, the nearshore waters off Point Lay, Kasegaluk Lagoon, and Peard Bay are important feeding and molting areas for waterfowl, especially oldsquaw, as well as common eider and Pacific brant, prior to and during the fall migration (Timson, 1976). For example, Johnson (1989, oral comm.) observed a concentration of 40,000 brant in August in Kasegaluk Lagoon. In September, large numbers of murres occur in rafts on the water near Capes Lisburne and Thompson prior to moving south to wintering areas.

Marine and coastal birds of the Siberian coast, specifically the Chukchi Peninsula and Wrangel and Herald Islands just west of the sale area, are similar in diversity and abundance of birds to arctic Alaska. Particularly notable colonies are located on Wrangel and Herald Islands (Portenko, 1972), and a large population of snow geese nests on Wrangel Island.

Marine and coastal birds of the Chukchi Sea include both offshore and nearshore feeders. Offshore feeders include arctic terns, common and thick-billed murres, black-legged kittiwakes, and some gulls. Offshore feeders prey primarily on fish such as arctic and saffron cod, sand lance, capelin, and sculpins, which comprise most of the diet of murres in this area (Roseneau and Herter, 1984). Overall, arctic cod is the major prey of most offshore feeders (Divoky, 1983), although sand lance is particularly important to some populations, such as the Cape Thompson and Cape Lisburne black-legged kittiwakes, during the nesting season (Springer et al., 1982). Nearshore coastal feeders such as waterfowl and shorebirds prey on various invertebrate species or graze on emergent vegetation. During the nesting season, waterfowl and shorebirds feed on various insect larvae, adult insects, crustaceans, and mollusks that inhabit the coastal saltmarshes and tundra ponds (Connors, Connors, and Smith, 1981). During the postnesting and staging period, many waterfowl and shorebirds shift their foraging to coastal lagoons, mudflats, and beaches, where they prey on



MINERALS MANAGEMENT SERVICE
ALASKA OCS REGION

CHUKCHI SEA (Sale 126)

GRAPHIC NO. 2

IMPORTANT HABITATS OF PINNIPEDS, POLAR BEAR, AND BELUKHA WHALE

LEGEND

- Chukchi Sea Proposed Sale 126 Area
- Leased Blocks (Sale 109)
- Landfast Ice – Ringed Seal Pupping Area
- Ice–Lead Area or Flaw Zone – Important Winter–Spring Habitat of Polar Bear, Bearded and Ringed Seals, Pacific Walrus, and Belukha Whale
- Approximate Mean September Pack–Ice Edge

Spotted Seal–Haulout Sites

- Major Site
- Minor Site

Pacific Walrus Use Areas

- Coastal–Haulout Area
- Area of Higher Summer/Fall Density

- Polar Bear Transitory Coastal–Concentration Area
- Spotted Seal and Belukha Whale Summer Habitat

Sources: Burns et al., 1985; Davis and Thomson, 1984; Fay, 1982; Frost, 1990; Frost et al., 1983; Gilbert, 1989; LaBelle et al., 1983; and Lentfer, 1988.

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amphipods and other epibenthic crustaceans (Gill, Handel, and Connors, 1985).

4. Pinnipeds and Polar Bear: Species commonly occupying northern Chukchi Sea habitats, and that may be affected by oil and gas activities in the proposed Sale 126 area, include ringed, bearded, and spotted seals; Pacific walrus; and polar bear. Two other species that are uncommon in the sale area, the ribbon seal and Steller sea lion, are not discussed further due to the relatively insignificant proportion of their populations occurring in the northern Chukchi Sea. All marine mammals in U.S. waters are protected under the Marine Mammal Protection Act of 1972. General habitat areas occupied by pinnipeds and polar bears are shown in Graphic No. 2.

a. Pinnipeds:

(1) Ringed Seal: This species is the most abundant seal in the sale area, with an estimated Chukchi Sea winter population of 300,000 to 450,000 seals (Burns, 1981) and a summer population of 1 or 2 million in ice habitats. In coastal habitats, ringed seal abundance is tied to the stability and extent of shorefast ice (Graphic No. 2). Low ridges or hummock areas on stable, landfast ice provide optimum habitat for ringed seal lair construction and are the most productive pupping areas (Burns, Frost, and Lowry, 1985; Kelly, 1988a; Smith, 1980). The estimated average density of ringed seals in the northern Chukchi Sea landfast-ice zone is two to three seals/km^2 (Burns, Shapiro, and Fay, 1980; Frost et al., 1988). During the summer, high densities of ringed seals associate with ice remnants (Burns, Shapiro, and Fay, 1980). Between 1970 and 1977, ringed seal densities declined as much as 50 percent in the Beaufort and northern Chukchi Seas, apparently due to heavy ice in 1975 and 1976. Increased densities occurred concurrently in the Bering and southern Chukchi Seas. Ringed seal densities within the sale area probably depend on a variety of factors such as food availability, ice stability, water depth, predation, and proximity to human disturbance. Although ringed seals do not occur in large herds, loose aggregations of tens or hundreds of animals do occur, probably in association with abundant prey.

Ringed seals are opportunistic feeders, preying on cod, amphipods, mysids, euphausiids, and small pelagic fishes. The availability of small prey organisms in concentrations sufficient for effective feeding is of particular importance in the annual nutrition requirements of ringed seals (Lowry, Frost, and Burns, 1980b). During the winter, arctic cod are considered the most important food source of ringed seals. Pups and subadults consume proportionately more crustaceans and fewer fish than do adults (Burns, Frost, and Lowry, 1985).

Ringed seals establish territories during the breeding season (Smith and Hammill, 1981). Pups are born in late March and April (Burns, Kelly, and Frost, 1981) in excavated lairs (Smith and Stirling, 1975). Females appear to be impregnated in mid- to late April, shortly after giving birth. During the pupping and breeding season (March-May), adults on shorefast ice generally are less mobile than individuals in other habitats; they depend on relatively few holes and cracks in the ice for breathing and foraging. During nursing (4-6 weeks), pups generally are confined to the birth lair. Ringed seals molt from May to early July (Eley and Lowry, 1978). During this process, rapid hair growth apparently is facilitated by warmth acquired through basking on the ice for long periods. Polar bears and arctic foxes are important predators of ringed seals.

(2) Bearded Seal: This species prefers areas where seasonal, broken sea ice occurs over water less than 200 m deep, avoiding areas of thick shorefast ice. Although they apparently are able to make and maintain breathing holes in continuous ice, bearded seals are most abundant in areas where natural openings occur. An estimated 250,000 to 300,000 bearded seals occupy the Bering and Chukchi Seas (Braham, Fiscus, and Rugh, 1977; Burns, 1981). In the Chukchi Sea, the winter population is estimated at 120,000 seals (Burns, 1981), while the summer population is substantially higher following the northward migration of the large Bering Sea overwintering population in spring. Bearded seals feed primarily on benthic and epibenthic invertebrate prey such as shrimps, crabs, and bivalve mollusks, while benthic fish such as sculpins, cod, and flatfishes are taken secondarily (Lowry, Frost, and Burns, 1980a).

Pupping occurs on the ice from late March through May, primarily in the Bering and Chukchi Seas. The nursing period is very short (12-18 days), with most pups reaching approximately 63 percent of adult length by the time they are weaned (Burns, 1967). Details of their reproductive behavior, as well as the annual molt, remain obscure (Kelly, 1988b). Bearded seals do not form herds, although loose aggregations of animals do occur. Polar bears are their chief predators.

(3) Spotted Seal: This species is a common seasonal resident of the Chukchi Sea coast. Spotted seals are found in large numbers along the coast of the sale area from June to October. The summer population of the Chukchi Sea is estimated to be between 30,000 and 37,500 seals (Burns, 1981). Spotted seals are particularly common in bays, estuaries, and river mouths (Frost, Lowry, and Burns, 1983). This is the only seal species that commonly hauls out on land adjacent to the sale area. The area from Kasegaluk Lagoon well south of Point Lay to the Kuk River mouth and Peard Bay are important spotted seal haulout and concentration areas adjacent to the sale area (Graphic No. 2). Two to three thousand seals frequent these coastal habitat areas. These seals may range considerable distances offshore to forage (e.g., 20 mi), especially when the ice front is located in the vicinity of coastal concentration areas. Spotted seals frequently enter estuaries and sometimes ascend rivers, presumably to feed on anadromous fishes. Important prey include pelagic fishes, octopus, and crustaceans (State of Alaska, ADF&G, 1981). Spotted seals migrate out of the Chukchi Sea in the fall (September to mid-October) as the shorefast ice reforms and the pack ice advances southward. They spend winter and spring periods along the ice front in the Bering Sea, where pupping and breeding occur in March and April. Molt extends from March to July.

(4) Pacific Walrus: The walrus population of the North Pacific--about 234,000 to 250,000 animals--represents approximately 80 percent of the world population (Burns, Frost, and Lowry, 1985; Fay 1982; Fay, Kelly, and Sease, 1986; Gilbert, 1989). Most of this population is associated year-round with the moving pack ice. Most walrus spend the winter in the Bering Sea, and over 100,000 individuals summer in the Chukchi Sea (Sease and Chapman, 1988); this represents about 40 percent of the Pacific population.

Nearly all pregnant females and those with dependent young migrate from the Bering Sea into the Chukchi Sea for the summer, while a substantial number of males remain in the south (Fay, 1982). Spring migration usually begins in April, and most individuals have moved through the Bering Strait by late June (Fay, 1982). Most calves are born during the northward migration. During the summer, two large arctic areas are occupied--from the Bering Strait west to Wrangel Island, and along the northwest coast of Alaska from about Point Hope to north of Point Barrow, encompassing much of the sale area. The Chukchi Sea is the primary summer feeding habitat for females with calves (Fay, 1982).

Most walrus concentrate along the pack-ice front in areas of less than 50- percent ice over water depths less than 80 m, with low walrus numbers occurring farther into the pack-ice zone. During summer and fall, a few hundred occasionally haul out on land between Capes Lisburne and Sabine (Graphic No. 2). With the southward advance of the pack ice from October to December, most of the walrus population migrates south of the Bering Strait. Solitary animals occasionally overwinter in the Chukchi Sea and the eastern Beaufort Sea (Fay, 1982).

The walrus is a bottom feeder, relying to a large extent on clams (Fay 1982; Fay et al., 1984a). Other invertebrate prey are of secondary importance. The estimated adult daily food intake ranges from 110 to 175 pounds. Censuses over the past 20 years indicate that the walrus population has increased rapidly and expanded its range (Fay and Kelly, 1980; Fay et al., 1984a). Decreases in the apparent physical fitness (mean blubber thickness) of animals collected recently suggest that the population may have exceeded the carrying capacity of the environment (Fay et al., 1984b). Recent trends in several population characteristics that have preceded declines in other wildlife populations suggest that the Pacific walrus population may experience a downward trend in the foreseeable future (Burns, Frost, and Lowry, 1985; Sease and Chapman, 1988). In fact, the most recent U.S. census (1985) suggests that a decrease already may have occurred, but confirmation awaits analysis of Soviet data.

b. Polar Bear: The polar bear is circumpolar in distribution. Available information suggests that Alaska has two somewhat discrete populations, a northern population in the Beaufort Sea and a western population including the Chukchi Sea (extending into Soviet territory), with the boundary between Point Lay and Point Barrow. Radiotelemetry studies suggest that more interchange of individuals takes place between the two areas than previously suspected (Gardner, 1990, oral comm.). Those in the Chukchi Sea make extensive north-south migrations in relation to the pack-ice edge (Amstrup and DeMaster, 1988), as well as into Soviet areas. The total Alaskan population is estimated at 3,000 to 5,000 bears (Amstrup, 1983a; Amstrup, Stirling, and Lentfer, 1986). There is substantial annual variation in the seasonal distribution and local abundance of polar bear in the Alaskan Beaufort and Chukchi Seas. Overall density appears to be about one bear per 75 to 211 km^2, with lower densities occurring farther than 160 km offshore (Amstrup, 1983b; Amstrup, Stirling, and Lentfer, 1986); however, much higher bear densities (e.g., one/12.5 km^2) have been observed in habitats where seals are more abundant, such as in areas of new-ice formation and along leads, than have been observed generally in the pack ice (Gardner, 1989, oral comm.).

The most important natural factors affecting polar bear distribution are sea ice and food availability. Drifting pack ice off the coast of the Chukchi Sea probably supports greater numbers of polar bear than either shorefast or polar pack ice because of the abundance and availability of subadult seals in this habitat (Smith, 1980). Local concentrations of polar bear may occur along the coast of Alaska when pack ice drifts close to the shoreline and shorefast ice forms early in the fall.

Polar bears off the Alaskan coast prey primarily on ringed seal and, to some extent, bearded seal and walrus. Polar bears typically are opportunistic feeders, occasionally frequenting coastal areas to feed on carrion, especially whale carcasses, and human refuse when it is available. Polar bears generally are found along the Chukchi Sea shoreline from October to March, when shorefast ice enables them to travel in from drifting pack ice. However, polar bears are capable of swimming several kilometers in open water and could be found year-round in nearshore areas. Two polar bear coastal concentration areas are located at Icy Cape and Point Franklin, locations of carrion and refuse accumulation adjacent to the sale area (Davis and Thomson, 1984) (Graphic No. 2).

Pregnant females and those with newborn cubs are the only bears that occupy winter dens for extended periods. According to Lentfer (1972) and Lentfer and Hensel (1980), polar bear dens have been located on offshore and barrier islands, on shorefast ice, and along river banks. Maternity dens also have been reported far offshore on the pack ice (Lentfer and Hensel, 1980; Amstrup, 1985). Pregnant females construct maternity dens in late October or early November. Major factors for den location appear to be depth and density of snow cover. Terrestrial dens usually are located not more than 8 to 10 km inland (Uspenski and Kistchinski, 1972). Dens along the Chukchi Sea coast appear to be less concentrated than in many denning areas elsewhere in the arctic, although information on denning in this region is limited and inadequate to determine the extent of this activity or its annual variation. Cubs are born from early December to late January (Uspenski and Belikov, 1974), and females with cubs leave the dens in late March or early April. Wrangel Island is an important denning area in the Chukchi Sea.

In addition to being protected by the Marine Mammal Protection Act of 1972, the polar bear and its habitats are also protected by the International Agreement on the Conservation of Polar Bears of 1976 between Canada, Denmark, Norway, the U.S.S.R., and the U.S.

5. Endangered and Threatened Species: An endangered species is defined by the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.), as a species that is in danger of extinction throughout all or a significant portion of its range. Threatened species are those likely to become endangered within the foreseeable future. Whales protected under the Endangered Species Act also are protected under the International Convention for the Regulation of Whaling (1946) and the Marine Mammal Protection Act of 1976. Endangered species likely to occur in or adjacent to the proposed Sale 126 area include bowhead and gray whales and the threatened arctic peregrine falcon. The biology of these species was described in Section III.B.5 of the Sale 97 FEIS (USDOI, MMS, 1987a), which is hereby summarized

and incorporated by reference. Endangered fin and humpback whales rarely occur in the sale area and thus would experience no significant effect from the proposal. There are no listed endangered plant species in areas adjacent to the sale area.

a. Bowhead Whale: The bowhead is an ice-associated whale. The western arctic stock of bowhead whales, estimated to number about 7,800 (Zeh, Reilly, and Sonntag, 1988), passes through the proposed sale area semiannually as they migrate between summering grounds in the Canadian Beaufort Sea and wintering areas in the Bering Sea. There are no reliable data on whether the western arctic bowhead population is increasing, stable, or decreasing. However, the Alaska Eskimo Whaling Commission (AEWC) believes that the bowhead population has increased dramatically in recent years. Assuming the current AEWC population estimate (7,800) and the estimated historic population (14,000-20,000 prior to commercial whaling) cited by Braham (1984)to be accurate, the bowhead population is currently about 40 percent of the historic population level. If these assumptions are valid, bowheads are more abundant now than at the close of the commercial whaling period, when they were estimated at about 1,000 animals.

After summering in the Canadian Beaufort Sea, bowheads begin moving westward in August into Alaskan waters. Generally, few bowheads are seen in Alaskan waters until the major portion of the migration occurs, typically between mid-September and mid-October. The extent of ice cover can influence the timing and duration of the fall migration. The primary migration corridor appears to be the area between the depth contours of 10 and 50 meters (Treacy, 1990).

Data on the bowhead fall migration through the Chukchi Sea is limited; however, it appears that before they move south into the Bering Sea, most bowheads cross the Chukchi Sea in a broad front from Point Barrow to the northern coast of the Chukotsk Peninsula (see Fig. III-B-5). The bowheads' northward spring migration appears to be timed with the ice breakup, usually beginning in April. In the Chukchi Sea, they follow leads in the flaw zone from outer Kotzebue Sound to Barrow. After passing Barrow from April through mid-June, they move through offshore leads in an easterly direction. East of Point Barrow, the lead systems divide into numerous branches that vary in location and extent from year to year. Bowheads arrive on their summering grounds in the vicinity of Banks Island/Amundsen Gulf in about late May to June (Fraker, 1979).

Bowheads feed throughout the water column (Wursig et al., 1985). Food items most commonly found in the stomachs of bowheads killed by Eskimos include euphausiids, mysids, copepods, and amphipods. Most feeding has been observed to occur in the Canadian Beaufort Sea; however, bowheads are opportunistic feeders and may feed anywhere within their range where feeding conditions are favorable. For example, feeding has been observed off Wainwright and Point Barrow during the spring migration (Carroll and George, 1985) and in areas to the east of Barter Island during the fall migration as bowheads migrate dwestward across the Alaskan Beaufort Sea (Thomson and Richardson, 1987). Bowheads also have been seen feeding in areas east of Point Barrow near the Plover Islands (Braham, Krogman, and Carroll, 1984; Ljungblad et al., 1985). Carbon isotope analysis of bowhead baleen indicates that a significant amount of feeding also may occur in wintering areas in the Bering Sea (Schell, Soupe, and Haubenstock, 1987).

Bowhead mating and calving appear to occur during the spring migration. Late winter is the most probable mating season, at the time when most of the population is located in the Bering Sea. However, mating behavior also has been reported north of Point Barrow. The peak of calving probably occurs in May, although the calving season can extend from late March until early August (Nerini et al., 1983). Although some mating, calving, and feeding occurs within the sale area, these activities generally occur elsewhere (due in part to the relatively short time during which the whales are actually in the sale area).

b. Gray Whale: The eastern Pacific gray whale stock is estimated to number 21,000 individuals (Breiwick et al., In Press). The eastern Pacific gray whale stock has recovered to, or now exceeds, its size prior to commercial whaling (Rice, Wolman, and Braham, 1984). In recent years, the population has grown by an estimated 2.5 percent per year.

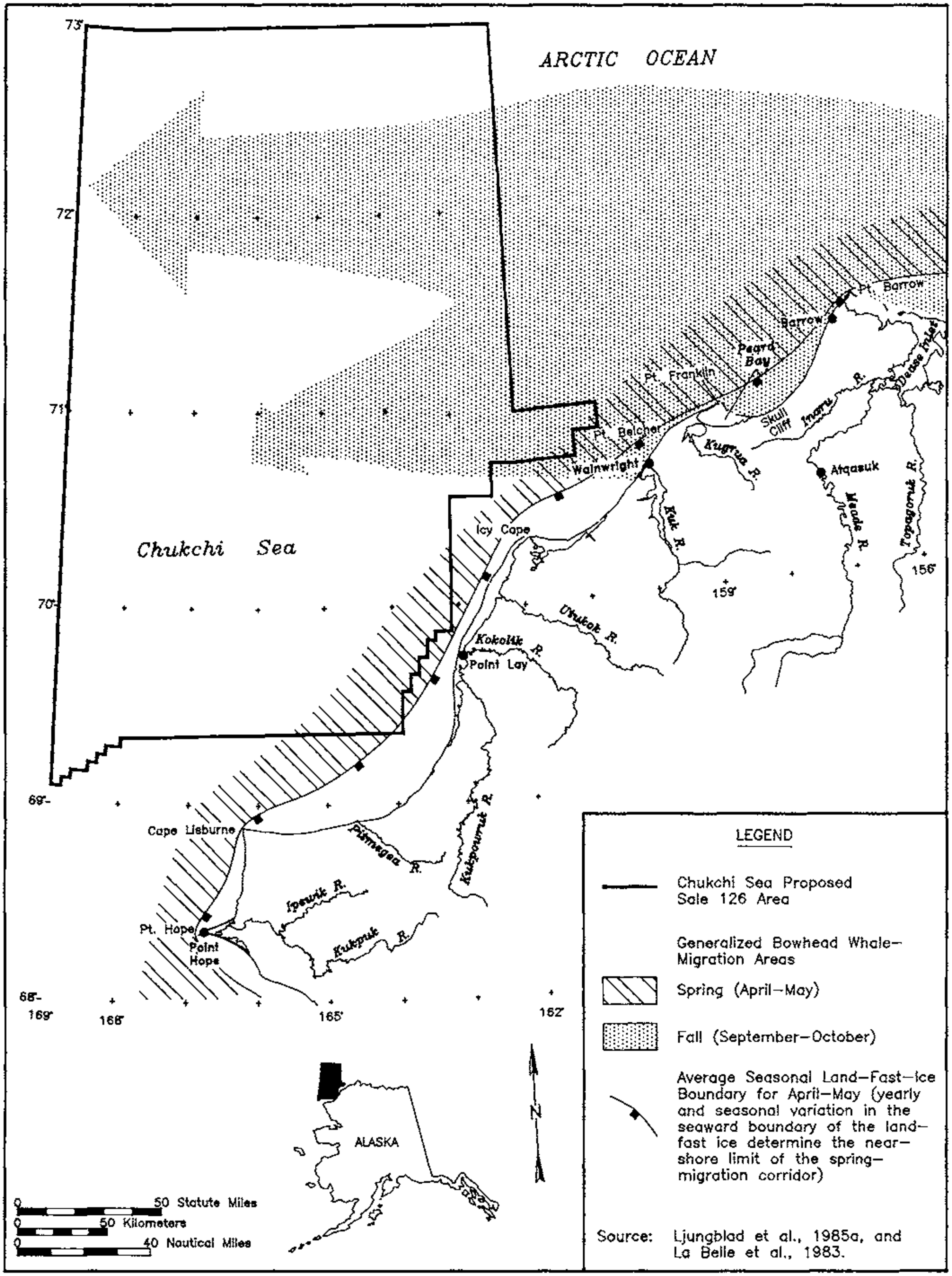


Figure III-B-5. Bowhead Whale-Migration Areas

Gray whales spend the summer-through-fall months feeding, calf rearing, and resting in the northern Bering and Chukchi Seas (see Fig. III-B-6). Their northern range generally extends to Point Barrow, but they have been sighted up to 445 km northwest of Point Barrow (Ljungblad et al., 1986; Clarke, Moore, and Ljungblad, 1989) and occasionally to the east of Point Barrow. However, for the most part, grays tend to be more concentrated in nearshore waters (often within 15 km of shore) between Point Hope and Point Barrow. Although these nearshore areas are essentially outside the sale area, some grays are likely to feed and move about within the sale area. From 1982 to 1984 (July through October), Moore, Clarke, and Ljungblad (1986) reported 323 gray whales sighted between Point Hope and Point Barrow. Most whales were feeding within 14.5 km of shore. All cow/calf pairs were seen in July between Wainwright and Point Barrow and Cape Lisburne and Point Lay, within 4 km of shore. Ljungblad et al. (1988) reported that 394 gray whales have been sighted in the nearshore area between Point Hope and Point Barrow since 1982 (September-October), that 85 percent were feeding in open water or light ice cover, and that they were also seen feeding 160 km northwest of Point Barrow. The southbound migration generally begins in September-October (Johnson et al., 1981; Moore, Clark, and Ljungblad, 1986).

Gray whales are predominantly suction-bottom feeders, but in some areas they have been observed feeding on dense swarms of pelagic euphausiids (Guerrero, 1985). Most feeding activities are believed to take place on the northern feeding grounds (Oliver et al., 1983); however, feeding during the spring migration has been documented to begin as early as March (Braham, 1984; Folkens, 1985). Feeding occurred most often in the Point Belcher area but was also observed between Point Hope and Point Barrow (Ljungblad et al., 1985). On the summer feeding grounds of the Chukchi and Bering Seas, gray whales feed primarily on benthic gammaridean amphipods; however, approximately 100 different prey species have been identified from stomach analysis.

c. Arctic Peregrine Falcon: Threatened arctic peregrine falcons occasionally enter the coastal area adjacent to the eastern boundary of the sale area between May and September. Arctic peregrine falcon nest sites have been found on cliffs, bluffs, and low hills (USDOI, FWS, Region 7, 1982), although cliff habitat used for nesting is virtually absent along the coast from Point Barrow to Cape Lisburne. The closest known nest sites are at Cape Thompson, to the south of the sale area; however, nesting is probable on the cliffs at Cape Lisburne (Fyfe, Temple, and Cade, 1976). Peregrines have been observed at Capes Lisburne and Sabine, and they have been seen migrating in the vicinity of Point Lay (Amaral, 1986, oral comm.). Immature arctic peregrines are known to use northern Alaskan coastal habitats east of the Colville River on a transient basis from mid-August to mid-September (USDOI, MMS, 1984a).

Based on 1988 surveys, the population of arctic peregrine falcons now stands at about 80 pairs and 120 young. The FWS estimates that 200 pairs of arctic peregrine falcons historically nested in Alaska. Beginning in the late 1940's, the use of organochlorine pesticides greatly affected peregrine falcons, causing birds to lay thin-shelled eggs that often failed to hatch, and consequently lowered reproduction. In Alaska, the population of arctic peregrine falcons declined to approximately 30 percent of historical levels. In 1978, a number of years after the United States had restricted the use of organochlorine pesticides, the peregrine falcon population began to increase, and the trend has continued to that present.

Peregrine falcons feed mostly on other birds. Prey remains at coastal sites in Alaska indicated that shorebirds, gulls, seabirds, waterfowl, and various small land birds were taken by peregrines (Wright, 1987). Similar species were taken by peregrine falcons migrating through central Alberta, Canada (Dekker, 1980). Shorebirds, gulls, and waterfowl appear to be important food sources in a number of wintering locations (USDOI, FWS, Region 7, 1982).

6. Belukha Whale: Like all other nonendangered marine mammals in U.S. waters, the belukha whale is protected under the Marine Mammal Protection Act of 1972. Belukha whales (a circumboreal species) are seasonal summer inhabitants of the northern Chukchi Sea. The North American arctic population is estimated to be at least 30,000 (Sergeant and Brodie, 1975), while an estimated 11,500 whales migrate through the proposed sale area to the eastern Beaufort Sea (Davis and Evans, 1982). Most

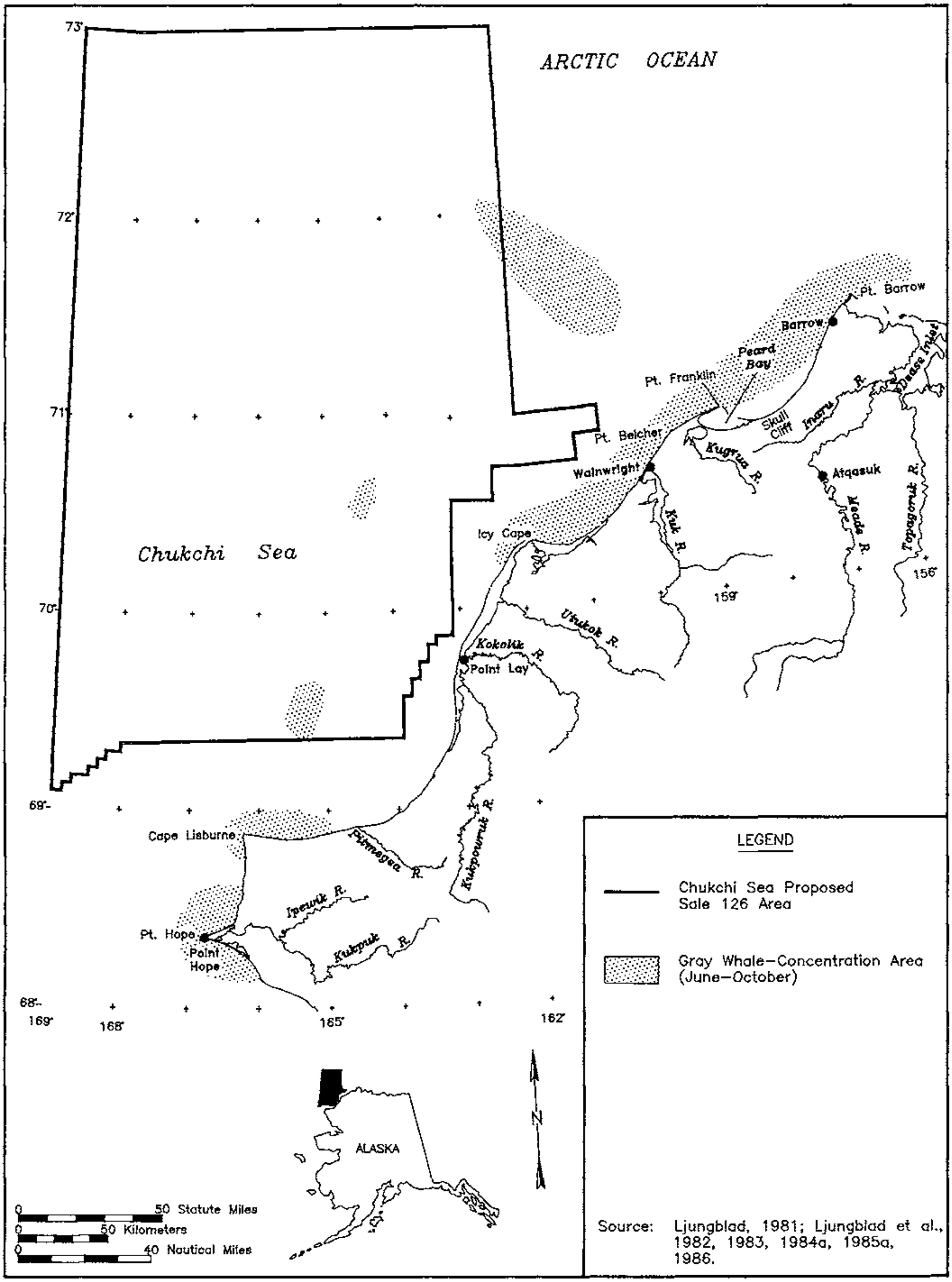


Figure III–B–6. Gray Whale–Concentration Areas of the latter population migrates from the Bering Sea into the Beaufort Sea in April or May; however, some whales may pass Point Barrow as early as late March and as late as July. The spring migration routes through ice leads are similar to those of the bowhead whale (see Sec. III.B.5). An estimated 2,500 to 3,000 belukha whales frequent bays and estuaries in Kotzebue Sound and along the northern Chukchi Sea coast during the open-water season (Seaman, Frost, and Lowry, 1985).

Kasegaluk Lagoon is an important belukha whale habitat area adjacent to the sale area (see Graphic No. 2). Some calving occurs and molting may occur in this warm-summer-water lagoon. Fall migration through and from the sale area occurs in September and October. Few belukhas are reported to overwinter in the southern Chukchi Sea immediately south of the sale area. Belukha whales feed and calve in the nearshore habitats of the Chukchi Sea (Moulton and Bowden, 1981). Their prey include a variety of marine vertebrates and invertebrates such as capelin, cod, herring, squid, and various crustaceans.

7. Caribou: The Western Arctic caribou herd, the largest in Alaska, currently numbers over 340,000 animals (Larsen, Dau, and Machida, 1990). Over the past 20 years, the Western Arctic herd has fluctuated between 75,000 and 340,000 individuals. Possible causes of this fluctuation include both natural and human factors such as habitat changes resulting from fires, disease, overhunting, and predation. The herd has exhibited substantial growth over the past decade, but apparently at a decreasing rate in recent years. The herd's range in northwestern Alaska extends approximately from the Colville River to the Chukchi Sea coast adjacent to the sale area, and from the Kobuk River north to the Beaufort Sea. The Central Arctic caribou herd ranges between the Canning and Itkillik Rivers and from the Beaufort Sea coast south into the Brooks Range. The most recent population estimate for this herd is 18,000 animals (Cameron, Smith, and Fancy, 1989). Apparently this herd also is growing at a decreasing rate.

During the summer months, caribou use exposed coastal habitats of the northern Chukchi and Beaufort Sea coasts, such as sand bars, spits, river deltas, and accessible barrier islands, for relief from biting insects. Calving takes place during late May and early June. The main calving area for the Western Arctic herd is located generally in the Utukok River uplands area, extending south to the Colville River (Fig. III-B-7). The Central Arctic herd calves along the Beaufort Sea coast. Postcalving and summer ranges include coastal tundra habitats adjacent to the sale area and the Beaufort Sea coast. A substantial number of Western Arctic caribou also overwinter in coastal habitats adjacent to the sale area, while the rest of the herd overwinters in the Noatak River area. The Central Arctic herd overwinters primarily in the foothills of the Brooks Range (Roby, 1980). Migration routes between summer and winter ranges vary from year to year; general movement patterns of the Western Arctic herd are shown in Figure III-B-7.

The caribou diet shifts from season to season and depends on the availability of forage. The winter diet consists predominantly of lichens and mosses, with a shift to vascular plants during the spring (Thompson and McCourt, 1981). Cottongrass buds appear to be very important in the diet of cows during the calving season (Lent, 1966; Thompson and McCourt, 1981), while shrubs (especially willows) are the predominant forage plants during the postcalving period (Thompson and McCourt, 1981). The availability of cottongrass tussocks during the spring--which apparently depends on temperature and snow cover--probably affects specific calving locations and success.

C. Social Systems:

1. Economy of the North Slope Borough: The direct economic effects of proposed Sale 126 would be restricted almost entirely to the North Slope Borough (NSB). Because almost no direct economic effects are expected to occur outside this region, the economics discussion in the EIS does not describe the statewide economy or the statewide economic effects of the proposed sale. The description of the economy of the NSB as contained in Section III.D.1 of the Sale 109 FEIS (USDOI, MMS, 1987b) is incorporated by reference; a summary of this description, augmented by additional material, as cited, follows.

The NSB includes the entire northern coast of Alaska and encompasses 88,281 square miles of territory,

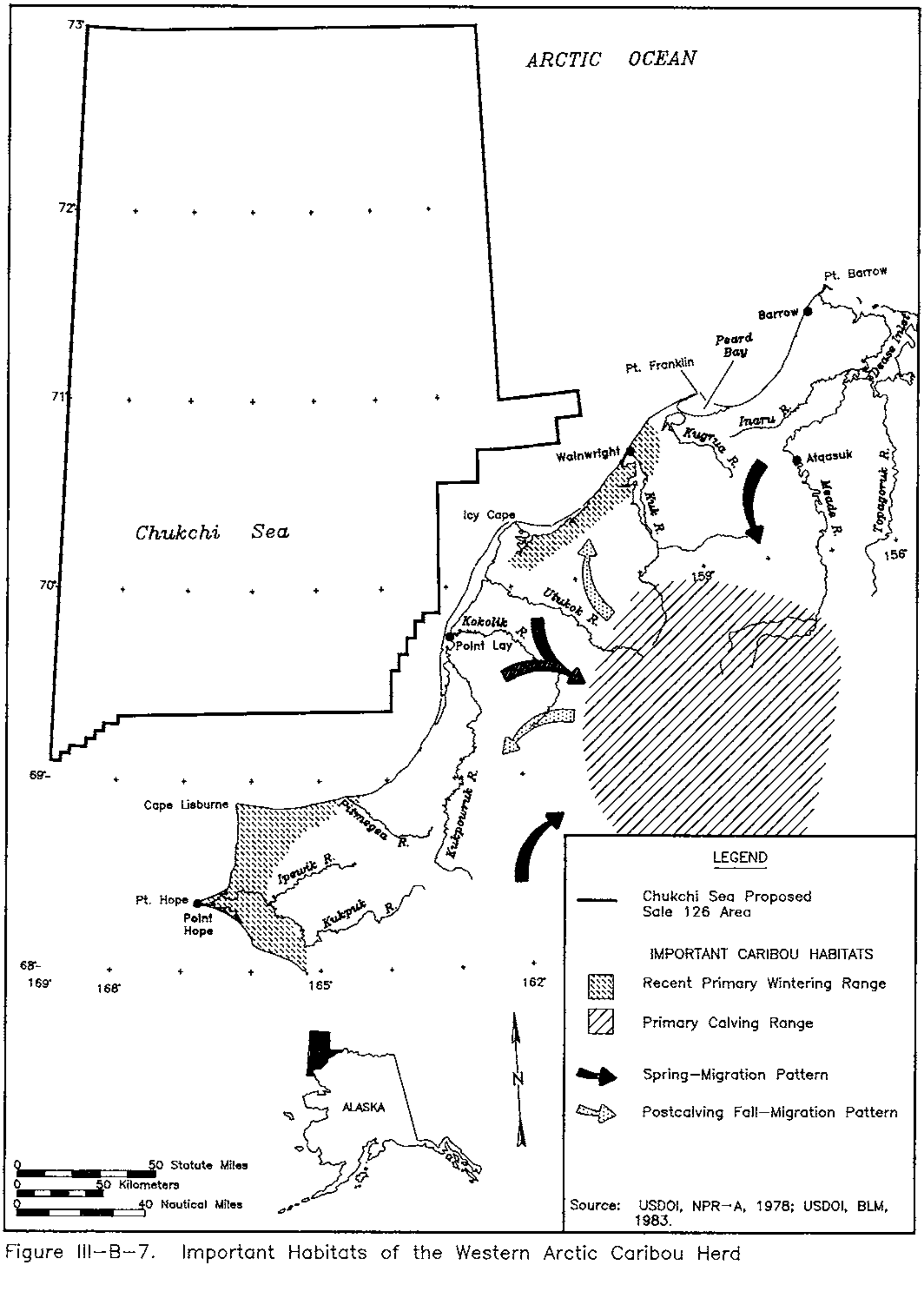


Figure III-B-7. Important Habitats of the Western Arctic Caribou Herd equal to 15 percent of the land area of Alaska. The predominantly Inupiat residents have traditionally relied on subsistence activities. This reliance substantially defines the character of the NSB economy. A discussion of the subsistence economy, together with a detailed description of NSB fiscal trends, employment, and population is included here. Subsistence-harvest patterns and sociocultural aspects of the region are discussed in Sections III.C.2 and III.C.3, respectively, of this EIS.

In all appearances the NSB economy differs from the national economy of which it is a part because of the special nature and cultural significance of subsistence. Like any other economy the subsistence economy may be defined as a system of production, exchange, distribution, and consumption. Economists usually focus on market exchanges for goods, services, labor, and natural resources in their analysis of economies; but the "subsistence economy" of the NSB includes a broader dimension of the production, exchange, and distribution of subsistence resources that is as important to the viability of the region as jobs and taxes.

These two aspects of the NSB economy--the market system and the subsistence system--are completely interdependent and woven together in a fabric of social interactions. People work at jobs to pay for equipment to hunt and fish; their harvest is shared and exchanged to provide for a lifestyle that holds people to home and kin and jobs. Because of subsistence, residents are protected from the vagaries of the market economy: boom and bust, inflation, and unemployment. Because of the economy, subsistence activities are more efficient and productive. Take either system away and the remaining component suffers: what economists would call a structural change occurs in the economy.

The complex interaction between the "Western," market-oriented economy and subsistence activities does not fit neatly into standard economic theory. For one reason, subsistence products are not exchanged in some kind of "balanced reciprocity," i.e., giving and receiving in kind and specified times of exchange; there is no price for subsistence products. The unit of analysis in standard economic theory is the individual or single nuclear household, whereas the extended-kinship network is important for economic decision making in the Inupiat culture of the NSB. The kinship-sharing network that is characteristic of Inupiat culture distorts the standard economic outlook on an economy. For example, jobs in the market economy are often held in order to support subsistence activities. Earnings from these jobs frequently are not earned by the principal harvester of subsistence resources but rather are contributed by the market-wage earner to the harvester's subsistence effort. Likewise, subsistence resources are contributed to those engaged in market-oriented activities. This, however, is only one possible combination of the relationship between the market economy and subsistence activities. Market-wage earners may also directly engage in subsistence activities. Furthermore, the sharing of resources among the kinship network is not a simple trade of equally valuable goods. Rather, it is based on tradition and status among the individuals within the network.

Because of this extensive subsistence-user/kinship network, changes in subsistence-harvest patterns could have ramifications that extend beyond the immediate family of the subsistence harvester to households that, by all appearances, principally engage only in market-economy activities. For example, an MMS survey research project on the North Slope found that for six North Slope communities (Barrow, Wainwright, Nuiqsut, Point Hope, Anaktuvuk Pass, and Kaktovik), about 70 percent of all households (regardless of ethnicity) obtained a majority of meat and fish in their diet from subsistence activities.

In spite of the difficulty that economists might have in measuring the economic importance of subsistence, they would not deny that subsistence has economic value. Subsistence resources contribute to the economic well-being of the residents of the NSB. Subsistence resources enter the calculation of economic well-being in at least two ways--the value of subsistence resources as a source of food and as their cultural value. Both of these values can be represented as a direct source of economic well-being and income for NSB residents. Very simply, subsistence resources enter into household income as a food source that does not have to be purchased in the marketplace. This food source is a substitute for income earned in the marketplace that would have to be used to purchase food. Furthermore, there is considerable evidence that Western foods are not considered equivalent to Native foods in the view of NSB residents (Kruse, Baring-Gould, and Schneider, 1983). Western foods are regarded as inferior subsititutes for Native foods.

Subsistence activities, and the value derived from these pursuits, however, go beyond a substitute for food bought in the market. As a way of life, there is a real, measurable economic value gained from NSB residents having access to such activities. Although there have been no studies to measure this value for NSB residents, studies that measured the recreational-hunting values and existence values of natural resources in other parts of the U.S. give a rough indication of the magnitude of such values (see, e.g., Brookshire, Eubanks, and Randall, 1983). Disruption of a subsistence harvest would result in a real loss of economic well-being to residents.

Located within the region is a vast petroleum-industry development centered at Prudhoe Bay. The most important economic linkage between petroleum activities and permanent residents of the region is the NSB government. The NSB is collecting very large property-tax revenues from petroleum-industry facilities. These revenues have funded greatly improved educational, health, and other government services and have financed an extensive Capital Improvements Program (CIP), which has created large numbers of construction jobs for permanent residents.

The following updates on NSB revenues and expenditures and employment in the North Slope region under existing conditions are from the Rural Alaska Model developed by the Institute for Social and Economic Research (ISER) for MMS. There are four key groups of assumptions to which the model is most sensitive or for which there is greater uncertainty as to their true values. These assumptions are (1) future NSB revenues, (2) the relationship between Native migration and unemployment, (3) the share of jobs in each category of employment available to Natives, and (4) the percentage of workers unable to find other jobs in the communities who will seek work in the oil industry.

a. <u>NSB Revenues and Expenditures</u>: The tax base that has allowed the recent high levels of local-government expenditures consists primarily (more than 95% in fiscal year [FY] 1984) of the enormously highly valued petroleum industry-related property in the Prudhoe Bay area. Because of this very valuable property, the NSB's tax base in 1984 was more than triple the base in the Fairbanks North Star Borough and almost equaled the base in the Municipality of Anchorage.

The NSB's total revenues in FY 1989 were estimated at $319 million. The largest source of these revenues was property taxes (71%). A large share of the general-fund revenues (69.6% in FY 1989) must be used to pay for previous expenditures, primarily the debt on general-obligation bonds that were sold to fund CIP projects.

Total property-tax value is projected to rise until 1990 and decline thereafter. Property values could be higher or lower than those projected, depending on world energy prices. However, property value is not considered to be the constraining factor for future NSB revenues. Future NSB revenues are likely to be constrained by a number of other factors, including (1) existing and potential State-imposed limits, (2) NSB residents' willingness to assume higher property-tax burdens, and (3) State and Federal revenue-sharing policies.

The FY 1985 mill rate applied by the NSB to assessed property was a record 18.37 mills. This rate is the sum of a rate of 1.78 mills for operations and 16.59 mills for debt service. Due to perceived adverse political and economic consequences, the NSB administration is not expected to increase the total rate any further. Although State statutes limit the mill rate for operations, the NSB's rate is well under the limit; therefore, the NSB administration is not now facing any legal constraints to raising the rate. However, debt service peaked in 1989; as a consequence the debt-service mill rate will decline. This allows the projected increase in the operations mill rate without increasing the overall mill rate. Total property-tax revenues peaked in 1988 and are now declining.

Figure III-C-1 shows actual and projected expenditures by the NSB from 1980 to 2010. Construction expenditures, primarily CIP, decline dramatically by the year 1990; and operating expenditures decline significantly by the year 2000. These drastic declines in expenditures will be the most important factors in

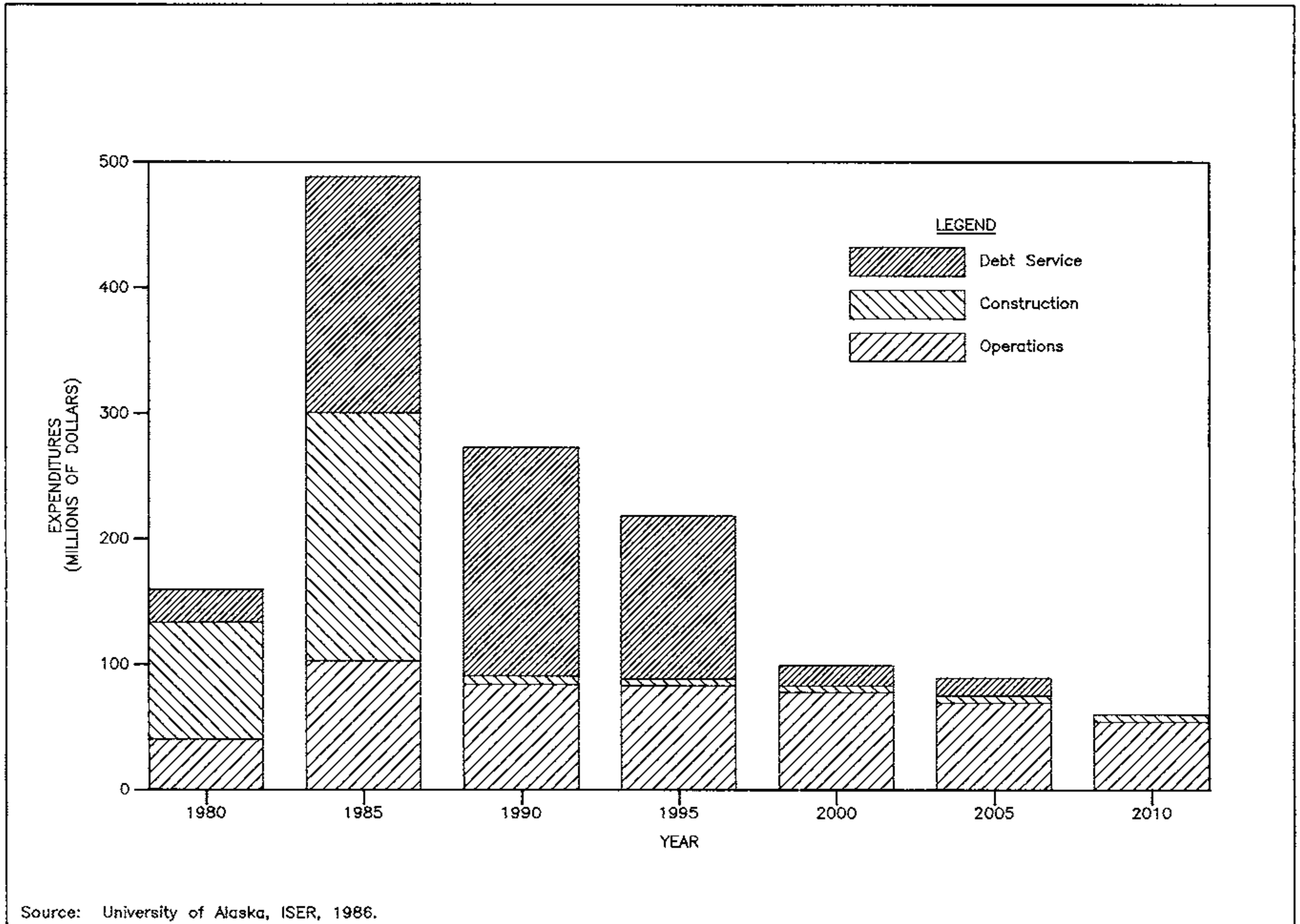


Figure III–C–1. North Slope Borough Expenditures (Actual and Projected) by Category, 1980–2010 the projected decline of resident employment discussed in the following section.

b. Employment: Total North Slope (resident and commuter) employment in 1989 was estimated at around 7,000, down from a peak of over 10,300 in 1983. Over 5,000 (72%) of the jobs in 1989 were in the oil industry, down from a peak of almost 7,800 jobs in 1983. Almost all petroleum-industry jobs (over 99%) are held by workers who commute to permanent residences outside the region. Commuters also held an estimated 141 jobs outside of the petroleum industry in 1989. Many of these jobs (30%) were associated with "other" CIP projects (wages not paid directly by the NSB). Other employment filled by commuters was with Federal and State government. The vast majority of the commuters are employed in isolated, self-sufficient industrial enclaves having relatively minor direct economic interaction with the Eskimo communities. Most of these enclaves are related to petroleum production or exploration, although one small enclave is the site of defense-related communications.

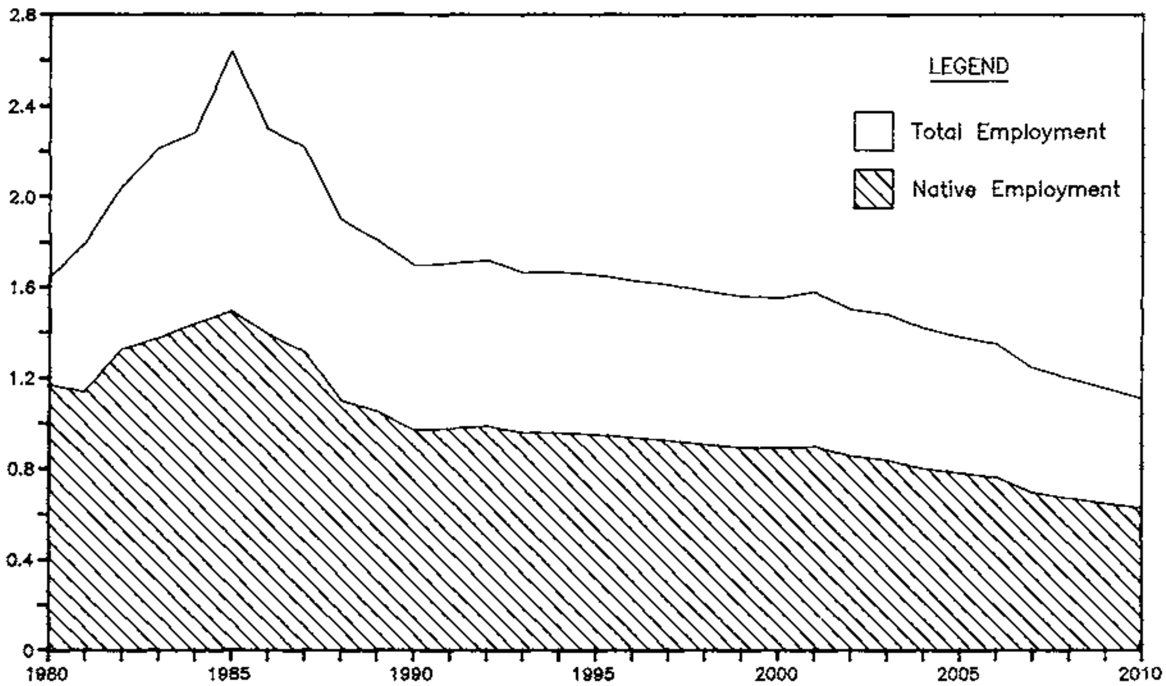
Figure III-C-2 provides data on Native and non-Native resident employment since 1980. Total resident employment in the year 1989 was estimated to be about 1,800, with about 60 percent of jobs held by Natives. Table III-C-1 provides a breakdown of employment by category. A primary goal of the NSB has been to create employment opportunities for Native residents, and the NSB has been successful in hiring large numbers of Natives for construction projects and operations. The NSB employment has been both high-paying and very flexible, permitting employees to take time off when they wish to and allowing employees to be rehired after quitting or being fired.

Only a small number of permanent residents hold jobs at the Prudhoe Bay industrial enclaves. Residents seem to prefer employment created by the NSB to jobs potentially available in industry. Pay scales offered by the NSB are equal to or better than those in the oil and gas industry, and the Natives consider the working conditions and flexibility offered by the NSB to be superior to those prevailing in the oil and gas industry. The report, "Description of the Socioeconomics of the North Slope Borough" (University of Alaska, ISER, 1983), provides a detailed description of the employment situation and the reasons for the small Native involvement in the oil and gas industry.

Non-Native-resident employment more than doubled between the years 1980 and 1985. Most of the employment (66%) was with NSB operations and CIP. These employment opportunities for non-Natives have resulted in the significant increase in the non-Native population discussed in Section III.C.1.c. Since 1985, non-Native-resident employment has declined 14 percent.

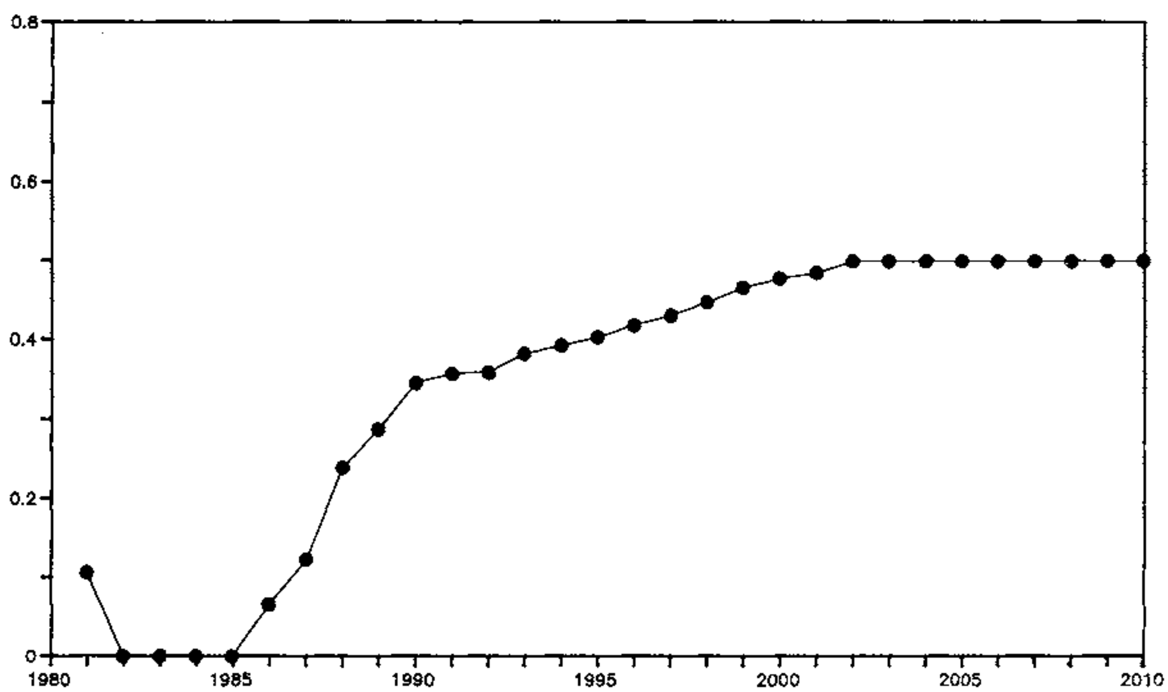
Figure III-C-2 presents projections of employment in the region. The biggest reason for the projected decline in resident employment is the projected decline in NSB revenues and expenditures, which results in an expected decline in NSB-funded CIP employment from 402 in 1985 to 10 by 1990. Other CIP employment is also expected to decline from 147 in 1985 to 4 by 1990. As CIP projects are completed, expenditures are shifted to operations. Even with an increased emphasis on operations, however, operating employment is expected to decline slightly, from 1,343 in 1985 to 1,100 by 1990. The share of resident employment held by Natives remains at about 56 percent between the years 1985 to 2010. The unemployment rate for Natives is shown in Figure III-C-3. After falling for several years, the rate began rising in 1986 and is projected to reach 50 percent by 2002. Outmigration of residents is projected to occur to keep the unemployment rate from rising above 50 percent. This outmigration would aggravate the reduction in NSB revenues, since intergovernmental transfers and operation revenues (from property taxes) are proportional to population levels.

Employment of Native residents in the petroleum industry has not changed much since 1985, although this may change due to the dramatic decline in CIP employment. Up to 1992, industry employment of Natives is constrained primarily by the Native labor supply (willingness to take advantage of industry-employment opportunities). After 1992, Native employment would be limited by industry's demand for labor (ability and willingness to offer industry-employment opportunities to Natives).



Source: University of Alaska, ISER, 1986.

Figure III–C–2. Employment (Actual and Projected) of Native and Total Residents of the North Slope Borough under Existing Conditions, 1980–2010



Source: University of Alaska, ISER, 1986.

Figure III–C–3. Unemployment Rates (Actual and Projected) for Native Residents of the North Slope Borough after Migration, 1981–2010

Table III-C-1
Estimated Native and Non-Native Resident Employment by Category
in the North Slope Region in 1985

Employment Category	Residents' Status		
	Native (percent)	Non-Native (percent)	Total (percent)
NSB Operations	681 (45%)	662 (58%)	1,343 (51%)
NSB CIP	302 (20%)	100 (9%)	402 (15%)
Local Support	315 (21%)	317 (28%)	632 (24%)
Other CIP	147 (10%)	0 (0%)	147 (6%)
Federal and State Government	23 (2%)	57 (5%)	80 (3%)
Oil Industry	30 (2%)	0 (0%)	30 (1%)
Totals	1,497 (100%)	1,136 (100%)	2,633 (100%)

Source: University of Alaska, ISER, 1986.

c. Population:

(1) Introduction: The population of the North Slope is divided among eight traditional Inupiat communities and various oil-related work camps. Traditional communities include Point Hope, Point Lay, and Wainwright on the Chukchi Sea; Barrow, Nuiqsut, and Kaktovik on the Beaufort Sea; and Atqasuk and Anaktuvuk Pass, both inland. The traditional communities are predominantly Inupiat, they are situated at long-used village or subsistence sites, and subsistence resources continue to play an important role in their domestic economies. Although historically these settlements grow and contract, they contain a core of resident households united by long-standing kinship bonds.

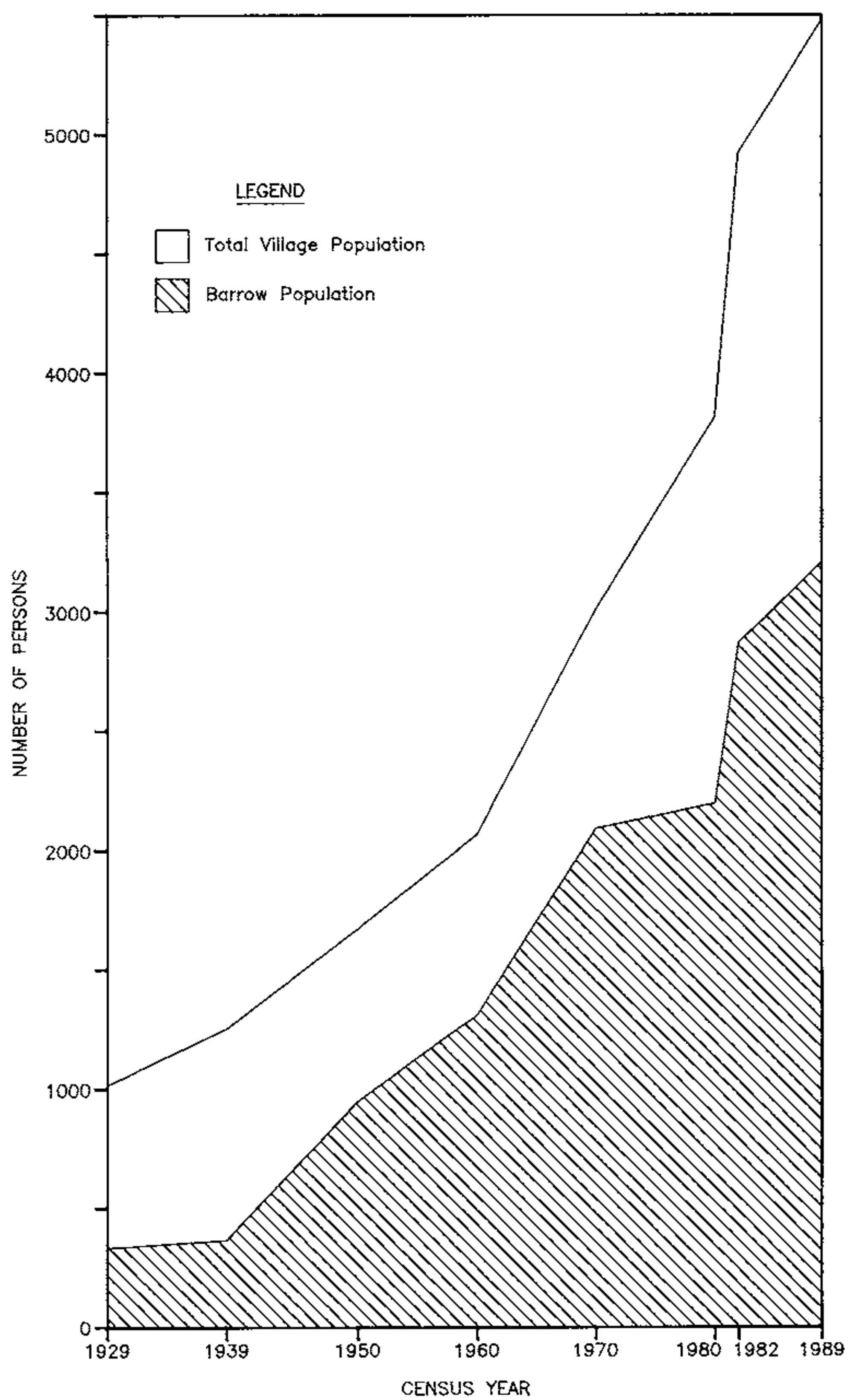
Oil-related work camps are comprised primarily of male employees who, when not working, reside in Anchorage, Fairbanks, other parts of Alaska, or out of State. At present, these camps are concentrated in the Kuparuk-Prudhoe Bay area; but their location is tied to the necessities of oil exploration, construction, and production. Naturally, the population of these camps is directly determined by the changes in oil development. Thus far, most North Slope work camps have been developed as industrial enclaves separated by rules and distance from the traditional communities. For this reason, the sociocultural effects of the oil industry remain, in large measure, indirect. Social, economic, and population dynamics of the communities are distinct from those of the work camps.

Table III-C-2 presents 1980 and 1982 population figures (as well as figures for 1985 and 1988-89) for communities and work camps in the region. The 1980 figures are given by community and by camp. They are totaled by census subarea as well as for the entire NSB. While these numbers present an adequate picture of North Slope community population, they do not adequately reflect the work camp population. The 1982 figures are broken down only for communities. Totals are given for traditional communities, oil-related work camps, and the NSB as a whole. The work-camp total is from a special census that represents an accurate picture of camp size at one point in time. According to Table III-C-2, of the 11,234 people counted on the North Slope in 1982, 43.9 percent resided in traditional communities and 56.1 percent were found in oil-related work camps.

(2) Traditional Communities: The same census figures for eight of the communities in Table III-C-2 are restated in Table III-C-3, which also includes available census data going back to 1929. Figure III-C-4 depicts this information for total North Slope community population and for Barrow. All communities grew between 1980 and 1982; and these communities increased by a total of 1,101 people--a phenomenal 28.8 percent in 2 years, or a growth rate of 13.5 percent per annum. Wainwright's population increased the least--7.7 percent. The "new" communities of Atqasuk, Nuiqsut, and Point Lay grew most rapidly--96.3, 38.0, and 54.4 percent, respectively. Barrow's population increased rapidly as well. In 2 years, this regional center grew by 675 people, or 14.3 percent per annum. While Barrow's 1982 population reached 2,882, other North Slope communities remained relatively small, with an average of 292 inhabitants. The largest of these communities contained 11 percent of the total North Slope village population, the smallest only 3 percent. Barrow, on the other hand, represented 58.5 percent of the North Slope total.

The future of this 1980's population explosion must be viewed against long-term trends. Until the early 1970's, North Slope trends conformed roughly to those found generally in Native rural Alaska (Alanso and Rust, 1977). As elsewhere in the State, by the 1950's, smaller North Slope communities were losing people to their regional center, Barrow, as well as to urban Alaska. In spite of high rates of natural increase, Point Hope and Wainwright grew relatively slowly. The smaller settlements of Atqasuk, Nuiqsut, and Point Lay diminished to almost nothing by the 1970's. On the other hand, Barrow--after it emerged as the regional center in the 1940's--grew rapidly with infusions of people from other communities (Milan, 1978). In 1939, Barrow's population comprised 56.7 percent of the North Slope total; by 1970, this figure climbed to 69.4 percent. Much of this drift from smaller to larger settlements was inspired by better economic prospects in the North Slope (see below).

Between 1929 and 1960, the North Slope population annually grew 2.3 percent. Barrow, reflecting its role as



Source: USDOC, 1981; Bureau of the Census, 1981; Alaska Consultants, Inc., 1981.

Figure III-C-4. North Slope Population Trends: 1929-1989 Total Village Population, Barrow

Table III-C-2
Population of the North Slope Region
1980, 1982, 1985, 1988-89

	Community	1980[1/]	1982[2/]	1985[3/]	1988-89[4/]
	Anaktuvuk Pass	203	250	234	264
	Atqasuk	107	210	214	219
	Barrow	2,267	2,882	3,075	3,223
	Cape Lisburne	36	[5/]	[5/]	[5/]
	Kaktovik	165	214	206	227
	Nuiqsut	208	287	337	314
	Point Hope	464	544	570	591
	Point Lay	68	105	129[6/]	158
	Wainwright	405	436	507	502
SUBTOTAL	Traditional Inupiat Communities	3,923	4,928	5,272	5,498
SUBTOTAL	Oil-Related Enclaves, Military Stations	276[7/]	6,306	3,036[8/]	[5/]
TOTAL	NORTH SLOPE BOROUGH	4,199	11,234	8,308	5,498

Sources: See footnotes below.

1/ USDOC, Bureau of the Census, 1981.
2/ Alaska Consultants, Inc., 1984.
3/ FY 1986 Revenue Sharing Program, State of Alaska, Department of Regional and Community Affairs.
4/ North Slope Borough Census Preliminary Report on Population Economy, May 1989.
5/ No data available.
6/ 1984 household census conducted by NSB.
7/ This figure from the 1980 U.S. Census under-represents the actual number of workers employed in petroleum-related enclaves.
8/ This number was calculated by Alaska Consultants, Inc., 1984, using a different methodolgy from that used in the 1980 Census. In 1982, the military stations contained around 200 people. The remainder of this subtotal consists of 39.1 percent of the latest average annual employment of the Prudhoe Bay, Kuparuk, and pipeline areas.

Table III-C-3
North Slope Population Trends
1929 to 1982

Community	1929	% Total	1939	% Total	1950	% Total	1960	% Total	1970	% Total	1980	% Total	1982	% Total	1988 1989	% Total
Anaktuvuk Pass	1/		1/		66	3.9	35	1.7	99	3.3	203	5.3	250	5.1	264	4.9
Atqasuk			78	6.2	49	2.9	30	1.4	2/		107	2.8	210	4.3	219	4.1
Barrow	330	32.4	363	28.9	951	56.7	1,314	63.3	2,098	69.4	2,207	57.7	2,882	58.5	3,223	58.6
Kaktovik	3/		13	1.0	46	2.7	120	5.8	123	4.1	165	4.3	214	4.3	227	4.2
Nuiqsut	3/		89	7.1	2/		2/		2/		208	5.4	287	5.8	314	5.7
Point Hope	139	13.7	257	20.4	264	15.7	324	15.6	386	12.8	464	12.1	544	11.0	591	10.5
Point Lay	351	34.5	117	9.3	75	4.5	2/		2/		68	1.8	105	2.1	158	2.9
Wainwright	197	19.4	341	27.1	227	13.5	253	12.2	315	10.4	405	10.6	436	8.9	502	9.1
TOTALS	1,017		1,258		1,678		2,076		3,021		3,827		4,928		5,498	

Source: USDOC, Bureau of the Census, 1981; Alaska Consultants, Inc., 1981; North Slope Borough Census, Report on Population and Economy, May 1989.

1/ Anaktuvuk Pass was not a village site in 1929 and 1939. It functioned as a seasonal camp.
2/ Settlement is abandoned, used as a seasonal camp, or too small to be censused.
3/ Figures are not available. Size is assumed to be small.

a regional center, grew at a 4.6-percent rate during these same years. Fueled by improving economic prospects and health care, the growth rate rose in the 1960's. In this decade, the North Slope added 945 people--3.8 percent per annum. Increasingly, economic prospects centered in Barrow, which grew 4.8 percent per year.

The early 1980's population boom is a unique event in the demographic history of the North Slope. It indicates indirectly the economic and social magnitude of NSB's CIP. During these years, CIP economic infusions created jobs, housing, and infrastructure in all the North Slope communities (see Sec. III.D.1, Sale 87 FEIS [USDOI, MMS, 1984a]). In these communities, this led to higher levels of population retention, to the return of people who had previously sought employment elsewhere, and to immigration of individuals--particularly non-Natives--who previously had not resided in the area. The newer communities of Atqasuk, Nuiqsut, and Point Lay grew much faster than Anaktuvuk Pass, Kaktovik, Point Hope, and Wainwright, with an annual average growth of 7.1 percent and 2.6 percent, respectively. This growth reflects higher per capita housing construction in the newer settlements. Outside Barrow, housing construction was the driving force in these CIP-fueled economies (Galginaitis, 1984). Barrow's growth boom in the 1980's--14.3 percent annually--indicates its role as the political and bureaucratic center for all these activities. Much of this growth has occurred from the inmigration of non-Natives. Between 1970 and 1980, this group grew from 9.5 to 22 percent of Barrow's total population. This group is made up primarily of Caucasians but includes Blacks, Filipinos, Koreans, Mexicans, and others (Smythe and Worl, 1985).

Figures for the preceding decade also show the importance of the NSB-CIP program. By the early 1970's, the area's growth rate was slowing. The Alaska Native Claims Settlement Act (ANCSA) settlement in 1971 and NSB incorporation in 1972 opened the way to expanded revenues, as well as to resettlement of Atqasuk, Nuiqsut, and Point Lay. This resettlement, financed primarily by the NSB, initially masked the CIP's role in promoting further centralization in Barrow. By creating construction jobs in the new settlements, other communities--most notably Barrow--lost inhabitants during the initial stages of elevated population growth. For the first time since 1939, Barrow actually lost ground in its share of the total North Slope population.

The effects of the CIP on the composition of North Slope communities can be seen from their non-Native populations. Between 1970 and 1980, the non-Native population grew by 150 percent. This population included teachers and technocrats, with or without their families, as well as skilled laborers required on local CIP projects. It also included other ethnic minorities who moved to Barrow and filled relatively low-paying unskilled and clerical jobs (Smythe and Worl, 1985). In particular, the number of laborers fluctuated rapidly along with construction demands. Nevertheless, in 1980, approximately 30 percent of all community inhabitants were non-Natives. The CIP-job-related characteristic of this influx is evident in its distribution among age groups. Only peak working years are well represented--children are relatively few, the aged almost nonexistent. Figure III-C-5 depicts total and Native-community population by percentage of age group. The age-30 to -34 group represents over 40 percent of all community inhabitants of that group. Actually, the percentage of non-Natives in these active years is under-represented by this graph. Since no age information was given for 19 percent of non-Native inhabitants, they were excluded from this tabulation.

The CIP expenditures were $93 million in 1980 and peaked at $302 million in 1983. They dropped to $211 million in 1984 and further to $199 million in 1985. The CIP projects face further drastic reduction and may drop to zero by 1990. This reduction is expected whether or not more OCS or onshore oil developments occur on the North Slope (see Sec. III.C.1.a). Because recent population growth has been tied to CIP-related opportunities, similar growth is not expected in the foreseeable future. Various population sectors should be differentially affected. Because non-Native residency is tied most directly to CIP projects, this group faces some reduction. This reduction may be heaviest among people in their 20's and 30's in settlements other than Barrow. It should involve people in construction roles more than those in managerial or technocratic roles.

In recent years, governmental functions have concentrated in Barrow; and its Native residents may be less affected by projected reductions in CIP expenditures than those in the smaller communities. Finally, with the

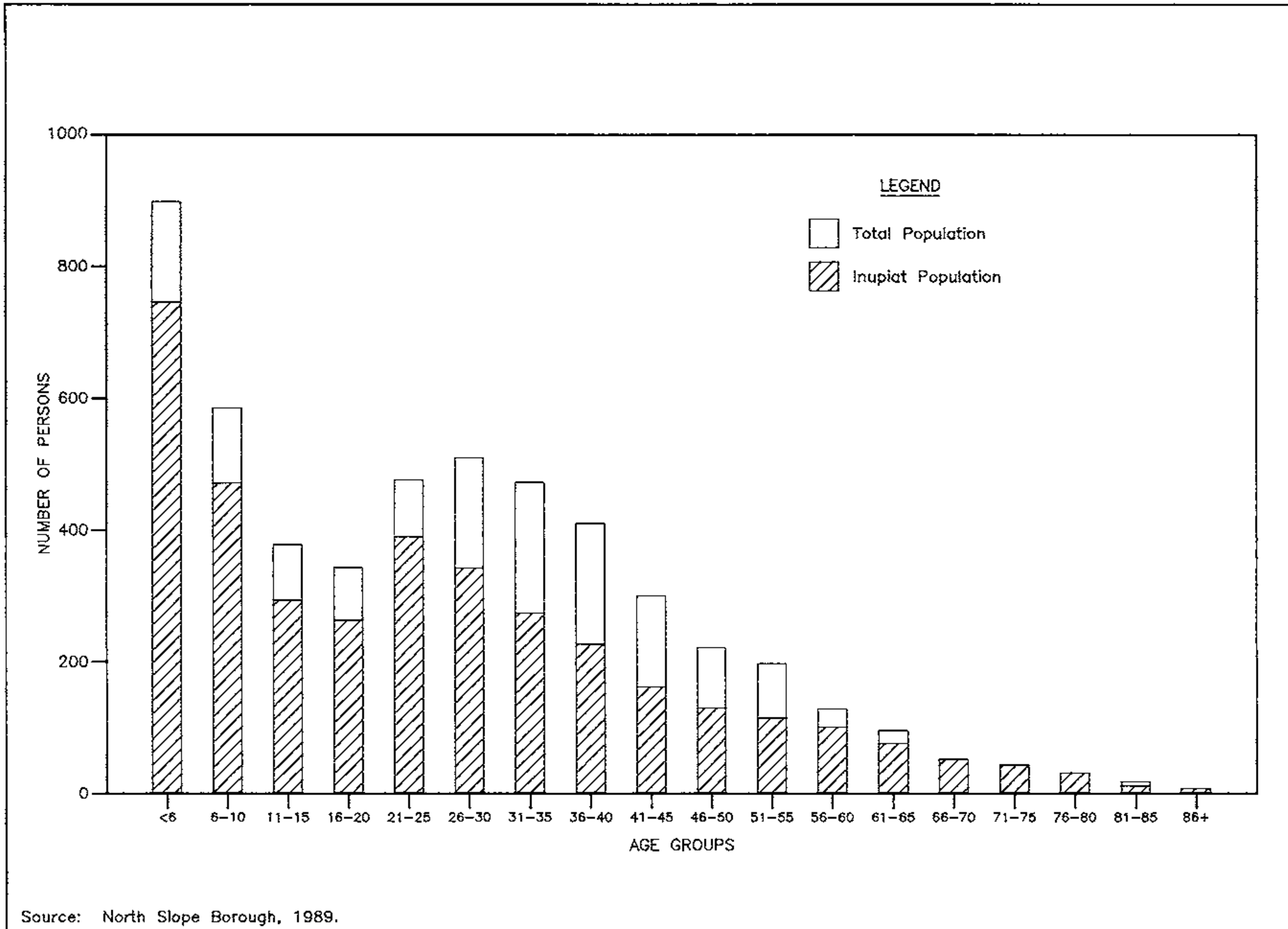


Figure III-C-5. Comparison of Inupiat and Total Population of the North Slope Borough, 1988 reduction of construction jobs, Native families may rely more on subsistence harvests. Native households with more developed subsistence-harvest and -sharing patterns may be less affected by demographic shifts than households without them. This may be particularly true in settlements other than Barrow.

2. Subsistence-Harvest Patterns:

a. Introduction: This section describes the subsistence- harvest patterns of the Inupiat (Eskimo) communities closest to the Sale 126 area: Barrow, Wainwright, Point Lay, Point Hope, Atqasuk, and Nuiqsut. This community-by-community description provides general information on subsistence-harvest patterns, harvest levels by resource, timing of those harvests, and harvest-area concentrations.

Subsistence-harvest patterns of several of the communities adjacent to the Chukchi Sea Sale 126 area are described in Section III.C.3 of the Beaufort Sea Sale 97 FEIS (USDOI, MMS, 1987a) as well as Section III.B.2 of the Chukchi Sea Sale 109 FEIS (USDOI, MMS, 1987b) and are incorporated by reference. The community residents in the Sale 126 area participate in a subsistence way of life. Until January 1990, Alaska statutes defined "subsistence uses" as: "the non-commercial, customary and traditional uses of wild, renewable resources by a resident domiciled in a rural area of the state for personal or family consumption" (AS 16.05.940) and subsistence uses were given priority over other uses. In January 1990, as a result of McDowell v. State of Alaska, this law was declared unconstitutional (inconsistent with the Alaska State Constitution) by the Alaska Supreme Court. However, Federal law (Title VIII of ANILCA) continues to define Alaskan subsistence and grants it priority over other uses. The January 1990 Alaska Supreme Court ruling means that Alaska cannot legally establish rural preference for subsistence; the effect of the ruling has been stayed until July 1, 1990. The State has until then to devise a solution to the issues raised in the McDowell decision.

Subsistence activities, which are assigned the highest cultural value by the Inupiat, provide a sense of identity as well as an important economic activity. Inupiat scoping concerns regarding oil development for Sale 126 can be divided into four categories (Kruse, Baring-Gould, and Schneider, 1983): (1) direct damage to subsistence resources and habitats, (2) disruption of subsistence species during migration, (3) disruption of access to subsistence areas, and (4) loss of Native food.

Effects on subsistence could be serious even if the net quantity of available food did not decline. Some species are important for the role they play in the annual cycle of subsistence-resource harvests. However, the consumption of harvestable subsistence resources provides more than dietary benefits; these resources also provide materials for personal and family use. The sharing of harvestable subsistence resources helps maintain traditional family organization. Subsistence resources provide special foods for religious and social occasions such as Christmas, Thanksgiving, and--the most important ceremony in the communities of the Sale 126 area--Nalukatak, which celebrates the bowhead whale harvest. The sharing, trading, and bartering of harvestable subsistence resources structures relationships among communities adjacent to the Sale 126 area, while the giving of such foods helps maintain ties with family members elsewhere in Alaska. Finally, subsistence provides a link to the market economy. Households within the sale area earn income from crafting walrus ivory and whale baleen and from harvesting furbearing mammals. As the availability of wage earnings associated with the oil industry and NSB Capital Improvements Program (CIP) projects declines in future years, this link may be expected to increase in importance in the communities of the sale area.

b. Community Subsistence-Harvest Patterns: This section provides general information regarding subsistence-harvest patterns in all of the communities close to the Sale 126 area. The extent of the subsistence area used by each community in the sale area is shown in Figures III-C-6 through III-C-11. These figures show the harvest-concentration areas for the various subsistence resources used by the communities of Barrow, Wainwright, Point Lay, Point Hope, Atqasuk, and Nuiqsut. Specific information regarding the harvest areas, species harvested, and quantities harvested is provided in the following discussion of each community. Under certain conditions, harvest activities may occur anywhere in the sale area; but they tend to be concentrated along rivers and coastlines, along migration routes, and near communities.

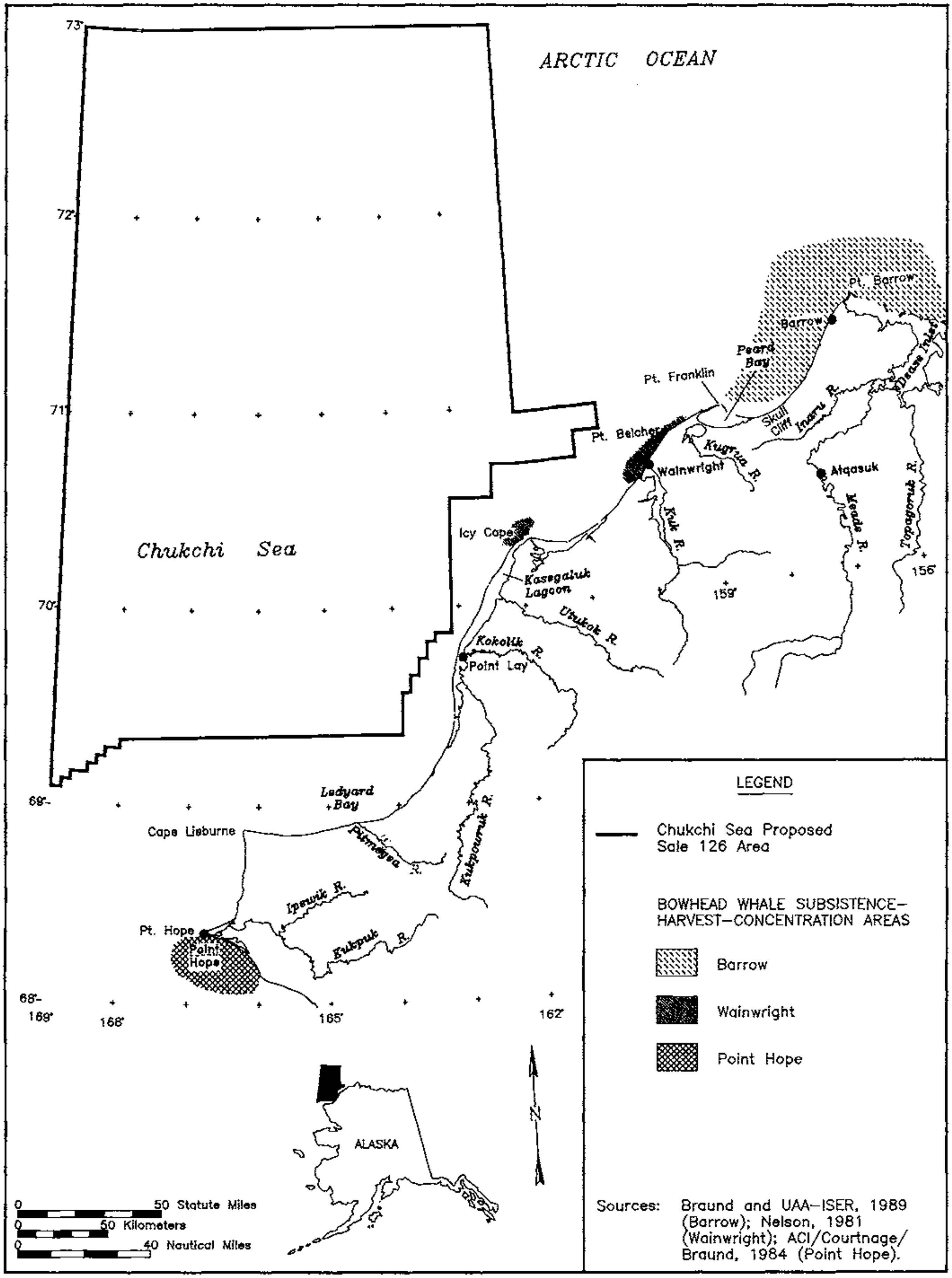


Figure III-C-6. Subsistence-Harvest-Concentration Areas for Bowhead Whale

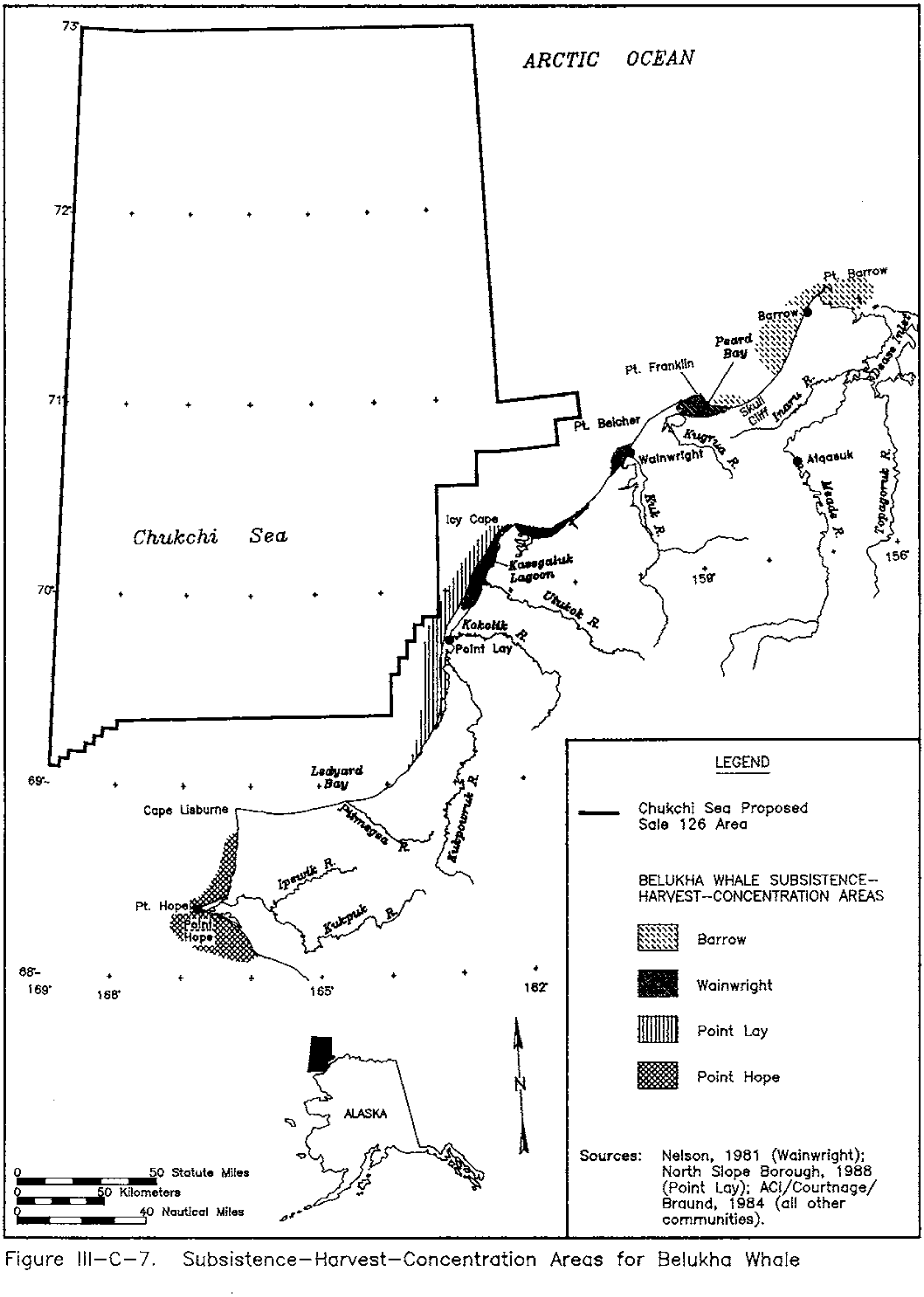


Figure III-C-7. Subsistence-Harvest-Concentration Areas for Belukha Whale

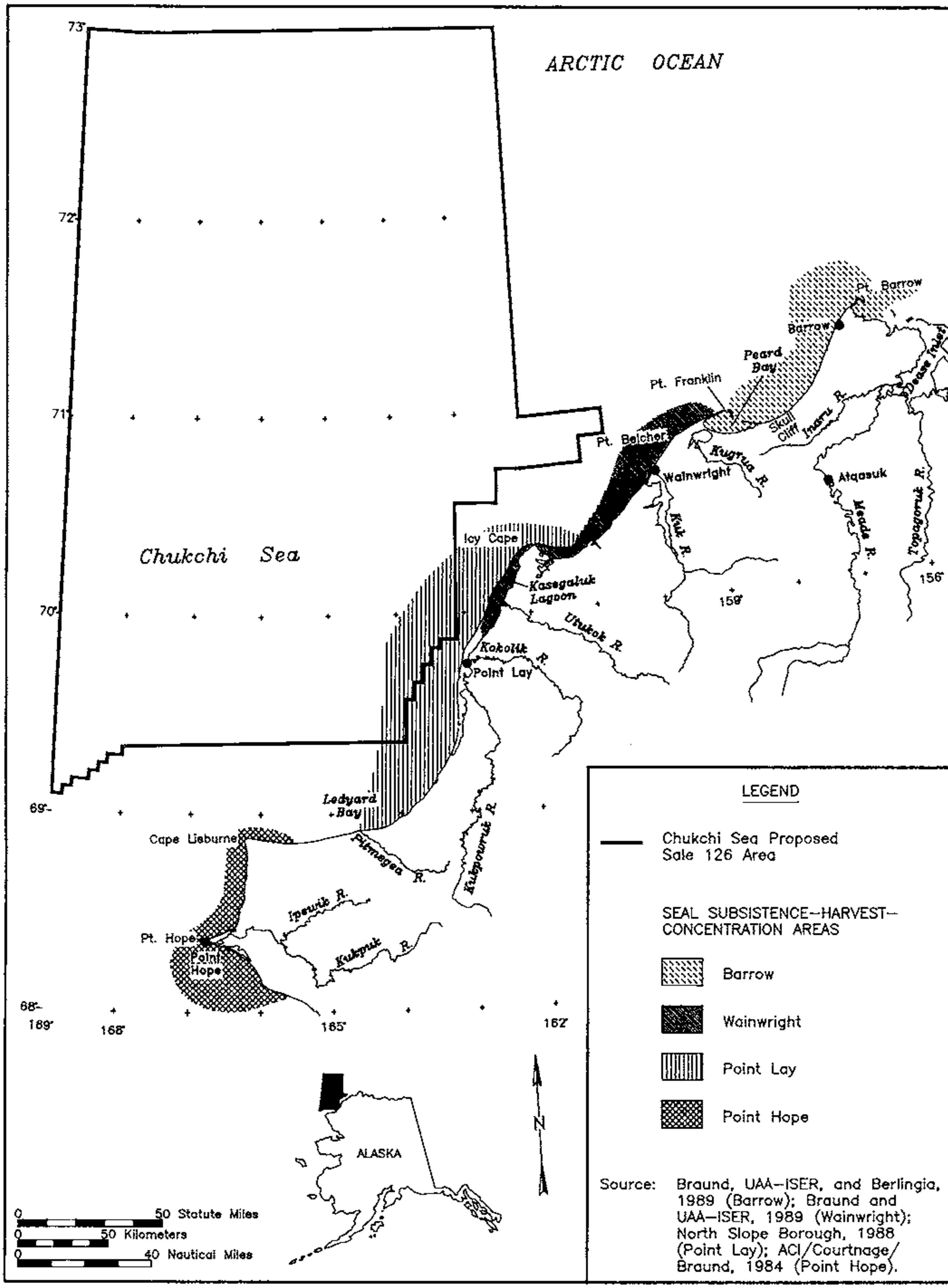


Figure III–C–8. Subsistence–Harvest–Concentration Areas for Seals

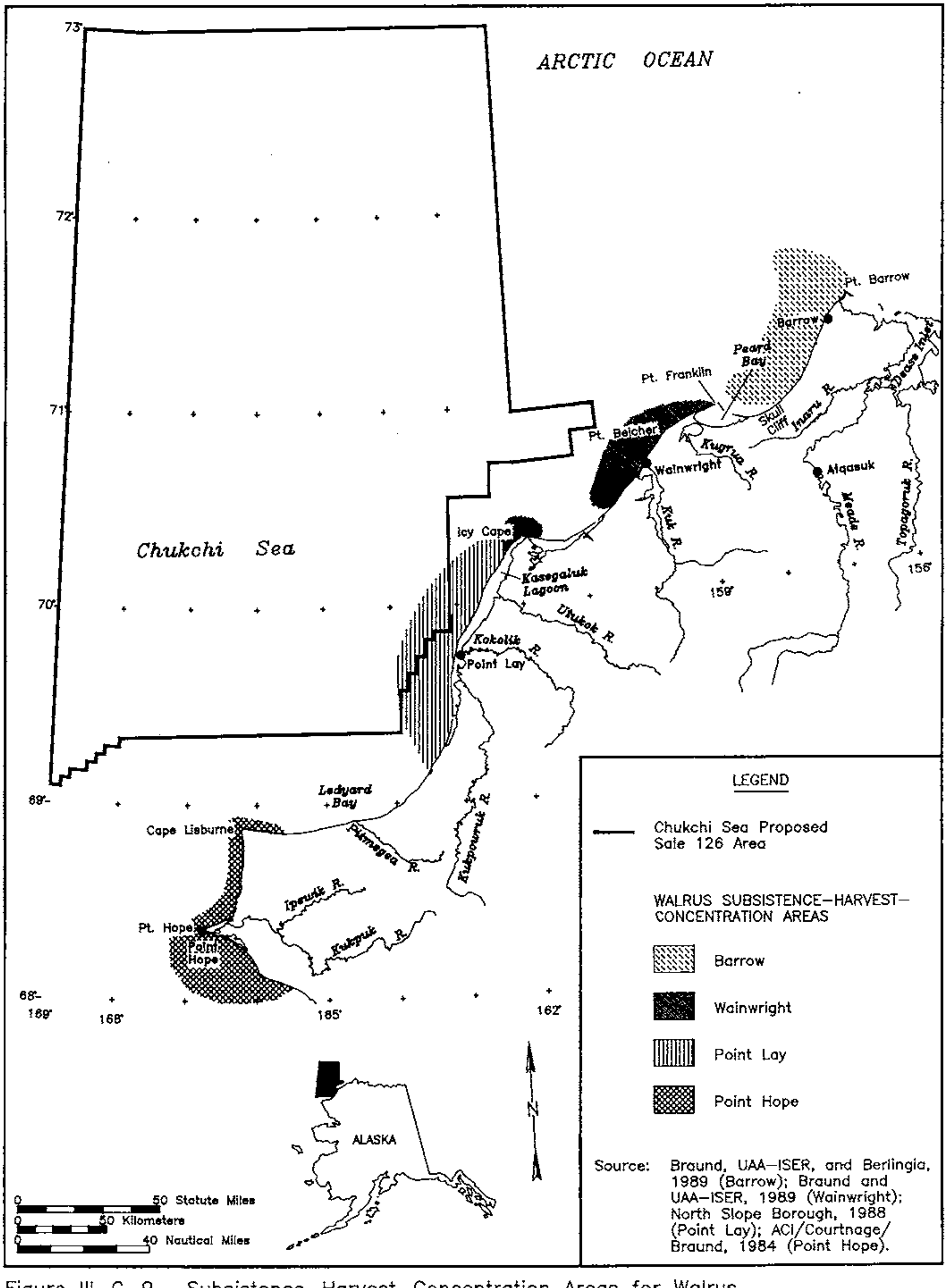


Figure III—C—9. Subsistence—Harvest—Concentration Areas for Walrus

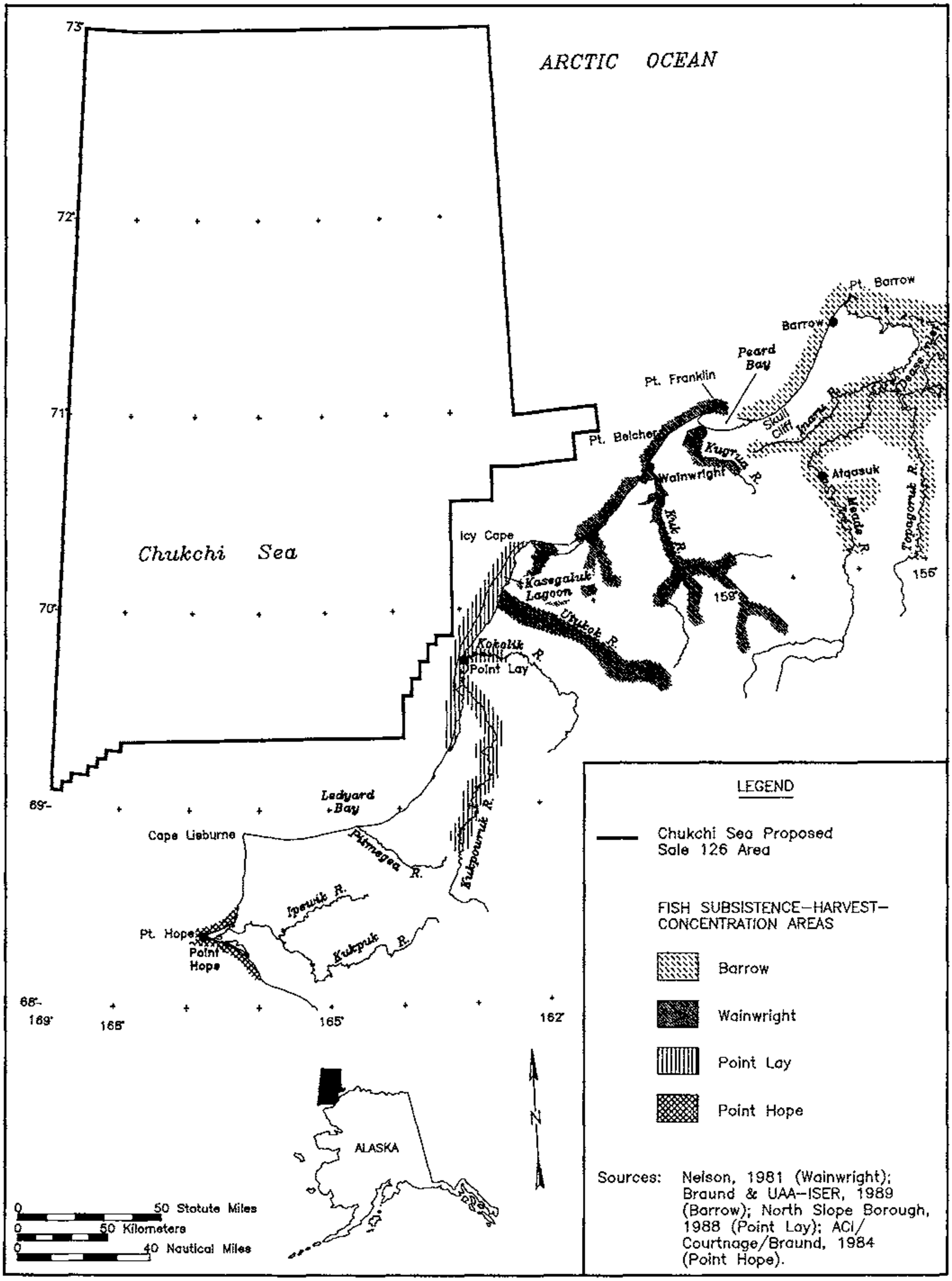


Figure III–C–10. Subsistence–Harvest–Concentration Areas for Fishes

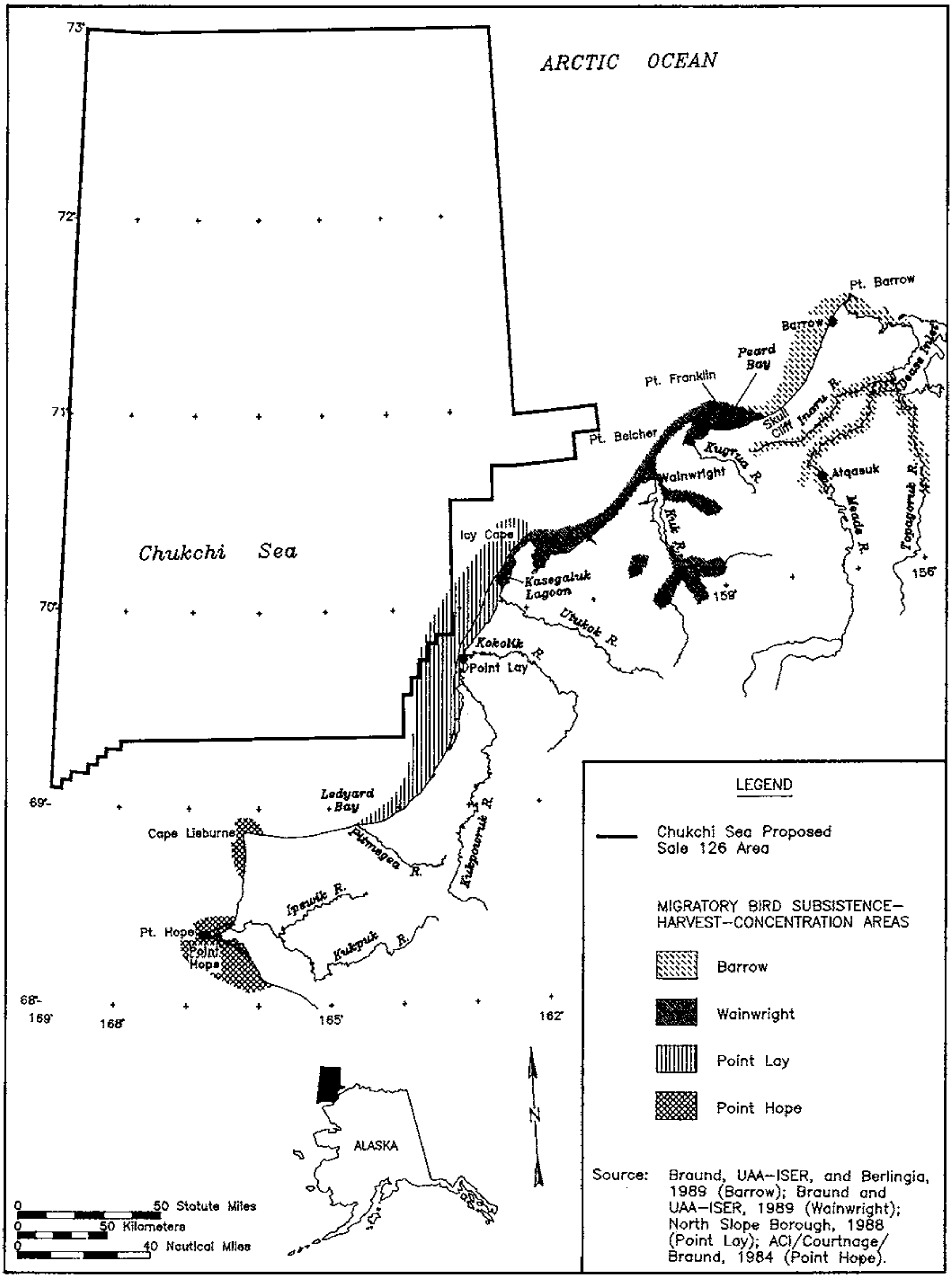


Figure III-C-11. Subsistence-Harvest-Concentration Areas for Migratory Birds

While the subsistence areas and activities of all six communities on the North Slope would be affected at least indirectly by proposed Sale 126, much of the marine subsistence-harvest areas of Wainwright, Point Lay, and Point Hope lie within or near the Sale 126 boundary. Parts of Atqasuk's and Barrow's marine subsistence-harvest areas, especially for bowhead whales, other marine mammals, marine fishes, and migratory waterfowl, lie near this boundary. The caribou hunting areas of Barrow, Wainwright, Atqasuk, and Nuiqsut would be most directly affected by pipelines and other onshore facilities associated with the proposal.

Subsistence harvest of vegetation by communities adjacent to the Sale 126 area is limited, while the harvest of faunal resources such as marine and terrestrial mammals and fishes is heavily emphasized. The spectrum of available resources in this region is limited when compared to more southerly regions. Tables III-C-4 through III-C-7 summarize residents' responses to the following categories: (1) subsistence resources most often harvested by communities close to the sale area, (2) resources that provided the largest source of meat, (3) resources that were consumed most often, and (4) resources that were preferred (see the Beaufort Sea Sale 97 FEIS, Sec. III.C.3 [USDOI, MMS, 1987a]). While the responses differed from community to community, the combination of caribou, bowhead whale, and fish was identified by between 75 and 95 percent of all respondents as being the primary group of resources harvested (Tables III-C-4 through III-C-7). The lowest percentage for this combination occurred in Point Hope, where residents use the greatest variety of subsistence resource.

Available data on kilograms of harvested and/or consumed subsistence resources provide a good idea of subsistence levels and dependency (Stoker, 1983, as cited by Alaska Consultants, Inc. [ACI], and Stephen Braund and Assoc., 1984). The caribou is the most important resource in terms of effort spent hunting and quantity of meat hunted (effort spent hunting is measured by frequency of hunting trips rather than total pounds harvested (Tables III-C-4 through III-C-7). However, an MMS-sponsored study (Stephen R. Braund and Assoc./University of Alaska [UAA], ISER, 1989a,b) indicates that in recent years the bowhead whale provided a higher portion of the subsistence diet for Barrow and Wainwright than previously thought (Table III-C-7). While these data may conflict with the recent data indicating an ascendant dietary position for caribou, this contradiction might be explained in three ways: (1) the relative abundance of the two species has changed; (2) due to the greater unit of effort required to harvest caribou, respondents have tended to overestimate the relative size of the caribou take; and (3) the Stephen R. Braund/UAA, ISER (1989a,b) data represent an anomaly in the subsistence-harvest cycle; and, in the long run, caribou will again dominate the subsistence harvest. The bowhead whale is a preferred meat and also is extremely important as a basis for sharing and community cooperation--the foundation of the sociocultural system (see the Sale 97 FEIS, Sec. III.C.3 [USDOI, MMS, 1987a]). Depending on the community, fish are the second- or third-most important resource after caribou and bowhead whale (Table III-C-5). The bearded seal and birds also are considered primary subsistence species. Waterfowl are particularly important during the spring, when they provide variety to the subsistence diet. Seal oil from hair and bearded seals is an important staple and a necessary complement to other subsistence foods.

Whaling is a major concern in the Sale 126 area. The subsistence pursuit of the bowhead whale occurs at Barrow, Wainwright, and Point Hope. Because they migrate too far offshore, bowheads are unavailable to the people of Point Lay. In Point Lay, a communal hunt of belukha whales serves many of the same economic and social functions that bowhead whaling serves in other coastal NSB communities. The people of Point Lay share the highly valued belukha meat with other communities in the area. At present, whaling is the most valued subsistence activity in the sale area. This is true in spite of International Whaling Commission (IWC) quotas and relatively plentiful supplies of caribou, fish, and other subsistence foods. Whaling traditions include kinship-based crews, use of skin boats, shoreline preparation for distribution of the meat, and total community participation and sharing. In spite of the rising household income, these traditions remain as central values and activities for all the Inupiat in these communities (see the Sale 109 FEIS, Sec. III.C.3 [USDOI, MMS, 1987b], for a discussion on the cultural importance of whaling). Barrow is the only community within the area that whales during both spring and fall (see Fig. III-C-6), although its fall whaling area lies to the east of the Sale 126 area. Wainwright and Point Hope residents hunt bowheads only during the spring season.

Table III-C-4
Subsistence Resources Most Often Harvested in 1981
by Selected North Slope Communities[1/]
(Percentage Distribution of Responses)

Resource	Wainwright	Barrow	Nuiqsut	Point Hope
Caribou	62.2	33.8	76.7	12.5
Walrus	2.7	5.6	0.0	6.2
Bowhead Whale	21.6	26.8	0.0	50.0
Fishes	10.8	24.0	16.7	9.4
Seals	0.0	1.4	0.0	3.1
Bearded Seal	2.7	4.2	16.7	9.4
Birds	0.0	1.4	3.3	0.0
Other	0.0	2.8	3.3	9.4
Total	100.0	100.0	100.0	100.0
(Number of Respondents)	(37)	(32)	(30)	(71)

Source: Alaska Consultants, Inc., and Stephen Braund and Assoc., 1984.

[1/] No data are available for Point Lay and Atqasuk.

Table III-C-5
Largest Sources of Meat Harvested in 1981
by Selected North Slope Communities[1/]
(Percentage Distribution of Responses)

Resource	Wainwright	Barrow	Nuiqsut	Point Hope
Caribou	55.2	64.2	75.9	26.5
Walrus	0.0	4.5	0.0	2.9
Bowhead Whale	20.7	10.4	0.0	17.6
Fishes	10.3	14.9	20.7	32.4
Seals	0.0	0.0	0.0	5.9
Bearded Seal	6.9	1.5	3.4	11.8
Birds	6.9	3.0	0.0	0.0
Other	0.0	1.5	0.0	2.9
Total	100.0	100.0	100.0	100.0
(Number of Respondents)	(29)	(67)	(29)	(34)

Source: Alaska Consultants, Inc., and Stephen Braund and Assoc., 1984.

[1/] No data are available for Point Lay and Atqasuk.

Table III-C-6
Meat Most Often Consumed from Subsistence Harvests by Selected North Slope Communities[1/] (Percentage Distribution of Responses)

Resource	Wainwright	Barrow	Nuiqsut	Point Hope
Caribou	79.4	71.4	93.4	32.4
Walrus	0.0	0.0	0.0	0.0
Bowhead Whale	17.6	8.6	0.0	29.4
Fishes	0.0	0.0	0.0	20.6
Seals	0.0	0.0	0.0	0.0
Bearded Seal	3.0	1.4	0.0	11.8
Birds	0.0	17.2	3.3	2.9
Other	0.0	1.4	3.3	2.9
Total	100.0	100.0	100.0	100.0
(Number of Respondents)	(34)	(70)	(30)	(34)

Source: Alaska Consultants, Inc., and Stephen Braund and Assoc., 1984.

[1/] No data are available for Point Lay and Atqasuk.

Table III-C-7
Preferred Meat from Subsistence Harvests for Selected North Slope Communities[1/] (Percentage Distribution of Responses)

Resource	Wainwright	Barrow	Nuiqsut	Point Hope
Caribou	30.5	17.8	50.0	2.7
Walrus	0.0	1.4	0.0	0.0
Bowhead Whale	66.7	72.6	32.1	94.6
Fishes	0.0	5.5	10.7	0.0
Seals	0.0	2.7	0.0	0.0
Bearded Seal	0.0	0.0	0.0	0.0
Birds	0.0	0.0	0.0	0.0
Sheep	0.0	0.0	0.0	0.0
Other	2.8	0.0	3.6	2.7
Total	100.0	100.0	100.0	100.0
(Number of Respondents)	(36)	(73)	(28)	(37)

Source: Alaska Consultants, Inc., and Stephen Braund and Assoc., 1984.

[1/] No data are available for Point Lay and Atqasuk.

Harvest data for Barrow, Wainwright, and Point Hope are only estimates that represent average values. Because of this limitation, resource-harvest data are presented in terms of a 20-year average for selected North Slope communities (Table III-C-8). Table III-C-8, which shows the contribution made by various harvestable subsistence resources to the Native diet, is based on the amount of usable meat and fat contributed to the diet rather than on the number of animals harvested. The 20-year averages do not reflect the important shift in subsistence-harvest patterns that occurred in the late 1960's, when the substitution of snow machines for dog sleds decreased the importance of ringed seal and walrus (two key dog foods) and increased the relative importance of waterfowl in the subsistence system. While ringed seal and walrus remain significant human foods and walrus still provides important raw materials for Native handicrafts, this shift illustrates that technological or social change may lead to long-term modifications of the subsistence system. Because of a projected decline in NSB CIP projects, community wage work, and incomes (see Sec. III.C.1), subsistence hunting in general may increase. The hunting of walrus and polar bear, particularly, may increase because of their importance for Native handicrafts. Because of recent changes in technology and subsistence-harvest patterns, the dietary importance of waterfowl also may continue to increase. However, none of these changes would affect the predominant dietary roles of caribou, whales, or fish. These three resources, for which there are no logical substitutes, play a central and specialized role in the North Slope subsistence system.

(1) Barrow: As with other communities adjacent to the Sale 126 area, Barrow residents (population 3,075 in 1985) enjoy a diverse resource base that includes both marine and terrestrial animals. Barrow's location is unique among the communities in the sale area--the community is a few miles southwest of Point Barrow, the demarcation point between the Beaufort and Chukchi Seas. The location offers superb opportunities for hunting a diversity of marine and terrestrial mammals and fishes.

(a) Bowhead Whale: Unlike residents of other communities close to the Sale 126 area, Barrow residents hunt the bowhead whale during both spring and fall; however, more whales are harvested during the spring whale hunt, which is the major whaling season. In 1977, the IWC established a quota for subsistence hunting of the bowhead whale by Alaskan Inupiat. The quota is currently regulated by the Alaska Eskimo Whaling Commission (AEWC), which annually decides how many bowheads each community may take; this number depends on the overall quota set by the IWC. Barrow whalers hunt in the fall only if they do not get their quota during the previous spring hunt. There are approximately 30 whaling camps along the edge of the landfast ice. The location of the camps depends on ice conditions and currents. Strong currents and many leads near Point Barrow prohibit crews from camping near the point. Most whaling camps are located south of Barrow, as far south as Walakpa Bay.

The bowhead is hunted in two different areas, depending on the season. In the spring (from early April until the first week of June [Fig. III-C-6]), the bowhead is hunted from leads that open when the pack-ice conditions deteriorate. The bowhead is harvested along the coast from Point Barrow to the Skull Cliff area (Fig. III-C-6). The distance of the leads from shore varies from year to year. The leads generally are parallel and quite close to shore, but they occasionally break directly from Point Barrow to Point Franklin and force Barrow whalers to travel over the ice as much as 16 km offshore to the open leads (see also Fig. III-C-6). The lead is normally open from Point Barrow to the coast, and the hunters are able to whale only 2 to 5 km from shore. A stricken whale can be chased in either direction in the lead. Spring whaling in Barrow is conducted almost entirely with skin boats because the narrow leads prohibit the use of aluminum skiffs, which are more difficult to maneuver than the traditional boats (Alaska Consultants, Inc. [ACI], Courtnage, and Braund, 1984). Fall whaling occurs outside of the Sale 126 area east of Point Barrow (Fig. III-C-6) from the Barrow vicinity in the Chukchi Sea to Cape Simpson in the Beaufort Sea. Hunters use aluminum skiffs with outboard motors to chase the whales during the fall migration, which takes place in open water up to 48 km offshore. No other marine mammal is harvested with the intensity and concentration of effort that is expended on the bowhead whale. The bowhead is very important in the subsistence economy and has accounted for 21.3 percent (an average of 10.1 whales/yr) of the annual subsistence harvest in a 20-year period ending in 1982, varying from zero harvested to 23 in the subject year (Tables III-C-9 and III-C-10). In the most recent study period (1987-88), the bowhead accounted for as much as 33 percent of

Table III-C-8
Annual Harvest of Subsistence Resources Averaged for the Period 1962-1982 for Selected North Slope Communities (Percentage Distribution of Responses)

Resource	Wainwright	Barrow	Nuiqsut	Point Hope
Bowhead Whale	1.50	10.10	0.30	4.50
	13,350	89,890	2,670	40,050
	8.2%	21.3%	8.6%	22.3%
Caribou	1,200	3,500	400	756
	84,000	245,000	28,000	59,920
	51.6%	58.2%	90.2%	29.5%
Walrus	86	55	---	15
	30,205	19,250	---	5,250
	18.5%	4.6%	---	2.9%
Bearded Seal	250	150	---	200
	20,000	12,000	---	16,000
	12.3%	2.9%	---	8.9%
Hair Seals	375	955	---	1,400
	7,125	18,145	---	26,600
	4.4%	4.3%	---	14.8%
Belukha Whale	11	5	---	29
	4,400	2,000	---	11,600
	2.7%	0.5%	---	6.6%
Polar Bear	7	7	1	9
	450	1,125	225	2,025
	0.3%	0.3%	0.1%	1.1%
Moose	2	5	---	4
	450	1,125	---	900
	0.3%	0.3%	---	0.5%
Reindeer	0	0	0	0
	0.0%	0.0%	---	0.0%
Small Land Mammals	---		---	---
	---	455	---	---
	---	0.1%	---	---
Birds			---	
	545	3,636	---	5,682
	0.3%	0.9%	---	3.2%
Fishes			---	
	1,273	27,955	---	18,182
	0.8%	6.6%	---	10.1%
Vegetation	---	---	---	---
	---	---	---	---
	---	---	---	---
Total Harvest (kg)	162,923	421,031	---	179,209
Per Capita Harvest (kg)	439	245	---	413

Source: Stoker, 1983, as cited by Alaska Consultants, Inc., and Stephen Braund and Assoc., 1984.

Table III-C-9
Primary Subsistence Resources Harvested for the Period
1962-1982 by Selected North Slope Communities[1/]
(Percentage of Average Total Village Harvest)

Village	Bearded Seal	Belukha Whale	Birds	Bowhead Whale	Caribou	Fishes	Hair Seal	Walrus	Other
Barrow	2.9	0.5		21.3	58.2	6.6	4.3	4.6	2.1
Point Hope	8.9	6.5	3.2	22.3	29.5	10.1	14.8	2.9	1.8
Wainwright	2.3	2.7		8.2	51.6		4.4	18.5	2.3

Source: Stoker, 1983, as cited in Alaska Consultants, Inc., and Stephen Braund and Assoc., 1984.

[1/] No data are available for Point Lay, Atqasuk, and Nuiqsut.

Table III-C-10
Subsistence Resources Harvested by Selected North Slope Communities[1/]

Resource	Barrow C/IN[2/]	Wainwright C/IN	Point Lay C/IN	Point Hope C/IN	Atqasuk IN	Nuiqsut IN/C
Bowhead Whale	X	X	[3/]	X		X
Caribou	X	X	X	X	X	X
Fishes	X	X	X	X	X	X
Belukha Whale	X	X	[3/]	X		X
Seals	X	X	X	X		X
Bearded Seal	X	X	X	X		X
Walrus	X	X	X	X		X
Polar Bear	X	X	X	X		X
Moose	X	X	X	X	X	X
Sheep				X		
Small Land Mammals	X	X	X	X	X	X
Ducks	X	X	X	X	X	X
Geese[4/]	X	X	X	X	X	X
Murres						
Owls					X	
Ptarmigan	X	X	X	X	X	X
Bird Eggs	X	X	X	X	X	X
TOTAL	14	14	14	16	9	13

Sources: NSB Contract Staff, 1979:10-14; Alaska Consultants, Inc., and Stephen Braund and Assoc., 1984: Tables 96, 97, 98, and 108.

[1/] This list of resources is derived from NSB Contract Staff (1979:14). For the purposes of this table, "primary" and "secondary" resources are joined and designated with an "X." Following ACI/Braund (1983: Tables 96, 97, 98, and 108), bowhead whales, caribou, and fishes are listed first to designate their relative importance.
[2/] C = Coastal/Marine; IN = Inland/Freshwater; the code listed first is emphasized.
[3/] Of these three important resources--bowhead whale, caribou, and fishes, caribou and fishes are major resources for both inland and coastal settlements. The bowhead whale is an important resource for all coastal North Slope communities except Point Lay, where they are not available. The belukha whale is very important at Point Lay, however, and plays an equivalent role to the bowhead in the Point Lay economy.
[4/] Migratory birds, particularly geese, are of increasing importance to the subsistence system; however, because of their limited mass, they cannot be classed with bowhead, caribou, or fishes.

the subsistence take (Table III-C-11).

(b) Belukha Whale: The belukha whale is available from the beginning of whaling season through June and occasionally in July and August (Fig. III-C-7) in ice-free waters. Barrow hunters do not like to hunt belukha during the bowhead hunt for fear of scaring the bowhead. The hunters harvest belukha after the spring bowhead season ends, which depends on when the bowhead quota is achieved. The belukha is harvested in the leads between Point Barrow and Skull Cliff (Fig. III-C-7). Later in summer, the belukha is occasionally harvested on both sides of the barrier islands of Elson Lagoon. Because the lagoon has numerous passes, it is not possible to herd the belukha as is done in Point Lay (ACI, Courtnage, and Braund, 1984). In a 20-year period ending in 1982, the annual average belukha harvest was estimated at 5, or 0.5 percent of the total annual subsistence harvest (Table III-C-9).

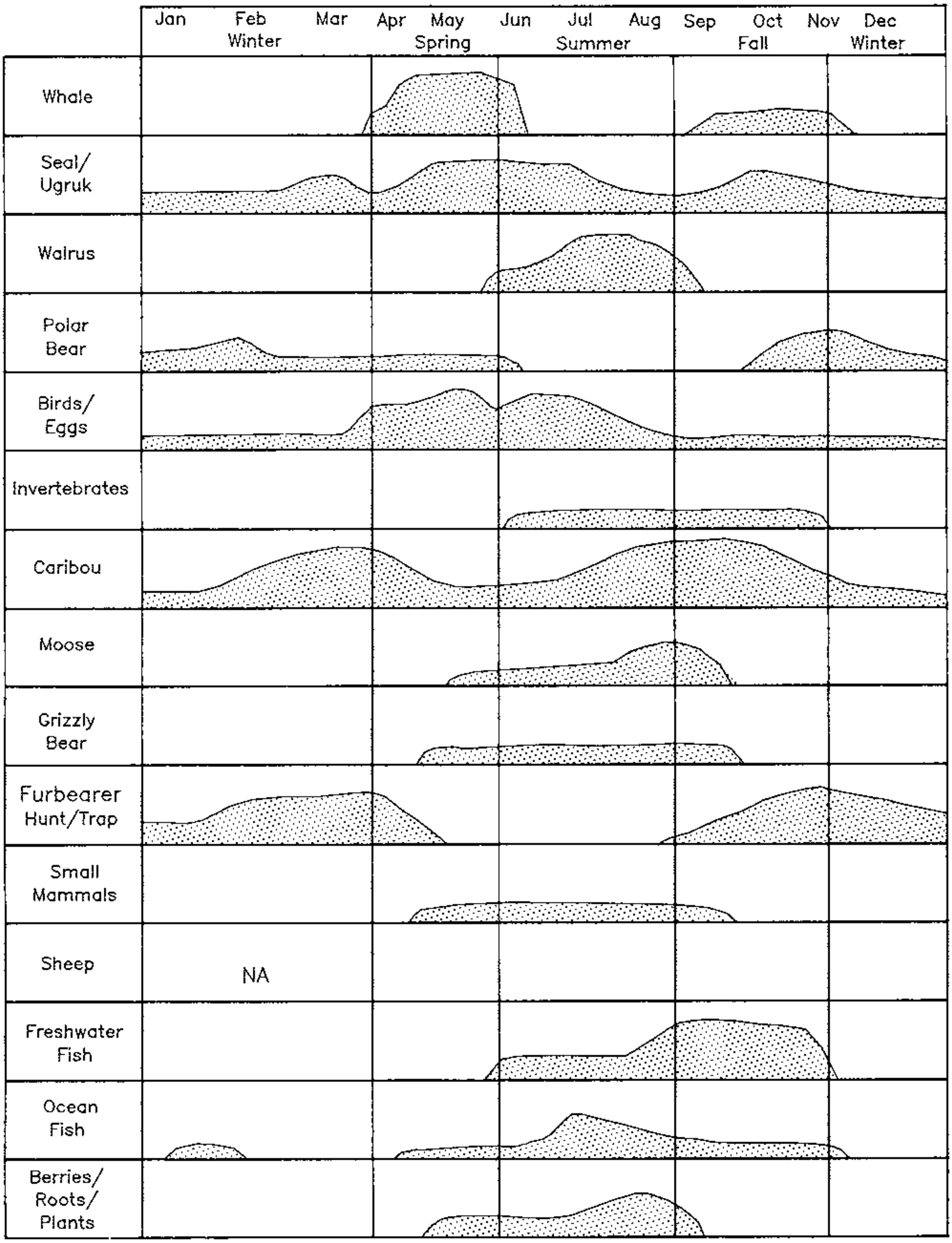
(c) Caribou: The caribou, the primary source of meat for Barrow residents, is available throughout the year, with peak-harvest periods from February through early April and from late June through late October (Fig. III-C-12). In a 20-year period ending in 1982, residents harvested an annual average of 3,500 caribou (Table III-C-8), which accounted for 58.2 percent of the total annual subsistence harvest.

(d) Seals: Hair seals are available from October through June; however, because of the availability of the bowhead, bearded seal, and caribou during various times of the year, seals are harvested primarily during the winter months, especially during February through March (Fig. III-C-12). The ringed seal is the most common hair seal species harvested. The spotted seal is harvested only in the ice-free summer months. Ringed seal hunting is concentrated in the Chukchi Sea, although some hunting occurs off Point Barrow and along the barrier islands that form Elson Lagoon (Fig. III-C-8). During the winter, leads in the area immediately adjacent to Barrow and north toward the point make this area an advantageous spot for sealing. The spotted seal also is occasionally harvested off Point Barrow and the barrier islands of Elson Lagoon. Oarlock Island in Admiralty Bay is a favorite place for hunting spotted seals (ACI, Courtnage, and Braund, 1984). In the past 20 years, hair seal harvests are estimated at between 31 and 2,100 seals a year (Table III-C-12). The average annual harvest over the past 20 years is estimated at 955 seals, or 4.3 percent of the total annual subsistence harvest (Table III-C-8).

The hunting of bearded seal is an important subsistence activity in Barrow because bearded seal is a preferred food, and its skin is used to cover the whaling boats. Six to nine skins are needed to cover a boat. The bearded seal is hunted from spring camps in the Chukchi Sea and from open water during concurrent pursuit of other marine mammals. The majority are harvested during the spring and summer months. Bearded seal occasionally is available in Dease Inlet and Admiralty Bay (Fig. III-C-8) (ACI/Courtnage/Braund, 1984). No harvest data are available for the number of bearded seals harvested annually; however, the annual subsistence harvest averaged over 20 years was 150 seals, or about 2.9 percent of the total annual subsistence harvest (Table III-C-8).

(e) Fishes: Barrow residents harvest marine and riverine fishes, but their dependency on fish varies according to the availability of other resources. Capelin, char, cod, grayling, salmon, sculpin, trout, and whitefishes are harvested (ACI, Courtnage, and Braund, 1984). Fishing occurs primarily in the summer and fall months and peaks in September and October (Fig. III-C-12). Fishing also occurs concurrently with caribou hunting in the fall. From December through March, communities fish for tomcod through the ice.

The subsistence-harvest area for fish is extensive, primarily because Barrow residents supplement their camp food with fish whenever they are hunting. From Peard Bay west of Barrow to east of Pitt Point on the Beaufort Sea coast, marine fishing occurs in the summer in conjunction with the pursuit of other subsistence resources (Fig. III-C-10). Most fishing occurs closer to Barrow in three areas: (1) along the Chukchi Sea coastline from Point Barrow to Walikpa Bay, (2) inside Elson Lagoon near Barrow, and (3) along the barrier islands of Elson Lagoon (Craig, 1987). From Barrow to Peard Bay, fishing occurs primarily during the spring and summer hunts for waterfowl and marine mammals. Intensive marine fishing takes place in the area of the Chukchi Sea just west of the point immediately adjacent to Barrow. In Elson Lagoon and along the



Source: North Slope Borough Contract Staff, 1979.

Figure III-C-12. Barrow Annual Subsistence Cycle *

* Patterns indicate desired periods for pursuit of each species based upon the relationship of abundance, hunter access, seasonal needs, and desirability. Peaks represent optimal periods of pursuit of subsistence resources.

Table III-C-11
Two-Year Subsistence Harvest for Barrow and Wainwright
1987-1988

	Edible Kilograms Harvested	Percent of Total Harvest	Per Capita Kilograms
Barrow			
Bowhead	94,809	33.6	31.4
Other Marine Mammals	58,156	20.6	19.3
Caribou	80,829	28.6	26.8
Other Terrestrials	11,958	4.3	3.9
Fishes	26,683	9.5	8.8
Birds	9,761	3.5	3.2
Wainwright[1/]			
Bowhead	49,177	42.3	98.5
Other Marine Mammals	32,277	27.8	63.9
Caribou	26,805	23.1	56.6
Other Terrestrials	726	.06	1.6
Fishes	4,488	3.9	55.1
Birds	2,794	2.4	5.9

Source: Stephen R. Braund and Associates, UAA/ISER and Beringia, 1989.

[1/] Data for Wainwright, 1988 only.

Table III-C-12
Annual Harvest of Subsistence Resources
for Which Sufficient Data Are Available, 1962-1982
Barrow

Year	Bowhead Whale (No.)	Walrus (No.)	Hair Seals[1] (No.)	Polar Bear (No.)	Total Harvest[2] (Kg)
1962	5	[5]	450	[3]	366,046
1963	5	165	412	[3]	403,824
1964	11	10	[5]	[3]	413,291
1965	4	57	114	[3]	351,462
1966	7	12	63	[3]	361,443
1967	3	55	31	[3]	390,284
1968	10	16	102	[3]	433,996
1969	11	7	2,100	[3]	478,896
1970	15	39	2,000	[3]	461,496
1971	13	51	1,800	[3]	547,421
1972	19	150	1,700	6	480,196
1973	17	20	1,500	5	405,196
1974	9	35	1,000	7	407,671
1975	10	15	1,000	10	565,496
1976	23	136	1,000	9	514,346
1977	20	62	1,000	15	348,741
1978	3	30	[5]	5	347,741
1979	3	30	[5]	1	411,891
1980	9	[5]	[5]	9[4]	365,766
1981	4	[5]	[5]	5[4]	412,131
1982	0	[5]	[5]	7[4]	[5]
Annual Average	10.1	55	955	7	424,716

Source: Stoker, 1983, as cited by Alaska Consultants, Inc., and Stephen Braund and Assoc., 1984.

1/ Seal-harvest figures are estimates only and are probably on the low side.
2/ Estimated kilograms, includes all species.
3/ Data are not available by community, only for the entire State (Schliebe, oral comm., 1987).
4/ Schliebe (1985: Tables 8, 9, and 10). In 1983 and 1984, Barrow residents harvested 11 and 35 polar bears, respectively (Schliebe, 1985: Tables 10, 11, and 12).
5/ No data available.

Beaufort Sea coast and in Dease Inlet and Admiralty Bay, fishing occurs during the summer and fall from caribou hunting camps, fall-whaling stations, and other camps. Marine fishing is conducted with gill nets and by jigging. Species harvested include whitefishes, least cisco, grayling, and a few burbot and salmon (Craig, 1987).

Fish camps established at traditional family sites along the coast are generally on points of land, at the mouths of rivers, and at other strategic locations. While coastal fishing can be an important source of fish, most of the fishing occurs at inland fish camps, particularly in lakes and rivers that flow into the southern end of Dease Inlet (Craig, 1987). Inland fish camps are found in the Inaru, Meade, Topagoruk, and Chipp River drainages. These camps provide good fishing opportunities as well as access to inland caribou and birds (ACI, Courtnage, and Braund, 1984). During 1969-1973, the average annual harvest of fish was about 37,727 kilograms (kg) (Craig, 1987); in the past 20 years, the estimated annual average was 27,955 kg, which accounts for 6.6 percent of the total annual subsistence harvest (Table III-C-8). In a 1986 partial estimate of fish harvests for the Barrow fall fishery in the Inaru River, the catch composition was least cisco (45%), broad whitefish (36%), humpback whitefish (16%), arctic cisco (1%), fourhorn sculpin (1%), and burbot (0.5%) (Craig, 1987).

(f) Walrus: The walrus is harvested during the spring marine mammal hunt west of Point Barrow and southwest to Peard Bay (Fig. III-C-9). Most hunters will travel no more than 24 to 32 km to hunt walrus. The major walrus-hunting effort occurs from late June through mid-September, with the peak season in August (Fig. III-C-12). The annual average harvest over 20 years is estimated at 55 walrus, or 4.6 percent of the total annual subsistence harvest (Table III-C-8).

(g) Migratory Birds: Migratory birds, particularly eider ducks and geese, provide an important food source for Barrow residents, not because of the quantity of meat harvested or the time spent hunting them but because of their dietary importance during spring and summer. Geese are harvested more often inland along rivers, while most eider and other ducks are harvested along the coast. Once harvested extensively, snowy owls are no longer taken regularly. Eggs are still gathered occasionally, especially on the offshore islands where fox and other predators are less common. Later in the spring, Barrow residents harvest many geese and ducks, with a peak in May and early June continuing until the end of June (Fig. III-C-12). Birds may be harvested throughout the summer, but only incidentally to other subsistence activities. For example, beginning in late April or early May, waterfowl provide a fresh meat source for whaling camps. In late August and early September, with a peak in the first 2 weeks of September, ducks and geese migrate south and are again hunted by Barrow residents. Birds, primarily eider and other ducks, are hunted along the coast from Point Franklin to Admiralty Bay and Dease Inlet. Concentrated hunting areas are located along the shores of the major barrier islands of Elson Lagoon.

After spring whaling, geese are hunted inland (Fig. III-C-11). A favorite spot for hunting birds is the "shooting station" at the narrowest point of the barrier spit that forms Point Barrow and separates the Chukchi Sea from Elson Lagoon. This area, a highly successful hunting spot during the spring and fall bird migrations, is easily accessible to Barrow residents (ACI, Courtnage, and Braund, 1984). Barrow residents harvested an estimated annual average (over 20 yr) of 3,636 kg of birds, which accounts for about 0.9 percent of the total annual subsistence harvest (Table III-C-8).

(h) Polar Bear: Barrow residents hunt polar bear from October to June (Fig. III-C-12). The locations of harvest areas are unavailable at this time. The polar bear comprises a small portion of the Barrow subsistence harvest, with an annual average of 7 bears harvested from 1971 to 1981 (Table III-C-12), or only 0.3 percent of the annual subsistence harvest (Table III-C-8).

(2) Wainwright: Wainwright residents (population 507 in 1985) enjoy a diverse resource base that includes both terrestrial and marine resources. Wainwright is located on the Chukchi Sea coast about 160 km southwest of Barrow. Marine-subsistence activities are focused on the coastal waters from Icy Cape in the southern range to Point Franklin and Peard Bay in the north. The Kuk River lagoon

system--a major marine estuary--is an important marine and wildlife habitat used by local hunters. Wainwright is not situated on a geographic point, as are Point Hope and Barrow, but rather on a long bight that affects sea-ice conditions as well as marine-resource concentrations.

(a) Bowhead Whale: The bowhead whale is Wainwright's most important marine resource. Beginning in late April, bowheads are available in the Wainwright area (Fig. III-C-13). Wainwright is not as ideally situated for bowhead whaling as are Point Hope and Barrow. Ice leads often break far from shore and are often wider than those near Barrow or Point Hope, and multiple leads are common. Skin boats are used early in the season, when the leads are narrower (ACI, Courtnage, and Braund, 1984). Because of the wider leads that occur later in the season, Wainwright whalers are likely to use aluminum boats to pursue bowheads farther offshore. There are approximately eight whaling camps along the edge of the landfast ice (ACI and Braund, 1984). In some years, these camps are 16 to 24 km offshore. The bowhead whale harvest area delineated in Figure III-C-6 indicates the harvest-concentration areas over the past few years. The harvest areas vary from year to year, depending on where the open leads form; and the distance of the leads from shore varies from year to year (ACI, Courtnage, and Braund, 1984). The bowhead accounts for 8.2 percent of the total annual subsistence harvest (an average of 1.5 whales taken each year over the past 20 years [Table III-C-8]). The annual bowhead harvest has not varied as much as the harvest of other subsistence resources; over the past 20 years, the number taken has varied only from zero to three (Table III-C-13).

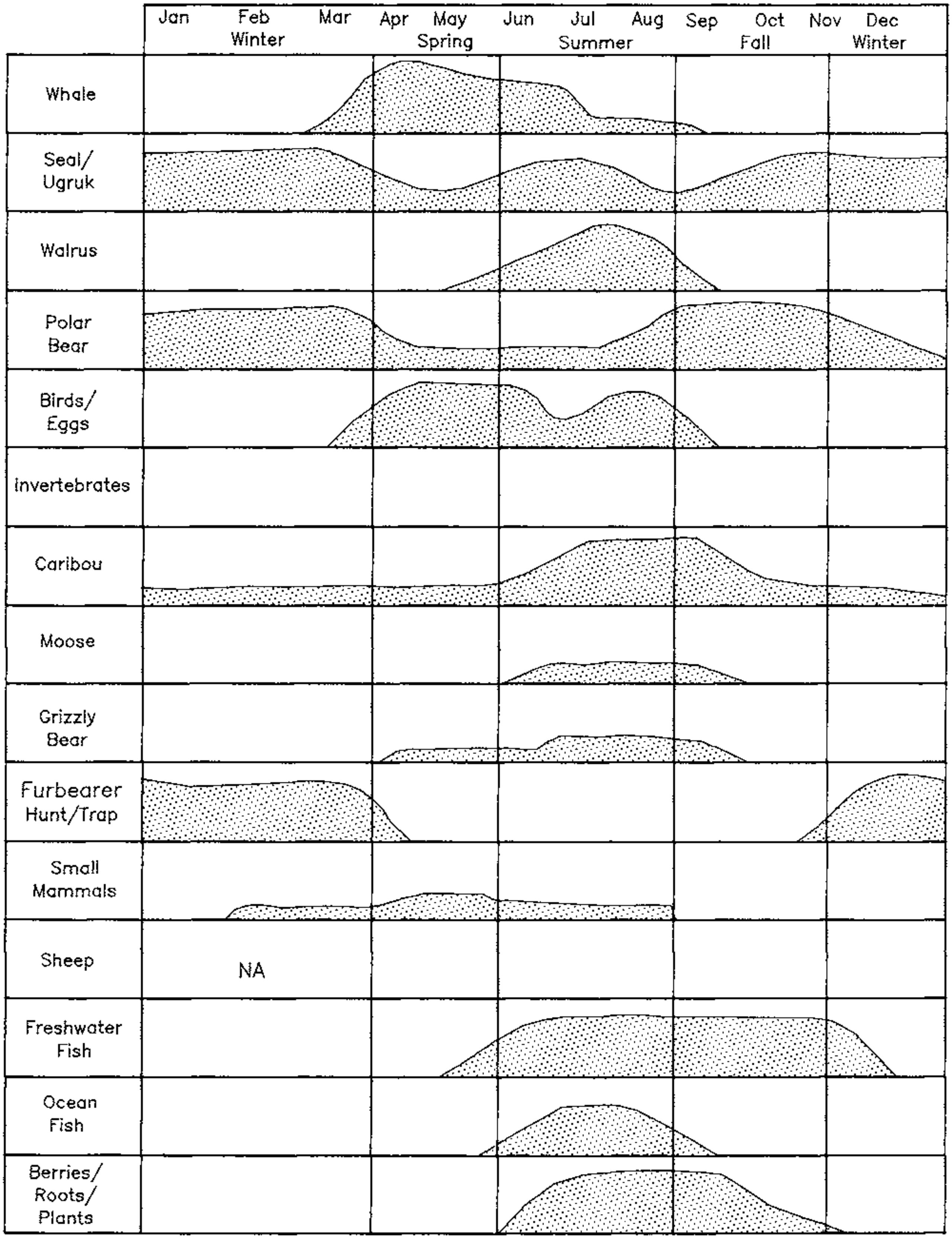
(b) Belukha Whale: The belukha whale is available to Wainwright hunters during the spring-bowhead-whaling season (late April to early June); however, pursuing the belukha during this time jeopardizes the bowhead whale hunt and, therefore, occurs only if no bowheads are in the area. The belukha also is available later in the summer (July through late August) along the coast in the lagoon systems (Figs. III-C-7 and III-C-13). The reluctance of Wainwright residents to harvest belukha during the bowhead whaling season means that they must rely on the unpredictable summer harvest for the major volume of this resource. Consequently, the relative importance of the belukha varies from year to year (Nelson, 1981; ACI/Courtnage/Braund, 1984). The annual average harvest of belukha (over 20 yr) is estimated at 11, or 2.7 percent of the total annual subsistence harvest (Table III-C-8).

(c) Caribou: The caribou is the primary source of meat for Wainwright residents. Prior to freezeup, caribou hunting is conducted along the inland waterways, particularly along the Kuk River system. During the winter months, most of the herd moves inland into the Brooks Range and then south of the North Slope; but some caribou remain near the coast. During the spring, the herd returns and concentrates near the Utukok and Colville River headwaters. In June, the herd follows major stream and river drainages toward the coast (Nelson, 1981).

An annual average (over 20 yr) of 1,200 caribou is harvested (Table III-C-8), for 51.6 percent of the total annual subsistence harvest. Caribou are available throughout the year, with a peak harvest period from August to October (Fig. III-C-13).

(d) Walrus: The walrus is present only seasonally in Wainwright, with the exception of a few that overwinter in the area. The peak hunting period occurs from July to August (Fig. III-C-13) as the southern edge of the pack ice retreats. In late August and early September, Wainwright hunters occasionally harvest walrus that are hauled out on beaches. The focal area for hunting walrus is from Milliktagvik north to Point Franklin, although hunters prefer to harvest them south of the communities (Fig. III-C-9) so that the northward-moving pack ice can carry the hunters back toward home while they butcher their catch on the ice. This northward-moving current also helps the hunters return home in their heavily loaded boats (Nelson, 1981). The estimated annual harvest ranges from 20 to 257 animals (Table III-C-13). The annual average (over 20 yr) is estimated at 86 walrus, or 18.5 percent of the total annual subsistence harvest (Table III-C-8).

(e) Seals: Wainwright residents hunt four seal species--ringed, spotted, ribbon (all hair seals), and bearded seals. The ringed seal (the most common species) is generally available throughout the ice-locked months.



Source: North Slope Borough Contract Staff, 1979.

Figure III–C–13. Wainwright Annual Subsistence Cycle*

* Patterns indicate desired periods for pursuit of each species based upon the relationship of abundance, hunter access, seasonal needs, and desirability. Peaks represent optimal periods of pursuit of subsistence resources.

Table III-C-13
Annual Harvest of Subsistence Resources
for Which Sufficient Data Are Available, 1962-1982
Wainwright

Year	Bowhead Whale	Walrus	Hair Seals[1/]	Polar Bear	Total Harvest[2/] (kg)
1962	1	[5/]	328	[3/]	157,580
1963	2	132	573	[3/]	187,130
1964	1	225	[5/]	[3/]	207,018
1965	0	194	345	[3/]	186,698
1966	1	140	69	[3/]	171,454
1967	0	47	277	[3/]	133,956
1968	2	85	40	[3/]	160,553
1969	3	92	450	[3/]	179,693
1970	0	89	480	[3/]	152,513
1971	2	23	250	[3/]	142,843
1972	2	56	1,600	3	179,143
1973	3	31	250+	4	153,968+
1974	1	38	250+	5	138,843+
1975	0	65	250+	4	139,168+
1976	3	257	250+	10	234,318+
1977	2	24	250+	9	143,643+
1978	2	20	[5/]	7	144,265+
1979	1	36	[5/]	0	139,293
1980	1	[5/]	[5/]	9[4/]	158,923
1981	3	[5/]	[5/]	10[4/]	177,623
1982	2	[5/]	[5/]	17[4/]	167,571.33
Annual Average	1.5	86	375	7	164,571.33

Source: Stoker, 1983, as cited by Alaska Consultants, Inc., and Stephen Braund and Assoc., 1984.

[1/] Seal-harvest figures are estimates only and are probably on the low side.
[2/] Estimated kilograms, includes all species.
[3/] Data not available by community, only for the entire State (Schliebe, oral comm., 1987).
[4/] Schliebe (1985: Tables 8, 9, and 10). In 1983 and 1984, Wainwright harvested 23 and 26 polar bears, respectively (Schliebe, 1985: Tables 10, 11, and 12).
[5/] No data available.

The bearded seal is available during the same period, but it is not as plentiful. Although harvested less frequently, the spotted seal is common in the coastal lagoons during the summer; most are taken in Kuk Lagoon. The ribbon seal occasionally is available during the spring and summer months. Ringed and bearded seals are harvested most intensely from May through July (ACI, Courtnage, and Braund, 1984). Most ringed seals are harvested along the coast from Milliktagvik to Point Franklin, with concentration areas along the shore from Kuk Inlet southward to Milliktagvik and from Nunagiaq to Point Franklin. Migrating seals are most concentrated at Qipuqlaich, just south of Kuk Inlet (Fig. III-C-8) (Nelson, 1981). The harvest of bearded seal is an important subsistence activity in Wainwright because seal is a preferred food and the skins are used as covers for whaling boats (ACI, Courtnage, and Braund, 1984).

The best harvest areas for bearded seal are on the flat ice south of Wainwright, off Qilamittagvik and Milliktagvik and beyond towards Icy Cape (Fig. III-C-8) (Nelson, 1981). Although no annual harvest data are available for the bearded seal, the annual average subsistence harvest (over 20 yr) is estimated at 250 seals, or about 12.3 percent of the total annual subsistence harvest (Table III-C-8). One hair seal harvest during the past 20 years is estimated at between 250 and 1,600 seals. The average annual harvest (over 20 yr) is estimated at 375, or 4.4 percent of the total annual subsistence harvest (Table III-C-8).

(f) Fishes: Wainwright residents harvest a variety of fishes in most marine and freshwater habitats along the coast and in lagoons, estuaries, and rivers. The most important local fish harvest occurs from September through November (Fig. III-C-13) in the freshwater areas of the Kuk, Kugrua, Utukok, and other river drainages (Craig, 1987) (Fig. III-C-10). Ice fishing for smelt and tomcod (saffron cod) occurs near the community primarily during January, February, and March. In the summer months, Wainwright residents harvest arctic char, chum and pink salmon, Bering cisco (whitefish), and sculpin along the coast and along the lower portions of Kuk Lagoon (Nelson, 1981; ACI, Courtnage, and Braund, 1984). The most common species harvested in the Kuk River system are Bering and least ciscoes, grayling, ling cod, burbot, and rainbow smelt. Other species harvested less frequently along the coast--in some cases, in estuaries or freshwater--include rainbow smelt, flounder, cisco, saffron cod, arctic cod, trout, capelin, and grayling (Nelson, 1981, Craig, 1987). Marine fishing is conducted from Peard Bay to Icy Cape and in Kuk Lagoon.

During the period 1969 to 1973 (the only available harvest data), the annual fish harvest was about 1,727 kg. The annual per capita fish catch was 4 kg. (The ADF&G cautions that these data were not systematically collected or verified [Craig, 1987]). Stoker (1983, as cited by ACI and Braund, 1984) uses these data and lists fish as a minor resource in the total harvest of Wainwright subsistence resources (approximately 0.8% of the annual harvest averaged over 20 yr [Table III-C-8]); fish were the third-largest source of subsistence foods (Table III-C-5) and the third-most-often-harvested species (Table III-C-4) in Wainwright in 1981. This difference can be attributed to the increase in the importance of fish as a subsistence resource because of the introduction of snow machines and motorized skiffs that have made distant fish camps more accessible, and to a value change that has stimulated the residents' interest in fishing and camping away from the community (Nelson, 1981). The fish harvest plays an important role in strengthening kinship ties in the community (Nelson, 1981; ACI, Courtnage, and Braund, 1984). In addition, fish are a crucial resource when other resources are less abundant or unavailable; over time, fish are a more reliable and more stable resource (Nelson, 1981).

(g) Migratory Birds: The migration of ducks, murres, geese, and cranes begins in May and continues through June. The harvest of waterfowl is initiated in May at whaling camps and continues through June (Fig. III-C-13). Hunting decreases as the bird populations disperse to their summer ranges. During the fall migration southward, the range is dispersed over a wide area (Fig. III-C-11); and hunting success is limited except at Icy Cape (ACI, Courtnage, Braund, 1984). Wainwright residents annually harvest an estimated 545 kg of birds (averaged over 20 yr), or about only 0.3 percent of the total annual subsistence harvest (Table III-C-8). Although the volume of waterfowl meat is a relatively small portion of the total subsistence harvest, waterfowl hunting is a key element in Wainwright's subsistence routine. Like fishing, bird hunting is highly valued in social and cultural terms (see the Sale 97 FEIS, Sec. III.C.3 [USDOI, MMS, 1987a]). Waterfowl dishes are an essential part of community feasts prepared for holidays like Thanksgiving and Christmas

(Nelson, 1981).

(h) Polar Bear: The polar bear is generally harvested along the coastal area in the Wainwright region, around Icy Cape, at the headland from Point Belcher to Point Franklin, and at Seahorse Island (Nelson, 1981). Wainwright residents hunt polar bear primarily in the fall and winter, less frequently in the spring, and rarely during the summer (Fig. III-C-13). The polar bear comprises a small portion of the Wainwright subsistence harvest, with an annual average (over 20 yr) of 7 harvested, or only 0.3 percent of the annual subsistence harvest (Table III-C-8). Since 1972, the prohibition of the commercial sale of polar bear hides has diminished the intensity of the harvest. Even so, the pursuit of polar bear continues to be an important manifestation of Inupiat traditional skills and an expression of manhood in a society that places an extremely high value on hunting as a way of life (Nelson, 1981).

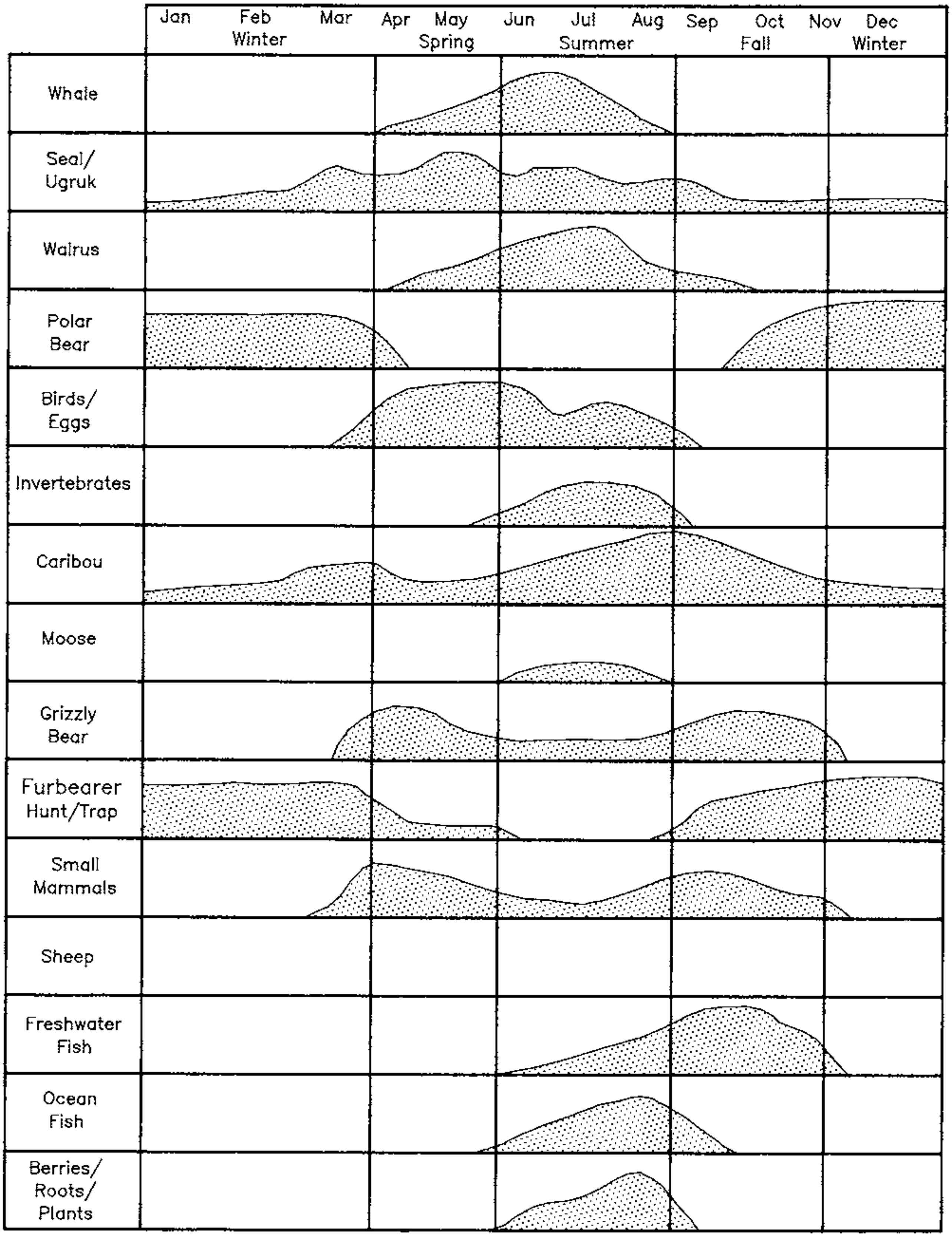
(3) Point Lay: The environmental setting of Point Lay (population 129 in 1985 [ACI, Courtnage, and Braund, 1984]) and the local land use patterns are different from those of the other coastal communities in the Sale 126 area. Point Lay is located on a point near the Kokolik River Delta that is not as prominent as the spit formations at Barrow or Point Hope. Point Lay's location consequently is not suitable for bowhead whaling. Although bowhead whaling occurred in the past, the most recent bowhead harvests occurred in the 1930's near Icy Cape and the old (Point Lay) community site. A few Point Lay residents participate in Barrow's and Wainwright's bowhead whale hunts. No harvest data are available for Point Lay to the extent found for other communities in the Sale 126 area; however, available data are reported here and cited where appropriate.

(a) Belukha Whale: The belukha whale is the most important marine resource harvested by Point Lay residents at this time. For the past several years, this species has provided a greater quantity of food than any other marine resource; in 1982, Point Lay hunters harvested 28 belukhas. Forty belukhas were harvested in 1988, 16 in 1989, and 62 in 1990 (Suydan, 1990, oral comm.). Local hunters actively harvest belukha whale during the first 2 weeks of July (Fig. III-C-14), when the hunt is concentrated in Naokok and Kukpowruk Passes, south of Point Lay (Fig. III-C-7). The hunters use as many boats as possible to herd the belukha into Kasegaluk Lagoon, where the whales are herded into shallow water and shot. If the hunt is unsuccessful in the passes, Point Lay hunters travel north to Akunik Pass and other passes in search of whales. Prior to July, hunters may occasionally try to harvest belukha south of the community, traveling by snow machine south along the coast toward Cape Beaufort, where the ice breaks early in the season. When the season is poor, hunters continue to search for whales into early August and, in rare cases, may travel as far north as Icy Cape. The belukha whale hunt is the only Point Lay subsistence activity that is a communal effort. Although the belukha hunt does not compare in cultural significance with the bowhead whale hunt in some other communities in the sale area, it is an important cultural and community unifier that involves all members of the community and, as with other subsistence foods, the meat is shared with friends and relatives (see the Sale 97 FEIS, Sec. III.C.3 [USDOI, MMS, 1987a]).

(b) Caribou: The caribou is the primary source of meat for Point Lay residents. Although caribou are available throughout the year, primary harvest times occur from February through April and from June through October, with the peak harvest from late August through October (Fig. III-C-14).

(c) Seals: Point Lay residents hunt two species of hair seal--ringed and spotted seals. Although ringed seal is available throughout most of the year, it is difficult to locate only in the ice-free months when the pack ice is farther offshore (July and August). The peak of the ringed seal harvest occurs from April through June (Fig. III-C-14). The first ringed seal harvested in April is taken near Cape Beaufort (Fig. III-C-14). Ringed seal is sometimes taken incidentally to walrus and bearded seal harvests in June and July. As spring progresses, ringed seal is harvested near the community. The spotted seal is hunted in Kasegaluk Lagoon during the summer months. These hair seals have desirable pelts and can be hunted in open water during the late summer because they are fat and buoyant when killed (ACI, Courtnage, and Braund, 1984).

The bearded seal does not have the same importance to Point Lay residents as to other communities in the



Source: North Slope Borough Contract Staff, 1979.

Figure III–C–14. Point Lay Annual Subsistence Cycle*

* Patterns indicate desired periods for pursuit of each species based upon the relationship of abundance, hunter access, seasonal needs, and desirability. Peaks represent optimal periods of pursuit of subsistence resources.

sale area because the residents do not hunt the bowhead whale and, therefore, do not use boats covered with bearded seal skin. The majority of bearded seals are harvested in June and sometimes as late as August if the hunters follow the ice north. Bearded seal hunting usually takes place 8 to 10 km offshore, but hunters may go farther out as they look for walrus. All seals, except the spotted seal, leave when the ice disappears, although seals are occasionally seen in Kasegaluk Lagoon. Point Lay hunters annually harvest from 2 to 10 bearded seals for the entire community, while they harvest an annual average of 3 to 4 ringed seals for each family (ACI, Courtnage, and Braund, 1984).

(d) Walrus: Although the community's walrus hunting range is greater than that of any other marine mammal, the importance of walrus in Point Lay has declined in recent years. Traditionally a primary source of dog food, the walrus is now only occasionally harvested for human consumption. During favorable ice conditions, Point Lay hunters harvest as many as 10 to 15 walrus; but walrus cannot be harvested when ice conditions restrict offshore access. Point Lay residents hunt walrus along the length of Kasegaluk Lagoon, south of Icy Cape, and as far as 32 km offshore (Fig. III-C-9). Because navigation in broken and moving ice is dangerous, the hunters prefer to hunt for walrus between 16 and 32 km directly offshore of the community. The walrus is generally hunted from the end of June through the month of July (Fig. III-C-14). If the hunters travel north to Icy Cape, the walrus can be hunted into August. One reason for the decline of the walrus hunt is that the peak harvest time coincides with the annual pursuit of the belukha--a preferred species to eat as well as a safer and more efficient species to hunt (ACI, Courtnage, and Braund, 1984).

(e) Fishes: Because fish are abundant and fishing is not a labor-intensive activity, this resource plays an important role in the subsistence economy of Point Lay (ACI, Courtnage, and Braund, 1984). Point lay residents harvest a variety of fishes in most marine and riverine habitats along the coast from Icy Cape to the southern edge of Kasegaluk Lagoon and in inland waters including the Utukok, Kokolik, and Kukpowruk Rivers (Craig, 1987). From July through October, Point Lay residents harvest arctic char, Pacific herring, whitefish, flounder, and grayling (Fig. III-C-14). Marine fishes are pursued with set-gill nets along the barrier islands and mainland coast, including a portion of Kasegaluk Lagoon south of Icy Cape and a small portion of the Chukchi Sea near the southern end of Kasegaluk Lagoon and occasionally at Sitkok Point (Fig. III-C-10). Set-netting occurs primarily along Naokok Pass, on both sides of the barrier island where the old Point Lay site is located, and along the shores of the mainland near the present community site. Although fishing is excellent around Icy Cape, Point Lay residents rarely travel that far north because fishing nearer the community is generally quite successful. Most fishing occurs within several miles of the community (Craig, 1987). Younger residents now fish with rod and reel for salmon several kilometers offshore of the southern end of Kasegaluk Lagoon. The proximity of good fishing to the community allows employed residents to check their nets daily after work, thus minimizing any conflicts between subsistence activities and wage employment. August is the peak month for marine fishing. Fishing, primarily for grayling, also occurs along the Kukpowruk and Utukok Rivers during September and October.

Harvest figures are available only for the summer and fall fisheries of 1983. The summer fishery (65 kg of mostly pink salmon) and the fall fishery (114-136 kg of mostly grayling) yielded a total catch of about 182 to 205 kg, for an annual per capita catch of 1.4 to 1.9 kg. Residents thought the catch was low that year, probably since pink salmon are less abundant in odd-numbered years (Craig, 1987).

(f) Migratory Birds: Waterfowl and other migratory birds provide a source of food for Point Lay residents in early spring, when fresh meat can be scarce. Eider and other ducks, brant, geese, and loons are harvested primarily in the spring (Fig. III-C-14). The harvest range for birds is as large as for other marine resources because birds are harvested concurrently (Fig. III-C-11). For example, waterfowl are hunted from the edges of ice leads during May, when Point Lay residents are hunting bearded and other seals (ACI, Courtnage, and Braund, 1984).

(g) Polar Bear: Point Lay residents occasionally hunt polar bear along the coast from late September to April (Fig. III-C-14). Although the polar bear was more available in past years, few were seen in 1983. Local hunters rarely travel more than 3 km offshore in pursuit of polar bear (ACI, Courtnage, and Braund, 1984).

(4) Point Hope: Point Hope residents (population 570 in 1985) enjoy a diverse resource base that includes both terrestrial and marine animals. The location of the community, on a cuspate spit that juts out into the Chukchi Sea, offers superb opportunities for hunting a diversity of marine mammals.

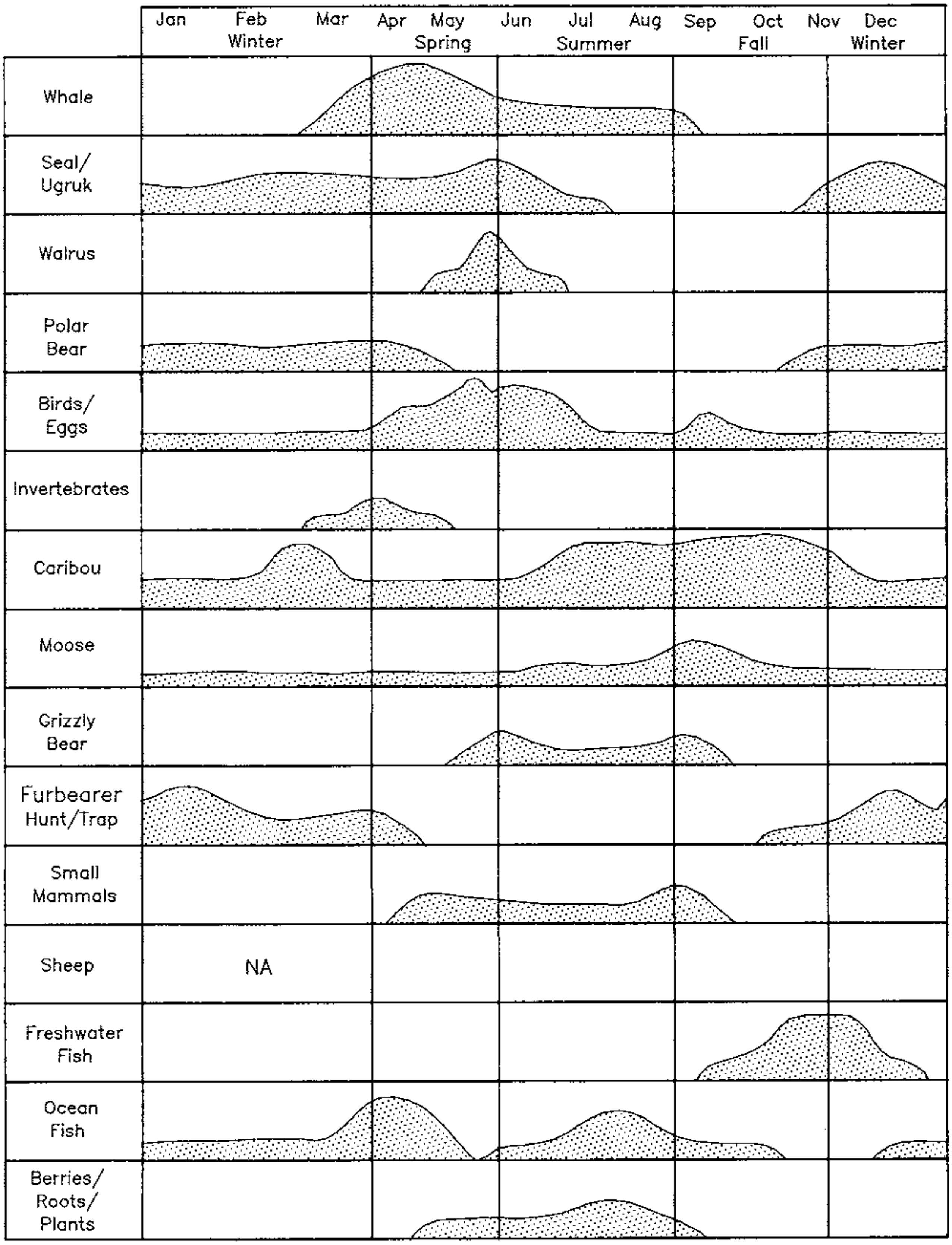
(a) Bowhead Whale: Beginning in late March or early April, the bowhead whale is available in the Point Hope area (see Figs. III-C-6 and III-C-15). Point Hope's strategic location close to the pack-ice lead makes it uniquely situated for hunting the bowhead. Approximately 15 to 18 whaling camps are located along the edge of the landfast ice. The actual harvest area varies from year to year, depending on where the open leads form. Camps as far south as Cape Thompson have been reported, but in recent years the camps tended to be closer to the community. In the recent past, the camps were situated south and southeast of the point. The intensive-use area delineated in Figure III-C-6 indicates the harvest-concentration areas over the past few years. The distance of the lead from shore varies from year to year. The lead is rarely more than 10 to 11 km offshore, but hunters have had to travel over the ice as far as 16 km away from the community to find the necessary open water for spring whaling (ACI and Braund, 1984).

Point Hope generally has open water for the majority of the whaling season; but sometimes two narrow leads develop, which presents a problem for Point Hope hunters because the whales may travel in the lead that is farther from shore and thereby become inaccessible to the whalers. The duration of the whaling season is limited by the IWC's quota. Despite the limited nature of both the whaling season and the harvest area, no other marine mammal is harvested with the intensity and concentration of effort that is focused on the bowhead whale, the most important resource in Point Hope's subsistence economy. The harvest periods of all resources vary from year to year, and the bowhead season is no exception. In a 20-year period ending in 1982, the total annual number of bowheads landed varied from zero to 14 (Table III-C-14). In the memory of community residents, 1980 was the only year in which a bowhead whale was not harvested (ACI and Braund, 1984).

(b) Belukha Whale: Point Hope hunters actively harvest the belukha whale during the offshore spring-bowhead-whaling season (late March-early June) and along the coast later in summer (July-late August/early September) (Figs. III-C-15 and III-C-7). The first, and larger, harvest of belukha occurs coincidentally with the spring-bowhead whale harvest. Hunters often use the belukha as an indicator for the bowhead. The number of belukhas harvested varies (Table III-C-14); according to Lowenstein (1981), each whaling crew harvests at least one belukha--and usually more--during the whaling season. The average annual belukha harvest (over 20 yr) is estimated at 29, or 6.5 percent of the total annual marine-subsistence harvest (Table III-C-14). The belukha is harvested intensively at distances as far south as Cape Thompson (Fig. III-C-7). The hunters go far offshore only during spring whaling. Although not as common, the belukha also is harvested in open water throughout the summer. During the summer season, hunters pursue belukhas primarily near the southern shore of Point Hope in the southern Chukchi Sea, in close proximity to the beach, as well as in coastal areas on the northern shore as far north as Cape Dyer. Because belukhas feed on the anadromous fishes of the Kukpuk River, hunters are particularly successful near Sinuk. Although belukhas are available in May and June, Point Hope residents generally do not pursue them because of deteriorating ice conditions along the landfast ice margins and the greater availability of bearded seal and walrus at this time.

(c) Caribou: The caribou is the primary source of meat for Point Hope residents. The annual average of 756 caribou harvested accounts for 29.5 percent of the total annual subsistence harvest (ACI/Courtnage/Braund, 1984). Although caribou are available throughout the year, peak harvest times occur from February to March and from late June through mid-November (Fig. III-C-15).

(d) Fishes: Point Hope residents harvest a variety of fishes during the entire year (Fig. III-C-15). As the shorefast ice breaks free in mid- to late June, residents use set-nets and beach seines to catch arctic char and pink, coho, and chum salmon. Fishing occurs from coastal fish camps (often converted from spring camps



Source: North Slope Borough Contract Staff, 1979.

Figure III-C-15. Point Hope Annual Subsistence Cycle*

* Patterns indicate desired periods for pursuit of each species based upon the relationship of abundance, hunter access, seasonal needs, and desirability. Peaks represent optimal periods of pursuit of subsistence resources.

Table III-C-14
Annual Harvest of Subsistence Resources
for Which Sufficient Data Are Available, 1962-1982
Point Hope

Year	Bowhead Whale	Belukha Whale	Walrus	Hair Seals[1/]	Polar Bear	Total Harvest[2/] (kg)
1962	6	[5/]	[5/]	2,000	[3/]	204,184
1963	3	[5/]	10	2,752	[3/]	190,022
1964	1	[5/]	10	[5/]	[3/]	146,534
1965	2	[5/]	6	2,016	[3/]	165,738
1966	5	[5/]	16	2,571	[3/]	206,483
1967	1	[5/]	3	980	[3/]	136,104
1968	3	[5/]	21	264	[3/]	146,600
1969	3	[5/]	5	2,300	[3/]	179,684
1970	8	[5/]	6	1,900	[3/]	216,934
1971	6	[5/]	35	1,800	[3/]	207,384
1972	14	10	45	250+	5	234,910+
1973	7	55	13	700+	3	196,509+
1974	6	35	69	727	14	202,197
1975	4	35	10	700+	27	166,159+
1976	12	35	4	700+	16	232,784+
1977	2	53	9	700+	11	151,609+
1978	1	16	1	[5/]	7	137,509
1979	3	11	5	[5/]	1	153,359
1980	0	[5/]	[5/]	[5/]	10[4/]	139,384
1981	4	[5/]	[5/]	[5/]	6[4/]	174,084
1982	1	[5/]	[5/]	[5/]	5[4/]	148,284
Annual Average	4.5	29	15	1,400	9	177,926.43

Source: Stoker, 1983, as cited by Alaska Consultants, Inc., and Stephen Braund and Assoc., 1984.

[1/] Seal-harvest figures are estimates only and are probably on the low side.
[2/] Estimated kilograms, all species included.
[3/] Data not available by communiity, only for entire State (Schliebe, 1987, oral comm.).
[4/] Schliebe (1985: Tables 8, 9, and 10).
[5/] No data available.

for hunting bearded seal and walrus) located along the shore from Cape Thompson north to Kilkralik Point (Fig. III-C-10). Some fishing may occur outside this area, but only in conjunction with other activities such as egg gathering or caribou hunting. The summer fishing season extends from mid- to late June through the end of August, with July the peak month. Other fishes harvested by Point Hope residents include whitefish, grayling, tomcod, and occasionally flounder. In the fall, residents harvest grayling and whitefish on the Kukpuk River during the October upriver fishing period. From December through February, residents fish for tomcod through the ice near the point (ACI, Courtnage, and Braund, 1984). The numbers of fish harvested are not available; however, an estimated annual average (over 20 yr) of 18,182 kg is harvested, which accounts for 10.1 percent of the total subsistence harvest (ACI, Courtnage, and Braund, 1984).

(e) Seals: Hair seals are available to Point Hope residents from October through June; however, because of the availability of bowhead, bearded seal, and caribou during various times of the year, seals are harvested primarily during the winter months, from November through March (Fig. III-C-15). The ringed seal is the most common hair seal species harvested, and the month of February is the most concentrated harvest period for this species. Hair seals are hunted from south of Cape Thompson to as far north as Ayugatak Lagoon (Fig. III-C-8). The area south of Point Hope is safer and more advantageous for hunting seals. In good weather conditions, it is safe for a hunter to travel 16 to 24 km offshore of the southern side of the point; however, it is more common for residents to hunt seals closer to shore. The area north of the point is more dangerous for seal hunting because of the poor ice conditions. Seal hunting in this area occurs closer to shore and is most successful at Sinuk, near the mouth of the Kukpuk River, and at the numerous small points between Point Hope and Cape Lisburne where open water is found (i.e., Kilkralik Point and Cape Dyer). South of the point, ringed seal hunting is generally concentrated within 8 km of shore on the ice pack between Point Hope and Akoviknak Lagoon. Some hair seal hunting takes place directly off the point when the ice first forms in October and early November (ACI, Courtnage, and Braund, 1984). Over the past 20 years, hair seal harvests have been estimated at between 250 and 2,752 seals a year; in recent years, approximately 700 a year have been harvested (Table III-C-14). Over the past 20 years, the average annual harvest is estimated at 1,400 seals, or 14.8 percent of the total annual subsistence harvest (Table III-C-14).

Hunting of the bearded seal is an important subsistence activity in Point Hope; the meat is a preferred food and the skin is used to cover the whaling boats. The majority of bearded seals are harvested during May and June, sometimes as late as mid-July, as the landfast ice breaks up into floes. More of the bearded seal than the smaller hair seal is harvested because of the former's larger size and use for skin-boat covers. Since the rifle was introduced, hunters have pursued seals with rifles and, in recent years, large aluminum boats with outboard motors. Larger engines allow the hunters to travel over larger areas in the same or less time than in the past. Bearded seals, like hair seals, are hunted from Cape Thompson to Ayugatak Lagoon (ACI, Courtnage, and Braund, 1984). No annual harvest data are available for bearded seal; however, the average annual harvest (over 20 yr) was 200 a year, or about 8.9 percent of the total annual subsistence harvest (ACI, Courtnage, and Braund, 1984).

(f) Migratory Birds: Throughout the year, waterfowl and other migratory birds also provide a source of food for Point Hope residents. Eiders and other ducks, murres, brant, geese, and snowy owls are harvested at various times of the year (Fig. III-C-15). Eiders are hunted and harvested as they fly along the open leads during the whaling season, thereby providing a fresh meat source for the whaling camps. Murre eggs are harvested from the cliffs at Capes Thompson and Lisburne. Later in the spring, Point Hope residents harvest eiders, geese, brant, and other migratory waterfowl along both the northern and southern shores of the point and in the numerous lakes and lagoons (Fig. III-C-11). Geese are harvested from mid-May until mid-June, while brant are harvested at this time and during September as they migrate from their summer breeding grounds. Snowy owls are occasionally trapped later in the fall, in October, as they migrate south. An estimated annual average (over 20 yr) of 5,682 kg of birds is harvested, which accounts for about 3.2 percent of the total annual subsistence harvest (ACI, Courtnage, and Braund, 1984).

(g) Walrus: The Point Hope Inupiat have traditionally used walrus; however, the increasing importance of the walrus as a subsistence resource has been directly related to its fluctuating population, which also has increased over the past decade. The walrus is harvested during the spring marine mammal hunt, which is based along the southern shore of the point (Fig. III-C-9). The major walrus hunting effort coincides with the spring bearded seal harvest, and both species are harvested from the same camps that stretch from Point Hope to Akoviknak Lagoon. Although the walrus is hunted primarily during June and early July (Fig. III-C-15), it is also hunted by boat during the rest of the summer along the northern shore, especially along the rocky capes and other points where they tend to haul out. The walrus harvest occurs in conjunction with other subsistence activities such as egg gathering, fishing, or traveling the shores in search of caribou. An estimated 10 to 30 animals are harvested during June (ACI, Courtnage, and Braund, 1984). The annual average harvest (over 20 yr) is estimated at 15 walrus, or 2.9 percent of the total annual marine mammal-subsistence harvest (Table III-C-14).

(h) Polar Bear: Point Hope residents hunt the polar bear primarily from January to April concurrently with the winter-seal-hunting season, and occasionally from late October to January (Fig. III-C-15). The polar bear is harvested mainly south of the community, generally in the area of intensive seal hunting (ACI, Courtnage, and Braund, 1984). The polar bear comprises a small portion of the Point Hope subsistence harvest with an annual average (over 20 yr) of 9 harvested, or only 1.1 percent of the total annual marine mammal-subsistence harvest (Table III-C-14).

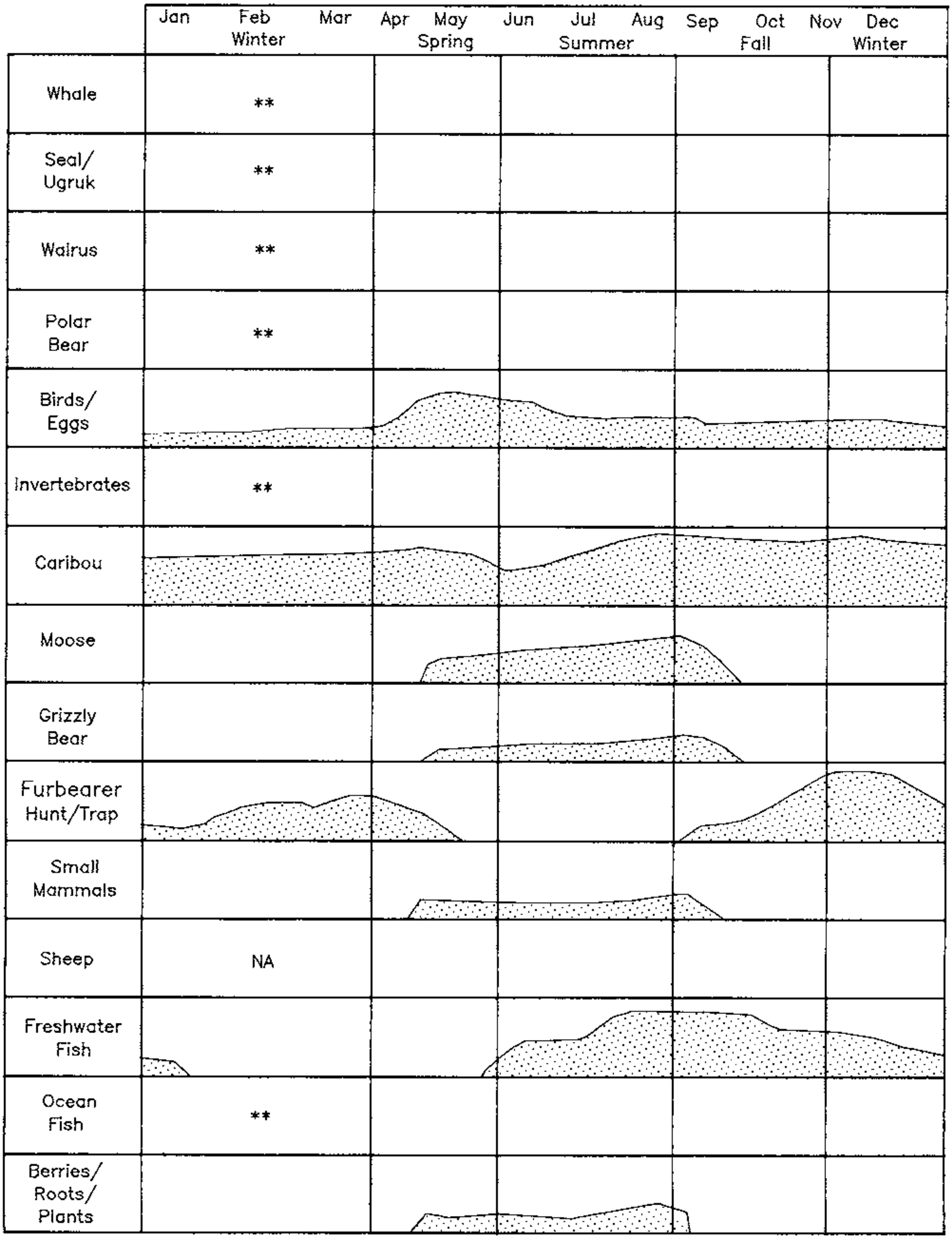
(5) Atqasuk: Atqasuk (population 214 in 1985) is the only inland community close to the Sale 126 area. The marine-resource areas used by Atqasuk residents are inclusive of those used by Barrow residents and thus are discussed in Section III.C.2.b(1). Only a small portion of the marine resources used by Atqasuk residents is acquired on coastal hunting trips initiated in Atqasuk; the majority of the marine resources are acquired on hunting trips initiated in Barrow with Barrow relatives or friends (ACI, Courtnage, and Braund, 1984). However, Atqasuk hunters harvest fish, migratory birds, and caribou in completely different areas from those of Barrow.

(a) Caribou: The caribou is the most important resource harvested by Atqasuk residents. Although the fall harvest is the most important, caribou also are harvested throughout the winter and in early spring (Fig. III-C-16). Migration patterns and limited access to caribou prohibit hunting in the late spring and summer. In recent years the caribou population has been high, and Atqasuk residents have not had to travel far to harvest caribou (distances are not available). Caribou camps often are also used for fishing along the Meade, Inaru, Topagoruk, and Chipp River drainages (ACI, Courtnage, and Braund, 1984).

(b) Fishes: Fish is a preferred food in Atqasuk, although respondents in one study (ACI/Courtnage/Braund, 1984) said that fish is the secondary resource in quantity harvested. Most fishing occurs along the Meade River.

Fish camps also are located on two nearby streams (Usuktuk and Nigisaktuvik Rivers) and downstream on the Meade River, near the Okpiksak River (Craig, 1987). Humpback and broad whitefishes, least cisco, grayling, burbot, and chum salmon (Craig, 1987) are fished with gill nets and baited hooks and by jigging. The most successful fishing months are July and August (Fig. III-C-10), when water levels drop in the Meade River and the river is clearer. Nets are most commonly set in close proximity to the community. During the fall and winter, fishing continues under the ice in the Meade River and in nearby lakes (ACI/Courtnage/Braund, 1984). Humpback whitefish and least cisco accounted for 96 percent of the summer catch in 1983 (the only year of harvest data). The summer gill-net fishery in the Meade and Usuktuk Rivers caught approximately 3,840 kg of fish. With other gear (500 kg) and winter catches (1,227 kg), the total harvest was approximately 5,568 kg. The annual per capita catch was about 19.5 kg (Craig, 1987).

(c) Migratory Birds: Atqasuk residents harvest migratory birds from late April through June, and again from late August through September, on numerous lakes and ponds as well as on the Meade River and its tributaries (Figs. III-C-16 and III-C-11). Eggs are gathered in the immediate vicinity of the community for a short period during June (ACI, Courtnage, and Braund, 1984).



Source: North Slope Borough Contract Staff, 1979.

Figure III-C-16. Atqasuk Annual Subsistence Cycle*

* Patterns indicate desired periods for pursuit of each species based upon the relationship of abundance, hunter access, seasonal needs, and desirability. Peaks represent optimal periods of pursuit of subsistence resources.

** These species are harvested only out of hunts originating in Barrow.

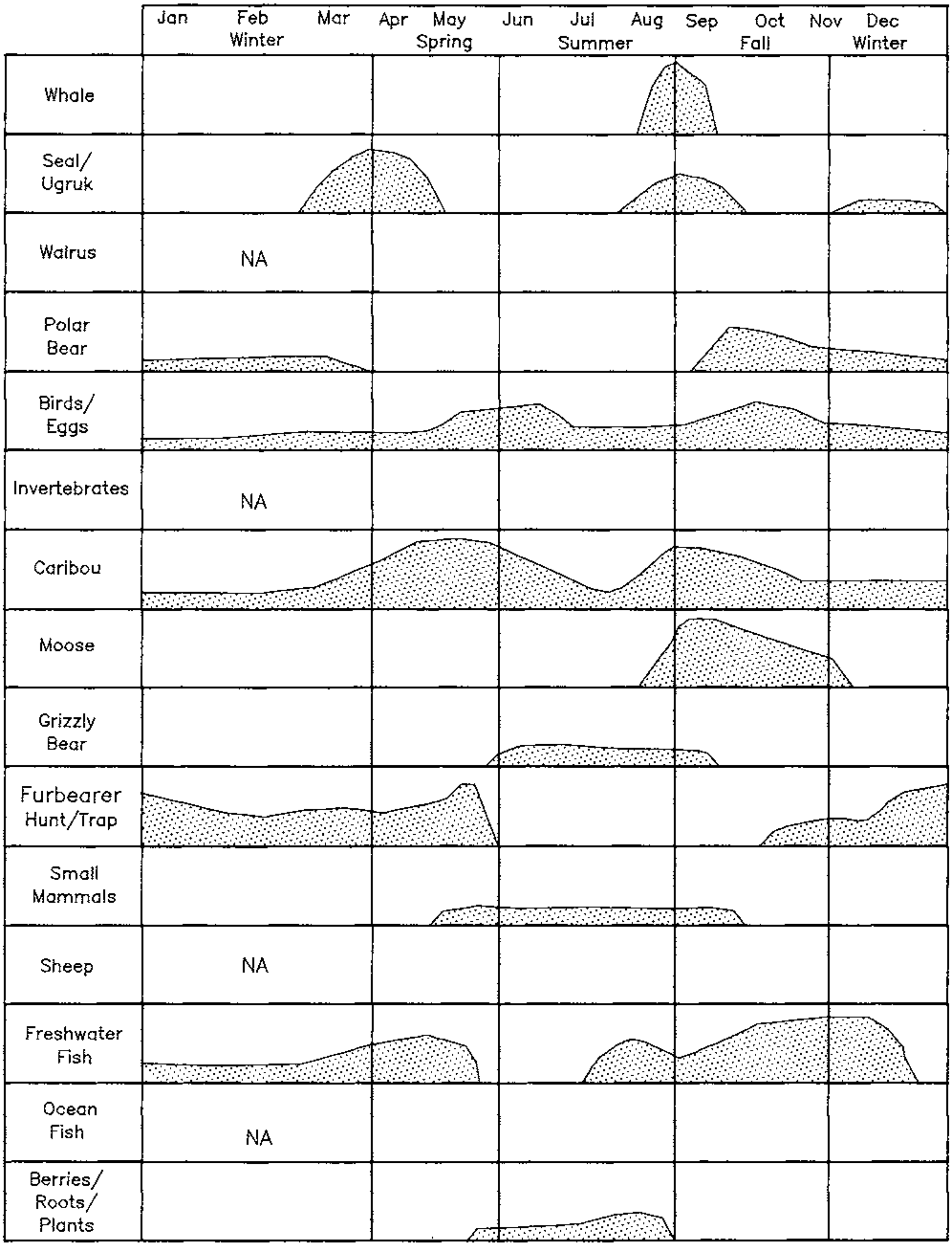
(6) Nuiqsut: Although the community of Nuiqsut (population 337 in 1985) is outside the Sale 126 area, it is discussed here because some of its subsistence-harvest areas lie in the vicinity of the overland pipeline included in the development and production scenario for this lease sale. Marine resources are not considered in detail because the subsistence-use area lies outside of the Sale 126 area. Located on the mouth of the Colville River, Nuiqsut's primarily terrestrial subsistence economy is oriented toward caribou.

(a) Caribou: The caribou is considered Nuiqsut's primary source of meat, according to an estimated 76 percent of the respondents to a community subsistence-harvest study (Table III-C-5). Caribou are harvested throughout the year, with peak harvests from April through June and in September and October (Fig. III-C-17). Caribou-harvest statistics are available only for 1976, when 400 caribou provided approximately 28,000 kg of meat (Stoker, 1983, as cited by ACI and Braund, 1984).

(b) Fishes: Anadromous fish provide an important subsistence resource at Nuiqsut. The harvests of most subsistence resources, such as caribou, fluctuate widely from year to year because of variable migration patterns and because harvesting techniques are extremely dependent on ice and weather conditions. The harvest of fish is an exception to this rule, which adds to the importance of fish in Nuiqsut's subsistence system. Nuiqsut has the largest documented subsistence-fish harvest on the U.S. Beaufort Sea coast (Moulton, Field, and Brotherton, 1986). Moreover, in October and November, fish may provide the only source of fresh subsistence foods. Nuiqsut residents harvest fish from January through May and from late July through mid-December, with the peak harvest apparently occurring in November and early December (Fig. III-C-17).

Fishing is an important activity for Nuiqsut residents due to its proximity to the Colville River, with its large resident fish populations. The river supports 20 species of fish; approximately half of these are taken by Nuiqsut residents (George and Nageak, 1986). Local residents harvest fish primarily during the summer and fall. The summer, open-water harvest lasts from breakup to freezeup (early June to mid-September). The summer harvest covers a greater area and is longer than the fall/winter harvest in duration, and a greater number of species are caught. Broad whitefish is the primary species harvested during the summer and is the only anadromous species harvested in July in the Nechelik Channel. In July, lake trout, northern pike, broad and humpback whitefishes, and arctic char are harvested in the Main Channel south of Nuiqsut. Salmon species reportedly have been caught in August but not in large numbers. All five species of Pacific salmon have been reported in the Colville; pink and chum salmon are the most commonly caught, although there reportedly has not been a great interest in harvesting these species (George and Nageak, 1986). Although arctic char is found in the Main Channel of the Colville River (Entrix, Inc., 1986), there is little mention of char as a subsistence species in subsistence studies (George and Nageak, 1986; George and Kovalsky, 1986). Char is apparently liked but not abundantly caught because the timing is critical (Moulton, 1986, oral comm.).

The fall/winter under-ice harvest begins after freezeup, when the ice is safe for travel by snowmachine. Local families fish for approximately 1 month or less after freezeup. The Kupigruak Channel is the most important fall fishing area in the Colville region. The primary species harvested are arctic and least ciscoes, harvested primarily in the Kupigruak Channel; other fishing for arctic and least ciscoes also occurs in the Nechelik and Main Channels of the Colville River. Arctic and least ciscoes composed 88 and 99 percent of the harvest in 1984 and 1985, respectively; however, the catch composition varied greatly depending on net-mesh size. Humpback and broad whitefishes, sculpin, and some large rainbow smelt also are harvested, but in low numbers (George and Kovalsky, 1986; George and Nageak, 1986). A fish identified as "spotted least cisco" also has been harvested. This fish is not identified by Morrow (1980) but may be a resident form of least cisco (George and Kovalsky, 1986). Weekend fishing for burbot and grayling also occurs at Itkillikpaat, 10 km from Nuiqsut, even though the success rate for grayling is quite low (George and Nageak, 1986). The summer catch in 1985 totaled about 8,755 kg of mostly broadfish. In the fall, approximately 27,682 kg of fish were caught, totaling 36,436 kg--an annual per capita catch of 109 kg (however, some of this catch was shipped to Barrow). In 1986, there was a reduced fishing effort in Nuiqsut; and the fall harvest was only 59



Source: North Slope Borough Contract Staff, 1979.

Figure III—C—17. Nuiqsut Annual Subsistence Cycle *

* Patterns indicate desired periods for pursuit of each species based upon the relationship of abundance, hunter access, seasonal needs, and desirability. Peaks represent optimal periods of pursuit of subsistence resources.

percent of that taken in 1985 (Craig, 1987).

Fish are eaten fresh or frozen; salmon also may be split and dried. Because of their important role as an abundant and stable food source, and as a fresh-food source during the midwinter months, fish may be shared at Thanksgiving and Christmas feasts and given to relatives, friends, and community elders. Fish also may appear in traditional sharing and bartering networks that exist among North Slope communities. Fishing serves as a strong social function in the community because it often involves the entire family. Most (20-25) Nuiqsut families participate in some fishing activity; however, the bulk of the fishing appears to be done by less than 12 families (George and Nageak, 1986).

(c) Marine Resources: Nuiqsut residents hunt and use the bowhead whale and seals. From one to five Nuiqsut whaling captains have registered each year to hunt the bowhead; in the past few years, the AEWC has alotted the community a quota of one whale a year. A number of Nuiqsut residents occasionally travel to Barrow to join Barrow whaling crews in the spring bowhead hunt, and Nuiqsut whalers occasionally join the Kaktovik whalers. Because of ice conditions and the lack of an adequate lead system in the spring, Nuiqsut whalers harvest bowheads only in the fall, from late August through October (Fig. III-C-17). From 1972 to 1982, an estimated annual average of 2,670 kg of meat was obtained from bowhead whales. Nuiqsut residents occasionally harvest seals from mid-March through May and in September and October (Stoker, 1983, as cited by ACI and Braund, 1984).

(d) Other Resources: Nuiqsut residents harvest other subsistence resources such as migratory birds, some moose, and an occasional polar bear. Birds are harvested year-round, with peak harvests in May to June and September to October (Fig. III-C-17). Moose are harvested from September though mid-December. The available information on the quantities harvested or their relative subsistence importance is sparse at this time. The best available indicator of relative importance is a study (ACI, Courtnage, and Braund, 1984) that reported that 3.3 percent of respondents most often consumed birds; 93.4 percent of the respondents indicated that caribou is the meat most often consumed (Table III-C-6). Because the study was conducted during the duck-hunting season, respondents may have tended to list birds as the meat most often consumed during the year since it was the resource being consumed at the time.

3. Sociocultural Systems: This section provides a profile of the sociocultural systems that characterize the communities near the Sale 126 area. The topic of sociocultural systems encompasses the social organization and cultural values of the society. The communities near the Sale 126 area that might be affected by this lease sale are Barrow, Wainwright, Point Lay, Point Hope, Atqasuk, and Nuiqsut--all within the North Slope Borough (NSB). The ethnic, sociocultural, and socioeconomic makeup of the communities on the North Slope is primarily Inupiat. Sociocultural systems of the North Slope Inupiat are described and discussed in detail in the Beaufort Sea Sale 97 FEIS (USDOI, MMS, 1987a, Sec. III.C.2) and the Chukchi Sea Sale 109 FEIS (USDOI, MMS, 1987b), which are incorporated by reference.

a. Introduction: The North Slope has a fairly homogeneous population of Inupiat (77% Inupiat in 1980). The percentage in 1980 ranged from 92 percent Inupiat in Point Hope to 71 percent Inupiat in Barrow (ACI, Courtnage, and Braund, 1984). In 1985, the populations of each of the communities in the sale area were 3,075 in Barrow; 507 in Wainwright; 142 in Point Lay; 570 in Point Hope; 248 in Atqasuk; and 220 in Nuiqsut (see also Sec. III.C.1.c).

North Slope society responded to early contacts with outsiders by successfully changing and adjusting to new demands and opportunities (Burch, 1975; Worl, 1978; NSB Contract Staff, 1979). Since the 1960's, the North Slope has witnessed a period of "super change," a quickening pace of change brought on by the area's oil developments (Lowenstein, undated). In 1952, the anthropologist Spencer was dependent upon interpreters for his Barrow work (Spencer, 1959). Today, few North Slope residents lack English skills (Klausner and Foulks, 1982); and communications with the "outside" are no longer uncertain. All North Slope communities are tied to the larger world via telephone, cable television, and regularly scheduled commercial air transportation. Oil-related work camps have altered the seascape and landscape of the

Prudhoe Bay-Kuparuk industrial complex, marking some areas as off limits to traditional pursuits such as hunting. Large NSB Capital Improvement Programs (CIP) dramatically changed the physical appearance of NSB communities. Blocks of modern houses, new schools, water-treatment plants, power plants, and community buildings stand out. Snow machines, all-terrain vehicles and, in many communities, cars and pickups abound.

The introduction of modern technology has tied Inupiat subsistence activities to a market economy (Kruse, 1982). Nevertheless, oil-supported revenues help support a lifestyle that is still distinctly Inupiat; and the area's people feel that their culture remains intact (Sale 87 FEIS [USDOI, MMS, 1984a]; ACI and Braund, 1984: Table 113). Indeed, outside pressures and opportunities have sparked what may be viewed as a cultural revival (Lantis, 1973). North Slope residents exhibit an increasing commitment to areawide political representation, local government, and the cultural preservation of such institutions as whaling crews and dancing organizations. People continue to hunt and fish; but aluminum boats, outboards, and three-wheelers now help blend these pursuits with wage work. Inupiat whaling remains a proud tradition that involves ceremonies, dancing, singing, visiting and cooperation between communities, and the sharing of foods.

The possible effects of the proposal on whales and whaling is a major scoping issue for residents of the North Slope (Kruse, Baring-Gould, and Schneider, 1983; ACI and Braund, 1984; USDOI, MMS, 1983b, Sale 87 Barrow Public Hearing Transcript). Whaling remains a primary subsistence activity for Barrow, Wainwright, and Point Hope (see Sec. IV.B.11)--an activity that has roots in Eskimo prehistory (Giddings, 1967). Whales are not only an important subsistence issue; they are the single-most important animal to the North Slope sociocultural system, which also has roots in prehistory (Lantis, 1938; Bockstoce et al., 1979; Worl, 1979).

The following sections describe the communities that may be affected by Sale 126. These community-specific descriptions discuss factors relevant to the sociocultural analysis; i.e., location of the community in relation to industrial activities, population, and current socioeconomic conditions. Social organization, cultural values, and other issues of all Sale 126 communities are discussed following these descriptions.

(1) Barrow: Although Barrow is outside of the Sale 126 area, Barrow would be one of the air-support bases for exploration because it is near the assumed pipeline landfall and shorebase site at Point Belcher. Some of Barrow's subsistence-harvest areas are within the proposed Sale 126 area, and many of the subsistence resources harvested by Barrow residents migrate through the sale area.

Barrow is the regional center and largest community on the North Slope. The majority of the population increases projected to occur as a result of this lease sale would occur in Barrow. In the period 1975 to 1985, Barrow experienced extensive social and economic transformations resulting from increased revenues from onshore oil development and production in Prudhoe Bay and other smaller oil fields; these revenues have been used to fund the NSB CIP. The NSB CIP stimulated a boom in the Barrow economy and an influx of non-Natives to the community. In 1970, the Inupiat population of Barrow represented 91 percent of the total population (U.S. Census); by 1985, the proportion had dropped to 61 percent (1985 Barrow Housing and Employment Survey, as cited by Worl and Smythe, 1986). In 1985, non-Natives outnumbered Natives between the ages of 30 and 50. An increasing number of non-Native families also have established permanent residence in Barrow. Another significant feature of the Barrow population since 1970 is the increase in ethnic diversification. Caucasians comprise 28 percent and Filipinos 5 percent of the total non-Native population. Other population groups include Blacks, Yugoslavians, Mexicans, and Koreans. The influx of non-Natives to Barrow has also brought an increase of mixed households since 1978, with an increasing number of Inupiat women choosing non-Natives as spouses (Worl and Smythe, 1986).

Inupiat women entered the labor force in the largest numbers ever and achieved positions of political leadership in the newly formed institutions. The proportion of Inupiat women raising families without husbands also increased during this period. The extended family, operating through interrelated households, is salient in community social organization (Worl and Smythe, 1986). During this same period, the social organization of the community became increasingly diversified with the proliferation of formal institutions. Socioeconomic differentiation is not new in Barrow. During the commercial whaling period and the reindeer herding period, there were influxes of outsiders and shifts in the economy. Other fluctuations have occurred during different economic cycles (trapping, U.S. Navy and Arctic Contractors employment, the recent CIP boom, and the periods of downturn in between [Worl and Smythe, 1986]). As a consequence of the changes Barrow has already experienced, Barrow may be more capable of absorbing additional changes as a result of this lease sale than would a smaller, homogeneous Inupiat community.

(2) Wainwright: Wainwright, which would be one of the air-support bases for exploration during this lease sale, is 20 to 25 km from the pipeline-landfall and shorebase site at Point Belcher; and its subsistence resources are harvested in the area of the highest oil-spill risk in the Sale 126 area.

Like other North Slope communities, the demographic changes in Wainwright from 1975 to 1985, stimulated by the NSB CIP boom, have not been as dramatic as the changes in Barrow. The CIP has led to retention of the population and the creation of new jobs, housing, and infrastructure. Although there has been an influx of non-Natives into Wainwright, unlike Barrow, most of these non-Natives are transient workers who cannot be considered permanently settled or even long-term residents. In 1983, approximately 30 percent of all Wainwright residents were non-Native. Of these approximately 100 residents, only a few would be in Wainwright 6 months to a year later. Even most of the eight Caucasian teaching couples had not been in Wainwright more than a year. Such nonpermanent, mobile residents tend to have relatively little interaction with the Native population--which creates benefits as well as tensions (Luton, 1985). Nevertheless, in Wainwright as in Barrow, the NSB CIP has changed the local economy; but it also has changed the physical face of the community and affected the quality of life. Residents now live in modern, centrally heated homes with running water, showers, and electricity. New buildings dominate the town, and upgraded roads have encouraged more people to own vehicles. Between July 1982 and October 1983, the number of pickup trucks and automobiles more than tripled in Wainwright (Luton, 1985).

(3) Point Lay, Point Hope, Atqasuk, and Nuiqsut: Point Lay, Atqasuk, and Nuiqsut are not located in the vicinity of proposed activities nor are they expected to experience any direct additional population growth or employment as a result of Sale 126. Indirect employment opportunities as a result of this sale are not expected to be large and would not have additional effects on the sociocultural systems of these communities. Effects on the sociocultural systems of these communities are only expected to occur as a result of increased NSB revenues and their effects on the subsistence-harvest patterns of these communities.

The following section describes the social organization, cultural values, and other issues for communities near the Sale 126 area.

b. Social Organization: The social organization of communities near the Sale 126 area is strongly kinship-oriented. Kinship formed "the axis on which the whole social world turned" (Burch, 1975). Historically, households were composed of large, extended families; and communities were kinship units. Today, there is a trend away from the extended-family household because of an increase in mobility, availability of housing, and changes in traditional kinship patterns. However, kinship ties in Inupiat society continue to be important and a central focus of the social organization.

The social organization of the North Slope Inupiat encompasses not only households and families but wider networks of kinspeople and friends. These various types of networks are related through various overlapping memberships and are also embedded in those groups that are responsible for the hunting, distribution, and consumption of subsistence resources.

An Inupiat household on the North Slope may contain a single individual or group of individuals who are related by marriage or ancestry. However, other individuals--related by birth, marriage, or friendship--may visit for extended periods and take their meals and sleep in this household. In fact, they may periodically visit a round of households where they stay for limited periods on a regular basis. In addition, households next door (or throughout the community) reciprocate various domestic functions, including the sharing of food preparation and meals, babysitting, and other activities. The members of an Inupiat household are fluid; relatives or friends may drop in and share meals and sleeping facilities for extended periods; and meals, babysitting, and other reciprocal activities regularly take place with other relatives and friends at their residences.

The interdependencies that exist among Inupiat households differ markedly from those found in the U.S. as a whole. In the larger non-Inupiat society, the demands of wage work emphasize a mobile and prompt work force. While modern transportation and communication technologies allow for contact between parents, children, siblings, and other extended family members, more often than not independent nuclear households (father, mother, and children) or conjugal pairs (childless couples) do not depend on extended family members for the day-to-day support of food, labor, or income. A key contrast between non-Native and Inupiat cultures occurs in their differing expectations; the Inupiat expect and need support from extended family members on a day-to-day basis.

Associated with these differences, the Inupiat hold unique norms and expectations about sharing. Households are not necessarily viewed as independent economic units; and giving, especially by successful community members (e.g., hunters), is regarded as an end in itself, although community status and esteem accrue to the generous. Kinship ties are strengthened through sharing and exchange of subsistence resources (Nelson, 1969; Burch, 1971; Worl, 1979; ACI and Braund, 1984; ACI, Courtnage, and Braund, 1984; and Luton, 1985). Kinship is also strengthened through cooperation in terms of group efforts and provision of cash and equipment for subsistence activities (ACI, Courtnage, and Braund, 1984).

c. Cultural Values: Traditional Inupiat values were centered on the Inupiat's close relationship with natural resources, specifically game animals; and although there have been substantial social, economic, and technological changes in the Inupiat lifestyle, subsistence continues to be the core or central organizing value of Inupiat sociocultural systems in the Sale 126 area. Indeed, "most Inupiat still consider themselves primarily hunters and fishermen" (Nelson, 1979). This refrain is repeated again and again by the residents of the North Slope (Kruse, Baring-Gould, and Schneider, 1983; ACI and Braund, 1984). Task groups are still organized to hunt, gather, and process subsistence foods. Cooperation in hunting and fishing activities also remains an important part of the Inupiat life. Whom one cooperates with is a major component of the definition of significant kin ties (Heinrick, 1963). Since subsistence tasks are, to a large extent, age- and sex-specific, subsistence-task groups are even important to the definition of such relations as the roles of husbands and wives, children and parents, friends, etc. (Wolfe, 1981; Thomas, 1982; Jorgensen, 1984; and Little and Robbins, 1984). In addition, large amounts of subsistence foods are shared within the community. Whom one gives to and receives from also are major components of the definition of significant kin ties (Heinrick, 1963; ACI, Courtnage, and Braund, 1984).

On the North Slope, "subsistence" is much more than an economic system; the hunt, the sharing of products of the hunt, and the beliefs surrounding the hunt tie families and communities together, connect people to their social and ecological surroundings, link them to their past, and provide meaning for the present. Generous hunters are considered good men. Good hunters are often respected leaders. Good health comes from a diet of products of the hunt. Young hunters still give their first game to the community elders. To be generous brings future success. These are but some of the ways in which subsistence and beliefs about subsistence join with sociocultural systems.

The cultural value placed on kinship and family relationships is apparent in the sharing, cooperation, and subsistence activities that occur in Inupiat society, as discussed above. However, the value also is apparent in the patterns of residence, reciprocal activities, social interaction, adoption, political affiliations (some families will dominate one type of government, e.g., the village corporation), employment, sports activities, and membership in voluntary organizations (Mother's Club, Search and Rescue, etc.) (ACI, Courtnage, and

Braund, 1984).

Bowhead whaling also remains at the center of Inupiat spiritual and emotional life; it embodies the values of sharing, association, leadership, kinship, arctic survival, and hunting prowess. The spring whale hunt off the Chukchi Sea lead system ties together these values with feasting and food preferences and symbolizes cultural integrity (see Bockstoce et al., 1979; ACI, Courtnage, and Braund, 1984).

The ramifications of the whale hunt are more than emotional and spiritual. The organization of the crews does much to delineate important social and kin ties within communities and to define community leadership patterns as well.

The structured sharing of the whale helps determine social relations both within and between communities (Worl, 1979; ACI, Courtnage, and Braund, 1984. Furthermore, the task-group formation and structured sharing that surround other subsistence pursuits are likewise important to Inupiat society. For example, the organization of summer boat crews for seal, walrus, and bird hunting helps to define kin ties and leadership within communities. The sharing of the proceeds of these hunts establishes meaningful ties between individuals and families. What is said for summer boat hunting holds true for caribou hunting, fishing, and other subsistence pursuits. In these communities, the giving of meat to the elders does more than feed old people; it bonds giver and receiver together, joins them to a living tradition, and draws them into their community.

Today, this close relationship between the spirit of a people, their social organization, and the cultural value of subsistence hunting may be unparalleled in other American energy-development situations. The Inupiat people's continuing strong dependence on subsistence foods, particularly marine mammals, creates a unique set of potential effects from offshore oil development on the social and cultural system. A recent analysis of the Inupiat's 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. The vast majority of concerns centered around 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 represent 83 percent of all the testimony taken on the North Slope (University of Alaska, ISER, 1983: Table 16).

d. Other Issues: Other issues important to an analysis of sociocultural systems are those that will affect or are already affecting Inupiat society. Section III.C.2 of the Sale 97 DEIS details the following issues: fiscal and institutional growth in the NSB, changes in employment, increases in income, decreases in Inupiaq fluency, and rising crime rates and substance abuse. A summary of these issues from the Sale 97 DEIS follows. The Sale 87 FEIS (USDOI, MMS, 1984a, Sec. III.C.2) and Sale 97 FEIS (USDOI, MMS, 1987a, Sec. III.C.2) consider the NSB's fiscal and institutional growth.

In addition, Smythe and Worl (1985) detail the growth and responsibilities of local governments. The NSB provides most government services for all six communities. These services include public safety, public utilities, fire protection, and some public health services. The NSB grew steadily in the late 1970's and early 1980's. Further fiscal and institutional growth is expected to be limited in the foreseeable future because of economic constraints in limiting direct Inupiat participation in oil industry employment and growing statewide budget constraints (Kruse, Baring-Gould, and Schneider, 1983). A massive NSB CIP in the early 1980's built schools, houses, roads, community buildings, fire stations, and health clinics, etc., and provided employment for the North Slope residents. The Arctic Slope Regional Corporation, formed under the ANCSA, runs several subsidiaries including Eskimos, Inc., and Tundra Tours. Most of the communities also have an Indian Reorganization Act (IRA) government as well as a city government. The IRA and village-corporation governments have not provided much in the way of services in the NSB.

The NSB CIP has caused the median yearly income of Natives to increase from $6,923 in 1970 to $32,515 in 1980 (per capita, not inflation adjusted) (Smythe and Worl, 1985). This increase was almost totally related to increases in Borough-related or Borough-created jobs. However, with oil revenues decreasing in 1985 and 1986, CIP and other employment opportunities have decreased; and there has been considerable concern on the North Slope about future employment opportunities.

While decreases in Native-language fluency have been noted among younger NSB residents, North Slope Inupiat are still generally bilingual. About 87 percent speak Inupiaq with some fluency; and, of those, only about 6 percent cannot speak English or speak it poorly. Although most people can speak Inupiaq, there seem to be a number of younger Inupiat who speak English exclusively to their children and who question their own fluency in Inupiaq when speaking (Galginaitis, 1985, oral comm.; Luton, 1985).

Recent statistics on homicides, rapes, and wife and child abuse present a sober 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 (ANHB) 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). 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 from reading earlier accounts of Inupiat society that there has been a drastic increase in these social problems. Recent information from Barrow (Worl and Smythe, 1986) details the important changes in Inupiat society that have occurred during the last decade in response to these problems. Services provided by outside institutions and programs have recently begun to assume some 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).

The baseline of the present sociocultural system includes change and strain. The very livelihood and culture of North Slope residents come under increasingly close scrutiny and regulation. The physical landmarks and regularities of life, such as homes, schools, and roads, all evidence of massive change and growth. In such a situation, the potential for "lost spirit" increases (Vesilind, 1983). This increase in stresses on social well-being and cultural integrity and cohesion comes at a time of economic well-being that is threatened by the decline of CIP projects across the North Slope (University of Alaska, ISER, 1983).

4. Archaeological Resources: "Archaeological Resources" can be defined as "any prehistoric or historic district, site, building, structure, or object [including shipwrecks] . . . Such term includes artifacts, records, and remains which are related to such a district, site, building, structure, or object" (National Historic Preservation Act, Sec. 301[5] as amended, 16 U.S.C. 470W[5]). Significant archaeological resources are either historic or prehistoric and generally include properties of greater than 50 years that (1) are associated with events that have made a significant contribution to the broad patterns of our history; (2) are associated with the lives of persons significant in the past; (3) embody the distinctive characteristics of a type, period, or method of construction; (4) represent the work of a master; (5) possess high artistic values; (6) present a significant and distinguishable entity whose components may lack individual distinction; or (7) have yielded, or may be likely to yield, information important in history. These resources represent the remains of the material culture of past generations of the region's prehistoric and historic inhabitants. They are basic to our understanding of the knowledge, beliefs, art, customs, property systems, and other aspects of the nonmaterial culture. The two major locational categories and two major time sequences of archaeological resources identified in the Sale 126 area are, respectively, offshore/onshore and prehistoric/historic.

a. Offshore (seaward from the 3-geographical-mile line): The known geological record of the proposed Sale 126 area covers only about one-third of the study area (See Appendix G, MMS Prehistoric Resource Analysis). In the prehistoric analysis, the 40-m bathymetric contour was used as the approximation of where the shoreline would have been in the Chukchi Sea planning area at 12,000 B.P., the date at which the area would have been inhabited by prehistoric man. Along this portion of the now-submerged shelf, relict terrestrial landforms provide indicators of areas where there is a higher potential for archaeological sites to occur. Currently, ice gouging is the only criteria for which there are sufficient published sources to document the level of probable destruction to archaeological sites.

A listing of shipwrecks in the Alaska OCS Region can be found on the MMS National Shipwreck Data Base (USDOI, MMS, 1990c). Shipwrecks are likely to have survived in the sale area, especially those that may be at a depth beyond intensive ice-gouging (Tornfelt, 1982, In Press). At least two, and perhaps more, of the 40 shipwrecks near the lease-sale area may have sunk outside the area of intensive ice-gouging. As previously stated, it is not possible to tell which, if any, erosional processes have destroyed archaeological resources in the sale area until surveys have been conducted and interpreted. The probability of finding a shipwreck is highest around Point Belcher, near Wainwright Inlet, and near Point Hope. Between Point Hope and Point Franklin, 48 ships went down between 1861 and 1924; of these ships, 32 were whaling vessels lost in the ice in the Wainwright Inlet/Point Franklin vicinity in 1871. Between 1890 and 1910, six ships are known to have sunk in the vicinity of Point Hope (USDOI, MMS, 1990c). To date, no successful surveys for shipwreck locations have been made nor have any of the shipwrecks been discovered; therefore, no exact locations are known.

b. Onshore: Information for some of the approximately 83 known archaeological sites onshore of the Sale 126 area may be found in the Alaska Heritage Resources Survey File (State of Alaska, DNR, 1990). State-listed sites WAI 008 through 015 are National Register sites as of March 18, 1980. Sites WAI 008, 010, and 011 are Kukmiut tradition; WAI 009 and 012 through 015 are Inupiat tradition. Twenty-one sites along the shore in the Wainwright Quadrant, 52 sites in the Point Lay Quadrant, and 10 sites in the Point Hope Quadrant exhibit just a small part of the archaeological-resource potential of the shore area along the Chukchi Sea coast. Onshore archaeological resources near the Chukchi Sea coast receive less damage from the receding shoreline than does the Beaufort Sea coast, which is subjected to more slumping because of water action and permafrost (Lewbel, 1984). The Chukchi Sea coast is eroding on an average of about 0.3 m per year. Although this erosion rate is considerably lower than that of the Beaufort Sea coast (1-2 m/yr), it accounts for a coast on which new archaeological sites periodically appear because of erosion. Known onshore archaeological resources exist in great numbers and quality. Villages, graves, whaling camps, and fishing/hunting camps have been found (Tornfelt, 1982).

The Ipiutak Site National Historic Landmark at Point Hope, Cape Krusenstern National Monument, and the Bering Land Bridge National Preserve are particularly important for onshore archaeological resources because oil transportation from the Sale 126 area may relate to these areas far south of the sale area. To the north of the sale area, the Birnirk Site National Historic Landmark at Barrow could also be of concern due to the northern directional flow of offshore currents.

(1) Cape Krusenstern National Monument: The core of this archaeologic district lies in the Cape Krusenstern National Monument, south of the Sale 126 area. A complex of approximately 114 marine beach ridges occurs here. These beach ridges run roughly east-west parallel to the present shoreline, are composed of alluvium, are only about 3 m above sea level, extend from 2.5 to 5 km toward the sea, and are about 14.5 km long. These beach ridges, formed of gravel deposited by major storms and regular wind and wave action, record in horizontal succession the major cultural periods of the Arctic over the last 4,500 years. The prehistoric inhabitants of northwest Alaska seasonally occupied the cape to hunt marine mammals, especially seals. As new beach ridges were formed, camps were made on the ridges closest to the water. Thus, over the centuries, a chronological "horizontal stratigraphy" was laid down in which the oldest cultural remains are found on the fossil-beach ridges farthest from the ocean, with more recent remains and modern camps found on beach ridges closer to the water. The discoveries made at Cape Krusenstern, especially when used in conjunction with those at Onion Portage in Kobuk Valley National Park, provide a definite, datable outline of cultural succession and development in northwest Alaska (USDOI, NPS, 1986a).

(2) Bering Land Bridge National Preserve: The Bering Land Bridge National Preserve contains archaeological resources that are valuable to the Nation because its record of the past was

not disturbed by the great ice ages (USDOI, NPS, 1986b). The succession of sand dunes at Cape Espenberg may provide information on human migration and habitation similar to the information collected from Cape Krusenstern. The coast north and south of the ancient village of Shishmaref contains numerous sites and some shipwrecks.

5. Land Use Plans and Coastal Management Programs:

a. Land Status and Use: Most land in the North Slope Borough (NSB) is held by a few major landowners. The Federal Government is the predominant landowner. Over one-half of the approximately 20 million hectares within the NSB is in the National Petroleum Reserve-Alaska (NPR-A) and the Arctic National Wildlife Refuge (ANWR). Other major landholders include the State of Alaska (1.4 million hectares), the eight Native village corporations in the NSB and the Arctic Slope Regional Corporation (ASRC) (1.4 million hectares combined), and the NSB (36,000 hectares). Much of the coastal area bordering the Chukchi Sea is in the NPR-A. Most of the remaining land along the coast is owned by the State or Native corporations.

Major land uses on the North Slope are divided among traditional subsistence uses of the land, community development, and hydrocarbon-development operations. Along the Chukchi Sea coast, traditional settlement patterns and subsistence uses of land prevail (subsistence uses are described in Sec. III.C.2).

Exploration for hydrocarbons and coal resources has occurred along the Chukchi Sea coast on lands leased by the ASRC and in the NPR-A. However, oil development and production has occurred only in the mid-Beaufort Sea region of the North Slope. Current operations include the Prudhoe Bay Unit, Lisburne field, Kuparuk River, Milne Point, and Endicott. The last field is offshore. Existing and potential developments are described in Appendix E and summarized in Table IV-A-2.

b. Land Use Planning Documents: Documents or programs that modify or control land use in the NSB include the Capital Improvements Program (CIP), the Comprehensive Plan and Land Management Regulations (LMR's), and the district coastal management program. The description of the NSB Coastal Management Program (NSBCMP) is included with the description of the Alaska Coastal Management Program in Section III.C.5.c(1). The following discussion focuses on land use plans in the NSB. Complete descriptions of the NSB CIP and Land Management Regulations are in the previous Chukchi Sea Lease Sale 109 FEIS (USDOI, MMS, 1987b), which is incorporated by reference. Those descriptions are summarized and updated in the following paragraphs.

(1) NSB CIP: Improvements identified in the NSB CIP are designated for each of the eight NSB communities, for Borough-wide projects, and for Service Area 10. The boundaries of Service Area 10 extend from Harrison Bay to the Canning River and include the Kuparuk Industrial Center, Prudhoe Bay, Bullen Point, and the Oxbow Landfill. Most major construction projects in the CIP have been completed.

(2) NSB Land Management Regulations: The North Slope Borough Comprehensive Plan and Land Management Regulations (LMR's) were adopted initially in December 1982. The LMR's were revised on April 12, 1990. The following description is based on the new regulations. The revisions simplified the regulatory process but did not alter the basic premise of the comprehensive plan--to preserve and protect the land and water habitat essential to subsistence living and the Inupiat character of life.

The new LMR's have five zoning districts--Village, Barrow, Conservation, Resource Development, and Transportation Corridor. All areas within the Borough are in the Conservation District unless specifically designated as within the limited boundaries of the villages or Barrow, as a unitized oil field within the Resource Development District, or along the TAP corridor within the Transportation Corridor. Therefore, new large scale development most likely would occur within the Conservation District. In that event, a

Master Plan for the development must be submitted to the NSB and adopted by the NSB Assembly as an amendment to the Comprehensive Plan, and the land must be rezoned from Conservation District to Resource Development District. During the process for rezoning for the Endicott development, several stipulations were attached to the Master Plan to mitigate adverse effects and to encourage beneficial effects.

In the new regulations, uses are no longer categorized as (1) uses-by-right, (2) prohibited uses, and (3) conditional uses (those that were neither prohibited nor allowed by "right"). Rather, the process identifies (1) uses that can be administratively approved without public review, (2) uses that require a development permit and must have public review before they can be administratively approved, and (3) uses that are considered conditional development that must be approved by the Planning Commission.

Policy revisions in the LMR's incorporated the NSB Coastal Management Policies and supplemented these with several additional policy categories--Village Policies, Economic Development Policies, Offshore Development Policies, and Transportation Corridor Policies. Offshore policies are specifically limited to development and uses in the portion of the Beaufort Sea that is within the NSB boundary. All the policies address offshore drilling.

The NSB Automated Geographic Information System is integrated into the NSB Comprehensive Land Use Program. Data mapped at two scales--1:250,000 and 1:63,360--enable the NSB to make decisions without necessarily visiting the site. The more precise scale is used for developed areas such as the Red Dog Mine and transportation corridor and the Dalton Highway (Fig. III-C-18).

c. Alaska Coastal Management Program: The Federal Coastal Zone Management Act (CZMA) and the Alaska Coastal Management Act (ACMA) were enacted in 1972 and 1977, respectively. Through these acts, development and land use in coastal areas are managed to provide a balance between the use of coastal areas and the protection of valuable coastal resources. The provisions and policies of both the Federal and State CMP's are described in MMS Reference Paper 83-1 (McCrea, 1983), which is summarized in the following paragraphs and incorporated by reference. Statewide standards and the interim boundaries of the Alaska CMP (ACMP) may be refined through local coastal programs prepared by coastal districts. Coastal districts are encouraged to prepare local CMP's to supplement the statewide standards within their districts. District programs must be approved by the Alaska Coastal Policy Council (CPC) and the Secretary of the U.S. Department of Commerce through the Office of Ocean and Coastal Resource Management (OCRM) before the programs are fully incorporated into the ACMP. The NSB, the only coastal district adjacent to the lease-sale area, has both State and Federal approval of its CMP. A description of the NSBCMP follows the description of the statewide standards of the ACMP.

(1) State Coastal Management Standards: The ACMP, as initially approved by the OCRM, includes the ACMA, guidelines and standards developed by the CPC, a series of maps depicting the interim boundaries of the State coastal zone, and an EIS prepared by the OCRM.

Legislative findings and policy in the ACMA are consistent with those of the CZMA. Standards developed by the CPC expand upon the statute and provide more specific policies covering coastal habitats, resources, and uses and activities. Standards that may be relevant to activities hypothesized in this EIS are summarized in the following paragraphs.

(a) Coastal Habitats: Eight coastal habitats were identified in the standards--offshore; estuaries; wetlands and tidelands; rocky islands and seacliffs; barrier islands and lagoons; exposed high-energy coasts; rivers, streams, and lakes; and important uplands. For each habitat a policy has been developed to ensure that the attributes that contribute to that habitat's capacity to support living resources are maintained or enhanced (6 Alaska Administrative Code [AAC] 80.130[b] and [c]).

Activities and uses that do not conform to the standards may be permitted if there is a significant public need and no feasible prudent alternatives to meet that need, and all feasible and prudent measures are

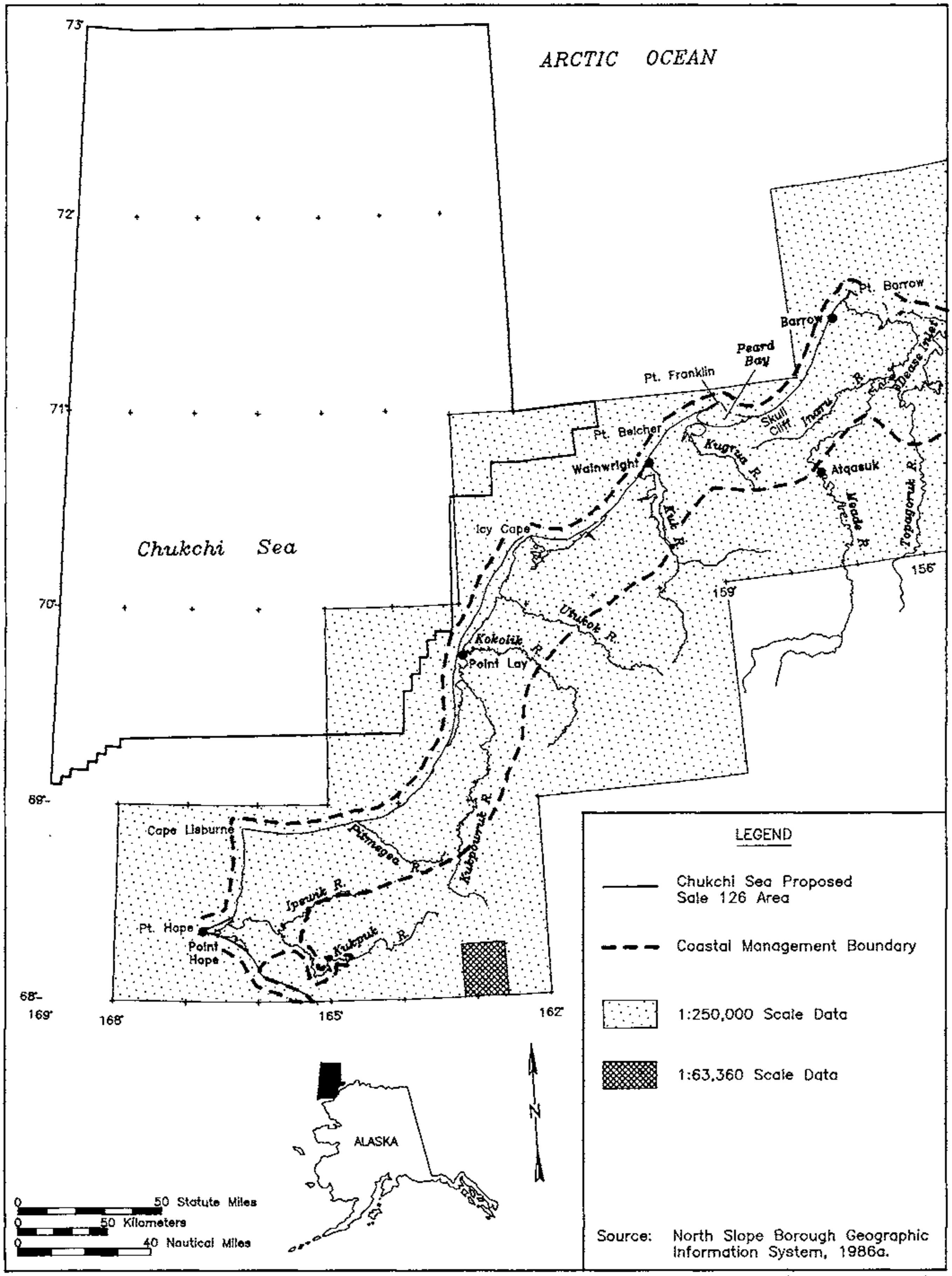


Figure III-C-18. North Slope Borough Automated Databases and Coastal Management Boundary incorporated to maximize conformance. Habitat policies frequently are cited in State consistency reviews.

(b) Coastal Resources: Two policy areas come under the heading of coastal resources: (1) air, land, and water quality and (2) historic, prehistoric, and archaeological resources. In the first instance, the ACMP defers to the mandates and expertise of the Alaska Department of Environmental Conservation (DEC). The standards incorporate by reference all the statutes, regulations, and procedures of the DEC that pertain to protecting air, land, and water quality (6 AAC 80.140). Concerns for air and water quality are cited frequently during State consistency reviews.

The policy addressing historic, prehistoric, and archaeological resources requires only identification of the "areas of the coast which are important to the study, understanding, or illustration of national, state, or local history or prehistory" (6 AAC 80.150).

(c) Uses and Activities: Nine topics are addressed under this heading: coastal development, geophysical-hazard areas, recreation, energy-facility siting, transportation and utilities, fish and seafood processing, timber harvesting and processing, mining and mineral processing, and subsistence. Uses and activities of particular relevance to the activities hypothesized for this lease sale include coastal development, geophysical hazards, energy-facility siting, transportation and utilities, mining and mineral processing, and subsistence.

Both the Federal CZMA and the ACMP require that uses of State and Federal concern be addressed and, in some way, accommodated in the local CMP. Major energy facilities fall into this category. As a result, before a local coastal district can restrict or exclude these facilities in its coastal program, the district must demonstrate that the use is not compatible with the proposed site and that the district consulted with affected government agencies and identified reasonable alternative sites (Alaska Statute [AS] 46.40.070[c]). Among the major energy facilities identified in the regulations are pipelines and rights-of-way; drilling rigs and platforms; petroleum or coal separation, treatment, or storage facilities; liquid natural gas plants and terminals; oil terminals and other port development for the transfer of energy products; petrochemical plants; and refineries and associated facilities (6 AAC 80.900[22]).

In developing district policies, the district must recognize and assure opportunities for subsistence use of coastal areas and resources. Areas that are used primarily for subsistence purposes must be identified and may be designated as special subsistence zones to the extent that this designation is compatible with the other districts' management plans for fish and game resources that are shared. Potentially conflicting uses or activities occurring within this designated area may be permitted only after a study is conducted to determine that possible adverse effects and safeguards are implemented to assure continued subsistence usage (6 AAC 80.120).

(2) NSBCMP: The NSBCMP was adopted by the Borough in 1984 and approved by the Alaska CPC in April 1985 and OCRM in May 1988. The NSB extended the State's interim coastal boundary inland on several waterways in order to include anadromous-fish-spawning and overwintering habitats. Along the Chukchi Sea coast, it was extended inland to include the Kukpuk River and a 1.6-km corridor along each bank (Fig. III-C-18).

The NSBCMP was developed to balance exploration, development, and extraction of nonliving natural resources and to maintain and ensure access to the living resources upon which the Inupiat traditional cultural values and way of life are based. The NSBCMP contains four categories of policies: (1) standards for development, (2) required features for applicable development, (3) best-efforts policies that include both allowable developments and required features, and (4) minimization-of-negative-impacts policies.

Standards for development prohibit severe harm to subsistence resources or activities and disturbance of cultural and historic sites. Required features address reasonable use of vehicles, vessels, and aircraft; engineering criteria for offshore structures; drilling plans; oil-spill-control and -cleanup plans; pipelines; causeways; residential development associated with resource development; and air quality, water quality, and solid-waste disposal.

Best-efforts policies allow for exceptions if (1) there is "a significant public need for the proposed use and activity" and (2) developers have "rigorously explored and objectively evaluated all feasible and prudent alternatives . . . " and briefly documented why the alternatives have been eliminated from consideration. If an exception to a best-efforts policy is granted, the developer must take "all feasible and prudent steps to avoid the adverse impacts the policy was intended to prevent."

Best-efforts policies allow development if all feasible and prudent steps are taken "to avoid the adverse impacts the policy was intended to prevent." Policies in this category address developments that could cause significantly decreased productivity of subsistence resources or ecosystems, displace belukha whales in Kasegaluk Lagoon, or restrict access of subsistence users to a subsistence resource. They also create restrictions on various modes of transportation, mining of beaches, or construction in certain floodplains and geologic-hazard areas.

Best-efforts policies also address features that are required by "applicable development except where the development has met [the two criteria identified above] and the developer has taken all feasible and prudent steps to maximize conformance with the policy." Developments and activities regulated under these policies include coastal mining, support facilities, gravel extraction in floodplains, new subdivisions, and transportation facilities. Policies include State habitat policies and encourage noninterference with important cultural sites or essential routes for transportation to subsistence resources.

All applicable developments must minimize "negative impacts." Regulated developments include recreational uses, transportation and utility facilities, and seismic exploration. Protected features include permafrost, subsistence activities, important habitat, migrating fish, and wildlife. Geologic hazards must be considered in site selection, design, and construction.

Two "areas meriting special attention" (AMSA's) were identified in the CMP--Point Thompson and Kasegaluk Lagoon. Upon further examination, Point Thompson was dropped and the Colville River Delta was added. Planning for the Kasegaluk Lagoon and Colville River Delta AMSA's is proceeding.

The NSB has adopted administrative procedures for implementing these policies based on the permit process established under Title 19 of the Borough's Land Use Regulations and the consistency-review process of Title 46 of the Alaska Statutes.

IV

ENVIRONMENTAL CONSEQUENCES

IV

IV. ENVIRONMENTAL CONSEQUENCES

A. Basic Assumptions for Effects Assessment

The effects of proposed Chukchi Sea Oil and Gas Lease Sale 126 are assessed in Section IV. Many of the basic resource and scenario assumptions used for effects assessment are discussed in Sections II.A through II.E and summarized in Table II-A-1. The Section IV assessment includes the analyses of the effects of Alternative I (low, base, and high cases); Alternative II, No Lease Sale; Alternative III, Delay the Sale; Alternative IV, Point Lay Deferral Alternative; the cumulative case; natural gas development and production; and a very large oil-spill event.

For Alternative I, the low, base, and high cases represent a potential range of resources, scenarios, and effects that might be possible given the uncertainties associated with estimating resources in a frontier area such as the Chukchi Sea Planning Area. The limits of a range of oil resources are assumed to be the low-case (430 MMbbl) and high-case (3,540 MMbbl) estimates. Within this range is a base-case estimate (1,610 MMbbl) of oil that is assumed likely to be leased and developed. These estimates are used to develop the exploration, development and production, and transportation scenarios used to analyze the potential effects of the proposed sale. (As noted in Appendix A, the low-, base-, and high-case estimates are determined by multiplying the 95th-percentile, mean, and 5th-percentile conditional estimates, respectively, by a factor representing the fraction of unleased oil in the planning area that is estimated to be leased and, for the base and high cases, economically developed; for Sale 126, MMS estimates this fraction to be 0.387.)

The low case represents a minimum resource volume of hydrocarbons likely to be present. The analysis of the low case in Section IV.B is based on the assumption that the volume of hydrocarbons likely to be present would be below the minimum economic resource required for development and production. Therefore, this analysis is based on a minimum amount of industrial activity that might occur in the Sale 126 area.

The base case represents a most likely amount of hydrocarbon resources that is assumed to be developed if commercial quantities of hydrocarbons are discovered. The base case includes (1) the undiscovered resources estimated to be leased, developed, and produced and (2) an estimate of the exploration, development and production, and transportation activities appropriate to that level of resources. The analysis of the base case in Section IV.C represents the principal analyses of the effects of the proposed action--the presumed result if the proposed lease sale is held.

The high case represents a maximum resource volume of hydrocarbons likely to be present in commercial quantities. The analysis of the high case in Section IV.D includes estimates of (1) a significantly higher level of resource recovery in comparison with the base case and (2) exploration, development and production, and transportation activities that might result from leasing more acreage than might occur for the base case or discovering and producing larger amounts of oil.

The potential effects of a proposed sale based on alternative sale-area configurations are analyzed for one deferral alternative--the Point Lay Deferral Alternative (Alternative IV, Sec. IV.G). The configuration of the sale area for this alternative was defined by deleting (not offering for lease) from the Alternative I area those blocks that contain, at various times of the year, significant biological resources and hold important cultural values for the Alaskan Natives who inhabit the nearby areas. The deleted blocks comprise the deferred area (not offered for lease) for the alternative. As noted in Section II.E.1, MMS estimates the amount of oil to be leased and discovered in the area to be offered for lease to be the same as in the base case. Because of this, the exploration, development and production, and transportation scenario and levels of activities associated with Alternative IV are also the same as in the base case.

The analyses of the potential effects of the cumulative case for Sale 126 (Sec. IV.H) are based on (1) exploration, development and production, and transportation activities in the three OCS planning areas of the Arctic Region (Beaufort Sea, Chukchi Sea, and Hope Basin Planning Areas; (2) the major projects listed in

Table IV-A-2, described in Appendix E, and shown in Graphic No. 3; and, (3) the additional projects (described in Sec. IV.H.2.a) considered in the migratory species cumulative effects analysis. The major projects considered in the cumulative-effects analyses for Sale 126 include past and future State of Alaska (State) and OCS oil and gas lease sales, North Slope Borough (NSB) capital improvement projects, onshore mineral development, and Canadian arctic oil and gas development. The additional projects considered in the analysis of migratory species encompass aspects of development within and beyond Alaska. The total amount of oil estimated to be present in the three OCS Arctic Region planning areas is about 5,480 MMbbl (Appendix A). (A larger volume of oil is used in the Oil Spill Risk Analysis because of tankering beyond TAP--this aspect is discussed further in this Section.)

Natural gas also may be discovered in the Sale 126 area during exploration drilling. Although gas resources are not considered economic to exploit at this time, they may be exploited in the future. Thus, leases containing natural gas that may be recoverable in the future probably will be retained by the leaseholder. Hence, the effects of potential natural gas exploitation that are in addition to the effects associated with oil development are analyzed in Section IV.I.

To analyze the potential effects of a very large oil-spill event, it is assumed that a spill of 160,000 bbl from a pipeline in the Chukchi Sea Planning Area would occur. The specifics of the scenario and analyses of effects are contained in Section IV.J.

The assumptions and the processes for performing the oil-spill-risk analysis and for calculating the probabilities of oil spills occurring and contacting environmental resources and coastal areas are described briefly in Section IV.A.1; a detailed description is given in Appendix C. Aspects of spilled oil, including (1) its fate and behavior; (2) the likelihood for contact and the extent and persistence along shorelines; (3) oil-spill-cleanup measures; and (4) toxicity in the marine environment are discussed in Section IV.A.2.

In analyzing the potential environmental effects of Sale 126, it is assumed that all activities associated with exploration, development and production, and transportation of petroleum will be performed in accordance with all applicable U.S. laws and Federal regulations. Compliance with applicable laws and regulations could mitigate some of the effects associated with petroleum exploitation.

Potentially affected communities should not use this EIS as a "local planning document." Site-specific planning cannot yet be done; it might be several years after the lease sale before any specific projections could be made. The exploration, development and production, and transportation scenarios described in this document represent only some of the possible types of activities that might be used to exploit the petroleum resources of the Chukchi Sea Planning Area. These scenarios are used to identify characteristic activities and areas where these activities may occur. They do not represent a recommendation, preference, or endorsement by the USDOI.

1. Oil-Spill-Risk Analysis: The oil-spill-risk analysis (OSRA) aids in estimating the risk from the Sale 126 base, high, and cumulative cases and the Point Lay Deferral Alternative by quantifying oil-spill risks to environmental resources and coastal (land/boundary) segments in the Chukchi Sea (Anderson and LaBelle, 1990; LaBelle, 1986; LaBelle and Anderson, 1985; Amstutz and Samuels, 1984; Samuels, LaBelle, and Amstutz, 1982-1983; Smith et al., 1982; Samuels, Huang, and Amstutz, 1982; Lanfear, Smith, and Slack, 1979). The OSRA considers the environmental resources' location in space and time, the oil-spill-occurrence probability, and the various spill-trajectories' probability.

a. Overview of the Oil-Spill-Risk-Analysis Model: This subsection provides a brief introduction to the OSRA. Details of the analysis are provided in Appendix C and references provided therein. The OSRA-model study area for lease Sale 126 base and high cases and the Point Lay Deferral Alternative is the central Chukchi Sea (Fig. IV-A-1).

(1) Location of Environmental Resources: Within the spill-trajectory study

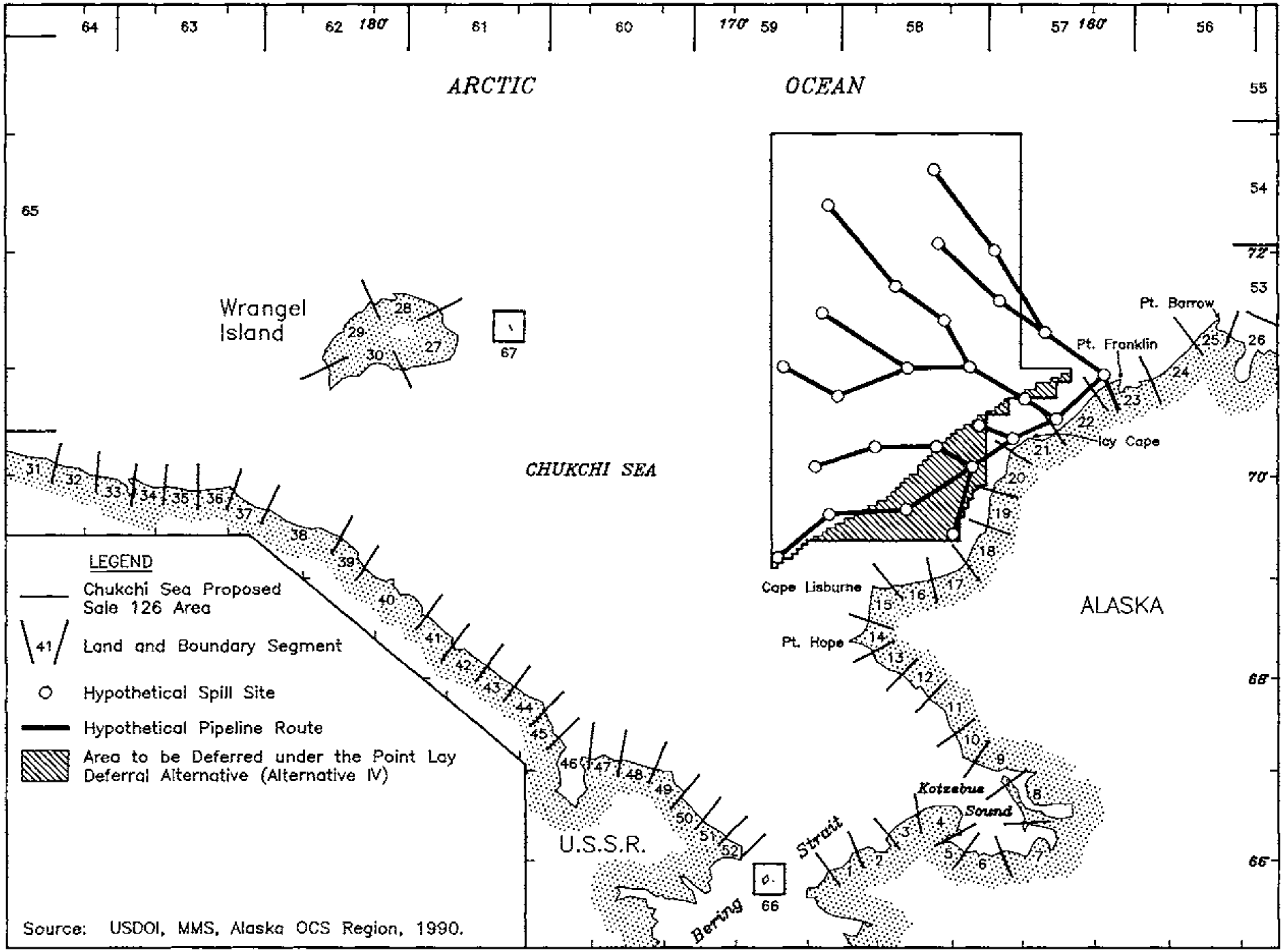


Figure IV–A–1. Study Area Boundaries, Land/Boundary Segments, and Other Elements Used in the Oil–Spill–Risk Analysis for Sale 126 area, the likelihoods of oil-spill contacts are calculated for 67 land/boundary segments and 25 environmental-resource areas. Land/boundary segments are identified in Figure IV-A-1 and environmental resources in Figures IV-C-1, IV-C-2, IV-C-3, and IV-C-7 (see Secs. IV.C.5, IV.C.6, IV.C.7, and IV.C.11, respectively).

(2) Probability of Oil-Spill Occurrence: The methods the MMS uses to calculate oil-spill-occurrence frequencies and probabilities are described by Anderson and Labelle (1990) and in Sale 124 FEIS, Section IV.A.1 (USDOI, MMS, 1990a), and are herein incorporated by reference; the following summary is augmented by additional material, as cited. For the base, high, and cumulative cases and the Point Lay Deferral Alternative, the mean spill number is estimated by multiplying historical spill rates (Sec. IV.A.1.a(2)(c) and Appendix C) by the resource-estimate volume (Appendix A). The oil-spill-occurrence probability is derived from the mean spill number using a Poisson distribution governing rare, random events.

(a) Oil-Resource Estimates: For Sale 126, the MMS uses low-, base-, high-, and cumulative-case and Point Lay Deferral Alternative oil-resource estimates. The oil-resource estimates are: (1) low case--430 MMbbl; (2) base case--1,610 MMbbl; (3) high case--3,540 MMbbl; (4) Point Lay Deferral Alternative--1,610 MMbbl; and (5) cumulative case--5,480 MMbbl in U.S. arctic OCS. (For the OSRA, additional reserves and resources for the cumulative case include 4,400 MMbbl in ANWR; 1,850 MMbbl in NPR-A undiscovered resources; and 2,760 MMbbl offshore arctic reserves and 11,440 MMbbl onshore arctic reserves totalling 25,930 MMbbl). The low-case oil-resource estimate is considered uneconomic. For analytical purposes the base-, high-, and cumulative-case and Point Lay Deferral Alternative oil-resource estimates are assumed to be leased, discovered, and produced.

(b) Transportation Assumptions: Use of any transportation scenario will depend upon finding commercial oil quantities, the oil location, and the subsequent environmental and economic-transportation-mode analyses. For the base and high cases and the Point Lay Deferral Alternative analyses, an assumption is made that oil is transported from offshore platforms by pipeline. Shown in Figure IV-A-2, the hypothetical spill sites (J3-J37) and transportation scenarios represent potential platform locations and pipeline routes for the base and high cases and the Point Lay Deferral Alternative. The hypothetical spill sites are a subset of the hypothetical spill sites used for Sale 109.

The hypothetical transportation scenario landfalls the OCS offshore pipeline at Point Belcher. Onshore pipelines traversing the NPR-A connect with the Trans-Alaska Pipeline (TAP) at Pump Station No. 2. At Pump Station No. 2, the OCS oil is commingled with the TAP oil. The oil is transported south by TAP to Valdez and shipped to the continental U.S. by tankers.

(c) Historical Oil-Spill Rates: Oil spills $\geq$ 1,000 bbl from tankers, platforms, and pipelines were analyzed (Anderson and LaBelle, 1990). Platform- and pipeline-spill rates were derived from U.S. OCS-spill data from 1964 to 1987. Due to data limitations, tanker-spill rates were derived from worldwide spill data from 1974 to 1985. For U.S. OCS platforms and pipelines, nonparametric tests indicated that the spill rate, based on volume of oil handled, had declined over time (Anderson and LaBelle, 1990). For worldwide tankers, the spill rate, based on volume of oil handled, had remained constant over time. U.S. OCS-platform- and pipeline-spill-rates are 0.60 and 0.67, respectively, per 10^9 bbl (Anderson and LaBelle, 1990). Worldwide tanker-spill rates are 0.90 at sea and 0.40 in port per 10^9 bbl (Anderson and LaBelle, 1990).

(3) Oil-Spill-Trajectory Simulations: For the base and high cases and the Point Lay Deferral Alternative, oil-spill trajectories were simulated by the Rand Corporation in Santa Monica, California. Rand's model description and model documentation, as contained in the Sale 109 FEIS, Section IV.A.1.c (USDOI, MMS, 1987b), is incorporated by reference; a model-description summary is augmented by additional material, as cited. Oil weathering, toxicity, and dispersion are not part of the trajectory analysis but are considered in Section IV.A.2.a. The modeled center-of-mass trajectories are reported at 12-hour positions. For Sale 126 base and high cases and the Point Lay Deferral Alternative, the MMS Branch of Environmental Modeling (BEM) in Herndon, Virginia, uses the trajectory positions to determine the contact

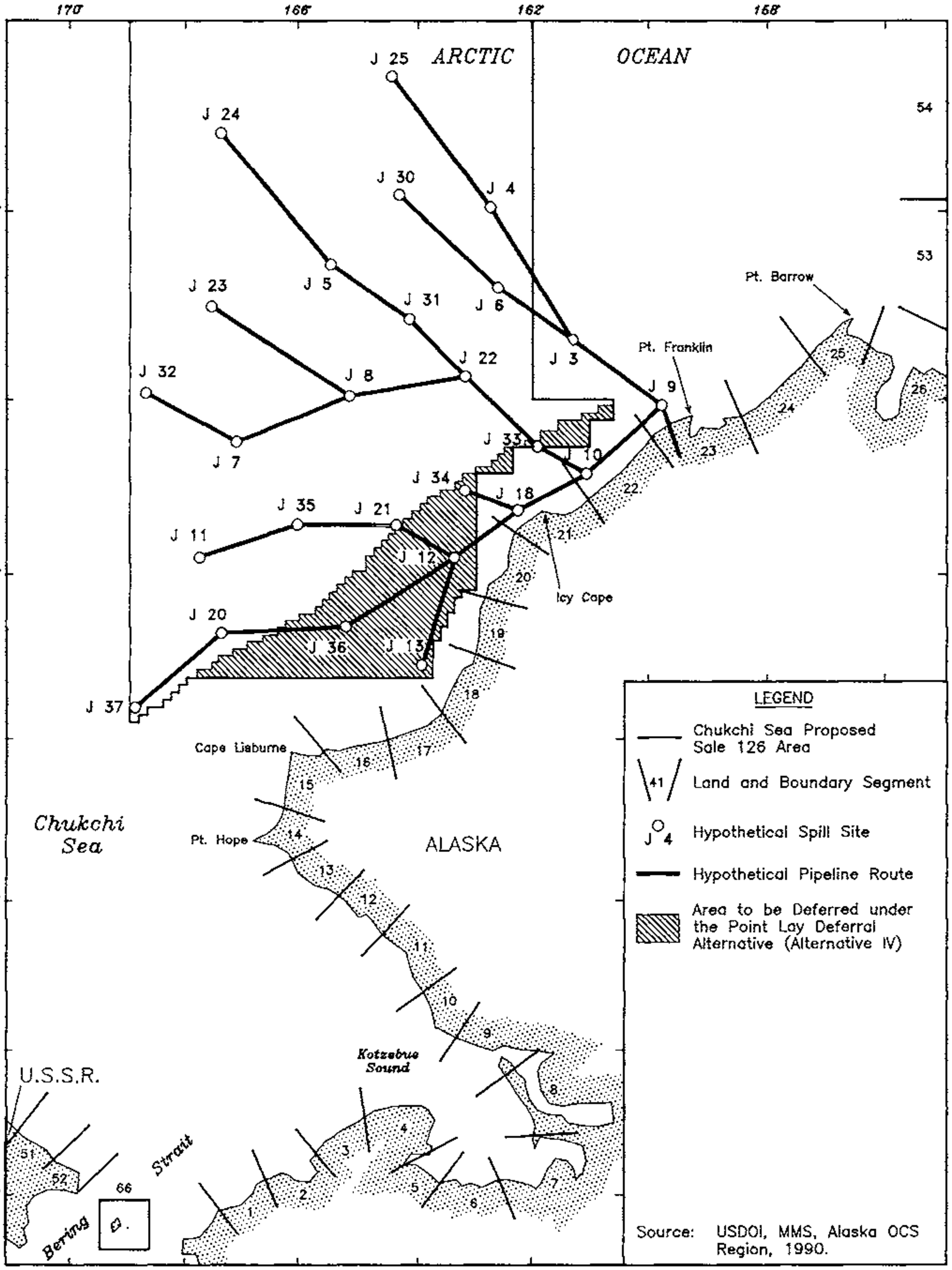


Figure IV-A-2. Detail Showing Hypothetical Spill Sites Representing Possible Platform Locations and Hypothetical Pipeline Routes Used for the Sale 126 Base and High Cases and the Point Lay Deferral Alternative Oil-Spill-Risk Analysis probability to environmental resources and land and boundary segments.

The BEM provides seasonal, combined probabilities as a final product. However, potential oil production is not delineated by season. For the OSRA seasonal-combined-probability-model run, the entire oil-resource estimate is used for both the summer- and winter-trajectory runs. This is an overestimate of the overall annual probability if summer and winter combined probabilities are added. In essence, twice the oil-resource estimate is run through the OSRA model.

No trajectories are simulated for the cumulative case or the Valdez-Prince William Sound tanker route. The OSRA treats these components of the overall risk separately by estimating the total oil spillage in the cumulative case and the spillage along the Valdez tanker route.

No trajectories are simulated for spills <1,000 bbl. The OSRA is primarily used to estimate contacts over days, not hours; consequently, only those spills that are large and can travel long distances or persist for several days are appropriate for this model (Anderson and LaBelle, 1990). Small-spill occurrence and potential effects are considered in Section IV.A.1.b(2)(b).

(a) Summer Trajectories: The modeled summer is 138 days from June 16 through October 31. In June, the average ice-concentration near the 70th parallel is approximately 4 oktas (okta = 1/8 surface coverage, 4 oktas = 50% coverage) and the water column is strongly stratified. Trajectories are computed using the ice-concentration data and a three-dimensional model reflecting the stratified water column. Trajectories are computed from 26 hypothetical spill sites. Under equally likely probability, oil is spilled every 5 days from the 26 hypothetical spill sites, providing 30 trajectories per launch point, totaling 780 summer trajectories. Although trajectories are provided on a seasonal basis, the entire oil-resource estimate is spilled during the summer-trajectory run because production is not delineated by season. Summer trajectories are run for 30 days, after which oil spills can not be modeled as a point source.

(b) Winter Trajectories: The modeled winter is 227 days from November 1 to June 15. For winter, 45 trajectories are run from each hypothetical spill site (26), totaling 1,170 winter trajectories. Oil is spilled in a staggered fashion, representing an equally likely occurrence chance throughout the entire 7.5-month-winter season. Although trajectories are provided on a seasonal basis, the entire oil-resource estimate is spilled during the winter-trajectory run because production is not delineated by season. Because spilled oil weathers very slowly in the arctic winter, the trajectories are followed up to the entire 7.5-month-winter season, rather than the 30-day trajectories that are followed in the summer. In the winter period, oil may, within hours or days, freeze into the sea ice and move with the ice throughout the winter. The oil-spill-trajectory model does not include the time-dependent oil freezing into the ice. In the model, the oil is assumed to be layered, unfrozen underneath the ice. Oil movement with ice or with underlying water depends on the relative ice and water velocity--which are both modeled. In general, unfrozen oil moves with the ice because of the low relative velocity of ice and water. Only under landfast ice will relative water velocity be sufficient to move oil on the ice underside.

b. Oil-Spill-Risk-Analysis-Model Results:

(1) Estimated Oil-Spill Occurrence: Assuming that the estimated resource is discovered and produced, mean-spill occurrence estimates are calculated for Sale 126 base, high, and cumulative cases and the Point Lay Deferral Alternative. Table IV-A-1 shows the statistically estimated mean spill number of ≥ 1,000 bbl potentially occurring from the Sale 126 base, high, and cumulative cases and the Point Lay Deferral Alternative. Estimated mean spill numbers are calculated for the Arctic for the low, base, and high cases and for the Arctic and Prince William Sound/Gulf of Alaska (PWS/GOA) for the cumulative case. In Sale 126, the most likely spill number in the base case is two and in the high case four for the Arctic Ocean (Fig. IV-A-3). For the Sale 126 Point Lay Deferral Alternative, the most likely spill number is two for the Arctic Ocean (Fig. IV-A-3). For the Sale 126 cumulative case, the most likely spill number is ten for the Arctic Ocean (Fig. IV-A-3), fifteen for PWS/GOA, and twenty-six for a total.

```
(a)  Spills ≥1,000 Bbl in the Sale 126 Base Case (Alternative I)

EXPECTED NUMBER (MEAN) =  2.03
PROBABILITY OF ONE OR MORE =  87%
MOST LIKELY (MODE) =  2
                                 10%  20%  30%  40%  50%  60%  70%  80%  90%
                               +----+----+----+----+----+----+----+----+----+----+
PROB. OF  0 = 13.13%  0 I
PROB. OF  1 = 26.66%  1 I
PROB. OF  2 = 27.06%  2 I
PROB. OF  3 = 18.31%  3 I
PROB. OF  4 =  9.29%  4 I
PROB. OF  5 =  3.77%  5 I
PROB. OF  6 =  1.28%  6 I

(b)  Spills ≥1,000 Bbl in the Sale 126 High Case (Alternative I)

EXPECTED NUMBER (MEAN) =  4.45
PROBABILITY OF ONE OR MORE =  99%
MOST LIKELY (MODE) =  4
                                 10%  20%  30%  40%  50%  60%  70%  80%  90%
                               +----+----+----+----+----+----+----+----+----+----+
PROB. OF  0 =  1.17%  0 I
PROB. OF  1 =  5.20%  1 I
PROB. OF  2 = 11.56%  2 I
PROB. OF  3 = 17.15%  3 I
PROB. OF  4 = 19.08%  4 I
PROB. OF  5 = 16.98%  5 I
PROB. OF  6 = 12.60%  6 I
PROB. OF  7 =  8.01%  7 I
PROB. OF  8 =  4.45%  8 I
PROB. OF  9 =  2.20%  9 I
PROB. OF 10 =  0.98% 10 I

(c)  Spills ≥1,000 Bbl in Sale 126 Point Lay Deferral Alternative
(Alternative IV)

EXPECTED NUMBER (MEAN) =  2.03
PROBABILITY OF ONE OR MORE =  87%
MOST LIKELY (MODE) =  2
                                 10%  20%  30%  40%  50%  60%  70%  80%  90%
                               +----+----+----+----+----+----+----+----+----+----+
PROB. OF  0 = 13.13%  0 I
PROB. OF  1 = 26.66%  1 I
PROB. OF  2 = 27.06%  2 I
PROB. OF  3 = 18.31%  3 I
PROB. OF  4 =  9.29%  4 I
PROB. OF  5 =  3.77%  5 I
PROB. OF  6 =  1.28%  6 I

(d)  Spills ≥1,000 Bbl in the Sale 126 Cumulative Case (Arctic Ocean)

EXPECTED NUMBER (MEAN) = 10.46
PROBABILITY OF ONE OR MORE = 100%
MOST LIKELY (MODE) = 10
                             10%  20%  30%  40%  50%  60%  70%  80%  90%
                            +----+----+----+----+----+----+----+----+----+----+
PROB. OF  3 =  0.55%  3 I
PROB. OF  4 =  1.43%  4 I
PROB. OF  5 =  2.99%  5 I
PROB. OF  6 =  5.21%  6 I
PROB. OF  7 =  7.79%  7
PROB. OF  8 = 10.19%  8 I
PROB. OF  9 = 11.84%  9 I
PROB. OF 10 = 12.38% 10 I
PROB. OF 11 = 11.78% 11 I
PROB. OF 12 = 10.26% 12 I
PROB. OF 13 =  8.26% 13 I
PROB. OF 14 =  6.17% 14 I
PROB. OF 15 =  4.30% 15 I
PROB. OF 16 =  2.81% 16 I
PROB. OF 17 =  1.73% 17 I
PROB. OF 18 =  1.01% 18 I
PROB. OF 19 =  0.55% 19 I

Source:  USDOI, MMS, Alaska OCS Region.
```

Figure IV-A-3. Most Likely Number and Poisson Distribution of Spill Probabilities for the Sale 126 Base and High Cases, the Point Lay Deferral Alternative, and the Cumulative Case

Table IV-A-1

Oil-Spill-Occurrence Estimates and Probabilities for Spills ≥1,000 bbl Resulting over the Assumed Production Life of Proposed Chukchi Sea Sale 126 Base, High, and Cumulative Cases, and the Point Lay Deferral Alternative

Source	Reserve Volume Produced (Bbbl)	Resource Volume Produced (Bbbl)	Estimated Mean Number of Spills, Arctic Ocean	Estimated Mean Number of Spills, PWS/GOA[1/]	Estimated Mean Number of Spills, Total	Probability of 1 or More Spills, Arctic Ocean (%)	Probability of 1 or More Spills, PWS/GOA Tankers (%)	Probability of 1 or More Spills, Total (%)
ALTERNATIVE I:[2/]								
Low Case		0.43	0	--	0	0	--	0
Base Case		1.61	2.03	--	2.03	87	--	87
High Case		3.54	4.45	--	4.45	99	--	99
ALTERNATIVE IV		1.61	2.03	--	2.03	87	--	87
CUMULATIVE CASE:								
Offshore:								
U.S. Arctic OCS		5.48	6.96	3.56	10.52	>99	97	>99
Endicott Field	0.31		0.39	0.20	0.60	33	18	45
Pt. Thomson	0.35		0.44	0.22	0.67	36	20	49
Seal/North Star	0.30		0.38	0.20	0.58	32	18	44
Niakuk	0.06		0.07	0.04	0.11	7	4	11
Tern, Hammerhead & Sandpiper OCS Prospects	[3/]							
Canadian Beaufort Sea	1.74		2.21	0	2.21	89	0	89
Onshore:								
Prudhoe Bay	3.29		0	2.14	2.14	0	88	88
Kuparuk River	0.94		0	0.61	0.61	0	46	46
Lisburne Field	0.16		0	0.10	0.10	0	10	10
West Sak	4		0	2.60	2.60	0	93	93
Ugnu	2.7		0	1.76	1.76	0	83	83
Point McIntre	0.3		0	0.20	0.20	0	18	18
Milne Point	0.05		0	0.03	0.03	0	3	3
Colville River	[3/]							
ANWR		4.40	0	2.86	2.86	0	83	83
NPR-A		1.85	0	1.20	1.20	0	70	70
Total	14.20	11.73	10.46	15.72	26.18	>99	>99	>99

Source: USDOI, MMS, Alaska OCS Region, 1990.

1/ The abbreviation PWS/GOA refers to Prince William Sound and Gulf of Alaska.

2/ The low case is based on an exploration-only scenario; spills are assumed not to occur. The base case is based on the estimated resources likely to be leased, discovered, and produced as the result of Chukchi Sea Lease Sale 126 and assumes the existence of economically recoverable hydrocarbons in the Sale 126 Area. There is an estimated 21% probability that such hydrocarbons exist and can be produced economically. The high case is based on the estimated resources that are significantly higher than the base case.

3/ No available estimate.

(2) Probability of Oil-Spill Occurrence: The likelihood that one or more ≥ 1,000-bbl oil spills can occur under the Sale 126 base, high, and cumulative cases and the Point Lay Deferral Alternative is high due to the estimated resource volume. For the base case, there is an 87-percent probability that one or more ≥ 1,000-bbl spills will occur over the base-case life in the Arctic Ocean (Table IV-A-1). For the high case, there is a 99-percent probability that one or more ≥ 1,000-bbl spills will occur over the high-case life in the Arctic Ocean (Table IV-A-1). For both the base and high cases, 53 percent of the spills will arise from transportation and 47 percent from platforms. For the Point Lay Deferral Alternative, there is an 87-percent probability that one or more ≥ 1,000-bbl spills will occur over the Point Lay Deferral Alternative life in the Arctic (Table IV-A-1).

For the cumulative case, 69 percent of the spills will arise from transportation and 31 percent from platforms. For the cumulative case, there is a >99-percent probability that one or more ≥ 1,000-bbl spills will occur over the cumulative-case life (Table IV-A-1).

(a) Assumed 1,000-bbl or Greater Spill Size: A ≥ 1,000-bbl spill is the minimum-sized spill in the ≥ 1,000-bbl category and is much smaller than the typical ≥ 1,000-bbl spill. Average ≥ 1,000-bbl spill sizes are 18,000 bbl for OCS platform spills; 25,000 bbl for OCS pipeline spills, and 110,000 bbl for tanker spills (Anderson and LaBelle, 1989; USDOI, MMS, 1990). Median ≥ 1,000-bbl spill sizes are 7,000 bbl for platforms, 6,000 bbl for pipelines, and 15,000 bbl for tankers. For the platform (18,000-bbl-average-spill size) and pipeline (25,000-bbl-average-spill size) scenarios for Alternative I (base and high cases) and the Point Lay Deferral Alternative, the source-weighted (frequency-weighted) average-size ≥ 1,000-bbl spill within the Chukchi Sea is 22,000 bbl and the median-size spill is 6,500 bbl. In this EIS, the ≥ 1,000-bbl-spill-volume assumptions conserve both the number and total volume (average size x the number of spills) of spills of at least 1,000 bbl. In this EIS, the assumed ≥ 1,000-bbl spills in the Chukchi Sea for the base case (two spills - 44,000 bbl), high case (four spills - 88,000 bbl), and Point Lay Deferral Alternative (two spills - 44,000 bbl) are additionally assumed to be 22,000 bbl each.

In the cumulative case (Hope Basin, Chukchi Sea, and Beaufort Sea Planning Areas), ten ≥ 1,000-bbl spills are estimated. Again, the average pipeline- and platform-spill size is 22,000 bbl; the total spillage will be ten times the 22,000-bbl average, or 222,000 bbl. With the ten spills, it is unlikely that each spill will be the average 22,000-bbl spill. Based on the OCS statistical-spill-size distribution, one-half of the spills should be less than one-third of the average size; and at least one spill should be considerably greater than the average size. This EIS assumes five median-size spills (6,500 bbl), four average-size spills (22,000 bbl), and one spill of 100,000 bbl in coastal arctic waters. The ten assumed spills total the 222,000-bbl total spillage estimated.

Along the tanker route in PWS/GOA, an average-size spill will be 110,000 bbl and a median-size spill will be 15,000 bbl; fifteen tanker spills ≥ 1,000 bbl are estimated to occur along this tanker route in the cumulative case. Because the average tanker spill ≥ 1,000 bbl is 110,000 bbl in size, total spillage along the tanker route is estimated to be 1.65 MMbbl. Again, the observed spill-size distribution--as for OCS pipeline and platform spills--indicates that about half of the fifteen spills should be much smaller than 110,000 bbl and a few spills should be much larger than 110,000 bbl. For Prince William Sound and the Gulf of Alaska, the distribution is seven 5,000-bbl tanker spills, one 15,000-bbl median spill, three 110,000-bbl average spills, three spills of 260,000 bbl (Exxon Valdez size), and one spill of 520,000 bbl (twice the Exxon Valdez size). The spill distributions maintain the statistical average- and median-spill sizes and also the total estimated spill volume.

(b) Spills of Less Than 1,000 bbl: Most OCS spills of <1,000 bbl are usually <50 bbl. Worldwide, <50-bbl oil spills from platforms contribute 0.02 to 0.03 MMbbl annually to a total oceanic release from offshore petroleum production of 0.3 to 0.5 MMbbl (National Research Council [NRC], 1985). Therefore, <50-bbl spills make up 4 to 10 percent of the total industry discharge and are not usually a major concern relative to larger-spill or deliberate-discharge losses.

During exploration in Alaskan OCS waters from 1982 to early 1989, 47 exploration wells were drilled, with five spills greater than 1 bbl and a total spillage of 45 bbl. From the Alaskan OCS data, the spill rate is eleven spills per 100 wells drilled, with a 9-bbl-per-spill-average volume. Based on Alaskan-OCS-spill data, no small spills are estimated during drilling of two exploration wells. For the base case, four exploration spills are estimated, with 36-bbl total spillage during exploration and delineation. For the high case, six exploration spills are estimated, with 54-bbl total spillage during exploration and delineation. For the Point Lay Deferral Alternative, four exploration spills are estimated with 36-bbl total spillage.

Less-than-1,000-bbl spills will be more frequent during the production years, but the anticipated spill volumes still will be small. Between 1971 and 1980 in Cook Inlet, the spill rate was 265 spills per Bbbl produced and transported. No reported spills in this timeframe were as large as 1,000 bbl; and the average size was 4.4 bbl (Sale 109 FEIS [USDOI, MMS, 1987b]). In OCS producing areas from 1964 to 1987, the offshore-oil industry spilled 23,688 bbl in 1,752 small spills (of at least 1 bbl but <1,000 bbl) while producing 7.5 MMbbl (crude and condensate). The OCS data show an OCS production-spill rate of 234 spills between 1 and 999 bbl in size per Bbbl produced, with an average 14-bbl-spill size. Thus, the OCS record shows a threefold higher oil-volume loss in small spills (<1,000 bbl) than in Cook Inlet (State) waters.

Based on OCS production-spill data, small-spill estimates are made for production in the base and high cases. For the base case (1.60 Bbbl), 380 production spills totaling 5,300 bbl are estimated. For the high case (3.5 Bbbl), 830 production spills totaling 11,600 bbl are estimated. For the Point Lay Deferral Alternative, 380 production spills totaling 5,300 bbl are estimated.

Combining spills during exploration and production provides the following overall estimates for small spills of at least 1 bbl but <1,000 bbl: (1) low case, no spills; (2) base case, 382 spills totaling approximately 5,300 bbl; and (3) high case, 834 spills totaling approximately 11,700 bbl; and (4) Point Lay Deferral Alternative, 382 spills totaling approximately 5,300 bbl.

(c) <u>Onshore Spills</u>: In 1,249 days from start up through January 1, 1981, the TAP (exclusive of tanker spills in Valdez) had 41 minor, 15 moderate, and 7 major spills involving spills of crude oil or refined-petroleum products. The respective average sizes of these spills are (1) minor spills of about 6 bbl, (2) moderate spills of about 98 bbl, and (3) major spills of about 1,500 bbl. Based on BLM's experience with TAP, the BLM-determined pipeline length/year is the best indicator of onshore pipeline spill rates. The BLM estimated that 40 percent of the length of a pipeline across the NPR-A would traverse wetlands (USDOI, BLM, NPR-A, 1983).

The Sale 126 scenario includes an onshore pipeline (across NPR-A) from Point Belcher to TAP Pump Station No. 2. The onshore pipeline is approximately 640 km long and crosses approximately 10 major rivers or their tributaries. Of greatest concern would be possible contamination of the Colville River, since the pipeline could cross four major tributaries of the Colville.

For the base and high cases and the Point Lay Deferral Alternative, 121 minor onshore pipeline spills totaling 730 bbl, 45 moderate onshore-pipeline spills totaling 4,410 bbl, and 22 major onshore-pipeline spills totaling 33,000 bbl are estimated (Table II-A-1). The total estimated onshore-pipeline spillage is 38,140 bbl.

To compute the probability of a spill contacting a major river tributary, the MMS assumed first that each kilometer of pipeline was equally likely to be a spill site, that a spill within a 1-km width of a river crossing could contaminate that river, and that the probability of onshore spills (like offshore spills) followed a Poisson distribution. One hundred eighty-eight spills of ≥ 2 bbl are estimated to occur. Given the length of the pipeline (640 km), the number of major river crossings (10), and the number of spills (188), the probability of at least one spill of ≥ 2 bbl occurring and contacting a major river tributary is 95 percent. Sixty-seven spills of ≥ 24 bbl are estimated to occur, with a 65-percent probability of contacting a major river tributary. In the largest size-class (those spills over 239 bbl, with an average size of 1,500 bbl), 22 spills are estimated. The probability of at least one spill greater than 239 bbl occurring and contacting a major river tributary is 29 percent. The probability of at least one large winter spill occurring and contacting a river is approximately 22 percent. These percentages assume contact only with the estimated 1-km segment encompassing that river and do not take into account contamination from wetlands outside that zone.

(3) Trajectory-Simulation Results: Trajectory-simulation results are presented as conditional and combined probabilities. Conditional probabilities assume that an oil spill occurs at a hypothetical spill site. The percentage of trajectories contacting a given environmental resource is the "conditional-probability" measure of an oil spill contacting that environmental resource, assuming that a spill occurs at the hypothetical spill site. The conditional probabilities, the estimated spill rates, transportation scenarios, and the unrisked mean-resource estimates are combined through matrix multiplication to yield overall, combined probabilities for $\geq$ 1,000-bbl spills. Thus, combined probabilities represent the risk to each environmental resource from all the hypothetical sites and their related transportation scenarios.

(a) Conditional Probabilities: The conditional probabilities are presented as (1) contacts with summer spills during the open-water season (Appendix C: Tables C-1 - C-6) and (2) contacts with winter spills during winter (Appendix C: Tables C-7 - C-12).

(b) Combined Probabilities: Combined probabilities for land/boundary segments for the Sale 126 base and high cases and the Point Lay Deferral Alternative are discussed in Section IV.A.2.b, and the combined probabilities for biological resources are discussed in Sections IV.B through IV.H. Combined-probability tables for the base and high cases are in Appendix C (Tables C-13 - C-16) and in Figures IV-A-4 and IV-A-5. Combined-probability tables for the Point Lay Deferral Alternative are in Appendix C (Tables C-17 -C-20) and in Figure IV-A-6.

2. Aspects of Spilled Oil: Detailed descriptions of spilled-oil fate and behavior, extent and persistence of oiled shoreline, and oil-spill-contingency measures are contained in Appendix L of this EIS. A summary of these descriptions follows.

a. Fate and Behavior of Spilled Oil: Arctic-oil-spill fate and behavior is discussed in Sale 109 FEIS, Section IV.A.2.a (USDOI, MMS, 1987b), and incorporated by reference. A summary pertinent to the Sale 126 base, high, and cumulative cases and the Point Lay Deferral Alternative, augmented by additional material, as cited, follows.

Surface spills and subsurface spills both form surface slicks and weather similarly. A spill of 22,000 bbl in open water of the Chukchi Sea could physically cover 2 to 5 km^2, and a spill of 100,000 bbl could cover on the order of 5 to 14 km^2. Winds, movement of the slick, and other forces would tend to spread the oil discontinuously over an area 20- to 200-fold greater than this actual area of oiled surface. Dissolution would account for only about 5 percent of slick mass; most spilled oil evaporates, grounds on the shoreline, or eventually forms tarballs or pancakes (Fig. IV-A-7a).

In arctic environments, the fate of spilled oil is influenced by the presence of ice and snow (Fig. IV-A-7b). The presence of broken ice would (1) retard spreading and (2) promote both of the competing processes of dispersion and mousse formation. Oil spilled under winter ice may pool and freeze to the underside of the ice. Thus, if the current speed is low, oil would not spread appreciably along the underside of the ice before being frozen into the ice. The spill would then move as part of the ice pack. Oil would melt out from multiyear ice more slowly than it would from first-year ice. Most oil would be released through the first summer following the spill, but some oil would not be released until the subsequent summer(s).

b. Likelihood of Shoreline Oiling: If an oil spill occurs, three important but nonbiological questions arise: (1) will the oil reach the shore; (2) if so, how much shoreline will be contaminated; and (3) how long will the contamination persist? The first issue is addressed below, the latter two in Sections IV.A.2.c and IV.A.2.d, respectively.

In winter, landfast ice may keep offshore spills away from the shoreline; and any oil reaching the shore will not penetrate into the frozen beach until thaw in the spring. In the OSRA model, winter shoreline oiling

COMBINED PROBABILITIES
SUMMER TRAJECTORIES ONLY

	BASE CASE			HIGH CASE		
	3 DAYS	10 DAYS	30 DAYS	3 DAYS	10 DAYS	30 DAYS
SEA SEGMENT 1						
SEA SEGMENT 2						
SEA SEGMENT 3						
SEA SEGMENT 4	4	5	10	8	11	21
SEA SEGMENT 5	1	4	15	2	8	30
SEA SEGMENT 6	39	50	54	66	79	82
SEA SEGMENT 7			1			2
SEA SEGMENT 8						
SEA SEGMENT 9						
SEA SEGMENT 10						
SEABIRD CONCENT. I						
SEABIRD CONCENT. II						
BERING STRAIT AREA						
MIGRAT. CORRIDOR A	44	44	44	72	72	72
MIGRAT. CORRIDOR B		3	18		6	36
MIGRAT. CORRIDOR C						
WHALE AREA A						
WHALE AREA B						
WHALE AREA C						
PEARD BAY AREA	18	18	18	35	35	36
BARROW SUBSIS. AREA						
WRGHT. SUBSIS. AREA	32	33	33	57	58	58
PT. LAY SUBSIS. AREA		1	7		1	14
PT. HOPE SUBSIS. AREA						
ANY SUBSIS. AREA	32	33	33	57	58	58
ALL LAND SEGMENTS			1			1
LAND SEGMENT 21			1			1

LEGEND

- <0.5 percent
- 10 percent
- 20 percent
- 30 percent
- 40 percent
- 50 percent
- 60 percent
- 70 percent
- 80 percent
- 90 percent
- >99.5 percent

Note: Land Segments with all combined probabilities <0.5 percent are not shown.

Source: USDOI, MMS, Alaska OCS Region, 1990.

Figure IV-A-4. Combined Probabilities of One or More Oil Spills $\geq$1,000 bbl Occurring and Contacting Environmental Resources over the Estimated Production Life of the Chukchi Sea Sale 126 Area for the Base and High Cases, Based on Summer Trajectories Only

COMBINED PROBABILITIES
WINTER TRAJECTORIES ONLY

	BASE CASE 3 DAYS	BASE CASE 10 DAYS	BASE CASE ENTIRE WINTER	HIGH CASE 3 DAYS	HIGH CASE 10 DAYS	HIGH CASE ENTIRE WINTER
SEA SEGMENT 1			3			6
SEA SEGMENT 2			5			12
SEA SEGMENT 3		3	11		7	22
SEA SEGMENT 4	5	17	31	11	33	56
SEA SEGMENT 5	10	25	38	20	47	65
SEA SEGMENT 6	44	53	54	72	81	82
SEA SEGMENT 7						1
SEA SEGMENT 8		1	1		2	2
SEA SEGMENT 9						
SEA SEGMENT 10						
SEABIRD CONCENT. I						
SEABIRD CONCENT. II						
BERING STRAIT AREA						
MIGRAT. CORRIDOR A	7	10	11	16	21	23
MIGRAT. CORRIDOR B	1	4	6	3	8	13
MIGRAT. CORRIDOR C						
WHALE AREA A						
WHALE AREA B						
WHALE AREA C						
PEARD BAY AREA	18	18	18	35	35	35
BARROW SUBSIS. AREA						
WRGHT. SUBSIS. AREA	33	34	34	59	59	59
PT. LAY SUBSIS. AREA	5	8	10	11	17	21
PT. HOPE SUBSIS. AREA						
ANY SUBSIS. AREA	33	34	34	59	59	59
ALL LAND SEGMENTS			25			46
LAND SEGMENT 21			2			5
LAND SEGMENT 27			13			27
LAND SEGMENT 28			9			19
LAND SEGMENT 30			2			4
LAND SEGMENT 40						1
LAND SEGMENT 46						1
LAND SEGMENT 61			1			3

LEGEND

(blank)	<0.5 percent
10	10 percent
20	20 percent
30	30 percent
40	40 percent
50	50 percent
60	60 percent
70	70 percent
80	80 percent
90	90 percent
(solid)	>99.5 percent

Note: Land Segments with all combined probabilities <0.5 percent are not shown.
Source: USDOI, MMS, Alaska OCS Region, 1990.

Figure IV-A-5. Combined Probabilities of One or More Oil Spills $\geq$1,000 bbl Occurring and Contacting Environmental Resources over the Estimated Production Life of the Chukchi Sea Sale 126 Area for the Base and High Cases, Based on Winter Trajectories Only

COMBINED PROBABILITIES
POINT LAY DEFERRAL ALTERNATIVE

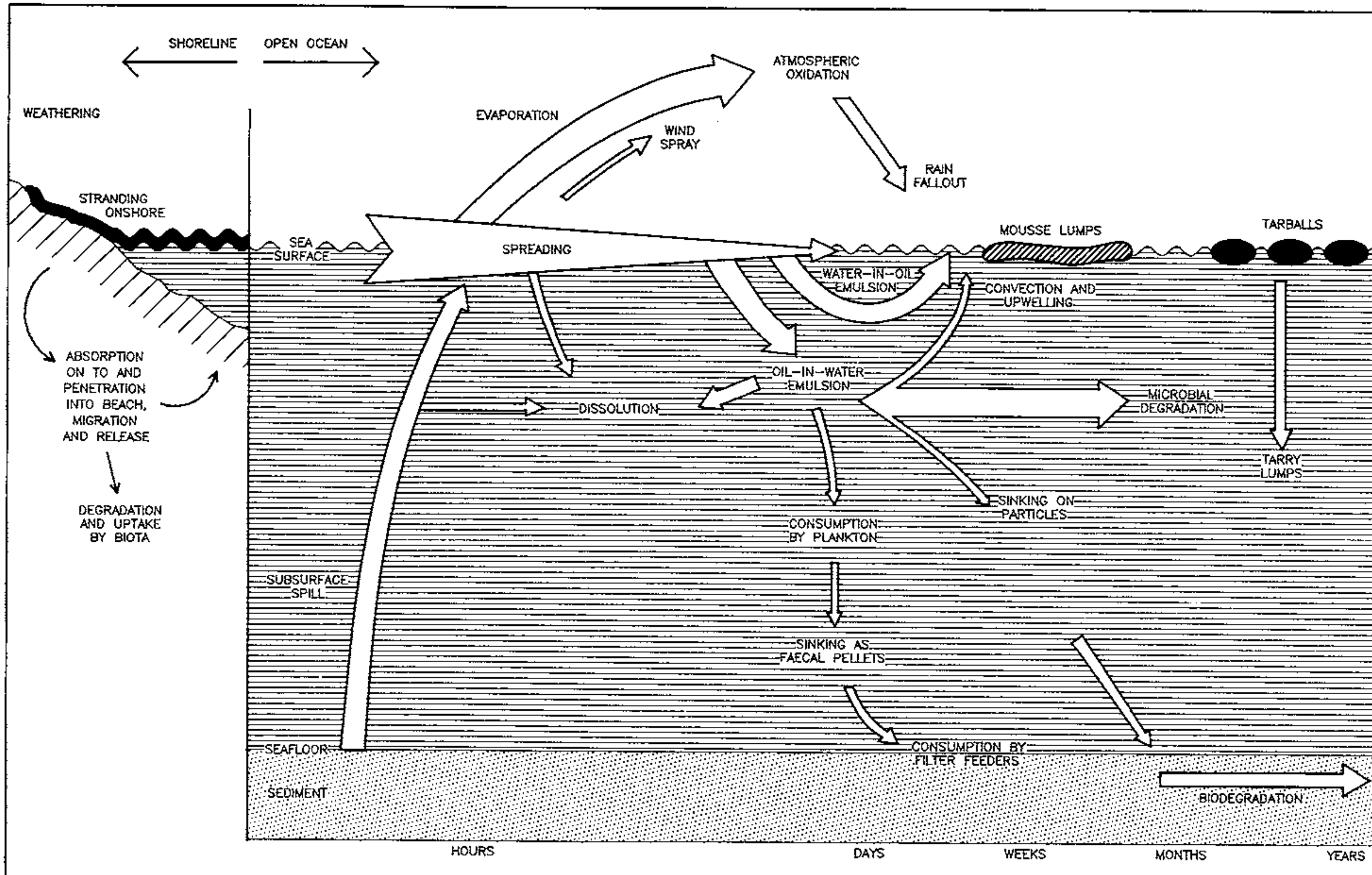
	SUMMER 3 DAYS	SUMMER 10 DAYS	SUMMER 30 DAYS	WINTER 3 DAYS	WINTER 10 DAYS	WINTER ENTIRE WINTER
SEA SEGMENT 1						3
SEA SEGMENT 2						5
SEA SEGMENT 3					3	11
SEA SEGMENT 4	4	5	10	5	17	31
SEA SEGMENT 5	1	4	15	10	25	38
SEA SEGMENT 6	39	50	54	44	53	54
SEA SEGMENT 7			1			
SEA SEGMENT 8					1	1
SEA SEGMENT 9						
SEA SEGMENT 10						
SEABIRD CONCENT. I						
SEABIRD CONCENT. II						
BERING STRAIT AREA						
MIGRAT. CORRIDOR A	44	44	44	7	10	11
MIGRAT. CORRIDOR B		3	18	1	4	6
MIGRAT. CORRIDOR C						
WHALE AREA A						
WHALE AREA B						
WHALE AREA C						
PEARD BAY AREA	18	18	18	18	18	18
BARROW SUBSIS. AREA						
WRGHT. SUBSIS. AREA	32	33	33	33	34	34
PT. LAY SUBSIS. AREA		1	7	5	8	10
PT. HOPE SUBSIS. AREA						
ANY SUBSIS. AREA	32	33	33	33	34	34
ALL LAND SEGMENTS			1			25
LAND SEGMENT 21			1			2
LAND SEGMENT 27						13
LAND SEGMENT 28						9
LAND SEGMENT 30						2
LAND SEGMENT 61						1

LEGEND

- <0.5 percent
- 10 percent
- 20 percent
- 30 percent
- 40 percent
- 50 percent
- 60 percent
- 70 percent
- 80 percent
- 90 percent
- >99.5 percent

Note: Land Segments with all combined probabilities <0.5 percent are not shown.
Source: USDOI, MMS, Alaska OCS Region, 1990.

Figure IV-A-6. Combined Probabilities of One or More Oil Spills ≥1,000 bbl Occurring and Contacting Environmental Resources over the Estimated Production Life of the Chukchi Sea Sale 126 Area for the Point Lay Deferral Alternative, Based on Summer and winter Trajectories



Source: After Mackay, 1985, and Rasmussen, 1985.

Figure IV-A-7a. Fate of Oil Spills in the Ocean During Summer

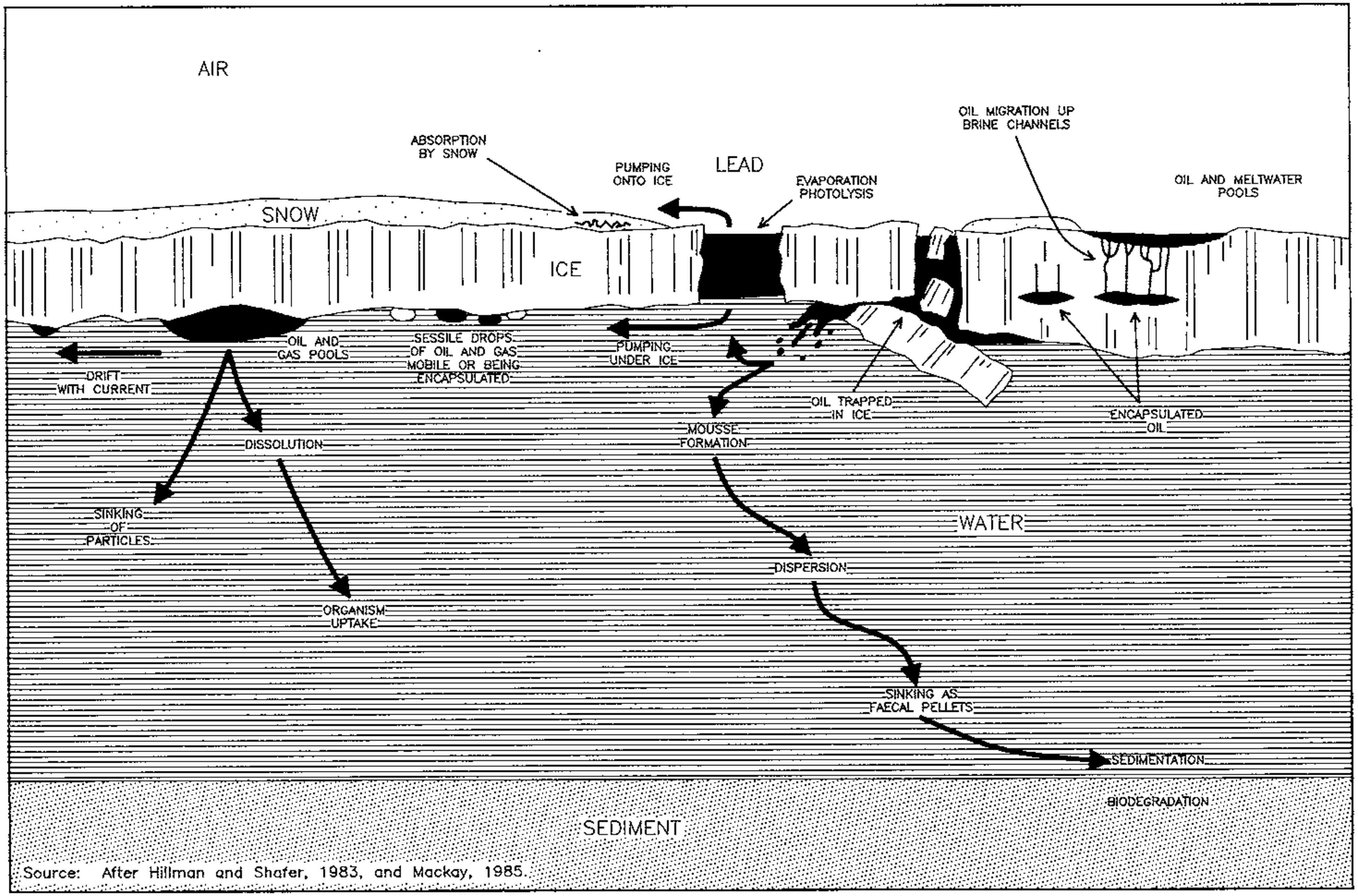


Figure IV–A–7b. Fate of Oil Spills in the Ocean During Winter occurs through the following mechanisms: (1) land can be oiled in ice-override events, (2) oil can be stripped from the ice underside by currents and moved shoreward, (3) oil may freely drift ashore early and late in winter if landfast ice is absent, and (4) land contact is assumed if oil-spill-trajectory center-of-mass distance is closer to land than the estimated slick radius. Mechanism (2) exaggerates the land-contact likelihood because the oil-spill-trajectory model omits the winter oil freezing into ice (see Sec. IV.A.1.c).

(1) Conditional Probabilities: The conditional probabilities show that if a spill occurs, the likelihood of contact to land will be low in summer (Appendix C: Tables C-1 - C-6). Summer conditional probabilities of contact to land are <0.5 percent for all hypothetical spill sites through 10 days. In the Sale 126 area, a spill will tend to move offshore, not onshore. Hypothetical Spill Sites J10 and J13 have a 3-percent and 7-percent summer conditional-contact probability, respectively, to land through 30 days.

(2) Combined Probabilities: For the base and high cases and the Point Lay Deferral Alternative, there is a 1-percent probability that a ≥ 1,000-bbl spill will occur and contact land within 30 days in summer (Appendix C: Table C-15; Fig. IV-A-8). Both the base and high cases and the Point Lay Deferral Alternative have a very low probability of one or more spills of ≥ 1,000 bbl occurring and contacting land in the summer.

For the base case and the Point Lay Deferral Alternative, there is a 25-percent chance of one or more ≥ 1,000-bbl spills occurring and contacting land sometime during the entire winter (Appendix C: Table C-16; Fig. IV-A-9). For the base case and the Point Lay Deferral Alternative, during the entire winter the probability of one or more ≥ 1,000-bbl spills occurring and contacting (1) Wrangel Island is 18-percent and (2) Alaskan shores is 1-percent (Fig. IV-A-9). For the high case, there is a 46-percent chance of one or more ≥ 1,000-bbl spills occurring and contacting land during the entire winter (Appendix C: Table C-16; Fig. IV-A-10). For the high case, during the entire winter the probability of one or more ≥ 1,000-bbl spills occurring and contacting (1) Wrangel Island (Land Segments 27-30) is 39 percent, (2) Alaskan shorelines (Land Segment 21) 5 percent, and (3) U.S.S.R. shorelines (Land Segments 40 and 46) 1 percent (Appendix C: Table C-15; Fig. IV-A-10).

c. Extent of Shoreline Oiling: The shoreline-oiling extent from offshore oil spills is discussed in Appendix L of this EIS. A summary pertinent to the Sale 126 base and high cases and the Point Lay Deferral Alternative, augmented by additional material, as cited, follows.

An offshore spill that reaches shore may not reach the shoreline in its entirety: contact may occur along a single location or jump along the coast, depending on the winds and longshore current.

d. Persistence of Stranded Oil: U.S.-arctic-shoreline-oil-retention characteristics are described in Sale 109 FEIS, Section IV.A.2.d (USDOI, MMS, 1987b), and incorporated by reference. A summary pertinent to the Sale 126 base and high cases and the Point Lay Deferral Alternative, as augmented by additional material, as cited, follows.

Stranded-oil persistence results from oil remaining after cleanup or where cleanup may cause more environmental damage than if the oil is left in place. Empirical data and Chukchi Sea coastline surveys rate the shoreline-oil-retention potential from low to very high (Fig. IV-A-11; Hayes and Ruby, 1979; Woodward-Clyde Consultants, 1981; Robilliard et al., 1985).

In the Chukchi Sea, areas such as marshes, low tundra shores, mudflats, deltas, low-energy beaches and low, vegetated barriers may be areas where most cleanup operations--contaminated soil and vegetation removal or even heavy foot traffic--may cause very long-term scars in the landscape and ecosystem. Based on the combined probabilities for summer, Land Segment 21 (Icy Cape) is at risk from a spill near hypothetical Spill Site J10 in the base and high cases and the Point Lay Deferral Alternative. Land Segment 21 (Icy Cape) shoreline has an average high oil retention rating with some portions having very high oil retention ratings. Icy Cape shorelines with high and very high ratings are in Kasegaluk lagoon, including low-energy beaches,

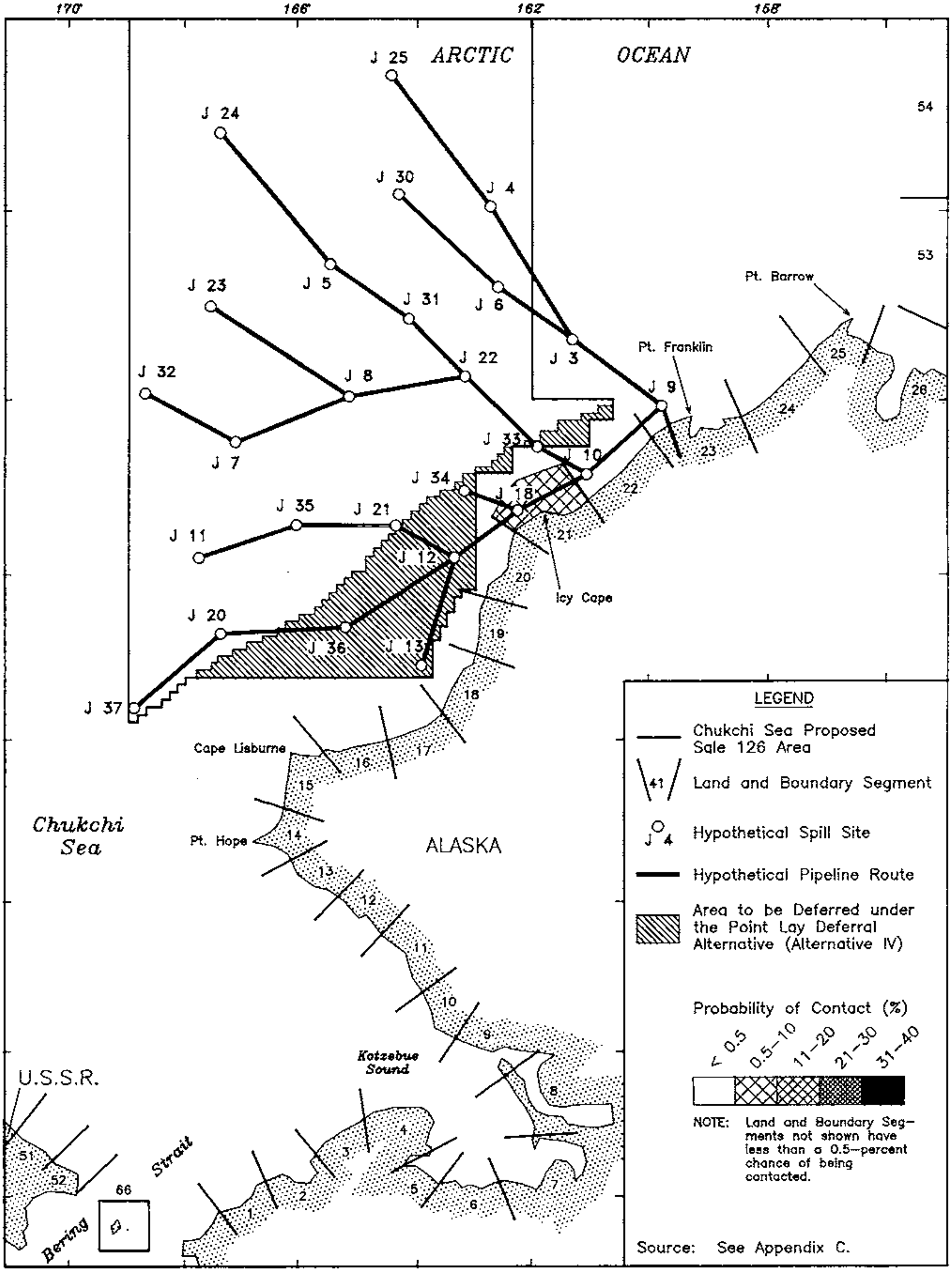


Figure IV–A–8. Combined Probabilities of One or More Oil Spills ≥1,000 bbl Occurring in Summer and Contacting Individual Land/Boundary Segments within 30 Days, over the Estimated Production Life of the Sale 126 Area for the Base and High Cases and Alternative IV

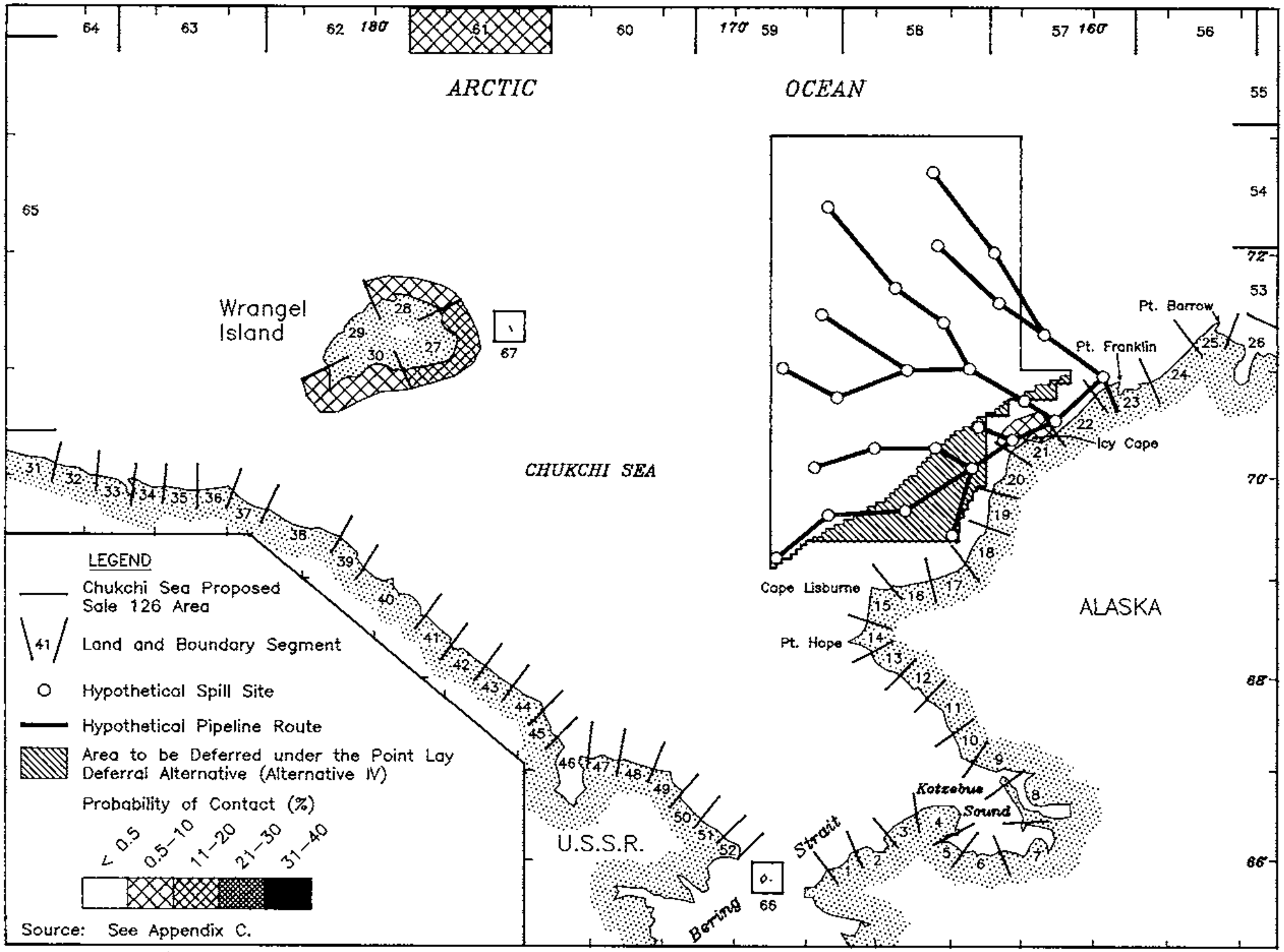


Figure IV–A–9. Combined Probabilities of One or More Oil Spills ≥1,000 bbl Occurring in Winter and Contacting Individual Land/Boundary Segments within 30 Days, over the Estimated Production Life of the Sale 126 Area for the Base Case and the Point Lay Deferral Alternative

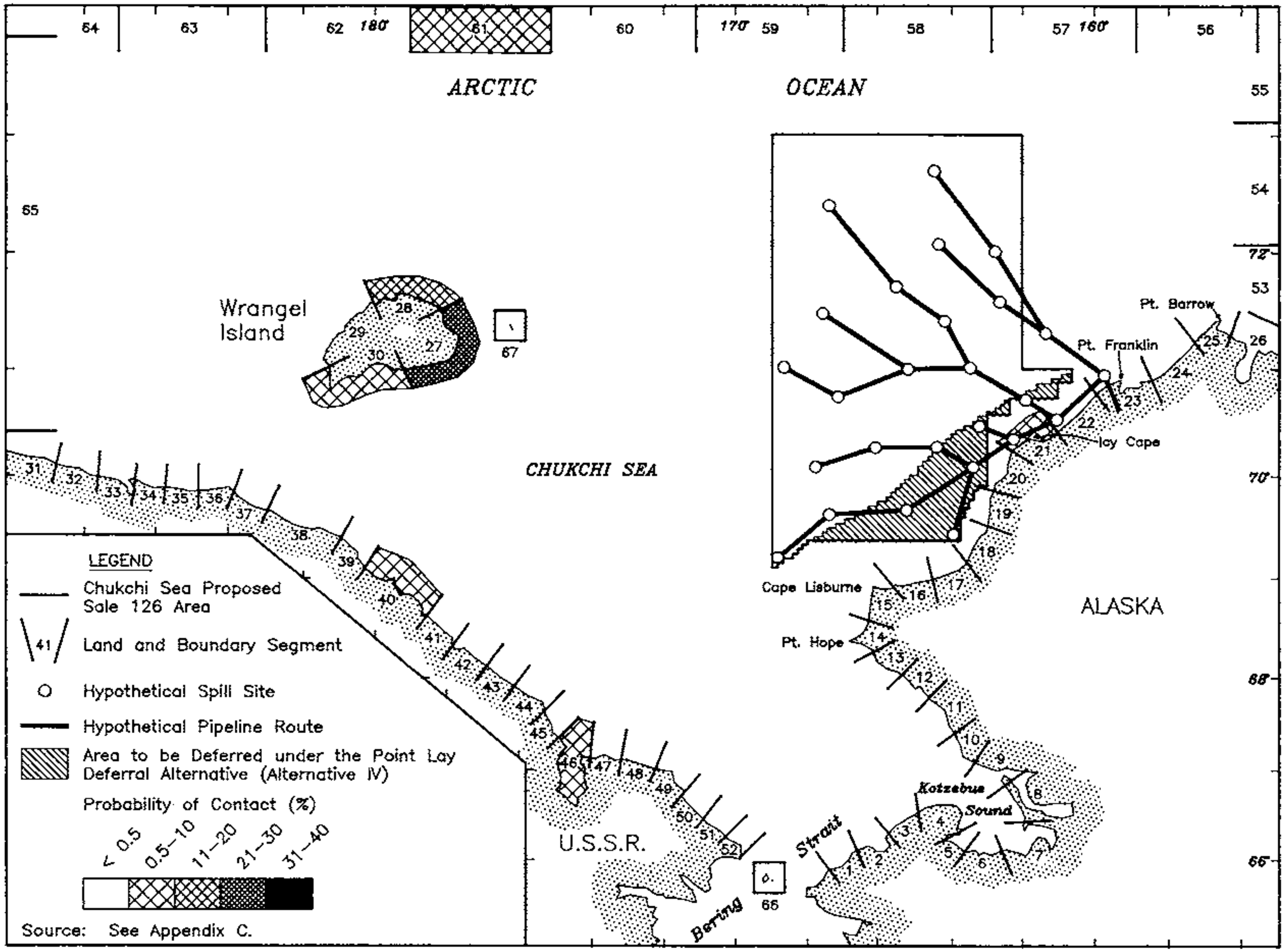


Figure IV-A-10. Combined Probabilities of One or More Oil Spills ≥1,000 bbl Occurring in Winter and Contacting Individual Land/Boundary Segments within 30 Days, over the Estimated Production Life of the Sale 126 Area for the High Case

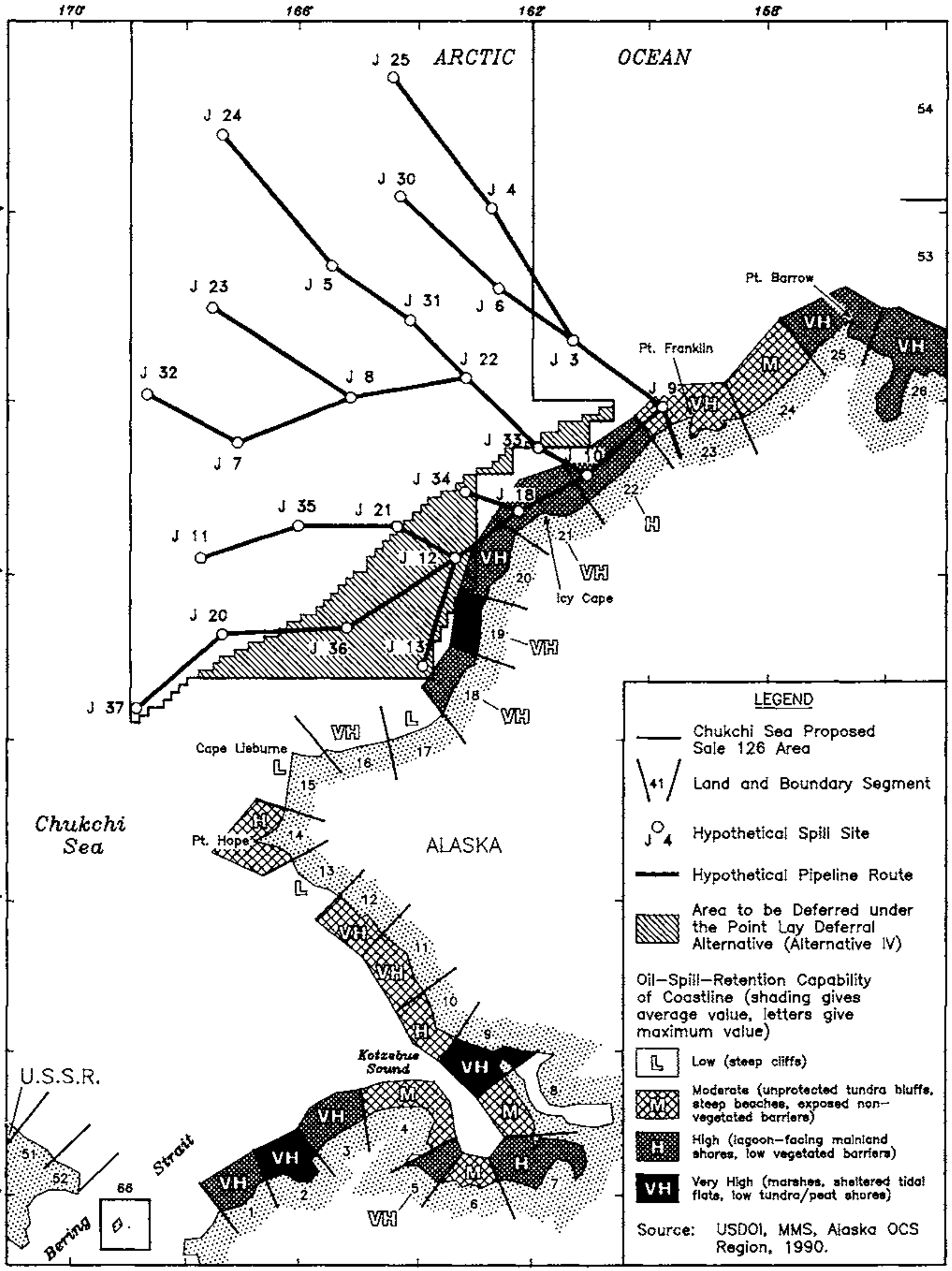


Figure IV-A-11. Oil-Spill-Retention Capability of Land Segments along the U.S. Chukchi Sea Coastline deltas, mudflats, and marshes. Although Kasegaluk Lagoon is protected from at-sea spills by barrier islands and recurved spits, Akoliakatat, Icy Cape, Utukok Passes; and two other unnamed passes allow substantial flow-through. In addition, there are numerous washover fans and channels indicating overflow into Kasegaluk Lagoon. Oil stranded in the high-retention zone may persist for decades if not cleaned up (Gundlach, Domeracki, and Thebeau, 1982). The gravel barrier islands' seaward sides have moderate oil retention, and oil may not persist for more than a year or two if not cleaned up (Gundlach, Domeracki, and Thebeau, 1982).

Based on the combined probabilities, Land Segments 21, 27, 28, 30, 40, 46, and 61 are at risk during the winter from the high case. Except for Land Segments 40 and 46, these segments also are at risk during the winter from the base case. Land Segments 27, 28, 30, 40, and 46 are within the U.S.S.R. and there is insufficient data to evaluate oil persistence on U.S.S.R. shorelines. Boundary Segment 61 is near the polar ice cap, and oil-retention potential within the ice cap will be high, with oil not weathering out for a decade when ice exits through Fram Strait (Colony and Thorndike, 1985).

e. Oil-Spill-Contingency Measures: OCS oil-spill-cleanup response is the spiller's responsibility. The Federal Government will step in as a last resort only if the Government considers the spiller's response to be inadequate. The Government's and the oil and gas industry's intent is to prevent spills before they occur. Attention is given to preventive measures such as better technology and better training. However, preparations for spill response are still made, just in case.

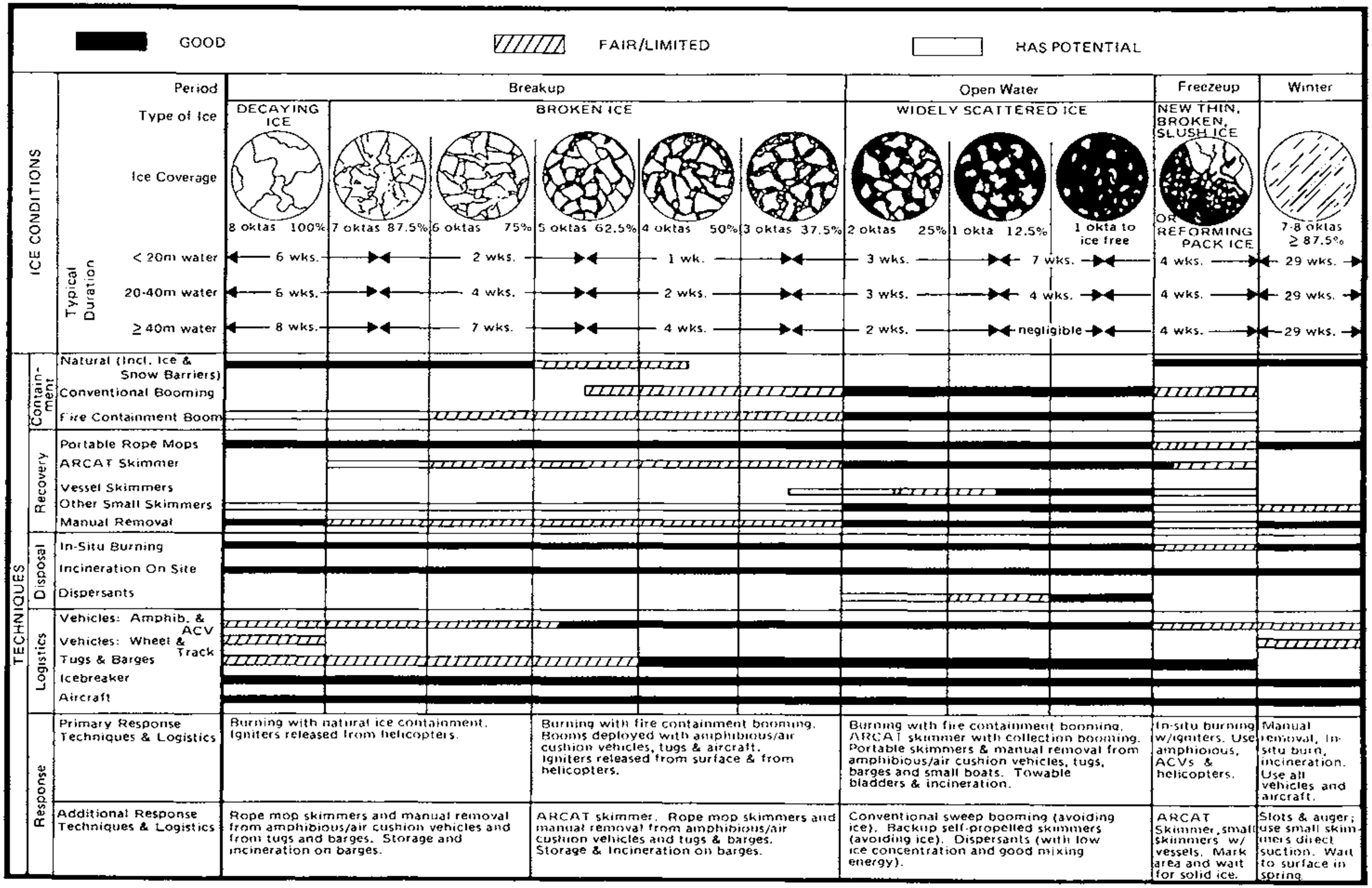
(1) Contingency Plans: Lessees are required to develop oil-spill-contingency plans as part of the lessee's exploration and development plans prior to drilling. To date, more than a dozen oil-spill-contingency plans have been submitted and approved for existing lease exploration in the Beaufort Sea Planning Area. One oil-spill-contingency plan has been submitted and approved for existing lease exploration in the Chukchi Sea Planning Area.

OCS-spill response arranges and ranks defense lines to prevent spilled oil from affecting the identified environmental resources. The first defense is offshore containment. For large, continuous spills, booms are often integrated into skimming or other recovery systems. Open-water-spilled-oil retrieval (without containment) is usually not successful. Containment slows oil spreading and provides time for more equipment and manpower deployment. Sea ice, acting as a natural containment barrier, facilitates in situ burning. For a blowout, well ignition is a drastic but potentially effective contingency measure. If conventional cleanup equipment cannot recover the oil before spill contact with environmental resources, dispersing the slick with chemical agents may be appropriate--if dispersant-use permission can be obtained from the U.S. Coast Guard On-Scene Coordinator.

After Oil and Gas Lease Sale 109, Alaska Clean Seas expanded to cover the Sale 109 area. Cooperatives are cost-effective and, therefore, willingly formed by leaseholders. Other Alaska CPA's or cooperatives locally stockpile more equipment than the minimum required by Federal regulations, thereby providing additional protection.

(2) Applicability of Oil-Spill-Response Techniques in the Sale 126 Area: Figure IV-A-12 summarizes techniques and equipment that can be used with ice in the Sale 126 area. "Good" applicability does not necessarily imply effective oil recovery or oil removal. Spill-response effectiveness is addressed in Section IV.A.2.e(5).

(3) Locally Available Spill-Cleanup Equipment: The MMS Alaska OCS Region requires a lessee that wishes to drill to have an initial 1,000-bbl/day spill-recovery capability. The oil-spill-contingency-plan preparation for drilling in the Chukchi Sea is especially challenging because of drilling-site remoteness from existing support facilities. The only exploration wells drilled to date kept oil-spill-response equipment on the drillship, on a large icebreaker/support ship, and on an oil-spill-response barge near the drill site. Additional equipment is available from Alaska-based equipment stockpiles (Clean Alaska, Inc.;



Source: USDOI, MMS, Alaska OCS Region; modified from Alaska Clean Seas, 1984, and Labelle et al., 1983.

Figure IV–A–12. Applicability of Oil–Spill–Response Techniques in the Proposed Sale Area

Martech; VRCA Environmental Services; Alaska Clean Seas; and Cook Inlet Response Organization) and Canada's Beaufort Sea Oil Spill Cooperative.

(4) Mobilization Time: The MMS Alaska OCS Region requires initial mobilization and response-equipment deployment to be undertaken within 6 to 12 hours of a spill, geography permitting. The spiller must be prepared to respond before the spill reaches shore (in <6 hr, if necessary). The <6-hour timeframe is for relatively small spills, although the MMS has not specifically defined size. Only onsite equipment or equipment transported by helicopter from Point Belcher or Barrow can meet deployment guidelines for most Sale 126 areas. The limited geographic and temporal presence of open water and slow vessel speeds in broken ice will preclude timely spill-equipment transport by sea. However, in the past, the Alaska OCS Region has invoked the "geography-permitting" clause, permitting a longer response time if a spill at the drill site cannot reach land in 6 to 12 hours.

For larger spills exceeding the local cleanup-response capability, the MMS Alaska OCS Region requires that additional equipment be available onsite within 48 hours. Additional response equipment to handle a large spill will be available from numerous sources. In good weather, equipment transported by plane or helicopter from Point Belcher or Barrow can satisfy the equipment-deployment criteria set by the MMS for 6-to-12-hour and 48-hour responses. Additional equipment from Alaska, Canada, or the lower 48 states also could be airlifted to Barrow or Point Belcher to meet the 48-hour criteria. Additional, slower-arriving equipment will still be useful for a major spill; but the MMS does not consider such equipment in judging whether oil-spill-contingency plans meet the MMS 48-hour-response criteria. If carried by helicopter, and if weather permitted, spill-cleanup equipment from Barrow could reach any point in the sale area within 3 to 6 hours.

(5) Effectiveness of Oil-Spill Cleanup at Sea: The 6-to-12-hour and 48-hour response times required of drilling lessees by the MMS Alaska OCS Region are mobilization and deployment requirements. Cleanup will continue as long as necessary, without any timeframe or deadline. For example, a winter spill in pack ice might require initial onsite response followed by further oil cleanup in late spring or summer when the oil melts out or pools on top of the ice.

The oil-spill-cleanup review, as contained in Gulf of Mexico Regional FEIS, Section IV.B.5 (USDOI, MMS, 1983a), is incorporated by reference; and a summary follows.

Offshore containment and cleanup are major, difficult tasks. Weather, sea conditions, and crew fatigue become critical factors; and cleanup at sea is generally only marginally effective. Using mechanical equipment, spilled-oil recovery generally ranges between 10 and 15 percent (U.S. Congress, OTA, 1990). Inshore-containment and -cleanup operations generally occur in calmer waters and closer to logistical bases. For inshore operations, spilled-oil recovery is approximately 20 to 50 percent (USDOI, MMS, 1983). At sea, mechanical recovery and in situ spilled-oil-burning effectiveness decreases rapidly with increasing sea state (sea roughness), while the dispersant and natural-dispersion effectiveness increases. Mechanical cleanup becomes nonfunctional between International Sea States 3 (2-4 ft waves) and 4 (4-8 ft waves). In the Sale 126 area from July through September, Sea State 4 or greater occurs 18 to 32 percent of the time (Brower et al., 1988). From October to June, the pack ice eliminates both high sea states and standard mechanical-cleanup-equipment use.

In open water, mechanical cleanup is usually more effective on low- or medium-viscosity oils than on high-viscosity oils. A low-viscosity oil will be a diesel or a fresh, light crude. A medium-viscosity oil will be a lubricating oil or a light, flowing emulsion. A high-viscosity oil will be a weathered crude, bunker oil, or thick emulsion. In Sale 126 average open-water conditions, Prudhoe Bay-like crude will initially have low viscosity but will quickly weather and form an emulsion in about 4 hours (calculated from the model of Payne et al., 1984a). Therefore, even in the absence of ice, mechanical cleanup will be difficult in the Sale 126 area.

Dispersants are also more effective on less viscous oils and lose all effectiveness when oil viscosity reaches

2,000 centistokes, or about 8 hours after a Prudhoe Bay-like crude spill in open water in the sale area (calculated from the model of Payne et al., 1984a). Dispersant use for fresh oil in long-duration blowouts may be effective but may not be effective on a Prudhoe Bay-like crude after several hours. Dispersant effectiveness also depends on factors such as oil thickness, oil composition, and dispersant-application rate.

Burning is also a possible spill remedy. Experiments suggest that burn efficiencies are 50 to 60 percent if the spill can be immediately set on fire (Laperriere, 1984). However, any delay in ignition will decrease combustion efficiency. (Thus, burning is a more promising technique for long-term blowouts than for other spill events.) If a blowout is either deliberately or accidentally set on fire at the wellhead, burn efficiencies can be high.

(6) Effectiveness of Oil-Spill Cleanup in Ice: Containment and cleanup are difficult when a spill disperses far from its source or when ice is moving. In pack ice, an effective response with mechanical equipment requires icebreaking capability locally stationed in both winter and summer and dedicated at least partially to oil-spill response.

During heavy ice periods, in situ burning may be an approach. Existing response capabilities are more effective on landfast ice than on broken or pack ice. Spills in the latter two ice types will be easiest to burn if the spill is contained within a small area close to its source. The ice itself can be useful in restricting the oil from spreading, keeping the oil thicker and more amenable to burning. Experiments conducted to date indicate that in situ burning in first-year ice could be a more effective technique for spill response than is mechanical recovery in open water (Benner et al., 1990).

f. Oil Toxicity in the Marine Environment: Oil dispersion in water, its movements, chemical modifications, effects on aquatic organisms, and persistence in the sea are all influenced by: (1) type and oil characteristics (for example, viscosity and percent aromatics); (2) oil-spill amount and duration; (3) sea state, in particular the tidal cycle and wave activity; (4) spill location, including the area's physiography and the distance from shore; (5) coastal geomorphology, including sediment size; (6) climatic conditions, in particular temperature, wind, and solar radiation; (7) the area's biota; (8) season; (9) the area's previous oil exposure; (10) exposure to other pollutants; and (11) mitigating-measures effectiveness taken by appropriate Federal and State agencies.

(1) Crude-Oil Characteristics: Toxicity to marine organisms depends upon the petroleum's individual hydrocarbon concentration and composition at contact time. The relative oil effect will shift as spilled oil weathers due to the change in its chemical composition.

Crude oil is a complex mixture of alkanes (aliphatic), naphthenes (cyclo- paraffinic), aromatics, and asphaltics (asphaltenic and heterocyclic compounds containing oxygen, sulfur, or nitrogen). The low-molecular-weight components are more toxic but are rapidly lost through evaporation and solution during the first days. High-molecular-weight aliphatics are the least toxic but may have an anesthetic or narcotic effect if concentrations are great enough.

In general, the relative oil toxicity is proportional to its aromatic content. Studies show low-molecular-weight aromatic hydrocarbons (benzenes and toluenes) to be moderately toxic to different animals. Intermediate-molecular-weight aromatic hydrocarbons (naphthalenes) are toxic to phytoplankton and some aquatic animals. However, the benzenes and naphthalenes are quickly lost to the atmosphere or diluted into the water column.

(2) Comparative Toxicity of Different Oil Forms in Water: Laboratory toxicity tests show that deleterious oil effects are related to oil's chemical components. Just as important in determining toxicity is the oil form at sea. The water-soluble fraction (WSF) is highly toxic to organisms, possibly due to the easier oil uptake in the WSF (Ottway, 1976; Winters and Parker, 1977). Water-in-oil emulsions are likely to cause biological damage due to physical effects, while oil-in-water emulsions probably

cause more biological damage due to toxic effects. Oil in dispersed droplets usually exhibits slightly less toxicity than the WSF's.

(3) Comparative Toxicity of Oil Types: Toxicities vary between oil types because the individual hydrocarbon concentration and composition varies. In general, refined oils are more toxic than crude oils due to refined oil's high aromatic-hydrocarbon concentrations, and refined oil's elevated mixing ability due to refined oil's less viscous nature. In general, crude oil spills, residual fuel, and lubricating oil may cause more biological damage due to viscous physical properties when considered over time, while refined oil spills, including gasoline and kerosene, are likely to cause biological damage due to refined oil's toxic nature over a relatively short time (Ottway, 1976).

(4) Biological Differences: Oil-pollution severity on different organisms in various habitats varies from no effect to avoidance responses, decreased activity, physiological stress, and death. Different species react differently, and different organism lifestages show different sensitivities to petroleum hydrocarbons. From bioassays, soluble aromatic hydrocarbons' lethal effects occur from 1 to 100 ppm for most adult marine organisms and from 0.1 to 1 ppm for the more sensitive larval and juvenile lifestages. Table IV-A-la shows toxicity concentrations of Prudhoe Bay crude to arctic species. Sublethal effects may occur from soluble aromatic concentrations ranging from 0.1 to 100 ppb (NRC, 1985). Major sublethal effects from exposure to petroleum hydrocarbons are reduced growth rates, reproductive maturation, and the reproductive potential or fecundity of an organism. The ecological-response significance is important at the population and community levels. A species may be proven sensitive to oil in the laboratory; but in the natural environment, an entire population may recover rapidly due to such factors as effective reproduction and dispersal strategies and immigration. Conversely, although an individual organism may show high tolerance to oil contamination in the laboratory, under natural conditions population recovery may never occur or may be delayed due to such factors as competition for food and space or dependence on a specific food resource. See Section IV.B for more specific biological-resource-toxicity discussions.

3. Constraints and Technology: Environmental hazards to petroleum exploitation in the Sale 126 area include sea ice, permafrost, waves and currents--especially during storm surges, unstable surface sediments, erosion, and superstructure icing. Physical environmental features are described in Section III.A. The following discussion summarizes and incorporates by reference the constraints and technologies description contained in the Sale 109 FEIS (USDOI, MMS, 1987b).

a. Sea Ice: In the Sale 126 area, sea ice is a principal environmental factor affecting offshore petroleum-resource development. The large lateral forces exerted by moving ice floes and sheets, ridges, floebergs, and ice islands are a major concern in the offshore-facilities design and operation associated with petroleum exploration and development and production. The force that moving sea ice exerts on a structure is limited by the ice strength and the driving-forces magnitude. Sea ice is a heterogeneous substance with many small- and large-scale variations. Sea ice variations are likely to cause stress concentrations and local failures well before the calculated failure loads are reached. Other concerns associated with sea ice include rideup, pileup, override, and seafloor gouging.

Mitigating strategies to diminish sea-ice effects are discussed in relation to the technologies and activities associated with exploration, development and production, and oil transportation. Sea-ice-mitigation strategies are based on the experiences and proposals associated with petroleum exploitation in the Beaufort Sea.

(1) Exploration: The drilling units used to drill exploration wells in the Alaskan and Canadian Beaufort Sea include (1) artificial islands, (2) caisson-retained islands, (3) ice islands, (4) bottom-founded mobile drilling units such as the Single-Steel Drilling Caisson (SSDC) and the Concrete-Island Drilling System (CIDS), and (5) floating units such as ice-strengthened drillships and the Conical Drilling Unit (CDU). Sea-ice forecasting has developed as a strategy to maximize drilling time and reduce the risks presented by moving sea ice. Ice observations are used to produce maps showing the various ice types, ages, concentrations, and movement direction. The ice information is combined with weather forecasts

Table IV-A-1a
Toxicity of Prudhoe Bay Crude and Arctic Diesel to Arctic Species

Species	Hydrocarbon	State	Temperature (°C)	Concentration	Lethal Effect	References
MOLLUSCA						
Macoma balthica	PB	Slick	7-12	5µl/cm²/d for 5d (N)	0% dead 2 mo.	Taylor et al. (1976)
	PB	WSF	8-18	0.036 ppm	20% dead 11 d	Taylor et al. (1976)
	PB	WSF	8-18	0.019-0.302 ppm	0% dead 11 d	Taylor et al. (1976)
	PB	OWD	7-9.1	0.3 mg/litre (N)	8% dead 180 d	Stekoll et al. (1980)
	PB	OWD	7-9.1	3.0 mg/litre (N)	81% dead 180 d	Stekoll et al. (1980)
MYSIDACEAE						
Mysis litoralis	PB	OWD	-1	200 ppm (N)	90% dead 96 h	Schneider (1980)
AMPHIPODA						
Anonyx laticoxae	PB	OWD	4.5	51 ppm (F)	96 h LC_{50}	Foy (1979)
Anonyx nugax	PB	OWD	-1	200 ppm (N)	5% dead 96 h	Schneider (1980)
	PB	OWD	-1	500 ppm (N)	45% dead 96 h	Schneider (1980)
	PB	OWD	0-3.5	32-43 ppm (F)	96 h LC_{50}	Foy (1982)
	PB	OWD	4.5	32 ppm (F)	96 h LC_{50}	Foy (1982)
Boeckosimus affinis	PB	Slick	5	0.1% v/v (N)	unshielded LT_{50} = 4 d shielded LT_{50} = 3 d	Busdosh & Atlas (1977)
	Ad	Slick	5	0.1% v/v (N)	unshielded LT_{50} = 1 d shielded LT_{50} = 14 d	Busdosh & Atlas (1977)
	PB	WSF	5	0.83-5.2 ppm (F)	LT_{50} = 4 weeks	Busdosh (1981)
		WSF	5	0.15-3.6 ppm (F)	LT_{50} = 8 weeks	Busdosh (1981)
	PB	OWD	-1	50 ppm (N)	25% dead 96 h	Schneider (1980)
				200 ppm (N)	45% dead 96 h	Schneider (1980)
	PB	OWD	-1	50 ppm (N)	0% dead 96 h	Schneider (1980)
				200 ppm (N)	0% dead 96 h	Schneider (1980)
Boeckosimus edwardsi	PB	PWD	3.5	44 ppm (F)	96h LC_{50}	Foy (1982)
Boeckosimus sp.	PB	OWD	4.5	57 ppm (F)	96 h LC_{50}	Foy (1982)
Gammarus oceanicus						
adult	PB	OWD	4.5	55 ppm (F)	96 h LC_{50}	Foy (1982)
Gammarus setosus	PB	OWD	4.5	56 ppm (F)	96 h LC_{50}	Foy (1982)
Gammarus zaddacki	PB	Slick	5	1,000 ppm (N)	unshielded LT_{50} = 5 d shielded LT_{50} = 2 w	Busdosh & Atlas (1977)
Onisimus litoralis						
adult	PB	OWD	0-3.5	49 ppm (F)	96 h LC_{50}	Foy (1982)
	PB	OWD	4.5	47 ppm (F)	96 h LC_{50}	Foy (1982)
	PB	OWD	4.5	68 ppm (F)	96 h LC_{50}	Foy (1982)

Table IV-A-1a
Toxicity of Prudhoe Bay Crude and Arctic Diesel to Arctic Species
(Page 2 of 2)

Species	Hydrocarbon	State	Temperature (°C)	Concentration	Lethal Effect	References
DECAPODA						
Eualus fabricii						
larvae	PB	WSF	3.5	6.36 ppm (IR)	96 h TLm	Rice et al. (1976a)
Pandalus borealis	PB	WSF	3.7-3.8	2.11 ppm (IR)	96 h TLm	Rice et al. (1976b)
		WSF	3.7-3.8	113 ppb (UV)	96 h TLm	Rice et al. (1976b)
FISH						
Pink fry	PB	FW	4	10 ppm	96 h LC_{50}	Rice et al. 1975
	PB	SW	5	11 ppm	96 h LC_{50}	Rice et al. 1975
	PB	SW	10-12	1.6 ppm	96 h LC_{50}	Rice et al. 1977
	PB	SW	10-12	(1.4-1.7) ppm	96 h LC_{50}	Rice et al. 1977
Sockeye fry	PB	FW	7	4.0 ppm	96 h LC_{50}	Moles et al. 1979
	PB	FW	7	(3.5-4.6) ppm	96 h LC_{50}	Moles et al. 1979
Sockeye smolts	PB	FW	8	2.7 ppm	96 h LC_{50}	Moles et al. 1979
	PB	FW	8	(2.4-3.0) ppm	96 h LC_{50}	Moles et al. 1979
	PB	SW	8	1.0 ppm	96 h LC_{50}	Moles et al. 1979
	PB	SW	8	(0.8-1.4) ppm	96 h LC_{50}	Moles et al. 1979
Chinook fry	PB	FW	6	3.6 ppm	96 h LC_{50}	Moles et al. 1979
	PB	FW	6	(3.1-4.1) ppm	96 h LC_{50}	Moles et al. 1979
Coho fry	PB	FW	8	3.7 ppm	96 h LC_{50}	Moles et al. 1979
	PB	FW	8	(3.3-4.1) ppm	96 h LC_{50}	Moles et al. 1979
	PB	FW	8	3.0 ppm	96 h LC_{50}	Moles 1980

Source: USDOI, MMS, 1990.

Key: Ad, arctic diesel; F, flourescence; FW, freshwater; IR, infrared; N, naphthalenes; OWD, oil-in-water dispersion; PB, Prudhoe Bay crude; SW, saltwater; UV, ultraviolet.

and historical ice-movement, wind, and current data to predict sea-ice motion. Sea-ice forecasts allow time for the well to be shut in safely and the drillship to disconnect from the well and the mooring system if weather and sea-ice conditions become severe enough to threaten the operation.

Icebreakers and icebreaking supply boats perform ice-management tasks to reduce the threat that sea ice poses to the drillship (Browne, Carter, and Kimmerly, 1984). Ice-management duties include breaking up ice around the drillship and breaking, towing, or pushing large floes so drifting ice misses the drillship. In heavy ice, the support vessels maneuver around the drillship to keep the ice sufficiently broken so that ice produces only minimal lateral forces on the drillship. Sea-ice forecasts also allow for efficient icebreaking-vessel deployment.

To protect the wellhead equipment on the seafloor from collisions with drifting ice-mass keels, the MMS requires subsea blowout-preventor (BOP) stacks in excavations (glory holes) deep enough so that the stack top is below the deepest probable gouge depth (30 CFR 250.56(e)(5)). The BOP closes the top of the well, controls fluid release, permits fluids to be pumped into the hole, and allows drill-pipe movement.

(2) Development and Production: If economically recoverable petroleum resources are discovered, development and production structures will be placed in the sale area. The experiences gained from exploration units will contribute to production-platform design and construction. Production platforms will be larger than exploration units because space must be provided for (1) drilling several production and service wells; (2) locating facilities to separate the oil, gas, and water that is produced from the wells; and (3) locating the equipment and wells that may be needed to inject gas and water. Production platforms may be larger versions of the units used for exploratory drilling.

Structures contemplated for year-round use in the stamukhi and pack-ice zones will have to resist the forces exerted by thick first-year- and multiyear-ice floes and sheets, ridges, and floebergs, and ice islands. Offshore-structure placement that could survive a large ice island impact may be difficult. However, if ice-island-impact probability is very low and an oil spill could be avoided, a production platform could be designed and installed in the pack-ice zone.

Concepts also are being developed for arctic-production platforms that are monolithic, multisided concrete or steel structures or large monopod/monocone-type structures. Numerous steels are available for construction use in low-temperature environments; and concrete has been used to construct many different structures that resist seawater, ice, and freeze-thaw cycles.

(3) Transportation: Oil may be transported from the production sites to refineries by pipeline. Experience with arctic-petroleum-transportation systems is limited; new problems must be solved.

Offshore Pipelines: In the sale area, ice gouges indicate that sea ice poses a threat to a marine-pipeline system. The most intense gouging occurs in the stamukhi zone; ice-gouge frequency decreases shoreward and seaward of the stamukhi zone. Pipeline burial beneath maximum gouge depth may afford protection from moving ice.

Offshore pipelines can be laid during the open-water period by laying pipe from a conventional lay or reel barge or with bottom or surface tows. Most present-day techniques for laying marine pipe were developed in an ice-free environment. Short pipelines and shallow-water, long pipelines will probably be installed by the bottom-pull method. Longer pipelines will probably be installed by a vessel that can lay pipe at a 2-km/day rate.

Pipeline-burial depth depends on estimating the deepest gouge cut into the seafloor during the operational pipeline life. Predicting maximum-gouge events occurring within a time interval for specific seafloor segments is difficult. However, several methods are being developed to predict ice-gouging depths and rates.

The principal quantitative method uses ice-gouge data obtained from a repetitive sonar seafloor-mapping system. Another method uses ice-ridge-drift rates and keel-depth distribution.

Trenches may have to be cut in the bedrock in areas where unconsolidated sediment is not thick enough to bury the pipeline below ice-gouge depth. A buried pipeline could be routed around known areas with intensive gouging or into the paleovalleys.

Offshore-pipeline segments crossing the shoreline must be protected from sea-ice hazards such as gouging, pileups, or rideups. Three methods that might be used for pipeline burial are: (1) beneath the offshore sediments and onshore soils, (2) in a causeway, or (3) in a frozen berm.

b. Other Constraints:

(1) Permafrost: Although unlikely, permafrost on the Chukchi continental shelf has not been entirely disqualified. Potential hazards associated with the permafrost include thaw subsidence and frost heave.

Thaw subsidence may be caused by activities that disrupt the permafrost thermal balance. The activities include (1) drilling wells through existing permafrost layers, (2) laying and maintaining crude-oil pipelines, (3) placing and operating bottom-founded gravity structures, and (4) constructing artificial islands and berms.

Thaw subsidence may be caused by crude oil production. Oil flow from multiple wells close together in the permafrost zone may lead to settlement. Due to permafrost thawing, the well casing may be subjected to increased loads as the pore pressure and sediment stiffness are reduced.

However, if the well is shut in and the hot-oil flow stops, the pore water in the surrounding sediments may refreeze. The refrozen-pore-water expansion may cause large radial pressures against the well casing. By adapting drilling-mud composition and hydraulics, drilling rates, cementing techniques, and casing designs to arctic conditions, wells that pass through permafrost zones are being successfully drilled, completed, and produced.

Pipelines may cause thaw subsidence if they are located in regions where ice-bonded permafrost is near the seafloor surface. Some permafrost thawing is acceptable if the thawing does not result in excessive pipe deformation. Submarine pipelines have substantial buckling resistance and can tolerate more deformation than terrestrial pipelines. Methods to prevent thaw subsidence during pipeline life include insulation, refrigeration, and overexcavation and backfill. Pipeline parameters that can be adjusted to reduce thawing include (1) increasing the insulation thickness or pipeline separation (if more than one line); and (2) decreasing pipeline temperature, pipe diameter, or cover depth.

Pipeline routes may be selected to avoid the thaw-unstable permafrost area near the surface. A relatively thick, unfrozen soil layer provides a thermal and mechanical buffer between the pipeline and ice-bonded permafrost.

(2) Waves, Currents, and Storm Surges--Flooding and Erosion: Waves in the Sale 126 area have the potential to cause flooding of low-lying structures and could induce shoreline erosion, a hazard for unprotected structures built from sand and gravel. Currents can erode natural and artificial islands, coastal areas, and the area around the foundations of bottom-founded structures. A storm surge is an extreme meteorological and oceanographic event of increased wind velocities, wave heights, and wave- and wind-induced current velocities. Sea ice in open-water areas during a storm surge increases the hazard severity. However, more than one-tenth ice coverage reduces the wave and surge buildup and thus limits potentially damaging surges to late summer and fall (LaBelle et al., 1983).

Coastal- and offshore-engineering experience from other areas can be adapted to the arctic environment.

Excluding storms, available information indicates that waves and currents should not be a major problem affecting offshore operations. In the absence of long-term measurements, methods are used to statistically hindcast the wind-driven wave, current, and storm-surge characteristics at potential operating sites. The hindcast results are used to determine wave heights and periods, storm-surge heights, and current velocities that could interact with structures of a given site during the operational life. Through regional and site-specific environmental data analysis, protective measures can be taken to reduce the moving-water-hazard effects.

(3) Unstable Sediments: An important consideration in the Sale 126 area is the seafloor sediments' ability to support the heavy, bottom-founded structures' weight and to resist sliding when sea-ice interacts with the structure. The sediments' geotechnical properties must be determined to understand how the sediments will react under static or cyclic vertical and lateral loads. Engineering experience associated with offshore foundations can be used in the Arctic.

Sediment instability and mass movement are related to relatively high seafloor gradients, low sediment strength in fine-grained sediment with high water content, sediment loading from waves during the storm passages, and ground motion during earthquakes. Mass movement includes slides, slumps, flows, and subsidence. Inshore of the 50-m isobath, the continental-shelf-seafloor slope is generally very low. Earthquake ground motions are generally low. Thus, mass movement in less than 50 m is generally not a hazard significantly affecting offshore operations. Mass-movement hazards occur in the deeper water depths on steeper slopes, particularly in the shelf-break vicinity.

Pipelines are susceptible to sediment creep, slides, flowage, and subsidence. Methods used to minimize potential damage to pipelines include (1) route pipelines following a mudslide-lobe contour, (2) crossing a flow in the general flow-movement direction, and (3) laying pipelines in mudslide areas that have less disturbance. Recent engineering adaptations to mudslide problems include using flexible joints, which allow some movement, and safety couples, which activate immediate line-flow shutoff if the line is moved.

Transported along the seafloor in response to bottom currents, sediments form ridges and migrating sediment-wave fields (Lewbel, 1984). Unstable sediments may be hazardous to navigation and offshore construction. Sediment movement may uncover buried pipelines. Frequent surveys may be necessary to detect current-produced sediment features that could be a hazard to offshore activities. When necessary, sediment accumulations that threaten an offshore activity can be removed through dredging.

(4) Superstructure Icing: Icing caused by sea spray is the most frequent and most important superstructure-icing form at sea (LaBelle et al., 1983). Ice buildup on a vessel's superstructure has both operational and safety implications. Ice buildup may affect equipment operations on deck and may pose a danger to personnel. Massive ice buildup may significantly affect a vessel's freeboard and center of gravity, with a corresponding reduction in vessel stability. Ice-buildup effects are of particular concern with regard to workboats or other small support vessels that may be used in offshore operations. Large drilling units and production platforms with considerable freeboard are less sensitive to superstructure icing than smaller vessels.

Sea-spray icing constitutes the most serious and largest number of icing cases (LaBelle et al., 1983). Sea spray is formed (1) as the vessel or structure meets waves--the most important with regard to superstructure icing, and (2) when the wind blows droplets off the wave crests--droplet formation depends on the wave form and steepness and begins at 8- to 10-m/sec windspeeds. The conditions necessary to cause significant superstructure-icing accumulations are: (1) air temperature less than the seawater-freezing point (-1.7 to -1.9°C, depending on the water salinity down to about -30°C); (2) 10-m/sec windspeed or more; and (3) seawater temperature colder than 8°C.

Kozo (1985) predicts that superstructure icing may occur from June through November and that September and October are the months when superstructure icing is most likely to occur.

Summary: The environmental hazards that affect petroleum exploration in the Sale 126 area are related to permafrost, sea ice, storm surges, factors that affect the sediments' geotechnical properties, and superstructure icing. Sea ice is the major hazard; however, the potential hazard severity varies with each activity, and measures can be taken to lessen hazard effects. Sea-ice measures include (1) scheduling activities to minimize exposure to a hazard, (2) conducting surveys to locate potentially hazardous areas and locating facilities away from known hazards, and (3) designing facilities to withstand a range of environmental forces. Sea-ice-hazard strategy use necessitates being able to (1) identify the hazards, (2) locate or predict where and when hazards will occur, and (3) estimate hazard effects.

4. Definitions Used in Effects Assessment: The definitions shown in Table S-2 at the beginning of this EIS were developed to help determine the relative extent of effects. The words VERY HIGH, HIGH, MODERATE, LOW, AND VERY LOW defined in the table appear in capital letters in Section IV only to ensure a common understanding of the terms and not to emphasize the level of effect.

5. Major Projects Considered in the Cumulative Case: The analysis for the cumulative case is based on the potential effects associated with (1) exploitation of the resources estimated for the cumulative case from OCS lease sales (Appendices A and B); exploitation of known or estimated resources from offshore or onshore private, State, or other Federal leases; and (3) major development and construction projects. Information on the projects considered in the cumulative-case analysis is summarized in Table IV-A-2 and described in Appendix E. The location of these projects is shown in Graphic No. 3.

Table IV-A-2
Major Projects Considered in Cumulative-Effects Assessment

Project Name[1]	General Location	Resource Estimate[2]	Exploration	Developmental Timeframe[3] Development Construction	Peak Daily Production[4]	Current Status 1989
Chukchi Sea Region						
North Slope Borough Capital Improvements Program (CIP) (2)	North Slope Borough	Not relevant	Not relevant	1983-1985+	Operation: 1983-1985+	Includes projects at villages, Prudhoe Bay, and Kuparuk.
Red Dog Mine (9)	145 km north of Kotzebue and 114 km east of Kivalina	77 million metric tons, primarily of zinc/lead reserves	Complete	1986-1989	[5]	Construction of the port facility began in the summer of 1986.
National Petroleum Reserve-Alaska (NPR-A) (11)	Northwest Alaska, west of Colville River	1.85 (oil) 3.26 (gas)	1944-1989	--	--	No commercial reserves have been discovered. In 1985, drilling began on areas leased under the USDOI program. Annual lease sales are scheduled.
Arctic Slope Regional Corporation (ASRC) (15)	Primarily north-western Alaska, south and west of NPR-A	--	1973 and thereafter	--	--	Low-level exploration ongoing; no discoveries. Drilling up to three wells in ANWR.
Discovered Resources (Oil Fields, Gas Fields, and Mining) (9)	Generally in the De Long Mountain area	--	--	--	--	With the development of the port facilities for the Red Dog deposit, other zinc/lead deposits--such as the Lik--may become commercial. Coal resources are present along the Chukchi Sea coast.
Future OCS Leasing (18)						
a. Chukchi Sea	Offshore Chukchi	2.7 (oil)	1990 and thereafter	--	--	See Sale 109 FEIS (USDOI, MMS, 1987b) for information on Chukchi Sea resources.
Mid-Beaufort Sea Region						
Trans-Alaska Pipeline (TAP) (1)	Prudhoe Bay to Valdez	Not relevant	Not relevant	1973-1977	Design capacity: 2.0 MMbbl/day	The 1,288-km pipeline and related facilities occupy 42.4 km^2. Current flow rate is 2.05 MMbbl/day.
Prudhoe Bay unit (PBU) Oil Production (3)	Prudhoe Bay onshore	9.6 (oil)	1965-1969	1969-1985	1977-2006 1.5 Mbbbl/day	Peak production to decline in 1990 and continue thereafter. New satellite field, Point McIntire, will produce from a 300-MMbbl reservoir in the early 1990's.

Table IV-A-2
Major Projects Considered in Cumulative-Effects Assessment
(Page 2 of 3)

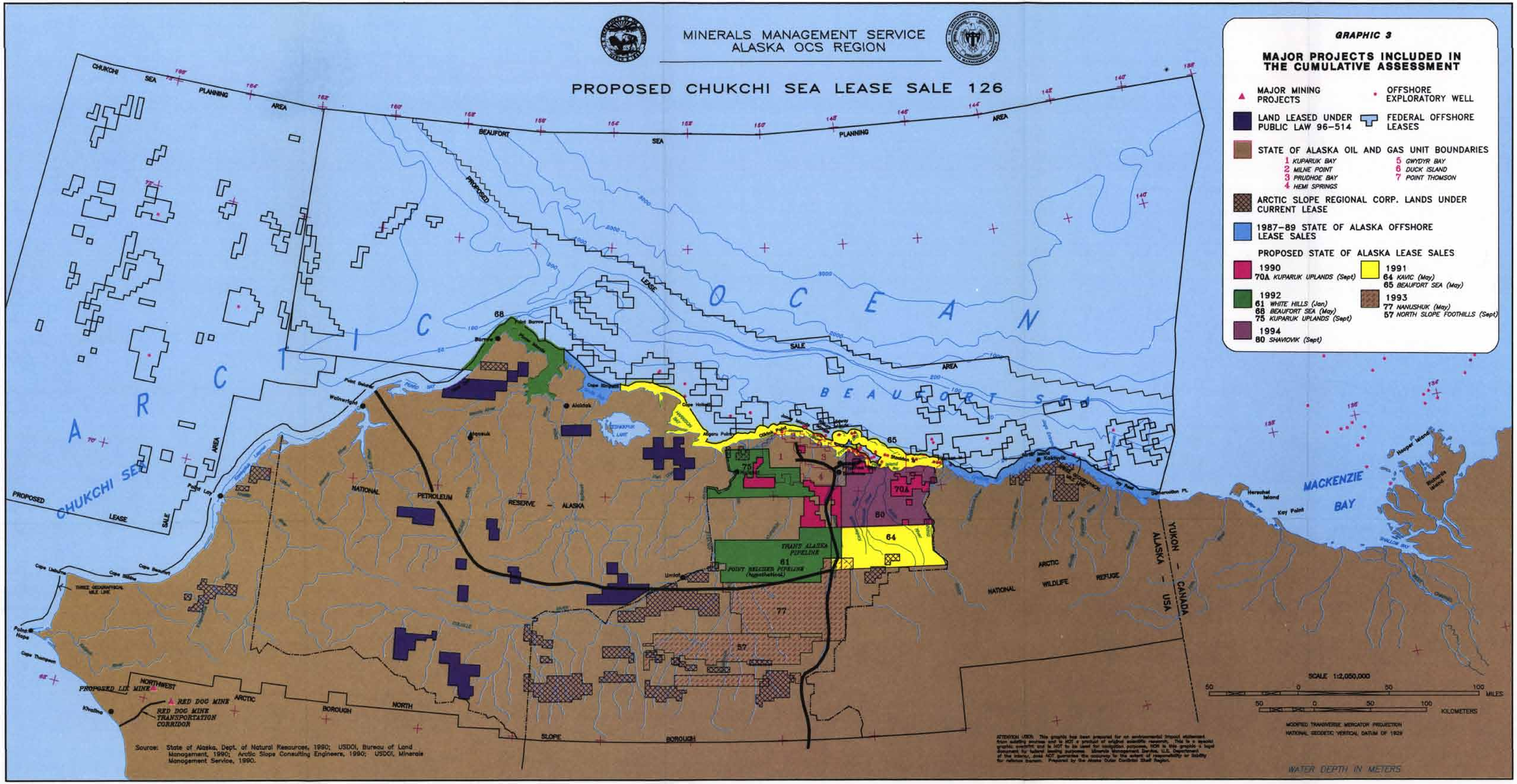
Project Name[1]	General Location	Resource Estimate[2]	Exploration	Developmental Timeframe[3] Development Construction	Peak Daily Production[4]	Current Status 1989
Lisburne Field (4)	PBU	0.35-0.45 (oil)	1968-1983	1984-1987	1987-2017 100,000 bbl/ day	Wells on five onshore sites. Offshore well site dropped. Production in 1989 reached 36,000 bbl/day.
Kuparuk River Unit (5)	Approx 25 mi west of Prudhoe Bay, onshore	0.4-1.3 (oil)	1970-1979	1981	1982-2002 300-320,000 bbl/day	Phase I production commenced in December 1981. Full field water flooding began in 1986.
West Sak (6)	Within Kuparuk River Unit	2.0-4.0 (oil)	1970-1975	1984 post-1986	1985-2015+ 200,000 bbl/ day if devel- oped; 2,500 bbl/day during pilot project	Pilot project is completed. Development will not occur until oil prices improve and become more stable.
Duck Island Unit (7)	19.3 km east of Prudhoe Bay	0.3-0.98 (oil)	1977-1982	1985-1987	1988-2000+ 100,000 bbl/ day	The Duck Island unit has produced 1,000 bbl/day as of the end of 1988. A waterflood project had begun to maintain unit formation pressure.
Milne Point (8)	North of Kuparuk River Unit	0.03-.08 (oil)	1970-1984	1984-1985	1986-2000+ 25,000 bbl/ day	Production began in 1985, was suspended in 1986, and restarted in 1988.
Niakuk Field	Offshore north- east of the Prudhoe Bay Field	Approx. 58 MMbbl reserves	1987-1988	1989-1991		Drilling will begin in 1991 and extend over a 13-month period. Production is scheduled to occur in the 4th quarter of 1991.
Discovered Resources (Oil Fields and Gas Fields) (9)	Mid-Beaufort Sea	--	--	--	--	Until gas infrastructure is available, gas fields such as Point Thomson and Gubik won't be developed. Others such as Gwydyr Bay, Ugnu Sands, and Simpson Lagoon need either technological advances or increases in oil prices before they can be developed.
Seal Island	Beaufort Sea	0.3 (oil)	1981-1986	1987-1990	1989-2014 5,000 bbl/ day	Additional wells are planned.
Previous Federal Offshore Lease Sales (14)	Barrow to Canada within 200-m isobath	0.6 (oil)	1981-1992	1992-1995	1995-2014	Exploration drilling is underway.

Table IV-A-2
Major Projects Considered in Cumulative-Effects Assessment
(Page 3 of 3)

Project Name[1/]	General Location	Resource Estimate[2/]	Exploration	Developmental Timeframe[3/] Development Construction	Peak Daily Production[4/]	Current Status 1989
Future OCS Leasing Beaufort Sea	Offshore Beaufort Sea	0.53	1990 and thereafter	1995 and thereafter	1996-2014+ 150,000 bbl/ day	Information for Sale 124 applies to future Beaufort Sea sales.
Future State of Alaska Leasing (17)	Offshore Beaufort Sea, onshore east and south of PBU	Moderate to high petroleum potential	1989 and thereafter	--	--	According to the State's 5-year leasing program (as of 1989), between Barrow and the Canning River, in excess of 4 million acres will be offered by 1993.
Eastern Beaufort Sea Region						
Arctic National Wildlife Refuge (ANWR) (12)	North of Brooks Range, east of Canning River	--	1983 and thereafter	Prohibited	Prohibited	ANILCA prohibits development or additional exploratory drilling until authorized by Congress.
Canadian Beaufort Sea (ESSO, Dome, Gulf acreage) (16)	Offshore Mackenzie Bay, Canada	7.0 (oil)	1973-1990	1982-2000+ and thereafter	1990-? in excess of 180,000 MMbbl	Delta gas project operators ESSO/Shell have applied for a permit to export gas. Offshore Amauligiak oil field being delineated.

Source: USDOI, MMS, Alaska OCS Region, 1990.

1/ The numbering in parentheses following the projects in this table corresponds with the listing and further description of projects in Appendix E of this EIS.
2/ Resource estimates for oil are expressed in billions of barrels of recoverable oil; gas estimates are expressed in trillions of cubic feet.
3/ Developmental timeframes are approximate. Dates are fixed with timing of first commercial field development. Timeframes for subsequent fields are not indicated.
4/ Production estimates, when available, are expressed in barrels of oil per day (MMbbl = million barrels) and cubic feet of gas per day (MMcf = million cubic feet).
5/ 636,364 metric tons per year of concentrates will be shipped.



MINERALS MANAGEMENT SERVICE
ALASKA OCS REGION
PROPOSED CHUKCHI SEA LEASE SALE 126
GRAPHIC 3
MAJOR PROJECTS INCLUDED IN THE CUMULATIVE ASSESSMENT
MAJOR MINING PROJECTS
OFFSHORE EXPLORATORY WELL
LAND LEASED UNDER PUBLIC LAW 96-514
FEDERAL OFFSHORE LEASES
STATE OF ALASKA OIL AND GAS UNIT BOUNDARIES
1 KUPARUK BAY
2 MILNE POINT
3 PRUDHOE BAY
4 HEMI SPRINGS
5 GWYDYR BAY
6 DUCK ISLAND
7 POINT THOMSON
ARCTIC SLOPE REGIONAL CORP. LANDS UNDER CURRENT LEASE
1987-89 STATE OF ALASKA OFFSHORE LEASE SALES
PROPOSED STATE OF ALASKA LEASE SALES
1990
70A KUPARUK UPLANDS (Sept)
1991
64 KAVIC (May)
65 BEAUFORT SEA (May)
1992
61 WHITE HILLS (Jan)
68 BEAUFORT SEA (May)
75 KUPARUK UPLANDS (Sept)
1993
77 NANUSHUK (May)
57 NORTH SLOPE FOOTHILLS (Sept)
1994
80 SHAVIOVIK (Sept)
CHUKCHI SEA PLANNING AREA
BEAUFORT SEA PLANNING AREA
PROPOSED LEASE SALE AREA
PROPOSED CHUKCHI SEA LEASE SALE AREA
ARCTIC OCEAN
BEAUFORT SEA
MACKENZIE BAY
NATIONAL PETROLEUM RESERVE - ALASKA
ARCTIC NATIONAL WILDLIFE REFUGE
TRANS ALASKA PIPELINE
POINT BELCHER PIPELINE (hypothetical)
YUKON - CANADA
ALASKA - USA
Point Barrow
Barrow
Point Belcher
Wainwright
Atqasuk
Point Lay
Cape Lisburne
Point Hope
Cape Thompson
Kivalina
Umiat
Kaktovik
Herschel Island
Kay Point
THREE GEOGRAPHICAL MILE LINE
PROPOSED LIK MINE
NORTHWEST ARCTIC BOROUGH
NORTH SLOPE BOROUGH
RED DOG MINE
RED DOG MINE TRANSPORTATION CORRIDOR
Source: State of Alaska, Dept. of Natural Resources, 1990; USDOI, Bureau of Land Management, 1990; Arctic Slope Consulting Engineers, 1990; USDOI, Minerals Management Service, 1990.
SCALE 1:2,050,000
MILES
KILOMETERS
MODIFIED TRANSVERSE MERCATOR PROJECTION
NATIONAL GEODETIC VERTICAL DATUM OF 1929
WATER DEPTH IN METERS

B. Alternative I--Low Case

Alternative I would offer for leasing about 4,319 blocks of the Chukchi Sea Planning Area, with the low case representing a minimum amount of industry activity that is expected to occur as a result of the lease sale. The MMS estimates the oil resources to be about 430 MMbbl for the low case. This estimate represents a quantity of oil that is less than an estimated minimum amount that would have to be discovered before development and production could occur (see Appendices A and B). Two exploration wells would be drilled in 1992. After testing, the wells would be plugged and abandoned and industry activity resulting from the sale would cease. For a discussion of the types and levels of exploration activities associated with the low case, see Section II.B.1.a.

This section presents the analyses of the potential effects that the low case for Alternative I might have on the physical and biological resources, sociocultural systems, and programs in and adjacent to the planning area.

1. Effects on Air Quality: 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-A-2). These maxima are designed to protect human health and welfare. However, one exceedance per year is allowed except for standards based upon an annual averaging period. The standards also include Prevention of Significant Deterioration (PSD) provisions for nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and total suspended particulates (TSP) to limit deterioration of existing air quality that is better than that otherwise allowed by the standards (an attainment area). Specific limited incremental concentrations are specified for each PSD pollutant. There are three classes (I, II, and III) of PSD areas, Class I allowing the least degradation. Class I also restricts degradation of visibility. The entire northern coast of Alaska is designated as a Class II area (State of Alaska, DEC, 1982). Baseline PSD pollutant concentrations and the portion of the PSD increments already consumed are established for each location by EPA and the State of Alaska prior to issuance of air quality permits. Air quality standards do not directly address all other potential effects such as acidification of precipitation and freshwater bodies or effects on nonagronomic plant species.

a. Air Quality Standards: With the recent enactment of the Clean Air Act Amendments of 1990, the U.S. Environmental Protection Agency (EPA) has jurisdiction for air quality over blocks to be leased under this lease sale. The lease operators shall comply with the provisions of Part C of Title I and with the requirements to be promulgated by the EPA by November 1991.

The State of Alaska shall have jurisdiction over the blocks to be leased, once the State of Alaska has promulgated, and the USEPA Administrator has confirmed adequacy of regulations to implement and enforce the requirements of Section 801, Title VIII. But there will not be a significant difference in the requirements to be complied with by the lease operators since there are no onshore nonattainment areas and the State of Alaska has adopted the national air quality standards and PSD regulations as the State standards and PSD regulations.

If an air quality analysis of air pollution from Sale 126 is required, the EPA-approved Offshore and Coastal Dispersion (OCD) Model would be used to calculate the effects of pollutant emissions due to Sale 126 on onshore air quality.

b. Effects on Air Quality: Under the proposal, in the event that only exploration occurs as a result of the lease sale, a maximum of two exploration wells would be drilled in a year. The most likely choice for an exploratory drilling vessel for the proposal would be drillships or arctic-class semisubmersibles supported by ice-capable support vessels. The minimum operating water depth of existing arctic-capable floating drilling platforms is 24 m (80 ft). The nearest unleased land in the sale area in 24 m of water is 18.5 km (11.5 mi) off Point Lay. The proposal is discussed assuming that all sale-related exploration and production occur 18.5 km off Point Lay. Estimated annual emissions for exploration and support activities are given in Table IV-B-1. Under Federal and State of Alaska PSD regulations, since the estimated annual uncontrolled NO_x emissions for peak year would exceed 250 tons per year, the lessee would be required to control NO_x emissions through application of Best Available Control Technology (BACT) to emissions sources to reduce NO_x emissions (Table IV-B-2). In addition, the lessee would have to employ BACT to the emission sources to reduce emissions of all regulated pollutants because these emissions would exceed the de minimis levels. An air quality analysis performed using the OCD Model for air pollutants emitted in the low case due to Sale 126 showed that maximum NO_x concentration, averaged over a year, would be 0.44 μ/m^3 at the shoreline: 1.8 percentiles of the available Class II increment for NO_x (Table IV-B-3). The existing air quality would be maintained by a large margin.

c. Other Effects on Air Quality: The amount of air pollutants reaching the shore is expected to be very low spatially and temporally because of the small amount of emissions from exploration activities and their distance from shore. In addition, there is no development or production under the low-case scenario to serve as a source of evaporation or smoke from oil spills. Consequently, the effects of air-pollutant emissions in the low case--other than with respect to standards--are expected to be very low.

Summary: Under the low case, impacts of air emissions from Lease Sale 126 activities on onshore air quality are expected to be <5 percent of the available national standards or PSD concentration increments, and the concentrations permitted by air quality standards be maintained by a large margin. Consequently, a very low effect on air quality--with respect to standards--is expected. Because of the low level of emissions and the distance of emissions from land, the other effects of air-pollutant concentrations at the shore due to exploration would not be sufficient to harm tundra vegetation on a more than short-term basis, even locally.

CONCLUSION: The effect of the low case on air quality is expected to be VERY LOW.

2. Effects on Water Quality: Water quality degradation could occur from exploration discharges and construction activities associated with oil exploration activities in the low case. These agents and their generic effects described in Section IV.B.2 of the Sale 109 FEIS (USDOI, MMS, 1987b) are incorporated by reference. In the context of this analysis, LOCAL refers to an area of less than 1,000 km^2 while REGIONAL refers to an area of at least 1,000 km^2.

a. Exploration Discharges: Exploration discharges would be regulated through a general National Pollution Discharge Elimination System permit (NPDES) from the EPA. General NPDES permits in Alaska prohibit discharges of halogenated phenol compounds, trisodium nitrilotriacetic acid, sodium chromate, sodium dichromate, oil-based drilling muds, and diesel-oil additives. These restrictions are expected to be retained in the Chukchi Sea Sale 126 NPDES permit for effluent discharge as would others that specify maximum-bulk-discharge rates, predilution requirements, and minimum-effluent-discharge depths. Exploration activities are expected to discharge bulk quantities of drilling muds and cuttings. Other discharges, such as sanitary/domestic wastes, desalination-unit discharge, boiler blowdown, test fluids, deck drainage, cooling water, blowout preventer fluid, uncontaminated ballast and bilge water, and excess cement slurry are not expected to be significant pollutant sources (USEPA, 1989). These discharges are expected to represent a small pollutant loading from exploratory drilling operations.

Drilling Muds and Cuttings: The major discharges resulting from exploration drilling would be muds and cuttings. Drilling muds are a complex mixture of clays, barite, lignosulfonate, lignite, sodium hydroxide, and other additives. The quantity of muds and cuttings discharged into the environment is dependent on the number of wells drilled and the depth of each well. During exploration, two wells averaging 10,400 feet in depth would be drilled. During the exploration period (1992), about 1,320 short tons of dry mud and 1,700 short tons of cuttings would be discharged (Appendix B). During drilling, cuttings are removed from the hole, separated from the drilling muds, and discharged. Muds are discharged, in bulk, when the mud type is changed, during cementing operations, or at the end of drilling. Discharge rates range from 30 to 1,200 bbl/hr (500 lb/bbl), with total discharges ranging from 100 to 2,000 bbl (USEPA, 1989). Discharge rates are specified in the general NPDES permit.

Table IV-B-1
Estimated Uncontrolled Emissions for the Chukchi Sea Sale 126 Low Case
(metric tons per year)

	Pollutant[1/]				
	CO	NO_x	TSP	SO_2	VOC
Exploratory Drilling Only[2/] Peak Year	445	1,722	168	162	57

Source: MMS, Alaska OCS Region, 1990. Computed from factors in Form and Substance and Jacobs Engineering Group, Inc., 1983.

[1/] CO = Carbon Monoxide
NO_x = Nitrogen Oxides (assumed predominately NO_2)
TSP = Total Suspended Particulates (includes most particulate matter less than 10 m in aerodynamic diameter)
SO_2 = Sulfur Dioxide
VOC = Volatile Organic Compounds (excluding nonreactive compounds such as methane and ethane)
[2/] Assumes 2 wells drilled in peak year.

Table IV-B-2
Comparison of Modeled Air-Pollutant Concentrations with Regulatory
Limitations (measured in micrograms per cubic meter)

Averaging Time	PSD Class II Increment[1/]	Maximum Modeled Concentration Over Land[3/2/]	Air Quality Standard
Low Case NO_x			
annual	25	0.44	100[3/]
24-hour			
8-hour			
3-hour			
1-hour			

Source: USDOI, MMS, Alaska OCS Region, 1990.

[1/] Increment above ambient concentration allowed in a designated PSD area. Ambient baseline concentration for PSD not established for this area.
[2/] Projected concentrations attributable to the proposal as modeled by the Offshore and Coastal Dispersion Model.
[3/] Annual arithmetic mean.

Table IV-8-3
Control Measures for Major Offshore Oil- and Gas-Emission Sources

Emission Source	Location[1]	Major Pollutant	Control Measure	Possible Emission Reductions	Measure In Use	Other Controls
Diesel Engines	Drilling vessel Marine tanker	NO_x	Injection-timing retard	10 - 20%	Yes[2]	Exhaust-gas recirculation
			Intake air cooling	30%	Some engines	
		SO_x	Low-sulfur fuel	Variable		
Gas Turbines	Platform Harvest, Hermosa, Hildago, and Gail	NO_x	Water injection	70 - 80%	Yes[3]	
		ALL	Waste-heat recovery[4]	26%	Yes[5]	SCR on exhaust gas
Flares	Drilling vessel Platform, OS&T	VOC	Vapor recovery	95%	No	
Valves, Flanges, Compressor Seals, Pumps	Platform Harvest, Hermosa, Hildago, and Gail	VOC maintenance	Inspection and	50 - 75%	Yes	Double mechanical seals on compressors and pumps; connect compressor pumps to vapor-recovery system
Storage Tanks	Platform	VOC	Use of floating roofs or vapor recovery on fixed roofs	75 - 95%	Yes[6]	
Oil Tanker Loading	Platform, OS&T	VOC	Vapor recovery	95%	Yes[2]	
Gas Processing	Platform, OS&T, and Grace	SO_x	Tail-gas treatment (e.g., Stretford); Sulfur-recovery unit (e.g., Claus)	95 -99%	Yes[7]	

Source: Form and Substance, Inc., and Jacobs Engineering Group, Inc., 1983.

[1] OS&T = Offshore Storage Treatment.
[2] Pacific OCS.
[3] Used on Exxon Platform Hondo, Texaco Platform Habitat. Some problems noted.
[4] Can eliminate need for external-combustion-process heaters.
[5] Exxon Platform OS&T, Grace, Harvest, Hermosa, Hildago, and Gail.
[6] Onshore facilities.
[7] Exxon Platform OS&T, Chevron Platform Grace.

Drilling fluids typically form two plumes when discharged into the water column. Muds tend to rapidly dilute over space and time, with concentration being reduced three and four orders of magnitude within 100 m of the discharge. The heavier materials settle to the sea floor slightly downcurrent of the discharge point. In shallow waters the majority of deposition occurs within 100 m of the discharge point with trace-metal and suspended-solid concentrations reaching background levels within 1,000 m. Due to their coarseness, cuttings settle rapidly and generally are deposited within 100 m of the well.

The fate of discharged drilling muds can be predicted using the Offshore Operators Committee (OOC) computer model. This model describes the fate of mud discharges by simulating the dilution of the discharge plume and makes predictions about the amount of material settling to the bottom. The model was run using varying assumptions to simulate shallow water, deep water, and under-ice disposal of muds in the Chukchi Sea environment. A summary of OOC model inputs and model runs can be found in Appendix J.

Potentially toxic trace elements in drilling muds are a major concern. Trace metals expected in discharged drilling muds include arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, vanadium, and zinc. With the exception of copper, trace-metal concentrations in drilling discharges can occur in concentrations higher than those of the average continental crust or Alaskan OCS sediments (USEPA, 1990). The maximum trace-metal concentrations in drilling mud discharges are identified in Table IV-B-3.

Federal water quality regulations (Clean Water Act, Sec. 4O3(c)) allow a 100-m-radius mixing zone for initial dilution of effluents. At the edge of the mixing zone, acute (1-hour average concentration) water quality criteria must be met. Acute criteria are applicable to instantaneous releases or short-term discharges of pollutants such as drilling mud discharges. Trace-metal measurements made for comparison with acute criteria values are legally required to be made by the total recoverable method. In the absence of total-recoverable-metals data, the EPA has considered estimated dissolved-metal concentrations (0.1% of total-metal concentration) to be the best estimator of total-recoverable concentrations. The EPA considers total-recoverable concentrations to be closer to dissolved-metal concentrations than total-metal values (USEPA, 1990).

Only about 0.1 percent of the trace-metal concentration in drilling mud would be expected in the dissolved state and would be lost to the water column during plume descent (Appendix J). The remaining metal would be bound in the solid state. The worst case predicted by the OOC model involved discharges of 1,000 bbl/hr into water depths of 15 m with a current speed of 10 cm/sec. Under these conditions, the dilution rate for dissolved concentrations at the edge of the mixing zone would be 530:1. The NPDES general permit for Chukchi Sea Sale 109 limited the maximum discharge of total muds and cuttings to 500 bbl/hr in water depths of 5 to 20 m (53 FR 37846). If this restriction is retained for the Sale 126 NPDES permit, the dilution rate expected at the edge of the mixing zone would be higher. As a result, dissolved-metal concentrations at the edge of the mixing zone for the above case would be overestimated. Table IV-B-3 compares the acute, total-recoverable-marine-water quality criteria with predicted total-, particulate-, and dissolved-trace-metal concentrations at the edge of the 100-m-radius mixing zone (see Sec. IV.B.2.a and Appendix J). Direct estimates or measurements of total-recoverable concentrations of metals in discharged drilling muds are not available (Appendix J). The dissolved concentrations of all trace metals considered by the EPA to be the best estimator of the total-recoverable concentration are below the acute marine-water quality criteria, at 100 m from the discharge point.

The USFWS has compared data for total-recoverable metals and total metals and found no statistically significant difference between the measurements (USDOI, FWS, 1990). A comparison of predicted total-metals concentrations at the edge of the mixing zone and acute marine-water quality criteria for the above case indicates that concentrations of copper and zinc could exceed the criteria (Table IV-B-4). However, as indicated earlier, the EPA prefers to use the dissolved-metal concentration (0.1% of total metals) as the best estimator of total-recoverable concentrations.

Long-term leaching of metals from deposited muds would be slight and no water quality criteria would be

Table IV-B-4
Comparison of Expected Dissolved, Particulate, and Total Metals Concentration at the Edge of the Sale 126 Mixing Zone to Marine-Water Quality Criteria

Metal	Maximum Concentration In Alaskan Muds Discharged (mg/kg)[1/]	Dissolved Concentration (ppm)		Particulate Concentration 100 m from Discharge (ppm)[4/]	Total Concentration 100 m from Discharge (ppm)	Marine Criteria 1-Hour Average (ppm)[5/]
		In Discharge[2/]	100 m from Discharge[3/]			
Arsenic	11.8	0.0118	0.000022	0.006742	0.006765	0.069
Barium	298,800	298.8	0.563773	170.7428	171.3066	none
Cadmium	5.5	0.0055	0.000010	0.003142	0.003153	0.043
Chromium	1,820	1.82	0.003433	1.04	1.043433	1.1
Copper	47.7	0.0477	0.0009	0.027257	0.027347	0.0029
Lead	33.1	0.0331	0.000062	0.018914	0.018976	0.14
Mercury	0.36	0.00036	0.000000	0.000205	0.000206	0.0021
Nickel	88	0.088	0.000166	0.050285	0.050451	0.075
Vanadium	235	0.235	0.000443	0.134285	0.134729	none
Zinc	3,420	3.42	0.006452	1.954285	1.960738	0.095

Source: USDOI, MMS, 1990.

1/ Based on whole mud concentrations as reported in USEPA, 1989.
2/ Dissolved concentration represents 0.1 percent of the total concentration in muds.
3/ Assumed dilution of 530:1. Corresponding to a discharge of 1,000 bbl/hr into water depths of 15 m and current speeds of 10 cm/sec.
4/ Assumed dilution of 1,750:1. Corresponding to a discharge of 1,000 bbl/hr into water depths of 15 m and current speeds of 10 cm/sec.
5/ From 45 FR 79318, 50 FR 30784, 51 FR 43665, and 52 FR 6203. One-hour average concentration (ppm) not to be exceeded more than once every 3 years on the average.

expected to be exceeded (USEPA, 1989).

During exploration activities, two rigs would be present at any one time. Only 0.03 km^2 would be affected by increased turbidity (or other regulated pollutants) per drilling rig (100-m radius around the discharge point); thus, a maximum of 0.06 km^2 of the sale area would have impaired water quality during the drilling period. This impairment would exist only during periods of actual discharge and would rapidly dissipate on completion.

b. Construction Activities: The amount of bottom disturbance and sediment resuspension associated with drilling two exploration wells would be minimal and restricted to the area immediately adjacent to the activity. Sediment levels would likely be reduced to background levels within several hundred meters downcurrent. This disturbance would occur over less than a 1-year period (1992)--only during exploration drilling.

Summary: The effects on water quality from exploration drilling and discharges associated with two wells would be minimal and temporary, occurring only during actual drilling over a 1-year period. The effect of exploration discharges would persist only during actual discharge within the 100-m-radius mixing zone around each discharge point. Dissolved concentrations of trace metals would not exceed the acute marine-water quality criteria at the edge of the mixing zone. The effect on local and regional water quality is expected to be very low.

CONCLUSION: The effect of the low case on local and regional water quality is expected to be VERY LOW.

3. Effects on Lower-Trophic-Level Organisms: In the low-resource case, oil exploration is at low level. A total of only two exploration wells with two different rigs would be employed over 1 year (1992). There would be no further activity with any projected discovery below the resource level that would be of economic value at the time. Discharged material from these exploratory-drilling operations would total an estimated 3.02 short tons over this period. Based on the volumes discharged and the limited dispersal, along with rapid dilution of soluble materials, the overall effect on lower-trophic-level organisms would be very low.

Other than temporary disturbance with minimal displacement during rig placement, this limited construction/installation would have no effect on lower-trophic-level organisms.

Seismic surveys required for this exploratory phase are generally assessed as having very low effects on lower-trophic-level organisms.

CONCLUSION: The effect of the low case on lower-trophic-level organisms is expected to be VERY LOW.

4. Effects on Fishes: Based on past operations and current drilling technology, the reduced weight/volume and subsequent distribution of exploration-drilling discharges (3.02 short tons) would not have any significant adverse effect on fishes. Only benthic species in close proximity to the discharge point could be affected. Seismic surveys that now usually employ airguns or related devices apparently have no effect on fish. Since there is no production under the low case, there would be no construction of either offshore pipelines or onshore oil-storage/transport facilities.

CONCLUSION: The effect of the low case on fishes is expected to be VERY LOW.

5. Effects on Marine and Coastal Birds: Under the low case, marine and coastal bird populations are most vulnerable to oil exploration activities in the open-water season (June-October), when large-scale movements of birds into and through the sale-area vicinity coincide with pack-ice breakup and initiation of the drilling season. Disturbance from aircraft and vessel traffic is expected to be the most important potentially adverse factor. Release of other hydrocarbons and muds and cuttings to the

environment is likely to have relatively insignificant effects on these populations.

The number of exploration-drilling units in the sale area is expected to be 2, requiring an estimated 60 to 150 helicopter flights and 20 support-vessel trips per month during an assumed 90-day drilling period that would occur during the open-water season. Seismic-survey vessels would cover an insignificant proportion of the sale area during the open-water season. Virtually all potentially disturbing activities would take place during the open-water season, when migrant and resident birds are abundant in several coastal habitats including spring-lead systems, river mouths, bays and lagoons, and areas near several major seabird-nesting colonies. The effect of helicopter overflights on individual bird flocks could be highly stressful during migration periods as well as in the summer nesting season. Frequent flights are likely to displace most individuals from the immediate vicinity of any routinely used flight path for the duration of each drilling season.

Within the Chukchi Sea area, disturbance of bird-nesting colonies at Capes Lisburne and Lewis could have a substantial effect on Chukchi Sea populations. Eiders and terns nesting on barrier islands may be disturbed by aircraft and boat traffic, and some disturbance of molting and/or staging eiders, oldsquaw, brant, and shorebirds at Peard Bay and Kasegaluk Lagoon is likely to occur. However, although Johnson (1982a) reported that oldsquaw may change their local distribution temporarily in response to disturbance, studies by Ward and Sharp (1973) and Gollup, Goldsberry, and Davis (1972) suggest that long-term displacement or abandonment of important molting and feeding areas by oldsquaw due to occasional aircraft disturbance is unlikely. Disturbance of nesting birds along the northern part of the Sale 126 area near Point Belcher is likely to occur but would not involve large numbers. Nests of most waterfowl and shorebirds are widely dispersed over the coastal tundra; thus, disturbance of local tundra-nesting birds probably would have little effect on North Slope populations as a whole.

Helicopter traffic between Barrow or Wainwright and drilling units would be the primary source of disturbance to marine and coastal birds. During exploration, goods would be barged to Point Belcher. Two drilling units would be used in the summer during exploration. The greatest disturbance is likely to be caused by aircraft flying near feeding and molting concentrations of birds at Kasegaluk Lagoon and Peard Bay (Graphic No. 1). Because of frequent low visibility due to fog, aircraft may not be able to avoid disturbing areas of bird concentration during the summer-fall period. For example, aircraft--especially helicopters--flying at low altitudes along the coast could greatly disturb larger flocks of several thousand to perhaps tens of thousands of molting and/or feeding waterfowl, particularly in August and September. Aircraft flying directly from the Barrow, Wainwright, and Point Belcher airstrips to offshore platforms are less likely to disturb birds than aircraft paralleling the coast. On occasion, offshore flights may briefly disturb foraging flocks of seabirds numbering in the hundreds to a few thousand, with little or no lasting effects. Such disturbance may disrupt migratory birds as they are acquiring the energy necessary for successful migration.

Low-altitude overflights of the Capes Lisburne and Lewis seabird colonies during the nesting season (June-September) could cause the direct loss of eggs and nestlings and might cause reductions in the productivity of these seabird populations. However, if air support is based in Barrow and Wainwright, it is not likely to pass near Capes Lisburne and Lewis and disturbance of these colonies would not occur. The overall effect on marine and coastal birds from aircraft disturbance associated with the low case is likely to be low.

Drillship and support-vessel traffic may coincide with bird movements in the vicinity of the sale area, displacing some and temporarily interfering with local movements or migrations. However, there is no evidence that vessel traffic would significantly delay marine bird migrations or exceed very low effects on their movements or distribution.

<u>CONCLUSION</u>: The effect of the low case on marine and coastal birds is expected to be LOW.

6. <u>Effects on Pinnipeds and Polar Bear</u>: Disturbance could result from helicopter flights

(round trips/drilling rig/month = 60-150), supply-boat trips (maximum of 20 trips/month), and various barges and ice-management vessels servicing the two exploration drillships present in offshore habitats of pinnipeds and polar bears. Seismic-vessel activity is expected to be minimal. Most drilling activity and aircraft and vessel traffic is likely to occur in the open-water season (July-October), when--except for spring- and fall-migration periods--pinniped and polar bear numbers in the sale area may be relatively low in years when the pack ice retreats out of the northern Chukchi Sea.

Although helicopter-disturbance events would be brief, the effect on individual walrus, particularly calves, and possibly other pinnipeds could be severe during migration periods and into the summer where ice is present. However, since the walrus nursery herds are widely distributed along the ice front and lead systems during spring and summer, flights to drillships are not likely to disturb a major proportion of the population, although injury or death of a small portion of the calf population is possible. Aircraft disturbance of spotted seals hauled out along the coast or ringed and bearded seals or polar bears on the ice is not likely to result in significant injury or mortality, although increases in physiological stress caused by frequent disturbance may reduce the longevity of some individuals. Frequent flights are likely to displace most pinnipeds and polar bears from the immediate vicinity of any routinely used flight path for the duration of industrial activity; however, some animals could be expected to exhibit varying degrees of habituation.

Drillship and support-vessel traffic may coincide with walrus, seal, and polar bear movements in the vicinity of the sale area, displacing some animals and temporarily interfering with local movements or migrations. However, there is no substantial evidence indicating that vessel traffic would block or significantly delay marine mammal migrations or result in greater than low-level effects on their movements or distribution.

CONCLUSION: The effect of the low case on pinnipeds and polar bear is expected to be LOW.

7. Effects on Endangered and Threatened Species:

a. Bowhead and Gray Whales: This analysis addresses the likely effect of industrial noise on bowhead and gray whales. The majority of this information was obtained through field and laboratory studies funded by MMS and various Canadian agencies. There have been few documented observations of bowhead and gray whales responding to industrial noise in Alaskan waters; nearly all such documentation has come from Canadian sources or from other geographic areas. However, the essential information pertaining to the likely effect of industrial noise on cetaceans in Alaskan waters was readily available.

This analysis is based on (1) the likely effect of industrial noise on bowhead and gray whales and (2) the likelihood of whales encountering industrial noise. Bowhead and gray whales are discussed together due to similarities in their responses to similar stimuli.

This analysis assumes that whales do not respond (in the adverse sense) to noise of any kind until it is perceived as either a threat or an annoyance, although the noise may be heard at great distances. It is further assumed that the distance from the source of noise where the response occurs represents the outer limit of the response zone. The response zone is defined as the range of distances where a behavioral response (attributable to the industrial noise) can be expected from about one-half of the whales in the vicinity of a given source of industrial noise (based on Miles 1984, 1986, and 1987). One-half was selected because it has the least amount of variability and the highest probability for valid cause-and-effect determinations in the relationship between industrial noise and whales. Hence, for the purposes of this discussion, encounters with industrial noise occur when one-half of the whales near a source of industrial noise are responding, or would be expected to respond, to the noise. On the basis of studies findings to date, including Richardson et al. (1990), which was conducted within the spring-lead system, the effect of industrial noise on bowhead whales in or near to the spring lead system is likely to be similar to that anywhere else, since the stimuli are the same. However, if an industrial operation occurred in the spring lead system, the rate of bowheads encountering industrial noise would likely be higher than elsewhere (assuming the spring migration is restricted to the spring lead system).

(1) Likely Effect of Industrial Noise: The noise sources present during exploration activities that are most likely to affect bowhead and gray whales consist of natural ambient noise and noises resulting from operational industrial equipment. Brown (1983) indicates that natural ambient underwater noise in the Arctic can be extremely loud or quiet--depending on the season, location, time of day, wind conditions, sea state, number of animals present, and ice conditions. Thiele (1982) indicates that the level of ambient underwater noise in the arctic region is strongly affected by sea ice and that the noise it generates is due to cracking, movement by wind currents or waves, breaking/crushing, capsizing, release of air in melting ice, and interaction with the sea bottom or shore.

Industrial noises associated with OCS exploration activities include those from support vessels, icebreakers, seismic vessels, aircraft, and drilling and dredging activities. Miles et al. (1987) indicate that few, if any, bowheads appear to respond overtly to industrial noises that are 15 dB or less above the ambient level and that some individuals apparently fail to respond at much higher levels. Similar observations have been made for the gray whale (Miles et al., 1986, 1987); however, industrial noise is not likely to affect many gray whales since they tend to concentrate shoreward of the Sale 126 area. Consequently, noise generated by industrial sources that does not exceed the ambient-noise level is unlikely to elicit any perceptible response from bowhead or gray whales.

(a) General Findings: The effect of industrial noise on whales, and the distance from the noise source where a behavioral response is expected to occur (the response zone), have been evaluated by investigators on the basis of observations of (1) bowhead and gray whale behavior at measured distances from operational industrial equipment, and (2) bowhead and gray whale behavior at measured distances from playbacks of prerecorded industrial noises. From the evaluations performed thus far, numerous findings have become apparent pertaining to the behavior of gray and bowhead whales in response to industrial noises, and to the distance at which responses are likely to occur. The response zone is defined as the range of distances where a behavioral response (attributable to the industrial noise) can be expected from about one-half of the whales in the vicinity of a given source of industrial noise.

The following summarizes research findings to date concerning the effects of industrial noise (vessel, aircraft, and drilling/dredging) on whales.

1. Only a small number of whales (outside the response zone) that may hear industrial noises are likely to respond in a perceptible fashion to such noises.

2. In comparison to the expanse of habitat available to whales, response zones generated by oil and gas operations are relatively small in size and few in number. This alone precludes most whales from passing through them.

3. Whales that pass within a response zone generated by industrial noise may or may not respond to such noise. Whales that do respond exhibit responses of differing intensities at differing distances (see below), depending on the nature of the sound received and differences in the behavior of individual whales. In general, whales exhibit a greater response to moving sources of noise and to sudden changes in received noise levels than to immobile sources of noise and consistent noise levels. Common responses to industrial noises include:

a. Slight changes in swimming speed and heading near the outer limit of a response zone, or

b. Greater changes in swimming speed and heading at closer ranges, or

c. Minor modification of surface respiratory pattern with no swimming- speed or course changes, or

d. Temporary cessation of an activity (a, b, and c above also possible).

Less common responses include:

e. A startle response that may result in tail slapping, a rapid dive, a sudden change in course or speed, or fleeing the area. Startle responses are more likely to occur due to sudden changes in received noise levels (e.g., at the onset of prerecorded noise during playback experiments, at the onset of an actual industrial operation, or during the reversal of a vessel's direction).

f. High-speed evasive swimming and/or a dive to avoid vessels that are in pursuit.

g. Dispersion of a social group.

4. Avoidance responses (a, b, e, f, and g above) are accompanied by varying degrees of a modified surface/respiratory pattern (a slower cycle in response to some noises; a more rapid cycle in response to others).

5. Whales that have modified their behavior in response to an industrial noise normally return to their pre-disturbance behavior within a few minutes to one-half hour after leaving a response zone. However, in some instances, the return may require up to 1 hour.

6. The acoustic sensitivity of migrating or feeding gray whales appears to be similar.

7. The acoustic sensitivity of bowhead and gray whales is generally similar, although bowheads appear to be somewhat more sensitive.

The specific distance at which a behavioral response is likely to occur in response to the various types of industrial noise depends on the nature and intensity of the noise involved, the specific location of the noise source, and individual differences in whale behavior. Additionally, predicted response distances depend on many site-specific variables and assumptions associated with sound propagation and mathematical modeling. Consequently, the distance at which a response is likely to occur due to an industrial noise is variable and must be considered as a general range or response zone (e.g., 1-4 km) rather than an absolute distance. It should also be noted that for any given response zone, more responses are likely to fall toward the center of the given range, rather than at either end.

(b) Response to Noise Associated with Vessels:

Support Vessels: The following information pertaining to the response of whales to support vessels and the distance at which responses are expected to occur is based on (1) observations of bowhead behavior at measured distances from operational support vessels in the Canadian Beaufort Sea (see Richardson, Wells, and Wursig [1985] below), and (2) site-specific measurements of the noise generated by tugs in the Alaskan Beaufort Sea, in concert with mathematical models that predict the response zones for bowhead and gray whales at the sites investigated (see Miles and Richardson [1987] below).

Regarding bowhead responses to support-vessel noise in the Canadian Beaufort Sea, Richardson, Wells, and Wursig (1985) indicate that whales begin to orient away from approaching vessels when they are as much as 4 km away. Some whales increase their swimming speed when an approaching vessel is 2 to 4 km away, but most do not do so until a vessel is about 2 km away. These authors noted that the sensitivity of individual whales appeared to be variable, with some bowheads responding at about 3 or 4 km and perhaps at 5 to 7 km, while others did not begin to move away until the vessel was within only 1 km. Bowheads continued to swim away for several minutes after the vessel passed, but alteration of behavioral activities sometimes continued longer. Mansfield (1983) notes that bowheads moved away quickly from vessels that approached within approximately 1 km, but that after passing the whales did not move any farther away.

Miles and Richardson (1987), in a modeling study, predict that the response zone for tugs operating in the Alaskan Beaufort Sea would be larger. Although no whales were actually observed during this study, the response zone was predicted to be 1 to 12 km. At these distances it was calculated that bowheads would be receiving tug noises at 30 dB above ambient and that there was about a 50-percent probability of avoidance at this level. The response zone was predicted to be 13 to 34 km at 20 dB above ambient at the sites investigated. However, during a recent tagging study, Wartzok et al. (1989) documented 181 cases of bowheads voluntarily approaching an active research vessel to within 0.1 to 0.5 km. The study went on to say that beyond 0.5 km, bowheads appeared to ignore the ship in spite of high levels of ship noise.

Due to the relatively low density of bowhead whales within the migratory corridor, few bowhead/vessel encounters are likely to occur during OCS operations. On the basis of studies findings, when bowheads do encounter vessels it is likely that they will avoid vessels at distances of 1 to 4 km, depending on differences in behavior and conditions associated with sound propagation. Based on Miles' and Richardson's (1987) predictions, it is possible that some bowheads may avoid vessels at greater distances. Also, Brown (1982) indicates that marine mammals do not seem to habituate to aggression associated with hunting activities, and that marine mammals consistently avoid such activities (including other forms of overt harassment). Hence, response zones >1 to 4 km are more likely in areas where bowheads are being hunted. Bowheads that approach or are approached by vessels may adjust their individual swimming paths in order to avoid a closer encounter (particularly in areas where hunted), and may modify their surfacing respiratory patterns and/or behavior while doing so. However, deflections in bowhead swimming paths, changes in surfacing/respiratory patterns, and temporary cessation or a change in activity are not expected to result in a significant effect on the bowhead population/migration. Concerning the response of migrating gray whales to vessel noise, Malme et al. indicate that the responses were variable and that gray whales engaged in a specific activity, such as feeding, continued that activity when the vessel was in the vicinity. However, if the vessel approached (usually within 100 m), the whales usually would move away or dive.

Thus, the likely effect of support vessels on bowhead and gray whales would be local, short-term behavioral responses in about half the whales that are within 1 to 4 km of such vessels (the observed response zone). Although never observed, this zone has been predicted to extend out to 12 km, based on predictive modeling studies. Behavioral responses would be limited to course deflections, changes in surfacing/respiratory patterns, and temporary cessation or a change in activity. Behavioral responses are likely to occur for several minutes per whale/vessel encounter but may persist for as long as an hour (Ljungblad, 1985). Consequently, noise from support vessels has not shown a significant effect on the bowhead or gray whale populations, although some individuals could be affected.

Icebreaking Vessels: The following information pertaining to the response of whales to icebreaking-vessel noise and the distance at which responses are expected to occur is based on (1) underwater measurements of icebreaker noise and observations of cetacean (belukha and bowhead whale and narwhal) behavior at measured distances from operational icebreakers in Canada, and (2) site-specific measurements of the noise generated by icebreakers in the Alaskan Beaufort Sea, in concert with mathematical models that predict the response zone for bowhead and gray whales at the sites investigated (see Miles and Richardson [1987]) below).

Underwater Sounds Associated with Icebreakers: It has been suggested that underwater sounds emanating from icebreaking vessels that were actively breaking ice might greatly exceed those of nonicebreakers and result in a greater level of disturbance to bowhead whales (possibly masking their ability to communicate). However, Brown (1982) indicates that only a modest increase in noise is expected in icebreakers when going from an ice-free to an icebreaking mode, and concludes that the noise of icebreaking is not significant in comparison to cavitation noise of the icebreaker.

Thus, it is likely that the net increase in underwater noise due to breaking ice would be minimal. Regarding the total amount of underwater noise of an active icebreaker under full power, Brown (1982) indicates that in either open water at 22 knots or in ice at 12 knots, the underwater-noise output would be comparable to that of other large ships at similar speeds. It is also noteworthy that much of an icebreaker's service time around an industrial operation would be at anchor (zero power output) or in thin ice at a much reduced power output.

Concerning the primary source of underwater vessel (icebreaker or nonicebreaker) noise that could mask bowhead communications, Brown (1982) indicates that the main source of underwater noise is propeller cavitation. Finley, Greene, and Davis (1983) indicate that, of the propeller-cavitation noises emanated by an icebreaker, the loudest noises occur during the brief (5-sec) transition from reverse to forward thrust during the icebreaking mode. It has been suggested that such noises may produce a "startle effect" in whales. Finley et al. (1984) indicate that sudden startups and highly variable noise levels associated with ramming and backing of the icebreakers may have evoked stronger reactions in the belukhas than if the noise source had been constant. Since the belukhas returned to the same area even though the noise levels in that area became louder, it is likely that their initial responses were startle responses.

In their analysis of the noises emanating from the MV Arctic (an icebreaker), Finley, Greene, and Davis (1983) and Finley et al. (1984) also point out that some of the loudest noises were due to machinery noises unrelated to the primary source of ship noise (propeller cavitation). Some components of machinery noise occur at higher frequencies and are closer to the hearing and communication ranges of pinnipeds and odontocetes. Other components of machinery noise occur at lower frequencies and are closer to the hearing and communication ranges of mysticetes, as are propeller-cavitation noises and the blade-rate tones of propellers. Hence, propeller cavitation and some components of onboard-machinery noise appear to be the primary sources of underwater noise that could interfere with nearby bowhead whale communications. The potential for these noises is essentially the same for either an icebreaker or a nonicebreaker operating in open water. The only additional underwater sound expected from an icebreaking vessel would be that due to increased propeller cavitation while in an icebreaking mode (direction reversals and when pushing ice). However, due to the widespread nature of the bowhead migration and the observed tendency of bowheads to avoid vessels that come within 1 to 4 km, such noises are not likely to mask bowhead communications.

Noises of the natural underwater environment can be extremely loud (potentially able to mask bowhead communications) or quiet, depending on the season, time of day, wind, sea ice, sea state, and number of animals present. Brown (1983) concludes that in an extreme case (20 ships operating in Canada in heavy ice at 10 kt), bowheads within 1 km could experience up to a 10-percent reduction in time available to communicate due to the masking effect of the icebreaker noise, whereas in a low case (4 ships operating in Canada in moderate ice at 15 kt), bowheads within 1 km would experience little or no reduction in time available for communication. Consequently, due to the local, short-term effect of intense vessel noise on whales within the response zone, and the low probability of bowheads being trapped for extended periods in areas of intense vessel noise (they typically avoid vessel encounters at 1-4 km), icebreaking vessels are not likely to have a significant effect on the bowhead whale population, although some individuals could be affected.

Cetacean Avoidance Behavior: Most investigators working in this field have identified response zones for the various types of industrial noise and have indicated that, once within these zones, some bowheads tend to avoid closer approaches to the source of noise. In general, avoidance of industrial noise by cetaceans, and the distance at which this occurs, depends on the activity of the whale, the activity of the vessel (or other source of industrial noise), the nature of the noise (e.g., intensity, discontinuous, or continuous), the time of year, the animal species, opportunities of space for whales to move away in, individual differences in whale behavior, site-specific differences in underwater ambient noise, and other factors associated with underwater-sound propagation.

For example, Finley and Davis (1984) and Finley et al. (1984) observed strong, long-range (35-50 km) avoidance behavior in belukha whales and narwhals due to a rapidly approaching icebreaker in open water. However, they also indicate that this behavior may have been due to the fact that no similar studies had been conducted in pristine marine environments with "industrially-naive" populations of marine mammals. In another study by Kanik, Winsby, and Tanasichuk (1980), whales apparently made no long-range attempts to avoid an approaching icebreaker, since belukha, narwhal, and bowhead whales were observed at only 0.1, 0.8, and 2.4 km, respectively, away from the icebreaker.

Similarly, during a study in 1979, Brueggeman (1988, oral comm.) observed bowheads less than 1 km away from an icebreaker in open water near Saint Matthew Island in the Bering Sea. Although the study was inconclusive (it was not designed to determine the effect of icebreakers on bowheads), the whales showed no apparent avoidance of the icebreaker. One bowhead surfaced only 10 m from the vessel and then swam around it for 6 minutes before moving off. Consequently, the long-range avoidance responses of belukhas and narwhals to icebreakers observed by Finley and Davis (1984) and Finley et al. (1984) apparently were the startle responses of "industrially naive" animals. It is noteworthy that the latter experiments were carried out on animals that were concentrated (an annual occurrence) along the ice edge of Lancaster Sound, Canada, and had no other escape route from the approaching icebreaker other than laterally along the ice edge.

Because bowheads of the Western Arctic stock have frequently been exposed to industrial noises, are widely dispersed and normally unrestricted in their movements rather than concentrated and essentially trapped along an ice edge, and differ considerably in their natural history, it is unlikely that they would be startled by icebreakers (whether icebreaking or not) at the great distances (35-50 km) observed by Finley and Davis (1984). Startle effects are more likely to occur to bowheads that closely approach or are closely approached by icebreakers that are commencing ice-management operations (because of sudden increases in propeller cavitation), or when icebreakers reverse direction while in an icebreaking mode. In such instances some bowheads are expected to respond with short-term avoidance behavior. In general, however, bowheads are expected to avoid close encounters with icebreakers in the same way they avoid close encounters with other vessels--by altering their heading. Such avoidance has been observed to have only minimal to no apparent effect on bowheads (unless the whale is actively pursued).

Miles and Richardson (1987) indicate that the response zone for icebreakers operating in the Alaskan Beaufort Sea would be up to 20km. At these distances the study predicted that bowheads would be receiving intermittent icebreaker noise at 30 dB above ambient, and that there was a 50-percent probability of avoidance at this level. The study also predicted a response zone of up to 50+ km for intermittent icebreaker noise at 20 dB above ambient.

Thus, icebreaking vessels are likely to cause local, short-term behavioral responses in half the whales within the response zone. This zone is likely to be similar to that already discussed for other support vessels (1-4 km), but has been predicted to be (although never observed) as much as 20 km on the basis of modeling studies. Expected behavioral responses would be the same as already discussed for support vessels, although there would also be an increased likelihood of startle effects when nearby icebreakers commence ice-management operations or when they reverse directions while managing ice. Noise from icebreaking vessels is not likely to have a significant effect on the bowhead whale population, although a few whales could be affected and temporarily disturbed.

Seismic Vessels: The following information pertaining to the response of whales to seismic vessels and the distance where responses are expected to occur is based on observations of (1) bowhead whale behavior at measured distances from operational seismic vessels in the Canadian Beaufort Seas (see Richardson, Wells, and Wursig [1985] and Ljungblad et al. [1985] below), and (2) gray whale behavior at measured distances from operational seismic vessels off the California coast and in the Bering Sea, in concert with mathematical models that predict the probability of avoidance or disturbance, and the hypothetical distance where this should occur based on existing conditions.

Seismic vessels produce both low-energy sonar impulses that assist in determining bottom conditions and high-energy impulses from airguns that assist in the location of potential oil fields within the earth's crust. Airgun surveys using single airguns and airgun arrays emit the loudest noises of any single petroleum-related industrial activity. Consequently, the response of whales to seismic vessels that are conducting airgun surveys serves to illustrate the extreme case where the effect of industrial noise on whales is concerned. Regarding the bowheads response to seismic noise from airgun arrays Richardson, Wells, and Wursig (1985) indicate that tests involving a full-scale seismic vessel showed that bowheads began to orient away when airgun arrays began to fire 7.5 km away, but that responses were weak and some whales continued feeding until the vessel was only 3 km away (whales were displaced by about 2 km). They also indicate that no unequivocal reactions to seismic ships were demonstrated at ranges exceeding about 7.5 km, even though the seismic-noise impulses propagate much farther. In another study involving bowhead response to airguns and airgun arrays, Ljungblad et al. (1985) indicate that changes in surfacing, respiration, and dive characteristics were noted at 5 to 7 km, and that avoidance (changes in orientation and flight) occurred at ranges of 3.5 to 5 km. Bowheads responding to close approaches by the active seismic vessel required 30 to 60 minutes to return to predisturbance behavior, but no discernible behavioral changes were noted beyond 10 km.

Concerning the effect of seismic vessels on migrating gray whales off the California coast, Malme et al. (1984) state the following regarding the point where avoidance can be expected to begin (i.e., a 10-percent probability of avoidance): "The probability of avoidance analysis for the air gun source showed that the threshold of avoidance behavior occurred for effective peak pressure levels around 164 dB." The study estimates that the probability of avoidance would increase to 50-percent when whales are receiving approximately 170 dB but does not indicate the range where avoidance would occur.

In subsequent efforts to determine the gray whale response zone for an operational single airgun, and for airgun arrays at various locations in the Bering Sea, Malme et al. (1986) indicate that there is a 10-percent probability of feeding disturbance for gray whales receiving 163 dB (calculated to occur at 1.3-1.8 km from a single airgun, and 5-7 km from an airgun array), and a 50-percent probability of feeding disturbance for gray whales receiving 173 dB (calculated to occur at 0.32-0.63 km from a single airgun, and at 2.6-3.0 km from an airgun array) for the locations investigated.

Thus, the response of bowhead and gray whales to seismic noise is expected to be similar to that already discussed for support vessels (local, short-term behavioral responses). The response zone, where half of the whales within the zone would be expected to respond to seismic noise, is likely to be 5 to 8 km. Short-term startle effects are likely to occur at the onset of seismic operations if bowheads are in the vicinity during such times. Consequently, noise from seismic vessels is expected to have short-term, local effects on individuals of the bowhead and gray whale populations.

(c) Response to Aircraft Noise: The following information pertaining to the responses of bowheads to aircraft and the distance at which responses are expected to occur is based on observations of bowhead whale behavior at measured distances from operational aircraft in the Canadian Beaufort Sea.

Concerning the effect of aircraft noise on bowhead whales, Richardson, Wells, and Wursig (1985) indicate that bowheads sometimes responded to fixed-wing aircraft when the aircraft flew over, or circled below or equal to 305 m. Responses were infrequent when the aircraft was at 457 m, and virtually absent at ≥ 610 m. These authors also indicate that, except in shallow water, behavior can almost always be considered undisturbed by aircraft if the aircraft remains at or above 457 m. Regarding the response of bowheads to aircraft noise in the spring, preliminary observations indicate (Richardson et al., 1990) that bowheads are no more sensitive to aircraft noise in the spring-lead system than during the fall migration in open water.

Thus, the effect of aircraft above 457 m on bowhead whales is expected to be minimal. Low-flying aircraft may affect bowheads by causing them to dive, resulting in short-term disturbance. Concerning gray whales, it is reasonable to assume that, because they are exposed to more aircraft and vessel noise along their migratory route and are not hunted from powered vessels as bowheads are, they have become more habituated to aircraft and vessel noise and are less sensitive to it. Malme et al. (1983) indicate that gray whales did not respond significantly to helicopter noise and that the noise was very localized in its effect. Consequently, noise from aircraft flying at or above 457 m have not shown significant effect on individual whales and their populations. Noise from aircraft below this altitude is expected to have an insignificant effect on whale populations as well but a more pronounced short-term effect on individual bowhead and gray whales.

(d) Response to Noise Associated with Drilling and Dredging: The following information pertaining to the response of whales to drilling and dredging activities, and the distance at which responses are expected to occur, is based on (1) observations of bowhead behavior at measured distances from operational drilling and dredging equipment in the Canadian Beaufort Sea (see Richardson, Wells, and Wursig [1985] below); (2) observations of gray whale behavior at measured distances from playbacks of prerecorded drilling noises off the California coast and in the Bering Sea, in concert with mathematical models that predict the probability of avoidance or disturbance and the hypothetical distance where this should occur for differing locations/environmental conditions (see Malme et al. [1984] below); and (3) site-specific measurements of the noise generated by operational equipment in the Alaskan Beaufort Sea, in concert with mathematical models that predict the response zone for bowhead and gray whales at the sites investigated (see Miles et al. [1986 and 1987] below).

Concerning the effect of drilling and dredging noise on bowhead whales in the Canadian Beaufort Sea, Richardson, Wells, and Wursig (1985) indicate that bowheads were observed within 4 to 20 km of drillships on several days while helicopter, island-construction, and seismic- and other-vessel activities were occurring in the area. The behavior of these bowheads during this time was said to be characteristic of undisturbed bowheads. Bowheads were also observed within a few kilometers of operating drillships and dredges (suction and hopper), yet they also seemed unaffected.

Concerning the effect of drillships, platforms, and helicopters on migrating gray whales off the California coast, Malme et al. (1984) indicate that there is a 50-percent probability of gray whales avoiding most of the playback sources (drillships, platforms, and helicopters) at <100 m (1.1 km from the drillship), and also that only the loudest industrial-noise sources evoked an avoidance response from migrating gray whales at ranges >100 m. In subsequent efforts to determine the response zone for simulated drillship noise at various locations in the Bering Sea (gray whales were observed during this study), Malme et al. (1986) estimate that the response zone would be 1.1 to 2.5 km for gray whales receiving 110 dB (0.1% probability of avoidance), and 0.3 to 0.7 km for gray whales receiving 120 dB (0.5% probability of avoidance) for the sites investigated.

Miles et al. (1986), in a predictive modeling study, theorize that response zones in the Alaskan Beaufort Sea would be greater. For drillships, the study predicted a 5.5- to 19-km response zone for drillship noise and a 6.4- to 22-km response zone for dredging noises at 20 dB above ambient. At 30 dB above ambient (0.5% probability of avoidance), the model predicted a 1.3- to 6.5-km response zone for drillships and a 1.5- to 7.4-km response zone for dredges for the sites investigated. At the same sites, Miles and Richardson (1987) predicted that the response zone for drillship noise was 4.6 to 8.8 km at 20 dB above ambient. At 30 dB above ambient (0.5% probability of avoidance), the study predicted a 1- to 4-km response zone for drillship noise and a 0.1- to 3.1-km response zone for dredging noise.

Thus, drilling and dredging activities are likely to cause only local, short-term behavioral responses in whales within 1 to 4 km. However, the foregoing research also indicates that the actual effect from a drillship or dredge is likely to be less than that expected from support vessels. This is largely due to the fact that drilling and dredging operations are stationary, produce relatively constant noise levels, and are therefore perceived as less threatening or annoying, whereas vessels are mobile, produce more variable and sometimes higher noise levels, and can therefore be perceived as more threatening or annoying. Consequently, noise from drilling and dredging activities is not expected to result in significant effects on the bowhead or gray whale populations. However, some individual whales would be affected by drilling and dredging activities.

(e) Whale Distribution in Response to Industrial Noise: Assuming there are whales in the vicinity of OCS operations, some are likely to make minor heading changes in response to industrial noise. In instances where several vessels are operating simultaneously in close proximity (e.g., 2 icebreakers, 1 drillship), the noise level of such vessels is not additive (Malme, 1987, oral comm.). However, in some instances where two or three vessels are operating simultaneously, bowheads may make slightly larger course deflections due to the additive effect of one or more response zones. This would be particularly probable during times of increased propeller cavitation, when icebreakers are pushing ice or frequently reversing directions. Larger deflections would depend on the proximity and activity of each vessel in relationship to approaching bowheads; the ambient noise level; local factors associated with sound propagation; and the approach angle, activity, and individual differences in the behavior of approaching bowheads.

In order to detect any shifts that may have occurred in the fall distribution of bowhead whales in the Alaskan Beaufort Sea, Treacy (1989) evaluated 1982-1988 bowhead sightings on the basis of median depth analysis. In general, the distribution of the bowhead whale population during this period appears related to the severity of annual ice conditions (rather than to the presence of industrial activities). For example, between 1982 and 1988 only five industrial operations occurred in the bowhead migratory corridor during the fall bowhead migration. Two occurred during a light-ice year (median depth was 26 m); two others occurred during a moderate-ice year (median depth was 31 m); and another occurred during a heavy-ice year (median depth was 42 m). These median depths show an apparent correlation with the intensity of the ice year. Further evidence along these lines is found in the median depths for the light-ice year of 1982 and the heavy-ice year of 1983 (years when there were no industrial operations in the migratory corridor). In the light-ice year median depth was found to be only 29 m, whereas in the heavy-ice year (the heaviest of the years considered) the median depth was found to be 347 m. This again shows an apparent correlation with the severity of ice conditions, rather than a correlation with industrial activities. Regarding the distribution of bowhead whales in the Canadian Beaufort Sea, Richardson et al. (1985) point out the uncertainty as to whether the changes in distribution that have occurred there are the result of industrial activities, natural factors, or both. However, since bowheads spend much of their time feeding in the Canadian Beaufort Sea, it is reasonable to assume that bowhead distribution is closely linked to food availability. Further, since food availability is influenced by many factors that cause it to vary from year to year in its geographic distribution (Thomson et al., 1985), bowhead distribution is likely to be dependent on this factor. In addition, annual differences in ice conditions are believed to play an important role in the general distribution of the bowhead population throughout its range.

Regarding gray whales, there appears to be no indication of any change in historic distribution due to oil-related activities. In fact, the gray whale population is apparently thriving (it now exceeds pre-exploitation numbers) despite exposure to an increased variety and quantity of vessel and aircraft noise. These sources of noise include numerous "whale-watching" vessels, where approaches are often close enough to take close-up pictures of gray whales without the aid of special lenses. It is also noteworthy that while the loudest oil industry noises (seismic-airgun arrays) were increasing by 2.5 percent annually between 1967 and 1979, the gray whale population was also increasing annually by about 3.7 percent (Malme et al., 1984). Further, as indicated earlier, few gray whales are expected to be in the Sale 126 area, since they tend to concentrate close to shore. Hence, noise from oil related activities is not expected to have an effect on the gray whale population, although a few individual whales would be affected.

Thus, based on a review of the research concerning the known effect of industrial noise on the distribution of bowhead and gray whales, it is likely that some whales would make minor course changes around oil-related activities. However, while some individuals may move to avoid a particular activity, a significant change in the seasonal distribution of the bowhead or gray whale population is unlikely.

(2) Likelihood of Encountering Industrial Noise: This section discusses the expected level of interaction between whales and industrial equipment associated with the low case for Sale 126. Exploratory operations associated with the low case are proposed for 1992 only and would total two operations over the life of the proposal. Exploratory operations in the Arctic typically require one drill rig and two to four support vessels to be onsite continuously and one to three aircraft intermittently. The low

case estimates that there would be 24 supply-vessel trips, 180 helicopter trips, and 365 trackline km of seismic surveys.

Exploratory operations in the sale area are generally limited by ice to the mid-July to October period. Hence, the spring bowhead migration, would not encounter noise associated with exploration, since it has already passed Point Barrow by mid-June, and the sale area is essentially outside of the spring-lead system. Gray whales tend to concentrate nearshore and seldom use the sale area. Hence, gray whale encounters with exploration noise are expected to be low to zero. Encounters with aircraft noise are not expected as long as aircraft remain at or above the response zone of 457 m.

Based on prior sightings, the width of the fall bowhead migratory corridor in the sale area is very broad and appears to include the entire sale area (Fig. III-B-5). Assuming that there are 7,800 bowhead whales in the Western Arctic stock, and an even distribution of all bowheads along a line (about 337°NNW from Point Lay) perpendicular to the average fall bowhead heading (about 247° [Ljungblad et al., 1988]), the width of the corridor in the sale area would be roughly 320 km (200 mi) and would contain about 24 whales/km (39 whales/mi). Assuming further that two exploratory operations are evenly distributed along this line, with five vessels per operation (seismic, drilling, support, icebreakers) having average response zones of 8 km (5 mi) in diameter per vessel, exploratory operations would affect about 80 km (50 mi), or 25 percent of the migratory corridor. This would result in about a fourth of the bowhead population (1,950 whales) entering industrial-response zones in the Sale 126 area. Based on the definition of an industrial-response zone, about half these whales--or about 12.5 percent of the population (975 whales)--would be expected to respond to industrial noise once within a response zone.

The actual rate of bowhead and gray whales encountering industrial noise would vary depending on the number of whales in the bowhead population, the number of exploratory operations per year, annual ice conditions, and unknown factors associated with migratory path selection within the greater fall migratory corridor. Due to the conservative nature of the above assumptions, and the low level of expected exploration activity, the likely rate of bowhead and gray whales encountering exploratory noise in the low case is expected to be very low in 1992, and zero thereafter. It is noteworthy that, to date, only zero to two exploratory operations per year have occurred on the arctic OCS, with two to five vessels per operation. On the basis of the above assumptions, prior exploratory operations would have resulted in annual bowhead encounters ranging from 975 per year (with no response in the other 6,825 bowheads) to no encounters in a year. On the basis of the studies discussed in Section IV.B.7.a(1), whales that respond to exploration noise are likely to exhibit only local, short-term responses. No significant effect on the timing or route of the spring or fall bowhead or gray whale migrations is expected. Any effect of the low case on bowhead and gray whales is expected to be minimal. Consequently, industrial noise associated with the low case, although a few whales could be affected, is not likely to have a significant effect on bowhead or gray whale populations overall.

Summary: In general, the type and duration of any behavioral response from whales due to industrial noise and the specific distance at which this occurs are dependent on the activity of the whale; the activity of the vessel; the nature of the noise received (e.g., intensity, discontinuous, or continuous); the time of the year; the opportunities for space in which whales can move away; the individual differences in whale behavior; and the site-specific differences in underwater ambient noise and other factors associated with sound propagation. The specific response of any given whale, and the distance at which it responds are dependent on how these factors combine to produce a perception of threat or nonthreat in the affected whale(s).

The effect of all industrial equipment associated with exploration on the OCS would be limited to local, short-term behavioral responses (modification of surfacing/respiratory patterns, temporary cessation of an activity, and possible course changes) in about half of the whales entering an industrial- response zone. The outer limit where these whales are likely to begin responding to industrial noise is at approximately 4 km, except for seismic-airgun arrays, which is at approximately 8 km. About half of the whales entering these zones would be expected to respond, but most of those that respond are not expected to respond until they are approximately 2 km from the source of noise (4 km from seismic-airgun noise). Behavioral responses are likely to last for several minutes but may persist for as long as an hour per whale encounter with an industrial-response zone. No change in the overall distribution of bowhead whales or other long-term effects due to noise associated with exploration are expected.

Exploratory operations would not affect the bowhead whale population in the spring, since operations would occur after bowheads have passed through the area, and the sale area is essentially outside of the spring lead system. A small number of bowhead whales are likely to encounter noise associated with the low case during their fall migration (September-November). Few gray whales are expected to encounter noise, since they tend to concentrate inshore of the Sale 126 area. Encounters with aircraft noise are not expected as long as aircraft remain at or above the response zone of 457 m.

Based on the assumption of two exploratory operations estimated for the low case, this could result in about 12.5 percent of the bowhead population (975 whales) responding to the noise. The actual rate of bowheads encountering industrial noise would vary depending on the number of whales in the bowhead population, the number of exploratory operations per year, annual ice conditions, and unknown factors associated with migratory path selection within the greater fall migratory corridor. Whales that respond to exploration noise are likely to exhibit only local, short-term responses. No significant effect on the timing or route of the spring or fall bowhead or gray whale migrations is expected.

Conclusion: The effect of the low case on bowhead and gray whale populations is expected to be very low.

b. Arctic Peregrine Falcon: Due to the low level of activity associated with the low case, and the very low level of expected interaction with oil and gas activities, the arctic peregrine falcon population is not likely to be affected by the low case. Consequently, the low case is not likely to have a significant effect on the arctic peregrine falcon population.

Conclusion: The effect of the low case on the arctic peregrine falcon population is expected to be very low.

CONCLUSION: The effect of the low case on endangered and threatened species is expected to be VERY LOW.

8. Effects on Belukha Whale: This analysis addresses the effect of industrial noise on the belukha whale. Although belukhas tend to respond to sounds of higher frequencies than bowhead and gray whales, the likely effect of industrial noise on belukha whales is expected to be similar to that discussed for bowhead and gray whales; hence, that information (see Sec. IV.B.7.a(1)) is incorporated by reference. This analysis assumes that whales do not respond (in the adverse sense) to noise of any kind until it is perceived as a threat, even though the noise may be heard at great distances. This analysis also assumes that a threat is perceived when whales begin to respond to the source of noise, and that this distance from the source of noise represents the outer limit of the response zone. Hence, for the purposes of this discussion, an encounter with industrial noise occurs when whales enter the zone where they begin to respond to industrial noise (see Sec. IV.B.7.a concerning response zones).

Belukha whales are common inshore of the Sale 126 area, but many (primarily in the fall) occur inside the sale area as well. During the spring (April-May), some belukhas migrate from the Bering to the Beaufort Sea, while others spend the summer months in the bays and estuaries of Kotzebue Sound and along the northern Chukchi Sea coast. In the fall (September-October), many belukhas in the Beaufort Sea migrate through the sale area on their way to the Bering Sea. Since spring/summer belukhas tend to be concentrated inshore of the sale area, they are not likely to be in areas where exploratory operations are ongoing. In the fall, when belukhas are migrating through the sale area, they are widely dispersed but may encounter exploratory operations infrequently.

For these reasons, and since the low case involves only two exploration operations, belukhas are not likely to encounter exploratory operations often, although those in the vicinity of an exploratory operation may hear industrial noise. Belukhas encountering exploratory operations are likely to experience the same local, short-term effects discussed for other whales. Any effect of industrial noise on belukha whales is expected to be minimal. Consequently, industrial noise associated with the low case is not likely to have a significant effect on belukha whale populations.

CONCLUSION: The effect of the low case on the belukha whale population is expected to be VERY LOW.

9. Effects on Caribou: Under the low case, onshore development associated with support activities would be minimal. A shorebase constructed near Wainwright (15-20 hectares) would result in some noise (probably very low effects) on the caribou range. Since the estimated resources could not be developed economically, no transportation facilities would be built on the range of the Western Arctic herd. Thus, caribou would not be disturbed by vehicle and air traffic associated with construction beyond that required for a shorebase. Caribou using shore areas for insect relief in summer could be disturbed by air traffic from a shorebase to drilling units, but this is likely to involve only a very small proportion of the herd.

CONCLUSION: The effect of the low case on caribou is expected to be VERY LOW.

10. Effects on the Economy of the North Slope Borough:

a. Employment: In the low case, the gains in direct employment from Sale 126 would result from exploration activities. These gains would be negligible relative to the North Slope Borough (NSB) economy as a whole. The estimated direct industry employment for the low case would be approximately 190 jobs in the year 1992. Most of these jobs would be offshore. All of these jobs would be filled by commuters who would be present at the work sites about half of the days in the year. Most workers would commute to permanent residences in the following three regions of Alaska--Southcentral; Fairbanks; and, to a lesser extent, the North Slope. Some workers would commute to permanent residences outside of Alaska. Because of the low overall employment generated in this case, and because most of this employment would go to commuters from outside the region who would be living and working either offshore or at the Prudhoe Bay enclave, the effect on employment in the NSB would be insignificant.

b. NSB Revenues and Expenditures: The low-case projections are expected to have an insignificant effect on NSB property taxes and expenditures. No significant increases in onshore facilities related to oil exploration are expected. The NSB only has the ability to tax onshore facilities.

c. Subsistence-Harvest Disruptions: Effects on subsistence-harvest patterns of the six communities near the Sale 126 area are expected to be very low as a result of exploration activities.

CONCLUSION: In the low case, the effect on the economy of the NSB is expected to be VERY LOW.

11. Effects on Subsistence-Harvest Patterns: Section III.C.2(1) describes the subsistence-harvest patterns characteristic of Inupiat communities adjacent to the Sale 126 area, (2) outlines the important seasonal subsistence-harvest patterns by community and resource, (3) provides figures depicting the areal extent of each community's general subsistence-harvest area and the timing of the harvests, and (4) presents estimated quantities of subsistence resources harvested. Sections III.C.2 and III.C.3 demonstrate that significant aspects of each community's economy, culture, social organization, normative behavior, and beliefs interact with and depend on patterns of subsistence harvest. The sociocultural aspects of effects on subsistence are addressed in Section IV.B.12.

This section analyzes the effects of the low case on the subsistence-harvest patterns of the communities close to the Sale 126 area. This analysis is organized by community and resource and discusses effects on subsistence-harvest patterns that may occur as a result of oil and gas exploratory activities carried on in the Chukchi Sea. The Sale 126 area includes or lies adjacent to much of the marine-subsistence-resource areas of Barrow, Wainwright, Point Lay, and Point Hope. Because the scenario associated with the low case is a "no-discovery case" that centers wholly on exploration-only activities, this analysis omits any discussion of effects on inland fisheries and caribou. As there would be neither resource production nor construction of the infrastructure associated with production, the effects of the low case on caribou and fishes for all communities under review would be very low. Further, because the polar bear is hunted almost entirely during that part of the year in which ice is prevalent, it is unlikely that the low case would have any effect on the harvest of that species because drilling activities associated with this case would occur entirely within the open-water season. Therefore, it is assumed that the effect of the low case on the polar bear would be very low for all communities under review.

a. Barrow: A portion of Barrow's subsistence-harvest area lies within the Sale 126 area. Barrow residents use Peard Bay to some extent for harvesting marine resources. The harvesting of marine resources in Peard Bay would be affected by construction of a small industry-support shorebase and the noise and traffic associated with its construction and operation. Barrow's belukha harvest area extends only to the northeastern edge of the Peard Bay area--too distant for noise, traffic, and construction activities to affect belukha whaling on more than a short-term basis at maximum. Given the short-term duration of activities associated with the low case, it is unlikely that the harvest would be affected at all. Therefore, the overall effect on Barrow's belukha-subsistence harvest as a result of activities associated with the low case is expected to be very low.

Bearded and hair seals are harvested by Barrow residents as far south as Peard Bay. Some disruption of the seal harvest could occur during the open-water season as a result of industry's construction and drilling-related activities. However, Peard Bay represents only a portion of Barrow's overall seal hunting area; and seal harvests occur throughout the year. Thus, it is likely that Barrow's seal harvest would experience very low effects. In contrast, the walrus is harvested during a very short period from early June through late August; and a reduction of the harvest during this period would result in a reduction of the entire harvest. Activities related to construction, platform emplacement, and offshore support-vessel traffic may cause some localized disruption of the walrus harvest; however, while the harvests might be affected, the harvest would not be greatly reduced--a low effect.

The bowhead whale is a preferred meat as well as a culturally important subsistence resource in Barrow (as well as Wainwright, Point Hope, and Nuiqsut). Noise and traffic would not affect Barrow's bowhead whaling because the exploration platforms, support vessels, and traffic related to construction would not be in the vicinity of the Barrow bowhead-harvest area. Further exploratory efforts are scheduled to occur between July and the end of August; in this timeframe the bowheads are usually not in the sale area. In regard to the noise effects of icebreakers that may operate in the Chukchi Sea during the bowhead migration, startle effects are more likely to occur to bowheads that approach or are closely approached by icebreakers that are commencing ice-management operations. In such instances some bowheads are expected to respond with short-term avoidance behavior; this level of reaction is expected to have only a very low effect on subsistence-harvest activities. Therefore, the overall effects of the low case are likely to be very low. For more discussion on the effects of noise on bowheads, see Section IV.B.7.

Conclusion: The effect of the low case on Barrow's subsistence-harvest patterns is expected to be very low.

b. Wainwright: A small shorebase that will support exploratory activities would be scheduled for construction at Point Belcher, in the vicinity of Peard Bay. Peard Bay is an important subsistence-harvest area for Wainwright for all subsistence resources except the bowhead whale, which is harvested off Point Belcher. The concentration of noise and traffic in the Peard Bay area is likely to cause more effects on the marine-subsistence harvest of Wainwright than in the other communities affected by the low case. Belukha whales are available to Wainwright hunters primarily during late spring (into June); while there may be some overlap due to the navigational requirements of the exploration drilling vessel, the primary belukha hunting season and the period of exploratory drilling would not coincide. Since the drilling season is assumed to begin in June and end in August, the belukha harvest should be virtually unaffected. Consequently, the effect of the low case on belukha whales is expected to be very low.

The harvest of bearded and hair seals is not expected to be appreciably affected in the low case action because these seals are available for harvest throughout the year. Given the scale of activities associated with the low case and the seasonal focus of activities, the seal harvest should be only minimally disturbed. Consequently, the effects of the low case on this resource are expected to be very low. Walrus, however, are harvested only during the summer months; thus, it is possible that traffic and noise associated with offshore operations could disturb and potentially limit the walrus harvest. The potential for disturbance would be limited by the scale of exploration activities. Offshore logistic support for the two drilling rigs would not be great, and the Point Belcher support facility would primarily provide air support. Therefore, the effects of the low case on walrus are expected to be very low.

The discussion of effects of the low case on Barrow stated that effects on the bowhead whale harvest would be very low because the bowhead spring migration and the exploratory drilling season would not overlap. A similar conclusion can be reached for the Wainwright bowhead-harvest area; therefore, the effects of the low case on bowhead whales are expected to be very low.

Conclusion: The effect of the low case on Wainwright's subsistence-harvest patterns is expected to be very low.

c. Point Lay: The community of Point Lay lies well away from Peard Bay and Point Belcher--the geographical focuses of activity related to Sale 126. It is unlikely that activity generated by the low case, due to its scale and its distance, would have any effect on the subsistence resources of Point Lay. Consequently, the effect of the low case on all resources utilized is expected to be very low.

Conclusion: The effect of the low case on Point Lay's subsistence-harvest patterns is expected to be very low.

d. Point Hope: Much of Point Hope's subsistence-harvest area lies adjacent to but not within the proposed Sale 126 area. Because of the distance of the Point Hope subsistence-harvest areas from Peard Bay, it is unlikely that any of the community's resource harvests would experience any effects from this sale. Further, as mentioned in previous discussions in this section, the bowhead whale hunts would occur during a period somewhat before and after exploratory drilling.

Conclusion: The effect of the low case on Point Hope's subsistence-harvest patterns is expected to be very low.

e. Atqasuk: The interior community of Atqasuk harvests marine resources in conjunction with Barrow; therefore, those effects that accrue to Barrow's subsistence harvests are also expected to affect Atqasuk's.

Conclusion: The effect of the low case on Atqasuk's subsistence-harvest patterns is expected to be very low.

f. Nuiqsut: The community of Nuiqsut lies well outside the sale area. The only potential effect the low case could have on Nuiqsut's subsistence-harvest patterns is on the bowhead whale. The migratory pattern of the bowhead is such that, in most years, the whales would have migrated east past Nuiqsut before drilling starts and west after drilling has concluded.

Conclusion: The effect of the low case on Nuiqsut's subsistence-harvest patterns is expected to be very low.

CONCLUSION: The effect of the low case on subsistence-harvest patterns is expected to be VERY LOW for all communities.

12. Effects on Sociocultural Systems: The effects analyses for the low case on the sociocultural systems of the Sale 126 area consider (1) industrial activity, (2) induced demographic changes, (3) and degree and opportunity for interaction between industry work bases and existing communities. These

three factors are examined in relation to their effects on the subsistence-harvest patterns and sociocultural systems of the six communities affected by proposed Sale 126. In regard to industrial activity, the low case is distinguished by a "no-discovery" scenario. The effects of this no-discovery scenario on the subsistence-harvest patterns of the subject communities are analyzed in Section IV.B.11, which concludes that the low case would have very low effects on the subsistence-harvest patterns of the six communities affected by Sale 126.

In regard to demographic change, a review of Section IV.B.10 indicates that local and regional population and employment would be little affected by the subject scenario. Less than 10 North Slope residents would be employed as a result of exploration activities, and these jobs would be only indirectly related to oil field operations. The supply-support base for offshore operations would be an enclave that offers limited potential for employment of North Slope residents. This enclave would not be connected by road to any community; however, this would not preclude access by snow machine. Enclave workers would be limited in their travel opportunities by the availability of snowmachines, the requirements of their jobs, and company policy. On the other hand, the general public probably would not be allowed access to the exploration base except by appointment. Construction of an ice road from Wainwright to the Point Belcher enclave is unlikely. The only economic purpose of such a road would be to move heavy equipment, and it is very probable that industry would construct a landing strip at Point Belcher to facilitate the movement of both men and material. Thus, the potential effects of the low case on the demographic and cultural attributes of the affected North Slope communities would be very low.

CONCLUSION: The effect of the low case on sociocultural systems of Barrow, Wainwright, Point Hope, Point Lay, Atqasuk, and Nuiqsut is expected to be VERY LOW.

13. Effects on Archaeological Resources: The two categories of prehistoric and historic archaeological resources identified in the Sale 126 area are offshore resources and onshore resources. Archaeological resources in the sale area could be affected by: (1) low-case offshore exploration, (2) recreational visits to archaeological-resource sites by OCS-related employees employed directly by oil companies and indirectly by many types of support companies, and (3) other oil-related activities.

a. Effects on Offshore Resources: Archaeological resources in the sale area could be affected by low-case offshore exploration. No comprehensive baseline study exists for the area for prehistoric or historic resources. Because of this, it is perhaps most useful to refer to areas as either "having potential" for archaeological resources or "not having potential." The areas that would have a potential for containing prehistoric archaeological resources would be those shoreward of the 40-m bathymetric contour, which would have been exposed as dry land at 12,000 B.P., the earliest undisputed date for the presence of prehistoric man in the Arctic. Areas that have been documented as having been severely affected by ice gouging or other geological processes would be considered as not having prehistoric archaeological potential. To date, only ice gouging has been documented in published sources on the Chukchi Sea as an erosional force in the study area that can be mapped. Therefore, prehistoric archaeological resources could occur on blocks located in water depths of 40 m or less and where ice gouging either is not severe or does not extend down below the Holocene sediments (see Appendix G, MMS Prehistoric Resource Analysis). However, even if only one resource existed in this part of the lease-sale area, low-case activities such as anchoring drill rigs and supply barges or other vessels (Table II-A-1) could, by definition (Table S-2), have some effect on the resource. Overall, the effects of the low case on offshore prehistoric resources are expected to be low.

In addition to prehistoric resources, there are also known historic shipwrecks in the Chukchi Sea. In the deeper waters offshore of Point Belcher, about 40 ships went down in the 1800's (See Appendix G, Shipwreck Update Analysis). Several factors affect the accuracy of shipwreck locations, making it somewhat difficult to pinpoint the location of even a known shipwreck without a survey. These factors include: inaccuracy in the original reported location, the possibility that the shipwreck has moved due to natural shelf processes, and the fact that many shipwrecks break up and scatter over time. Activities associated with exploration platforms near Point Belcher, where about 28 ships went down in 1871, could have a moderate effect on historic resources. However, surveys on blocks where the archaeological stipulation is invoked could locate evidence of shipwrecks exposed at the seafloor prior to lease activities, thereby making avoidence possible. Such survey evidence of whaling-fleet shipwrecks would have a positive effect by increasing archaeological knowledge of whaling (1800 to early 1900's), which was of great importance to the U.S. economy.

b. Effects on Onshore Resources: One of the important onshore archaeological sites near the sale area is the Shipwreck City Historic Site. Over 40 ships were wrecked somewhere offshore of Point Belcher in September 1871 and September 1876; and the 1,219 survivors (including families of crew members) of the wrecks on September 7, 1871, spent the night at the onshore location now referred to as the Shipwreck City Historic Site (State of Alaska, DNR, 1990). Activities associated with the offshore exploration facilities projected for the low case (Table II-A-1) could disturb these resources and their in situ context if increased visits were made to archaeological sites by offshore personnel and their families. Personnel and equipment transported over archaeological sites during cleanup-training runs could cause low effects on sites located in OSRA Land Segments 14 through 24 (Fig. IV-A-1).

Concentration areas for bowhead and belukha whales, seals, fishes, and migratory birds near Point Hope and Wainwright are also likely places of prehistoric human habitation because of their location near food and freshwater (Kotani and Workman, 1980). The effects of the low case on the Ipiutak Historic Site are expected to be low due to the site's location at the boundary of the Sale 126 area. The effects of the low case on the Cape Krusenstern National Monument and the Bering Land Bridge National Preserve are expected to be very low due to their locations outside of the area of activity related to Sale 126.

CONCLUSION: The effect of the low case on offshore and onshore archaeological resources, both prehistoric and historic, is expected to be LOW.

14. Effects of Land Use Plans and Coastal Management Programs: Most activities that would result from Sale 126 would require some local or State determinations with respect to the NSB Land Management Regulations (LMR's) or the Alaska Coastal Management Program (ACMP), as amended by the North Slope Borough Coastal Management Program (NSBCMP). Potential conflicts with the policies of these programs are assessed on the basis of the effects determined in the previous sections (Secs. IV.B.1 through IV.B.13).

a. NSB Comprehensive Plan and Land Management Regulations: These regulations apply only to activities that occur within the NSB. In the low case, no development is assumed in order to support offshore exploration activities. As a result, no conflict with land use or the land use plan for the NSB is anticipated.

b. Alaska Coastal Management Program: Coastal management policies apply to the lease sale and to all activities that occur within the coastal boundaries of the NSB or that directly affect the use and resources of the coastal zone. However, this analysis of potential conflicts between the activities assumed to occur and the ACMP is not a consistency determination pursuant to the Coastal Zone Management Act of 1972, as amended, nor should it be used as a local planning document. It is highly unlikely that all the hypothesized events would occur as assumed in this EIS. Changes made by lessees as they explore for petroleum products from leases offered in this sale could affect the accuracy of this assessment.

Noise and disturbance were identified in Sections IV.B.1 through IV.B.13 as the primary source of conflict. Birds and marine mammals would exhibit avoidance or startle responses in reaction to the disturbance. If this occurred, NSBCMP Policy 2.4.4(a) (NSBMC [NSB Municipal Code] 19.70.050.I.1) requires that "vehicles, vessels, and aircraft. . .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." Although significant disturbance is not anticipated, horizontal and vertical buffers may be required to avoid conflict with this policy.

Noise and disturbance also could disrupt the bowhead whale harvest. If the harvest for any of the communities were disrupted in a year when the whaling season was short due to weather, the possibility exists that the harvest would be unavailable for that season. The statewide standard for subsistence guarantees opportunities for subsistence use of coastal areas and resources (6 AAC 80.120). Subsistence uses of coastal resources and maintenance of the subsistence way of life are primary concerns of the residents of the NSB. NSBCMP Policy 2.4.3(b) (NSBMC 19.70.050.B) states that "offshore drilling and other development within the area of bowhead whale migration during the migration seasons shall not significantly interfere with subsistence activities nor jeopardize the continued availability of whales for subsistence purposes." Conflict with this policy is unlikely because exploration drilling in the Chukchi Sea most likely would occur during the open-water season. Subsistence hunting for bowhead whales should be completed by that time.

CONCLUSION: For the low case, the potential for conflict with land use plans and coastal management programs is expected to be LOW.

15. Effects on Wetlands: Under the low case, 25 to 30 hectares of wetlands would be filled in with gravel for the exploration-support base assumed to be developed and located at Wainwright. No oil development or onshore-pipeline-road corridor would be developed under the low case.

CONCLUSION: The effect of the low case on wetlands is expected to be minimal.

C. Alternative I--Base Case

Alternative I would offer for leasing about 4,319 blocks of the Chukchi Sea Planning Area, with the base case representing the likely amount of unleased oil resources (assuming hydrocarbons are present) assumed to be leased, discovered, and developed and produced as a result of Sale 126 (see Appendices A and B). The MMS estimates the oil resources to be about 1,610 MMbbl for the base case. The types and levels of activities associated with the base case include (1) drilling of 39 exploration and delineation wells (1992-1998), (2) installing 6 production platforms (2000-2002) and drilling 214 production and service wells (2000-2004), (3) installing 200 mi of offshore pipeline and 400 mi of onshore pipeline (1999-2001), and (4) producing 1,610 MMbbl of oil (2002-2020). A more detailed discussion of the types and levels of activities associated with the base case is presented in Section II.B.2.a.

This section presents those analyses of the potential effects that the base case for Alternative I might have on the physical and biological resources, sociocultural systems, and programs in and adjacent to the planning area.

1. Effects on Air Quality: A discussion of air quality regulations and procedures can be found in Section IV.B.1.a. Under the base case, the year of peak emissions from exploration would be from drilling 6 exploration and 4 delineation wells drilled from 5 rigs. Peak emissions from development and production would include concurrent drilling of 80 production wells and 135 MMbbl of oil produced from 6 platforms and transported by pipeline. Table IV-C-1 lists estimated uncontrolled-pollutant emissions for the peak-exploration, peak-development, and peak-production years. Under the Federal and State of Alaska PSD regulations, since the estimated annual uncontrolled NO_x emissions for peak exploration, peak development, and peak production would exceed 250 tons per year, the lessee would be required to control NO_x emissions through application of BACT to emissions sources to reduce NO_x emissions (Table IV-B-2). In addition, the lessee would have to employ BACT to emission sources to reduce emissions of all regulated pollutants during exploration and CO, TSP, and VOC during development and production because these emissions would exceed the de minimis levels. An air quality analysis performed using the OCD Model for air pollutants emitted for exploration under the base case due to Sale 126 showed that the maximum NO_x concentration, averaged over a year, would be 1.02 and 0.46 μ/m^3 for peak exploration and production, respectively, at the shoreline: 4.1 and 1.8 percentiles of the available Class II increment for NO_X (Table IV-C-2).

Other Effects on Air Quality: Other effects of air pollution from OCS activities and other sources on the environment not specifically addressed by air quality standards include the possibility of damage to vegetation and acidification of coastal tundra, as discussed in Sections III.D.7 and IV.G.7 of the Diapir Field Lease Offering (Sale 87) FEIS (USDOI, MMS, 1984a) and in Olson (1982). This information is incorporated by reference, and a summary pertinent to Lease Sale 126 follows. Effects may be short-term (hours, day, or weeks), long-term (seasons or years), regional (on the scale of half or more of the North Slope of Alaska), or local (nearshore only). The analysis for Sale 87 was conducted on the basis of emissions occurring 5 km (3 mi) from shore. For Lease Sale 126, the nearest distance would be approximately 18.5 km (11.5 mi), allowing dispersion of pollutants. Consequently, the likelihood of either regional or local effects is reduced.

A significant increase in ozone concentrations onshore is not likely to result from development and production under the base case. Photochemical pollutants such as ozone are not emitted directly but rather form in the air from the interaction of other pollutants in the presence of sunshine and heat. Although sunshine is present 24 hours each day during the summer in the sale area, temperatures remain relatively low (Brower et al., 1988). Also, activities under the base case are well offshore and separated from each other, diminishing the combined effects from sale-related activities and greatly increasing atmospheric dispersion of pollutants before they reach shore.

Olson (1982) reviewed the body of knowledge that demonstrates the known high susceptibility of fruticose lichen, an important component of the coastal tundra ecosystem, to sulfurous pollutants. There is evidence that SO_2 concentrations as low as 12.0 $\mu g/m^3$ for short periods of time can depress photosynthesis in several

Table IV-C-1
Estimated Uncontrolled Emissions for the Chukchi Sea Sale 126 Base Case
(metric tons per year)

	Pollutant[1/]				
	CO	NO_x	TSP	SO_2	VOC
Base Case[2/]					
Peak Exploration Year	4,301	8,704	933	316	299
Peak Production Year	3,037	4,085	234	31	765

Source: USDOI, MMS, Alaska OCS Region. Computed from factors in Form and Substance, Inc., and Jacobs Engineering Group, Inc., 1983.

[1/] CO = Carbon Monoxide
NO_x = Nitrogen Oxides (assumed predominately NO_2)
TSP = Total Suspended Particulates (includes most particulate matter less than 10 μm in aerodynamic diameter)
SO_2 = Sulfur Dioxide
VOC = Volatile Organic Compounds (excluding nonreactive compounds such as methane and ethane)

[2/] Assumes 10 exploration wells drilled in peak exploration year and 80 production wells drilled and 135 million barrels of oil produced from 6 platforms in peak production year. Exploration drilling and production platforms are assumed to be located 18.5 km offshore of Point Lay. Peak emissions from development and production occur concurrent and are given as a sum for each phase.

Table IV-C-2
Comparison of Modeled Air Pollutant Concentrations with Regulatory Limitations
(measured in micrograms per cubic meter)

Averaging Time	PSD Class II Increment[1/]	Maximum Modeled Concentration Over Land[2/]	Air Quality Standard
Base-Case Exploration			
NO_x			
annual	25	1.02	100[3/]
24-hour			
8-hour			
3-hour			
1-hour			
Base-Case Production			
NO_x			
annual	25	0.46	100[3/]
24-hour			
8-hour			
3-hour			
1-hour			

Source: USDOI, MMS, Alaska OCS Region, 1990.

1/ Increment above ambient concentration allowed in a designated PSD area. Ambient baseline concentration for PSD not established for this area.
2/ Offshore and Coastal Dispersion Model.
3/ Annual arithmetic mean.
4/ Annual geometric mean.

lichen species, with damage occurring at 60 $\mu g/m^3$. Also, 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 on the North Slope, other than near Prudhoe Bay, the ambient concentrations at most locations may be assumed to be near the lower limits of detectability. The most recent ambient-measured SO_2 concentrations for the Prudhoe Bay area are considerably less than allowed by standards (including PSD limitations) (see Table III-A-2). Because of the distance of the proposed activities from shore, attendant atmospheric dispersion, and low existing levels of onshore pollutant concentrations, the effect on vegetation under the proposal is expected to be low.

The Sale 87 analysis of acidification of coastal tundra was conducted on the basis of emissions occurring 5 km from shore. A sulfur budget has not been compiled for the arctic tundra ecosystem. Such a budget is necessary to determine potential contributions to tundra acidification from acid deposition of pollutants. However, Rahn (1982) estimated a total input of 14 kg/km^2 over the Arctic Ocean with a factor-of-3 uncertainty. An approximation of maximum deposition from the base-case SO_2 annual concentration can be made from OCD model calculations, assuming a constant rate of deposition. The estimate shows annual deposition of 0.1 kg/km^2/year. Deposition rates of 670 kg of sulfur/km^2/year are associated with damage such as fish kills, lower ecosystem productivity, and die-out of plant species in susceptible areas. In addition, the sulfur-deposition estimate for the base case assumes a constant rate of deposition over the land area, which overestimates the deposition. Because the concentrations and deposition of sulfurous pollutants would be well below the level of significant acidification of the coastal tundra, even on a local basis, the effect of acidification is expected to be very low.

Effects of Accidental Emissions: Accidental emissions result from gas blowouts, evaporation of spilled oil, and burning of spilled oil. The number of OCS blowouts--almost entirely gas and/or water--has averaged 3.3 per 1,000 wells drilled since 1956 (Fleury, 1983). The data show no statistical trend of a decreasing rate of occurrence. The blowout rate has actually averaged somewhat higher since 1974, at 4.3 per 1,000 wells drilled; but the difference between the post-1974 period and the longer 1956-to-1982 record is statistically insignificant.

A gas blowout could release 20 metric tons per day of gaseous hydrocarbons, of which about 2 metric tons per day would be nonmethane hydrocarbons classified as VOC. Based on the assumption of the Poisson distribution, the probability of experiencing one or more blowouts in drilling the 214 wells projected for the base case would be 51 to 60 percent (USDOI, MMS, 1990b). If a gas blowout occurred, it would be unlikely to persist more than 1 day; and it would very likely release less than 2 metric tons of VOC. Since 1974, 60 percent of the blowouts have lasted 1 day or less; and only 10 percent have lasted more than 7 days. A gas blowout would release up to 0.03 metric tons of hydrogen sulfide gas per day (Stephens, Braxton, and Stephens, 1977). Hydrogen sulfide and other gases from blowouts could be extremely harmful to workers on or near the drilling rig. At farther distances or onshore, no significant effects would result because of rapid dispersion and oxidation of hydrogen sulfide to sulfur dioxide (forming up to 9.09 metric tons of sulfur dioxide/day). Because most blowouts last 1 day or less and the total amount of sulfur dioxide from blowouts would be much lower than for operations, sulfur-dioxide emissions over the life of the field are expected to have a very low effect onshore.

Oil spills are a second accidental source of gaseous emissions. The average size of a $\geq$ 1,000-bbl OCS spill are 18,000 bbl for OCS platform spills and 25,000 bbl for OCS pipeline spills. Modeling predictions of hydrocarbon evaporation (Payne et al., 1984a,b, 1987) from a 22,000-bbl slick over 30-day periods near Prudhoe Bay estimate that between 4,049 and 4,189 bbl--or 565 to 585 metric tons--of hydrocarbon would evaporate. Because approximately 10 percent of gaseous hydrocarbons are nonmethane VOC, between 56.5 and 58.5 metric tons of VOC would be lost to the atmosphere. The movement of the oil slick during this time would result in lower concentrations and dispersal of emissions over an area several orders of magnitude larger than the slick itself. Under the base case, the most likely number of spills of $\geq$ 1,000 bbl is two. Smaller spills of <1,000 bbl occur more frequently than larger spills. The number of small spills projected for the base case is 380, totaling 5,300 bbl over the life of the field. Evaporations from these spills could release an additional 19 metric tons of VOC over the projected 30 years of exploration and production for the proposed sale.

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.

Burning affects 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 (Table IV-C-3). If an oil spill is ignited immediately after spillage, the burn can 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 injects about 10 percent of the burned crude oil as oily soot, plus minor quantities of other pollutants, into the air (Table IV-C-4). 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 (see Evans et al., 1987). Clouds of black smoke from a 360,000-bbl oil-spill tanker fire 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 two or three orders of magnitude smaller do not appear to cause noticeable fallout problems. Along the TAP, 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).

Coating portions of the ecosystem in oily residue is the major, but not the only, potential air quality risk. Recent examination of polycyclic aromatic hydrocarbons (PAH) in crude oil and smoke from burning crude oil indicate that the overall amounts of PAH change little during combustion, but the kinds of PAH compounds present do change. Benzo(a)pyrene, which is often used as an indicator of the presence of carcinogenic varieties of PAH, is present in crude oil smoke in quantities approximately three times larger 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 more than 250 $\mu g/m^3$ to be a health hazard for bronchitis.

Over the life of oil exploration and production in the sale area, oil spills of ≥ 1,000 bbl could be accidentally or deliberately set on fire. Predominant winds in the sale area would transport smoke plumes generally west (offshore) or southwest (parallel to the coast). Long-term monthly wind records for the sale area compiled by NOAA and the Arctic Environmental Information and Data Center (AEIDC) show that offshore winds predominate along the U.S. Chukchi Sea coast (Brower et al., 1988). Potential contamination of the shore would be limited because exploration, development, and production activities under the proposal would be at least 18.5 km (11.5 mi) offshore, with the exception of the oil-transport pipelines. Also, large fires create their own local circulating winds--toward the fire at ground level--that affect plume motion. In any event, soot produced from burning oil spills tends to slump and wash off vegetation in subsequent rains, limiting any health effects to the very short term. Accidental emissions are, therefore, expected to have a low effect on onshore-air quality.

<u>Summary</u>: Effects from air emissions due to Sale 126 on onshore air quality are expected to be less than 5 percentiles of the maximum allowable PSD Class II increments and would not make the concentrations of criteria pollutants in the onshore ambient air approach the air quality standards. Consequently, a very low effect on air quality with respect to standards is expected. Principally because of the distance of emissions from land, the other effects of air-pollutant concentrations at the shore due to exploration and production or accidental emissions would not be sufficient to harm tundra vegetation on a more than short-term basis, even locally. A light, short-term coating of soot over a localized area could result from oil fires.

Table IV-C-3
Emissions from Burning 20 Metric Tons of Natural Gas per Day during a Blowout
(metric tons)

	Duration of Blowout		
	1 day	4 days	7 days
Total Suspended Particulates	0.009	0.04	0.06
Sulfur Dioxide	0.0003	0.001	0.002
Volatile Organic Compounds	0.004	0.02	0.03
Carbon Monoxide	0.009	0.04	0.07
Nitrogen Oxides	0.04	0.15	0.26

Source: Calculated from emission factors in Frazier, Maase, and Clark, 1977.

Table IV-C-4
Emissions from Burning Crude Oil
(metric tons)

	Size of Burn	
	10,000 bbl	100,000 bbl
Total Suspended Particulates[1/]	130	1,300
Sulfur Dioxide[2/3/]	86	860
Volatile Organic Compounds[2/]	0.5	5
Carbon Monoxide[4/]	89	890
Nitrogen Oxides[4/]	3.8	38

Source: USDOI, MMS, Alaska OCS Region, 1990.

1/ Estimated as 10 percent of the total burn, less residue (Evans et al., 1987).
2/ Burning assumed to be the same as residual oil firing in industrial burners. Emissions calculated from factors in Frazier et al. (1977).
3/ Assumes a sulfur content of 2.9 percent.
4/ Emissions calculated from factors in Evans et al. (1986, 1987).

CONCLUSION: The effect of the base case on air quality as a result of exploration and development and production is expected to be VERY LOW.

2. Effects on Water Quality: A wide range of water quality degradation could occur as a result of oil activities associated with the base case. Degradation could result from discharges, construction activities, and accidental hydrocarbon discharges due to spills, blowouts, and chronic small-volume spills. These agents and their generic effects are described in Section IV.B.2 of the Sale 109 FEIS (USDOI, MMS, 1987b) and are incorporated by reference. In the context of this analysis, LOCAL refers to an area of less than 1,000 km^2 while REGIONAL refers to an area of at least 1,000 km^2.

a. Discharges: Exploration and production platforms would be expected to discharge bulk quantities of drilling muds and cuttings. During production, formation waters may also be discharged. Other discharges (see Sec. IV.B.2) are not expected to be significant pollutant sources (USEPA, 1989). Discharges from platforms would be regulated through a general NPDES permit from the EPA (see Sec. IV.B.2).

Drilling Muds and Cuttings: The quantity of muds and cuttings discharged into the environment is dependent on the number of wells drilled and the depth of each well. During the exploration period (1992-1998), about 25,740 dry short tons of muds and 33,150 short tons of cuttings could be discharged. During the development period (2000-2004), from 23,540 to 149,800 dry short tons of muds and 197,950 short tons of cuttings would be discharged. For information on the fate of discharged muds, see Section IV.B.2.a.

Federal water quality regulations allow a 100-m-radius mixing zone for initial dilution of effluent. At the edge of the mixing zone, acute (1-hour average concentration) water quality criteria must be met. Acute criteria are applicable to instantaneous releases or short-term discharges of pollutants such as drilling mud discharges (see Sec. IV.B.2.a). Table IV-B-3 compares the acute, total-recoverable-marine-water quality criteria with predicted total-, particulate-, and dissolved-trace-metal concentrations at the edge of the 100-m-radius mixing zone (see Sec. IV.B.2.a and Appendix J). Direct estimates or measurements of total-recoverable concentrations of metals in discharged drilling muds are not available (Appendix J). The dissolved concentrations of all trace metals considered by the EPA to be the best estimator of the total-recoverable concentration are below the acute marine-water quality criteria, at 100 m from the discharge point. Long-term leaching of metals from deposited muds would be slight and no water quality criteria are expected to be violated (USEPA, 1989).

During exploration and delineation activities, five rigs could be present at any time; thus, a maximum of 0.15 km^2 of the sale area would have impaired water quality during the drilling periods (1992-1998). This impairment would exist only during periods of actual discharge and would rapidly dissipate upon completion. During production, six platforms with twelve drilling rigs would be in operation. Assuming that maximum discharge rates are limited by EPA to the same extent during production as during exploration, instantaneous discharges would be of the same order of magnitude in production as in exploration. About 0.18 km^2 of the sale area could have impaired water quality during the production-well-drilling period (2000-2004). The effect on local and regional water quality is expected to be very low.

Formation Waters: Formation waters are produced from wells along with the oil. These waters contain dissolved minerals and soluble fractions of the crude oil. Process equipment installed on the production platform separates the formation water from the oil and treats it for disposal. The salinity usually ranges from 1 to 250 parts per thousand ($^{\circ}/_{\circ\circ}$). (Seawater has an average salinity of $35^{\circ}/_{\circ\circ}$.) Oil and grease concentrations in such waters are limited by EPA to a maximum of 72 mg/l (72 ppm) with a maximum monthly average of 48 mg/l (48 ppm). The EPA-approved analytical procedures used to measure oil and grease exclude lower-molecular-weight hydrocarbons (less than Cl4), which pose most of the risk to the biota (NRC, 1985). The National Research Council has estimated that formation waters average 20 to 50 ppm of lower-molecular-weight hydrocarbons and 30 ppm higher-molecular-weight hydrocarbons. In Alaska, treatment facilities for State fields in Cook Inlet discharge 6.6 to 21 ppm total aromatic hydrocarbons into

Cook Inlet (51 FR 35460).

Over the life of the field, the volume of formation waters produced is equal to 20 to 150 percent of the oil-output volume (Collins et al., 1983). As oil is pumped from a field, the ratio of water to oil being produced increases. Toward the end of the production life of a field, 10 bbl of water may be produced for every barrel of oil. On this basis, the production of formation waters over the life of the field has been estimated at 322 to 2,415 MMbbl. Over the life of the field, the mass equivalent of about 24,100 to 180,100 bbl of oil would be contained in produced waters.

Treated formation waters may be discharged into the open ocean, reinjected into the oil-producing formation to maintain pressure, or reinjected into underground areas offshore. Discharge of formation waters would require an EPA permit and would be regulated so that water quality criteria, outside an established mixing zone, would not be exceeded.

The major constraint to underground injection is finding a formation at shallow depth that (1) has a sufficiently high permeability to allow large volumes of water to be injected at low pressure and (2) can contain the water. Water cannot be injected into a formation that might otherwise be a future potable-water supply.

If formation waters were reinjected or injected into different formations, no discharges of formation waters would occur and no effect would occur. If formation waters were discharged, the effect on water quality would be local and would continue for the life of the field. The effect on local water quality is expected to be moderate, while the effect on regional water quality is expected to be very low.

b. Construction Activities: Sediment resuspension and bottom disturbances are likely to occur as a result of siting platforms, and trenching and burying subsea pipelines. The amount of disturbance associated with platform siting, anchor setting, and drilling would be minimal and restricted to the area immediately adjacent to the activity. Sediment levels would likely be reduced to background levels within several hundred meters downcurrent.

About 325 km of offshore pipelines connecting the six production platforms to an onshore pipeline to TAP Pump Station No. 2 could be emplaced between 1999 and 2001. The pipeline would have to be placed in a dredged trench at a rate of between 1 and 2 km/day during summer and possibly fall. Trenching would disturb 946 hectares (9.46 km^2) of ocean bottom in the Chukchi Sea. Dumping of dredged spoils would disturb an additional 1,892 hectares (18.92 km^2) in the Chukchi Sea, or somewhat less if the spoils were used to backfill the trench. Total volume of fill material would be 28,000,000 m^3.

The size, duration, and amount of turbidity depends on the grain-size composition of the discharge, the rate and duration of the discharge, the turbulence in the water column, and the current regime. The sea bottom over the sale area within 80 km of shore is mostly sand; farther from shore, the bottom is mostly mud (Lewbel, 1984). Turbidity typically would extend perhaps 3 km from trenching and dumping operations.

Experiences with actual dredging or dumping operations elsewhere offshore of Alaska and in other U.S. waters show a decrease in the concentration of suspended sediments with time (2-3 hr) and distance (1-3 km) downcurrent from the discharge. In dredging operations associated with artificial-island construction and harbor improvements in the mostly sandy sediments of the Canadian Beaufort Sea, the turbidity plumes tended to disappear shortly after operations ceased. Plumes generally extended from a few hundred meters to a few kilometers (Pessah, 1982). Because dredging occurs at a rate of up to 2 km/day, the extent of the turbidity plumes would be about 6 km^2 at any one time (a 1-km by 3-km area).

Prior to any discharge, site-specific discharges of dredge or fill material into U.S. waters will be evaluated in follow-up environmental documents as required. Effects on water quality from dredging (and dumping) are expected to be local and short-term. Effects on local water quality are expected to be low, while regional effects are expected to be very low.

c. Oil Spills: In addition to permitted discharges, accidental oil spills are likely to occur. Based on experiences in other OCS areas, two spills of 1,000 bbl or greater would be estimated to occur in arctic waters as a result of the base case. For analysis purposes, it is assumed that two spills of 22,000 bbl would occur. This is the average size of platform and pipeline spills (see Sec. IV.A.1.b.2). In addition to large spills, more chronic spillage of smaller volumes also is estimated. About 380 small spills totaling 5,300 barrels are estimated to occur over the life of the field.

The more volatile compounds in an oil slick, particularly aromatic volatiles, are usually the most toxic components of the slick. In situ, cold-water measurements (Payne, 1981, 1982, 1984; Payne et al., 1984a,b) have demonstrated that individual compounds in a slick decrease significantly in concentration in hours to tens of days. Because the bulk of these compounds is lost in less than 3 days, 3-day trajectories are considered an appropriate length of time to approximate the initially higher toxicity of Alaskan spills. Over the first 10 days of a spill, only about 5 percent of a slick can be expected to dissolve (Butler, Morris, and Sleeter, 1976, as cited by Jordan and Payne, 1980).

Highest dissolution rates of aromatics from a slick, and accumulation in underlying water, occur in the first few hours of a spill (Payne, 1981). By the time dissolved oil has worked down 10 m in the water column, it would have been diluted and spread horizontally over about 10,000 m. The slick would have become patchy, with the total area containing widely separated patches of oil being orders of magnitude larger than the actual amount of surface area covered by oil. At sea, the water under a slick changes continuously and aromatics do not continue to accumulate in the same water.

Water-column concentrations of hydrocarbons following spills are difficult to compare to existing State and Federal water quality standards because of ambiguity in the standards. Applicable ambient-water-quality standards for marine waters of the State of Alaska are the lower of 0.015 ppm total hydrocarbons and 0.010 ppm aromatic hydrocarbons or 0.01 of applicable continuous-flow, 96-hour LC_{50} for critical lifestages of important local species (State of Alaska, DEC, 1979). Federal standards are set at 0.01 of the applicable LC_{50}; no absolute Federal concentration standard exists for hydrocarbons (USEPA, 1986). The State of Alaska criterion of a maximum of 0.015 ppm of total hydrocarbons in marine waters--about fifteenfold background concentrations--provides the readiest comparison. This analysis considers 0.015 ppm to be a chronic criterion and 1.5 ppm--a hundredfold-higher level--to be an acute criterion.

Major spills generally result in peak, dissolved-hydrocarbon concentrations that are only locally and marginally at toxic levels. The highest concentration observed following the Argo Merchant spill was 0.25 ppm, despite the presence of 20 percent by volume of the more soluble cutting stock (NRC, 1985). Volatile liquid hydrocarbons in the Ixtoc spill decreased from 0.4 ppm near the blowout to 0.06 ppm at a 10-km distance and to 0.004 ppm at a 19-km distance from the blowout. Similarly, relative and rapid decreases were also found for specific toxic compounds such as benzene and toluene (NRC, 1985). Concentrations of volatile liquid hydrocarbons--present mostly as an oil-in-water emulsion--within 19 km of the Ekofisk Bravo blowout in the North Sea--ranged up to 0.35 ppm (Grahl-Nielsen, 1978). Lesser amounts of oil (probably less than 0.02 ppm) were detectable in some samples, at a 56-km distance, but not at an 89-km distance.

In more restricted waters during flat calm, a test spill during the Baffin Island Oil Spill Project resulted in maximum hydrocarbon concentrations in the water column of 1 to 3 ppm (Green, Humphrey, and Fowler, 1982). These concentrations were reached within 2 hours of the spill and persisted through 24 hours. No oil was detected deeper than 3 m, and the most oil and highest concentrations were in the top meter.

These concentrations of oil in the water column are relatively low because even if a slick were completely mixed into the same water mass through use of chemical dispersants, vertical--and especially horizontal--dispersion and consequent dilution would rapidly decrease hydrocarbon concentrations for all but the largest spills in several hours to a few days after spillage ceases (see Mackay and Wells, 1983).

Only a small portion of the oil from a spill would be deposited in the sediments in the immediate vicinity of the spill or along the pathway of the slick. The observed range in deposition of oil in bottom sediments following offshore spills is 0.1 to 8 percent of the slick mass (Jarvela, Thorsteinson, and Pelto, 1984). Generally, the higher percentage of deposition occurs in spills near shore, where surf, tidal cycles, and other inshore processes can mix oil into the bottom. Farther offshore, suspended sediment loads are low; and only about 0.1 percent of the crude would be incorporated into sediments within the first 10 days of a spill (see Manen and Pelto, 1984).

If the spilled oil were of a composition similar to that of Prudhoe Bay crude, about 68 percent of the spilled oil could persist as individual tarballs dispersed on the water surface after the slick disappeared. Slow photo-oxidation and biological degradation would continue to slowly decrease the residual amount of oil. Through 1,000 days, about 15 percent of the tarballs would sink, with an additional 20 percent of slick mass persisting in the remaining tarballs (Bulter, Norris, and Sleeter, 1976, as cited by Jordan and Payne, 1980). Because of the drift of the oil over distances of hundreds or thousands of kilometers during the slow process of sinking, individual, sunken tarballs would be widely dispersed in the sediments. The average levels of local or regional contamination in sediments would be insignificant.

Only if oil were mixed into the shoreline and then dispersed offshore could elevated concentrations of hydrocarbons occur locally.

Decomposition and weathering processes for oil are much slower in cold Alaskan OCS waters than in temperate OCS regions. Prudhoe Bay crude remained toxic to zooplankton in freshwater ponds for 7 years after an experimental spill, demonstrating persistence of toxic-oil fractions or their weathered and decomposition products. In marine waters, advection and dispersion would reduce the effect of any release of toxic-oil fractions or their toxic-degradation products--including those from photo-oxidation--except possibly to the isolated waters of embayments or shallow waters under thick ice, or from a fresh spill in rapidly freezing ice.

Peard Bay--the only shallow, isolated embayment within the sale area--would be the most susceptible exception. A spill in Peard Bay during a period of rapid ice growth could leach water-soluble aromatics into the sinking brine waters. In such an area, the mixing of brine waters would be restricted by both topography and the high density of the brine. The brine and any dissolved oil could flow down the bottom of the Barrow Canyon farther offshore and form a thin, intermediate-density layer at about a 100-m water depth. Stability of the stratified water mass would limit dispersion of the dissolved hydrocarbons, and high concentrations (a few ppm) could be hypothesized to persist for several years. However, oil released under such conditions (rapid ice formation) would freeze into the ice in at most 5 to 10 days, thus stopping dissolution and limiting the effect of this freezeup scenario.

The two estimated oil spills of 1,000 bbl or greater could occur in either the summer or winter seasons. Hydrocarbon concentrations following a summer open-water spill of 22,000 bbl in the Chukchi Sea would be expected to decline rapidly in the first 30 days following the spill. The average hydrocarbon concentration after 3 days in the top 10 m of the water column below the discontinuous slick would be 0.16 ppm. The discontinuous slick would cover 57 km^2 after 3 days. The average concentration, in the top 10 m of the discontinuous slick, would be expected to be 0.09 ppm after 10 days and 0.04 ppm after 30 days following the spill (Appendix L: Table L-2). The mean area of the discontinuous slick would reach 260 km^2 after 10 days and 1,100 km^2 after 30 days (Appendix L: Table L-1).

A spill occurring in the winter season would be frozen in the ice and would move with the ice for the remainder of the winter. Spills in first-year ice would melt out in late spring or early summer. Spills in multiyear ice would melt out later in the summer or in subsequent summers. Spills released from the ice would be relatively unweathered and would have the characteristics of fresh oil. Before the oil was released from the ice, the contaminated ice could drift for hundreds of kilometers. A 22,000-bbl meltout spill in the Chukchi Sea (see Sec. IV.A.) would have the following hydrocarbon concentrations: 0.03 ppm after 3 days;

0.05 ppm after 10 days; and 0.04 ppm after 30 days (Appendix L: Table L-2). The discontinuous slick size would cover from 1,400 km^2 after 3 days to 2,200 km^2 after 30 days (Appendix L: Table L-1).

Sustained degradation of water quality to levels above State and Federal criteria from hydrocarbon contamination is unlikely. Hydrocarbon concentrations from two oil spills of greater than 1,000 bbl could exceed the chronic criterion of 0.015 ppm total hydrocarbons on at least several thousand square kilometers for a short period of time. Concentrations above the acute criterion (1.5 ppm) are not anticipated. The persistence of individual oil slicks would be short-term (less than 1 year), but the slick--intact and unweathered in the pack ice--could drift hundreds of kilometers. The 380 small spills under 1,000 bbl estimated to occur over the life of the field would result in local chronic contamination. Effects of oil spills on water quality are expected to be low both locally and regionally.

Summary: In the base case, water quality in the Chukchi Sea would be affected by platform discharges (muds and cuttings and formation waters), construction activities (drilling, and platform and pipeline placement), and oil spills.

Discharges of muds and cuttings are regulated by the EPA such that water quality criteria must be met at the edge of an EPA-established mixing zone. The effect of exploration and production drilling muds and cuttings discharges would persist only during actual discharge within the 100-m-radius mixing zone around each discharge point. Concentrations of trace metals would not exceed the acute marine-water quality criteria at the edge of the mixing zone. The effect on local and regional water quality is expected to be very low.

The production of formation waters over the life of the field can be estimated at 322 to 2,415 MMbbl. If formation waters were discharged into the water column rather than reinjected, the effect on water quality would be local and would continue for the life of the field. The effect on local water quality is expected to be moderate, while the effect on regional water quality is expected to be very low.

Effects on water quality from dredging (and dumping) are expected to be local and short-term. Turbidity would increase over a few square kilometers in the immediate vicinity of dredging operations only during actual dredging. Effects on local water quality are expected to be low, while the effect on regional water quality is expected to be very low.

Sustained degradation of water quality to levels above State and Federal criteria from hydrocarbon contamination is unlikely. Hydrocarbon concentrations from the two estimated oil spills of 1,000 bbl or greater could exceed the chronic criterion of 0.015 ppm total hydrocarbons on at least several thousand square kilometers for a short period of time. Concentrations above the acute criterion are not anticipated. Effects of an oil spill on water quality are expected to be low both locally and regionally.

CONCLUSION: The effect of the base case on water quality as a result of exploration and development and production is expected to be MODERATE locally and LOW regionally.

3. Effects on Lower-Trophic-Level Organisms: This discussion incorporates by reference the analysis of effects on lower-trophic-level organisms in the Beaufort Sea Sale 97 FEIS (USDOI, MMS, 1987a), the Norton Basin Sale 100 FEIS (USDOI, MMS, 1985), and the Chukchi Sea Sale 109 FEIS (USDOI, MMS, 1987b), with augmentation by additional information, as cited. Exploration and development of oil resources in the proposed Sale 126 area could have various potential effects on lower-trophic-level organisms. These effects include responses to oil spills, seismic disturbance, drilling discharges, and construction activities. A summary of each of these potential effects follows.

Marine plants and invertebrates of greatest concern, due to their abundance or trophic relationships, are (1) benthic epifauna and infauna that serve as prey for numerous higher-order consumers such as marine mammals, fishes, birds, and other invertebrates; (2) kelp beds (only two have been reported and their extent has not been determined); (3) planktonic and epontic communities, especially their linkage to other consumers; and (4) particularly the dense planktonic community occurring off Cape Lisburne that indirectly supports the huge colonies of birds nesting nearby.

Aside from the kelp-bed communities, which are vulnerable because of their extremely restricted distribution, marine plants and invertebrates assume importance as primary producers (transforming energy from the sun into organic carbon) and as sources of food for other organisms. In the Chukchi Sea, a number of marine mammals (including gray whales and walrus) as well as birds and fish depend on invertebrates as their primary food sources. These invertebrates are, in turn, dependent on primary producers. Since both marine plants and invertebrates can occur in different habitats, consideration is given to effects on pelagic, benthic, and epontic communities.

a. Effects of Oil Spills: Oil has been observed to cause both lethal and sublethal effects on marine plants and invertebrates. Although lethal effects may be initially more obvious or compelling, sublethal effects of oil also may be important and generally develop at much lower concentrations than lethal effects (Steele, 1977; Rossi and Anderson, 1978). These effects include reduction in growth and/or fecundity, increased physiological stress, and behavioral changes. These sublethal effects may increase the probability of death, or may lead to reductions in future population size.

Concentrations of oil used in lab experiments are usually higher than those observed following natural and experimental spills (Sec. IV.A.2); however, concentrations of less than 1 part per million (ppm) have produced a variety of negative effects in marine organisms ranging from phytoplankton to fish (NRC, 1985: Table 5-18).

Effects of oil on marine plants and invertebrates are briefly summarized below.

(1) Marine Plants: Both lethal and sublethal effects of oil have been observed in marine plants (phytoplankton, macroscopic algae, and sea grasses). Effects vary with the species of plant, type, and concentration of oil, and timing and duration of exposure. Sublethal effects include alterations in chlorophyll a content, photosynthesis, growth, and reproduction. When exposed to low concentrations of oil, many phytoplankton and macroscopic algae show stimulation of photosynthesis and growth; at higher concentrations, these functions are inhibited. The mechanism whereby low concentrations of oil stimulate algal photosynthesis is unknown (Hsiao et al., 1978). Experiments using samples of natural arctic-marine phytoplankton taken from the Beaufort Sea and Eskimo Lakes area showed that photosynthetic production varied with the type of oil the samples were exposed to, phytoplankton density, species composition, and environmental conditions. High concentrations of oil also led to inhibition of photosynthesis (Hsiao, Kittle, and Foy, 1978).

Reproduction of both phytoplankton and macrophytes may be affected by exposure to oil. For unicellular phytoplankton, growth equals reproduction; so reductions in chlorophyll a content, photosynthesis, and growth following exposure to oil may all result in a reduced reproductive rate.

In addition to direct effects caused by petroleum hydrocarbons, marine plants may show indirect effects, such as alterations in population sizes of particular species through changes in competition or predation (Foster, Neushul, and Zingmark, 1971; North, 1973; Teal and Howarth, 1984; Howarth, 1985).

In the Sale 126 area, the marine plants of greatest concern are (1) the phytoplankton and epontic algae, and the relationship between these primary producers and consumers; and (2) the kelps and other macroscopic algae that form beds in the nearshore Chukchi Sea. Since effects on phytoplankton and zooplankton are interrelated, the likely effects of oil on the plankton are discussed later in this section in Effect of Oil on Pelagic Communities (Sec. IV.C.3.a(3)(a)).

Effects of oil on several of the brown algal species that predominate in the Skull Cliff kelp bed (Phyllaria dermatodea and Desmarestia viridis) have not been examined directly. Tests with the kelp, Laminaria saccharina, from Liverpool Bay and the Eskimo Lakes in the Canadian Beaufort Sea, indicated that primary production was significantly inhibited by all types and concentrations of oil tested. Exposures to whole crude-oil concentrations as low as 43 ppm caused about 25-percent inhibition of photosynthesis, while concentrations of 4,000 ppm caused a 45- to 60-percent decline in photosynthesis (Hsiao, Kittle, and Foy, 1978).

An oil spill that contacted areas with kelp beds in the Chukchi Sea would be expected to have a relatively short-term effect on kelp and the other macroscopic algae present, particularly since these plants are all subtidal and thus are not likely to be coated by oil. If these plants are similar to Laminaria solidungula from the Beaufort Sea, which shows maximum growth in late winter or early spring, a reduction in photosynthetic rate during the open-water season might later become manifested in reduced growth or reproduction the next year. The most likely effect of an oil spill on kelp and other macroscopic algae in the Chukchi Sea is expected to be low. However, there is very little chance that oil would contact the kelp beds. The conditional probability of an oil spill of ≥ 1,000 bbl contacting land near the kelp beds (Fig. IV-A-1, Land Segments 22 and 23) in the open-water season within 30 days is <0.5 percent (Appendix C: Table C-6). If a large or continuous spill occurred in the immediate vicinity of a kelp bed, moderate effects are possible because the populations are restricted and reproduction and/or recruitment could be affected. Thus, the effect of spilled oil on phytoplankton and macroscopic algae in the Sale 126 area is expected to be very low, although moderate effects could accrue to macroscopic algae in the kelp beds if a large or continuous spill occurred in the near vicinity.

(2) Invertebrates: Oil spills have often resulted in extensive mortality of marine invertebrates, which has been particularly observable in the intertidal (Teal and Howarth, 1984). Sublethal effects, as observed in both the laboratory and the field, include effects on physiology, growth, development, and behavior (see Johnson, 1977b; Cowles, 1983; Cowles and Remillard, 1983; NRC, 1985). Effects may be linked; e.g., reduced feeding may lead to reduced reproductive effort, etc.; and alterations in behavior may increase the probability of death. Of great concern is the potential for disruption of chemically mediated behaviors, which are common among invertebrates and which appear to be disturbed by very low concentrations of hydrocarbons (as low as 1 part per billion [ppb]) (Jacobson and Boylan, 1973; Takahashi and Kittredge, 1973; Johnson, 1977b). If such disruption occurred, feeding, mating, and habitat-selection activities could be affected. Both reproduction and recruitment of benthic invertebrates and zooplankton may be affected by exposure to sublethal concentrations of petroleum hydrocarbons (Berdugo, Harris, and O'Hara, 1977; Johnson, 1977b; Cowles and Remillard, 1983; Teal and Howarth, 1984). Invertebrate larval forms are generally more sensitive to toxic agents than are adults (Johnson, 1977b; Lewbel, 1983), with eggs often somewhat less sensitive than larvae (Lewbel, 1983).

In the Sale 126 area, the invertebrates of greatest concern include (1) zooplankton in the Cape Lisburne area that are an important trophic link between phytoplankton and higher-order consumers and (2) benthic epifauna and infauna that serve as prey for numerous higher-order consumers. Since effects on phytoplankton and zooplankton are interrelated, the likely effects of an oil spill on the plankton are discussed in Section IV.C.3.a(3)(a)) (Effects of Oil on Pelagic Communities).

Among the important invertebrates are crustacean members of the plankton or the epibenthos (prey of whales, fish, and other animals; see Fig. III-B-1). Crustaceans and other invertebrates that are benthic as adults, but that occur in the plankton while they are larvae, are susceptible to the surface slicks of spilled oil, dissolved fractions of oil that move through the water column, and oil that becomes entrained in sediments. Lab studies have indicated that oil concentrations ranging from 1 to 4 ppm can cause significant mortality to both adult and larval crab and shrimp after 96 hours of exposure (Starr, Kuwada, and Trasky, 1981).

Sensitivities may vary among species; Rice, Karinen, and Korn (1978) found that although subtidal species were generally more sensitive to oil than intertidal species, among the subtidal species mysids were considered tolerant. In the Chukchi Sea, where mysids are an important component of nearshore benthic communities, such a difference in sensitivity or tolerance could affect local species composition following a spill, leading in turn to some changes in fish, bird, or invertebrate diets.

Amphipods are another important crustacean group in both nearshore and lagoon-al environments as well as in whale and fish diets. Amphipods, in particular ampeliscid amphipods, seem sensitive to oil; and some species have suffered great mortality following spills (Teal and Howarth, 1984; Howarth, 1985). If oil contaminated the sediments, recruitment of larvae or emigration of amphipods and other epibenthic invertebrates could be affected for some time, depending upon the degree of contamination and the sensitivity of the species involved. Effects are more likely to occur in nearshore areas, where water depths are shallow.

Under the base case, the probability of one or more oil spills of ≥ 1,000 bbl occurring and contacting land in the open-water season within 10 days is <0.5 percent (Appendix C: Table C-13). For particular land segments bordering Peard Bay and Kasegaluk Lagoon (Fig. IV-A-1, Land Segments 22 and 23; Appendix C: Tables C-14 and C-15), the probability of occurrence and contact is <0.5 percent for both open-water and winter spills (to contact within 3- and 10-day periods).

There is a much higher probability of oil occurring and contacting the Peard Bay environmental resource area, an area that includes both nearshore and offshore environs and where gray whales have been observed feeding. There is an 18-percent probability that a spill of ≥ 1,000 bbl would contact Peard Bay within 3 days during the open-water season. The same probability (18%) exists for a ≥ 1,000-bbl spill to occur and contact this target over the entire winter (Appendix C: Table C-16). The total area of Peard Bay is approximately 400 mi^2, and it is unlikely that an oil spill from offshore would contact any large part of this total area even though the probability of contact is high. Any oil reaching here would also be weathered, with reduced toxicity. The probability of oil contacting sediments where amphipods live is much lower. Very little concentrated oil would be expected to reach sediments in offshore areas. Concentrations greater than a few ppb are unlikely.

Given the generally broad distributions of most invertebrate species in the Chukchi Sea (Fig. III-B-1) and the relatively small area likely to be contacted by spilled oil (see Table IV-J-2), the effect of oil on invertebrates in the Sale 126 area is expected to be very low.

(3) Marine Communities: The effects of oil on pelagic, epontic, and benthic marine communities are detailed in the Norton Basin Sale 100 FEIS (USDOI, MMS, 1985) and Chukchi Sea Sale 109 FEIS (USDOI, MMS, 1987b); and effects on benthic and pelagic communities are discussed in Clark (1982), Teal and Howarth (1984), Howarth (1985), and NRC (1985).

(a) Pelagic Communities: Because of the fluid, mobile environment of planktonic communities, the broad distributions of the species components, and the believed ease of recolonization, persistent effects of oil are considered unlikely for these communities unless chronic discharges occur. If a spill occurred nearshore, or in more open-ocean areas, plankton abundance and dynamics within the plankton could be affected. The effects of an oil spill depend on (1) whether species composition within either the zooplankton or phytoplankton changes due to differing relative sensitivities to oil and (2) whether zooplankton or phytoplankton are relatively more sensitive.

Plankton in the Cape Lisburne area have a high probability of being contacted by oil in the open-water season, when their concentrations are presumably highest and when they indirectly support the dense colonies of nesting seabirds found in that region. The probability of an oil spill of ≥ 1,000 bbl occurring during the open-water season and contacting the nearshore and offshore waters near Cape Lisburne (Appendix C: Tables C-13 and C-14, Seabird Concentration Area I) within 10 days is <0.5 percent. The likely effect of the base case on these plankton is very low due to the density and distribution of the plankton versus distribution of the oil. While only two oil spills of ≥ 1,000 bbl are estimated to occur under the base case, plankton could be affected at some time and in rather localized areas. Regional populations of planktonic species are unlikely to be affected by a spill, given the broad distributions of most planktonic species and the apparently great input of plankton from the Bering Sea (Fig. III-B-1a). Therefore, the effect of oil spills on planktonic communities in the Sale 126 area is most likely to be localized and very low.

(b) Epontic Communities: Epontic (under-ice) communities are transient in the Chukchi Sea, and effects of accidental oil spills are expected to be very localized. Oil spilled onto the surface of the ice would reduce the light reaching epontic algae, resulting in lowered productivity. If oil were spilled under the ice and trapped directly beneath it, those epontic organisms that were not highly mobile would probably be smothered and killed. The oil would probably become encapsulated within the ice with increasing time. The areal extent of these effects would be small. Assuming two ≥ 1,000 bbl spills as likely to occur over the life of proposed Chukchi Sea Lease Sale 126, and assuming homogenous spreading on the undersurface of the ice, an area covering 198.9 km^2 would be affected (Chukchi Sea Sale 109 FEIS [USDOI, MMS, 1987b]). If oil on, in, or under the ice should be released during ice breakup, effects could spread. Since ice algae are thought by some to serve as an important source of food in early spring, when food is presumably in short supply for larval or overwintering zooplankton, effects on the epontic community could extend to the open-water community. If a spill of ≥ 1,000 bbl occurred, only a minute portion of the regional community would be affected; and expected effects would be very low.

(c) Benthic Communities: Changes in species composition have been observed following a number of spills due to massive kills of species present, followed by colonization or proliferation of species that are more resistant and/or opportunistic. Most macroscopic benthic organisms are longer-lived than species in planktonic and epontic communities, and shifts in species composition may be very long lasting if the newly predominant species inhibit recruitment or recolonization of previously predominant species. Many epibenthic invertebrate species that predominate in the nearshore Chukchi Sea are believed to be good colonists, since the zone where shorefast ice occurs is probably repopulated on an annual basis. However, the nearshore areas are unlikely to be contacted by spilled oil (the probability of a spill of ≥ 1,000 bbl occurring and contacting land during the open-water season within 10 days is <0.5% [Appendix C: Table C-14]).

Benthic organisms in more offshore areas are not very likely to be contacted by oil, since oil is relatively buoyant; and even though it can become mixed into the water column, the rate of horizontal mixing is much faster (1,000-fold) than the rate of vertical mixing. Thus, the probability of appreciable quantities of oil contacting sediments in offshore areas is very small. Concentrations of oil greater than a few ppb are unlikely. Thus, for the base case, the effect of spilled oil on benthic communities in the Sale 126 area is most likely to be very low.

(4) Trophic Interactions: Certain aspects of the Chukchi Sea environment and communities make its constituents vulnerable to effects deriving from oil-related activities. For one, the environment is highly seasonal. Timing and synchronization of events can be exceedingly important. Pulses of primary production, whether resulting from epontic or open-water activity, may be critical to the success of zooplankton and to the reproductive activities of these and other consumers. Epontic production may be more important as an early pulse of energy available to larval or overwintering forms than for the magnitude of its production. Activities that significantly reduce primary production or alter timing in such a way that utilization of resources is affected could have significance beyond the expected magnitude of effect. In the Chukchi Sea, effects on plankton could be translated to the benthos rather directly if the planktonic larval forms of benthic organisms suffer (e.g., die, starve, show delayed growth, etc). Recruitment to the benthos could readily be affected; however, since effects on the plankton are expected to be localized, effects on the benthos are also expected to be limited in extent. In some areas like the Cape Lisburne region, dense planktonic communities support pelagic consumers that are fed on by huge numbers of nesting seabirds. If a large spill occurred in this region and affected the density of arctic cod or other important zooplankton consumers, some seabirds could be affected for that season. Since the seasonal and internal dynamics within the plankton are not well understood, it is difficult to hypothesize very concretely about the effects of a large spill. Annual variability in ice cover probably has a greater effect on the pelagic communities and the success of nesting seabirds than an oil spill would.

Food webs in a large part of the Sale 126 area appear to be dependent on detrital carbon becoming available to benthic organisms, which in turn support a diverse array of higher-order consumers (including gray whales, walrus, and bearded seal). Since detrital carbon may originate, at least to some extent, from more southerly regions, effects on plankton might not be translated to the benthos except in several situations. One situation, mentioned earlier, would occur if the planktonic larval stages of benthic organisms were affected. The second situation would occur if primary production itself were affected; then the standing crop of both phytoplankton and zooplankton would become reduced, and this could affect the amount of carbon sinking to the benthos. However, effects like this are expected to be very localized and are not anticipated to affect regional populations of benthic organisms. If it is true that populations of walrus, which feed extensively on benthic bivalves (clams) in the Chukchi Sea, are now reaching the carrying capacity of the environment and are competing for food, then a decrease in the abundance of bivalves in an area could lead to decreased health of the walrus, a shift in the diet to alternative prey, and/or a shift in feeding location. Given the difficulty of delineating cause-and-effect relationships in offshore-arctic waters, it is unlikely that we could ascribe such a scenario to changes in primary production resulting from an oil spill.

In general, activities associated with the base case are not expected to have significant, broad effects on trophic interactions.

b. Effects of Seismic Disturbance: The sources of acoustical energy used in seismic exploration have included explosives of different sorts (high explosives, low explosives, and blasting agents); airguns, which capitalize on compressed-air releases to generate sounds; and waterguns, which use the release of water pressure to create a seismic pulse.

The effects of seismic exploration on marine plants are quite likely to be very low since the acoustic energy sources now commonly employed do not appear to have any significant injurious effect on this group of organisms. Airguns, which are much more innocuous for fish than explosives, were shown to have no effect on caged oysters placed close to the airgun (Gaidry, Unpubl., as cited by Falk and Lawrence, 1973). To our knowledge, effects of waterguns on marine organisms have not been assessed; but their effects are expected to be less than those of airguns, since the energy released is orders of magnitude less. Due to the prevalent use of airguns and waterguns in Alaskan OCS waters, seismic exploration would have very low effects on invertebrates and marine plants in the Sale 126 area.

c. Effects of Drilling Discharges: The types of material deliberately discharged during the drilling for oil include drilling muds, cuttings, and formation waters. The effects of drilling-fluid discharges on phytoplankton, zooplankton, and benthic communities are discussed in the Chukchi Sea Sale 109 FEIS, Appendix I (USDOI, MMS, 1987b), and are incorporated by reference. Other discussions of effects on these communities are found in the Beaufort Sea Sale 97 FEIS, Appendix L (USDOI, MMS, 1987a), and the Norton Basin Sale 100 FEIS, Appendix F (USDOI, MMS, 1985); and these discussions are herein summarized and incorporated by reference.

During exploration, the previously analyzed effects on lower-trophic-level organisms could be based on previous offshore operations. Based on oil-spill-risk analysis for the Sale 126 area, the average-size oil spill that might occur would be about 22,000 bbl (Sec. IV.A.1.b(2)(a)). Should this occur during the winter season, most of the oil would entrain in the ice cover; however, that which was not recovered would enter marine waters during the summer season. The volume of oil (1) that entered the water at meltout would be indeterminate in an oil spill of this volume and (2) that entered marine waters during the open-water season would affect lower-trophic-level organisms over an area of about 57 km^2 after 3-days 260 km^2 after 30 days (Appendix L: Table L-1). These affected areas are only small components of the habitats of lower-trophic-level organisms in the Chukchi Sea Planning Area. The effects of oil spills on lower-trophic-level organisms are further ameliorated by the rapid dilution of oil in the water column.

In the exploratory phase of the base case, a total of about 26,000 short tons of drilling muds and 33,000 short tons of drill cuttings are expected to be released (see Sec. II.B.2.a, Scenario Assumptions). These discharges would occur over a 7-year period from 1992 to 1998. During this period, a maximum of 5 exploration and delineation wells would be drilled during one year, numbering 39 wells in all. Thus, a maximum of about 3,000 short tons of drilling muds and about 4,000 short tons of drill cuttings would be released in a single year, with lesser weights during other years of exploratory drilling.

The establishment of the drilling vessel on platform and the seismic surveys needed for its siting could cause temporary disturbance/displacement of some lower-trophic-level organisms. During exploratory drilling, however, the drill structure might have some protective effect for some organisms. The exploration phase of the base case on lower-trophic-level organisms is expected to be very low.

During the development and production phase of the base case, 214 wells are expected to be drilled from 6 platforms over a 3-year period, with a maximum total release of about 24,000 to 150,000 short tons of drilling muds and 198,000 short tons of drill cuttings. Details of the extent and timing of water quality effects are presented in Sections IV.B.2, IV.C.2, and IV.D.2.

For phytoplankton and zooplankton, the effect of discharged drilling muds and cuttings is expected to be very low, primarily because of the low levels of toxicity demonstrated and the small area that would be affected. Benthic communities are generally expected to incur a low effect; however, effects would probably be longer-lasting (but localized) due to the deposition of drilling muds and cuttings. Some benthic species will colonize the disposal area while others may be displaced.

Kelp-bed communities are considered particularly vulnerable to effects from drilling discharges in the Chukchi Sea because these communities are uncommon and apparently have very limited spatial distributions. Only two kelp-bed communities have been reported in the Chukchi Sea--one near Skull Cliff, about 20 km northeast of Peard Bay, and another about 25 km southwest of Wainwright. Both the large seaweeds that predominate in the community and the invertebrate residents (particularly the filter feeders) could be affected by sedimentation and the chemical composition of the drilling fluids. Sedimentation effects are more likely to be significant for organisms in the kelp communities than is the chemical nature of the released drilling fluids. Sedimentation could reduce larval and spore settlement and survival, as well as feeding efficiency of filter-feeding invertebrates. Turbidity in the water column is likely to reduce productivity. Effects of discharges of drilling fluids on these organisms could be moderate but will depend on where operations are sited. If activities are sited sufficiently far from the kelp beds, probably more than 1,000 m away, effects are more likely to be very low.

Formation waters are produced from wells along with oil. Toxic effects on marine plankton and the benthos could be produced by the hydrocarbons, metals, or chlorides (brine content) in formation waters. Discharges of formation waters differ from those of other drilling fluids in that almost all such discharges would occur during development and are likely to be continuous through production. Such discharges should increase in volume as the oil reservoir is depleted. Reinjection of formation waters back into the reservoir as an enhanced oil-recovery mechanism would lower the total amount discharged.

The effects of formation-water discharges associated with the base case are likely to produce only small effects. Factors that suggest this are (1) the low toxicity of formation waters (LC_{50} values of 1,850-408,000 ppm [Menzie, 1982]); (2) the rapid dilution of these discharges within a short distance from the source; and (3) the relatively small area that would be affected by these discharges (1,000-m radius).

Acute toxic effects appear to be low (Menzie, 1982). Chronic lethal and sublethal effects may present more of a problem because of the continuous nature of the discharge and the potential for accumulating hydrocarbons in the sediments. The latter could produce long-term effects on benthic organisms. Dilutions greater than the toxicity values reported would probably be achieved within several hundred meters of a platform. Assuming a 1,000-m radius for all effects in both water column and sediments around each of six production platforms, a total of 27 km^2 could be affected.

Assuming no reinjection, the effects of formation waters on planktonic and benthic organisms would very likely occur through the development and production phases. These effects, as well as those from drilling discharges, are expected to be very low. Moderate effects from drilling discharges could accrue to kelp beds if activities associated with the base case are sited close enough for siltation and turbidity effects to occur. Although only two kelp beds have been reported from the Chukchi Sea (see Sec. III.B.1.c(1) and earlier discussion of effects of drilling fluids), the lack of systematic surveys for such beds means that other kelp beds also could occur along the coast. The bathymetry of the Chukchi coast and the general occurrence of kelp beds in fairly shallow water (<20 m) suggest that drilling discharges from OCS activities are unlikely to affect kelp beds.

d. Effects of Construction Activities: Construction activities, as well as release of drilling muds and cuttings, could alter habitats of benthic or epibenthic animals and plants. Activities relating to siting and construction of platforms and pipelines are expected to be very localized. Six platforms are expected to be built in conjunction with base-case oil activities. Platforms add a three-dimensional structure to the environment that may provide habitat for refuging fish or for invertebrates and plants requiring hard substrate for settlement. In general, one would expect organisms relying on soft-sediment areas altered or preempted by platforms and pipelines to be negatively affected, whereas organisms utilizing hard substrate may be favored by the construction of platforms. Because of the number of platforms (6) projected to be built in the Sale 126 area, the small area expected to be affected, and the apparently broad distributions of most adult and larval marine organisms in the Chukchi Sea, regional populations are not expected to be affected. However, the localized effects are expected to be long-term for those benthic organisms that are affected.

During the development and production phase of the base case, it is possible, although quite uncertain, that a channel would be dredged in Peard Bay. Since such action could greatly alter the physical environment, abundances and distributions of invertebrate species could be greatly affected. If dredging occurred, a long-term, moderate effect is likely; and if the distribution of species in the bay were highly restricted, a high effect is also possible. Dredging activities in nearshore waters are regulated by the U.S. Army COE, which could require extensive environmental studies before action were allowed.

During the development and production phase of the base-case scenario, oil is assumed to be transported offshore and onshore by pipelines. Buried pipelines from the six production platforms would converge offshore and come onshore at Point Belcher. The section of pipeline coming onshore might be buried, or raised and supported by trusses. In laying an estimated 325 km (200 mi) of offshore pipeline, trenching and dumping of fill material would affect an estimated total of 2,838 hectares. Dredging can affect marine organisms by physically altering the benthic environment, increasing sediments suspended in the water column and thereby decreasing water quality, displacing sediments and thereby smothering some benthic organisms, altering water currents by modifying benthic topography, and killing some organisms directly through mechanical actions (Starr, Kuwada, and Trasky, 1981; Lewbel, 1983).

Since pipelines would be in place for years, effects of pipeline installation are expected to be localized but may be long-term for those benthic organisms affected. The kelp-bed communities are considered to be quite vulnerable to effects from construction activities because these communities are uncommon and have very spatially restricted distributions. As discussed in Section IV.C.2 (Effects of Drilling Discharges on Kelp Beds), the bathymetry of the Chukchi Sea coast and the general occurrence of kelp beds in shallow water (<20 m deep) suggest that construction activities associated with OCS exploration and development (except the laying of pipeline) are unlikely to affect kelp beds. If construction activities were sited sufficiently far from these communities, effects could be very low. If a pipeline or platform were sited within the community, a very high effect could ensue; however, this effect is not very likely given the apparent rarity of these communities. In general, the most likely effect of the base case on marine plants and invertebrates is expected to be low, since only a small portion of the benthos would be affected; and regional populations are not expected to be significantly affected.

In summary, effects of construction activities would vary depending on the species involved. Some sessile marine organisms would be killed or displaced by these activities, but effects are expected to be extremely localized. Those species that require hard substrate for settlement and growth may increase in abundance because platforms increase the available substrate. Construction activities should benefit these species. Invertebrate populations in Peard Bay could suffer a moderate effect if dredging occurred there, or a high effect if the distribution of some species were highly restricted.

Kelp-bed communities are vulnerable and could incur very high effects if construction activities were located in their midst. In general, effects on marine plants and invertebrates in the Sale 126 area are expected to be low, with regional populations of these organisms not significantly affected.

Summary: Marine plants and invertebrates of greatest concern because of their abundance or trophic relationships are (1) benthic epifauna and infauna that serve as prey for numerous higher-order consumers such as marine mammals, fishes, birds, and other invertebrates; (2) kelp beds; (3) planktonic and epontic communities, especially their linkage to other consumers; and (4) in particular, the dense planktonic community occurring off Cape Lisburne that indirectly supports the huge colonies of seabirds nesting nearby.

Oil spills are more likely to cause widespread negative effects on marine plants and invertebrates than are other activities associated with exploration, development, and production of oil resources. In general, oil spills are most likely to have very low effects on marine plants and invertebrates, since the distributions of most of these organisms are quite broad, the populations are large in number, and recolonization of affected areas is quite likely unless sediments become too contaminated. At greater risk to effects are benthic and epibenthic organisms living in nearshore shallow environments, where contact with oil could occur more easily. However, the oil-spill-risk analysis indicates that nearshore areas are very unlikely to be affected by spilled oil. A very large spill that contaminated nearshore sediments could affect populations of benthic invertebrates, perhaps for years. Oil-spill effects on the planktonic and epontic communities are expected to be low due to the limited area likely to be affected. Effects on these communities are not expected to be noticeably translated to higher-trophic levels, although if a large spill occurred in the Cape Lisburne area during the open-water season, some seabirds could be affected for that year.

Effects from other activities (seismic exploration, drilling discharges, and construction activities) would be very localized. The effect of seismic exploration would be very low; and the effects of other activities generally are expected to be low.

Construction activities (e.g., dredging) in Peard Bay could lead to a moderate effect on benthic invertebrates, since localized, long-term changes would occur; and a very high effect is possible if some species were restricted in their distribution to Peard Bay. However, the most likely effect would be very low.

Kelp-bed communities in the Chukchi Sea are more vulnerable to effects from oil-related activities, since they are very restricted spatially. Because productivity and successful recruitment could be affected if a large or continuous oil spill occurred nearby, effects could be moderate. However, low effects from oil spills on this community are most likely. The location of wells (as related to drilling discharges) and construction activities also could lead to more significant (larger) effects on kelp beds if these activities were located close to, or in the midst of, beds. Drilling discharges that occurred too close (probably within 1,000 m) to kelp beds could lead to moderate effects, while construction that occurred within a bed could have a very high effect. Drilling discharges and construction activities associated with Sale 126 are more likely to have a very low effect on kelp beds, since the known kelp beds are located near the periphery of the sale area.

CONCLUSION: The effect of the base case on lower-trophic-level organisms as a result of exploration and development and production is expected to be LOW.

4. Effects on Fishes: This discussion incorporates by reference the discussion of the effects on fish contained in the Beaufort Sea Sale 97 FEIS (USDOI, MMS, 1987a), the Norton Basin Sale 100 FEIS

(USDOI, MMS, 1985), and the Chukchi Sea Sale 109 FEIS (USDOI, MMS, 1987b), with augmentation by additional information, as cited. Fish in the nearshore zone would be the most vulnerable to petroleum-related effects because this zone contains the highest densities of fish in the proposed Sale 126 area, at least during the open-water season (see Sec. III.B.2 for details). In the summer, anadromous fish move into the nearshore estuarine area to feed; in the fall, some return to the rivers to overwinter and spawn, and others move to the open ocean to mature. A few marine species also use the brackish-water area for feeding; and with some exceptions, they return to the deeper, more offshore regions during and following freezeup to overwinter and spawn. The larval and juvenile development stages of fish are more sensitive to oil-development activities than adults and are often concentrated in the estuarine areas. Activities, agents, or events associated with oil development under the base case that could result in effects on fish in and near the sale area include oil spills, drilling discharges, construction activities, and seismic surveys.

a. Effects of Oil Spills: The interaction of oil with fish could produce a variety of lethal and sublethal responses (refer to Malins, 1977; Hamilton, Starr, and Trasky, 1979; Neff and Anderson, 1981; Rice, 1981; and Starr, Kuwada, and Trasky, 1981, for a more detailed discussion of these responses). Such responses include actual mortality if lethal concentrations are encountered, or damage to fish (i.e., gills, brain, liver, lateral line, eyes, etc.) that could later lead to death. Sublethal effects include an assortment of physiological and behavioral responses that could alter the ability of the fish to resist disease, find food, or avoid predation. Once fish that have been exposed to sublethal amounts of oil return to clean water, a majority of the hydrocarbons are released from their systems.

Lethal and sublethal amounts of hydrocarbons vary depending on the type of oil, the method used to determine the concentration, and the species and development stage of the fish. Most acute-toxicity values (96-hr lethal concentration for 50% of the test organisms [96-hr LC_{50}]) for fish are generally on the order of 1 to 12 ppm. However, the concentrations observed under past crude-oil spills and those calculated by modeling are lower than the determined acute values for fish. Concentrations observed at 0.5 to 1 m beneath a slick from the Tsesis spill (Kineman, Elmgren, and Hansson, 1980) ranged from 50 to 60 ppb. Modeled concentrations were less than 1 ppm after 12 hours at a distance of 2 km from a blowout discharging oil at 100 bbl/hr with a wind of 6 m/sec and a rate of incorporation into the water of 6.8 $g/m^2/hr$.

The most likely number of oil spills that could occur for the base case is two spills of ≥ 1,000 bbl. These spills are estimated to occur over the life of the project and to be indeterminate in interval and location.

The brackish-water zone is characterized as important fish habitat, especially for the anadromous species that use this zone during the open-water season. The conditional probability that a spill of ≥ 1,000 bbl would contact a portion of the entire nearshore area within 3 days during summer is <0.5 percent (Appendix C: Table C-6). However, there is a >99.5-percent chance that the Peard Bay area would be contacted by a ≥ 1000-bbl spill in 10 days during the summer. This conditional probability occurs because of the convergence of the pipelines just offshore Point Belcher, southwest of Peard Bay. There is a <0.5-percent conditional probability that an oil spill would contact Kasegaluk Lagoon (Land Segments 20 and 21) within 10 days in the summer. During the entire winter, there is a slightly greater conditional probability (to 29%) of ≥ 1,000-bbl spills contacting land, with the highest chance of contact to Wrangel Island. Low probabilities of oil contact prevail during summer and winter for important fish habitats such as river deltas or lagoons (Appendix C: Tables C-1 - C-9).

(1) Anadromous Fish: Avoidance reactions to hydrocarbons have been observed in some fish species but not in others and in different lifestages within species (Maynard and Weber, 1981; McCain and Malins, 1982). In avoidance tests, coho smolts avoided 1.9 ppm of total aromatic hydrocarbons. Presmolts, however, were not prone to displacement and did not avoid the aromatic hydrocarbons until the concentration was 2.8 to 3.7 ppm (Maynard and Weber, 1981). Adult coho salmon were exposed to various amounts of hydrocarbons in an estuarine environment as they headed upstream to spawn; the adults avoided aromatic hydrocarbons above 3.2 ppm (Weber et al., 1981).

Estuaries and lagoons (i.e., Kasegaluk Lagoon) may decrease in productivity if contacted by an oil spill in a relatively unweathered (i.e., within 3 days) state during conditions--such as high turbidity or surf--that would promote sinking or mixing of oil into the bottom sediments. The probability of a $\geq$ 1,000-bbl spill contacting such areas during summer under these conditions is <0.5 percent (Appendix C: Table C-1 - C-6).

Adult salmon would be likely to return to spawn, even if they were delayed by an oil spill in their migratory route (Weber et al., 1981; Craig, 1984). An oil spill is most likely to have a very low effect on salmon, while some individuals in the affected area could die or be displaced; the total numbers involved would not comprise a significant segment of a run. However, an oil spill that occurred during June or July and reached the brackish-water areas within 10 days (<0.5% probability of contact) could have a moderate effect on the very small local salmon populations by affecting the more sensitive and vulnerable smolts.

Rainbow smelt are vulnerable to oil spills in late winter, when the adults form under-ice aggregations off the mouths of spawning rivers. Since rainbow smelt do not migrate far from their spawning streams and many spawn only once, the local population could be affected for a period of time by the loss of a group of adults. Larvae are unlikely to be affected by a spill since the large river discharge at breakup would retard or prevent significant amounts of oil from moving upstream to the spawning grounds. The effect of oil spills on rainbow smelt could then be moderate. However, the areas around river mouths show reduced oil-spill risk (the maximum conditional probability is 11% for the Icy Cape land segment 21; other land segments of interest near the Kuk, Utukok, Kokolik, and Kukpowruk Rivers have conditional probabilities of <0.5% to 1% during winter). Therefore, the most likely overall effect of an oil spill on rainbow smelt would be low.

Other anadromous fish such as arctic char, ciscoes, and whitefish appeared uncommon during 1983 investigations in the Sale 126 area (Fechhelm et al., 1984; Kinney, 1985); however, no conclusion can be drawn for normal abundance from this limited sampling.

Information that arctic char in Beaufort Sea drainages show distinct genetic dissimilarity suggests that separate stocks occur in each drainage (Everett and Wilmot, 1987). Thus, an oil spill affecting the majority of a year-class, spawning run, or migration in or out of a particular river could significantly affect that population. If arctic char behave similarly in the Beaufort and Chukchi Seas, the total population in a drainage is not expected to be decimated by an oil spill for several reasons. Young fish from zero up to 4 years of age remain in freshwater (between ages 2 and 5, char start moving to sea in the summer). In some populations, male char do not migrate to saltwater even though females in the same population are anadromous (Glova and McCart, 1974; Morrow, 1980). Also, the movements of large and small char in the Beaufort Sea vary somewhat with time (see Cannon and Hachmeister, 1987). In general, the variation in timing of movements of these different age-classes reduces the probability that both these groups will suffer large effects from an oil spill.

An oil spill contacting the nearshore environment in midsummer, when arctic char are thought to be widely dispersed, is expected to have a low effect on arctic char. However, contact with char while they are in close association with the delta of their home drainage may result in a moderate effect, since individuals are aggregated and one or more age-classes could be affected, with a resultant effect that could last for more than one generation.

Other anadromous species, such as ciscoes and whitefish, are not known to be tied to specific drainages in the Chukchi region. If their biology is similar to individuals in the Beaufort Sea, they are likely to be widely dispersed in the nearshore environment during the open-water season and would be most likely to incur a low effect if contacted by a spill.

The paucity of information regarding stock sizes, fidelity to streams, and movements of anadromous fish in the Sale 126 region means that analysis is based primarily on generalization from Beaufort Sea populations. If these fish are much rarer in the nearshore Chukchi Sea, as preliminary data suggest stocks may be more vulnerable, particularly when and if aggregated in nearshore zones. Since eggs and larvae (and juveniles of some) of these species are in freshwater habitats, an oil spill contacting aggregated assemblages in the nearshore is not expected to cause a greater than moderate effect on the populations. A low effect would be most likely if, as in Beaufort Sea populations, movements of individuals into and out of freshwater are spread out in time.

(2) Marine Fish: Marine fish are susceptible to hydrocarbon exposure in both nearshore and offshore habitats during different lifestages. Pelagic eggs and larvae (i.e., arctic cod) are often near the ocean surface, thereby increasing the likelihood of contact with lethal or sublethal concentrations of hydrocarbons. The sublethal quantities may inhibit growth and/or eventually result in death. The sensitivity to hydrocarbons of 39 adult marine fish and invertebrates found around Alaska was evaluated by Rice et al. (1979), and similarities were found based upon habitat. Pelagic fish and shrimp were the most sensitive (96-hr LC_{50} = 1-3 ppm); benthic animals were moderately sensitive (96-hr LC_{50} = 3-8 ppm); and intertidal species were the most tolerant (96-hr LC_{50} = 8-12 ppm) to Cook Inlet crude oil.

Arctic cod are found throughout the Sale 126 area in both nearshore and offshore habitats and are the most common fish in Kasegaluk Lagoon. They are most vulnerable when the oil is released from the ice at breakup, when the adults and eggs are near the underside of the ice; however, no concentrations of adult arctic cod or eggs have been found during the winter. Large schools have been seen in estuarine areas during the open-water season, but the conditional probability of a ≥ 1,000-bbl spill contacting these areas during the first 10 days of the spill during the summer is <0.5 percent (Appendix C: Table C-5).

Marine species such as arctic and saffron cod, flatfish, sculpins, and capelin are abundant, widespread, and live and reproduce over a broad area. One area used by several fish species is Kasegaluk Lagoon. This lagoon and other barrier-island, estuarine areas provide productive habitats for growth and maintenance of various development stages of fish. Arctic cod and capelin populations are more vulnerable to oil spills because they may form concentrations in the nearshore area during the open-water season and may spawn only once. The most likely effect of an oil spill on marine fish species would be low, since some individuals could die or be displaced. However, capelin could suffer moderate effects if spawning adults or eggs and developing larvae on sandy beaches were contacted by oil. Since the conditional probability of oil spills contacting the nearshore area in an unweathered state during the open-water season within 10 days is <0.5 percent, a moderate effect is possible.

The above analyses of effects of offshore oil spills on fish are based on spills of ≥ 1,000 bbl, with two spills most likely to occur. The effects of a large spill would be basically the same as for the smaller spills described earlier; but the oil would cover more area, potentially contacting more fish and important fish habitat, resulting in increased mortality in the local populations. Nonetheless, the affected area remains only an infinitesimal part of the total marine fish habitat of the Chukchi Sea. Therefore, a moderate effect is more likely to occur. However, given the low probability of a large spill contacting the nearshore zone, the most likely effect of such a spill on fish is expected to be low.

In summary, the broad distribution of fish, the low concentrations of hydrocarbons in the water column associated with oil slicks, and the low probabilities that offshore spills would contact important coastal or nearshore habitats in the open-water season is most likely to result in a low effect on the fish of the Alaskan Chukchi Sea as a result of potential offshore oil spills associated with the base case. Moderate effects are possible for some anadromous fish (salmon, rainbow smelt, and arctic char) and capelin if spawning-year individuals, aggregated multiage assemblages, or a year-class of young were affected by a spill in nearshore waters; however, with only two oil spills of ≥ 1,000 bbl estimated to occur during the 19-year period of the Sale 126 base case, the likelihood that they would occur during the period when these anadromous species are present is probably quite remote.

Onshore-Oil-Spill Effects: The construction of a pipeline from near Point Belcher on the Chukchi Sea coast to connect with the TAP (adjacent to the Sagavanirktok River) opens up an extensive section of the interior to potential oil spills. Of greatest significance to fish would be the occurrence of a spill that contaminated freshwater habitats. If a spill contacted a river, the oil might contaminate the river from the spill point down to the Beaufort Sea. Fish in freshwater may be more sensitive to spilled oil than fish in marine waters (Anderson and Anderson, 1976, as cited by USDOI, BLM, 1983). Eggs and larvae, generally the lifestages most sensitive to oil, could be affected while in bottom sediments (e.g., gravel) or in the water. Juveniles or adults in the rivers also could be affected. Since most anadromous fish in the Beaufort Sea/North Slope region spend the majority of each year in freshwater (e.g., arctic and least ciscoes, arctic char, and broad and humpback whitefish), an oil spill that affected the quality of the habitat, sensitive lifestages, or concentrations of these fish could significantly affect fish populations of the resident species. Overwintering habitat is hypothesized to be the main factor limiting many anadromous fish populations in the Beaufort Sea (Craig, 1987); and within a river, entire stocks of species may reside in a few overwintering areas. If this habitat--or nest-site areas--were affected, then one or more year-classes of fish could be affected. The time of occurrence of a spill also could be important. Most rivers freeze solid except for a few deeper holes or springs, and a spill that occurred and contacted a river in the winter probably would become encapsulated in ice before contaminating much of the river. However, this oil would be released in a generally unweathered state during spring breakup and then could contaminate the river while still fairly toxic. If fish that had just finished overwintering were contacted by oil while still in the river, they could be especially vulnerable because of their poorer condition. Griffiths and Schmidt (1986) have observed dead fish in overwintering areas, and most fish are thought not to feed during the winter. A spill occurring in winter could be more severe since all age-classes are in the river at that time. A spill that occurred in summer and contaminated a river is more likely to affect eggs and larvae of anadromous species, since the juveniles and adults of many of these species spend the majority of the open-water season in nearshore, marine environments.

The projected onshore pipeline would be 640 km long and would cross approximately 10 major rivers or their tributaries. Of greatest concern would be possible contamination of the Colville River, since the Colville contains the most extensive fish overwintering habitat of all the rivers feeding into the Alaskan Beaufort Sea. Based on their experience with the TAP, the BLM has determined that the NPR-A pipeline length/year is the best predictor for pipeline spillage. The BLM also has estimated that 40 percent of the length of a pipeline across the NPR-A would traverse wetlands (USDOI, BLM, 1983). It is likely that fish in freshwater would be affected by an onshore-pipeline spill. The effect of a large spill contacting fish in rivers is likely to be very high, since concentrations of various species of multiple ages as well as important overwintering and rearing habitats could be affected. The channelization of the spilled oil and stream flow would affect a large area of fish habitat in the Colville River and would also have an adverse effect on food used by fishes.

A large onshore oil spill occurring and contacting a major river is likely to have a very high effect on fish, but only in that river, and a very high effect is possible if the Colville River were contaminated.

Over the 19-year production life of the Sale 126 base case, a total of 188 onshore-pipeline oil spills are estimated to occur. Of this total, 121 spills would be classified as minor (averaging about 6 bbl), 45 would be moderate (averaging about 98 bbl), and 22 would be major (averaging about 1,500 bbl). There is a 95-percent probability that at least one oil spill of $\geq$ 2 bbl would occur and contact a major river tributary. Minor oil spills would probably have a very low effect on riverine fish and their habitat, given the distribution of fish over a relatively large volume of freshwater. Sixty-seven spills of $\geq$ 24 bbl are estimated to occur, with a 65-percent probability of contacting a major river tributary. This volume of oil could have a high effect on fish and their habitats. Twenty-two major oil spills $\geq$ 239 bbl are estimated, with a 29-percent probability of one occurring and contacting a major river tributary. The probability of at least one large winter spill occurring and contacting a major river tributary is 22 percent. Major oil spills would contaminate a large area of riverine-fisheries habitat, with a consequent very high effect on fish.

b. Effects of Drilling Discharges: The toxicity of drilling muds to Alaskan fish species has been reviewed by Jones and Stokes Associates, Inc. (1983). For the eight Alaskan fish species tested with a total of 24 drilling muds, 95 percent of the 96-hour LC_{50} values exceeded 10,000 ppm. The lowest 96-hour LC_{50} value was 3,000 ppm observed for pink salmon fry (Dames and Moore, 1978). Data obtained in studies of species common in the Chukchi Sea reveal that 96-hour LC_{50} values for fourhorn sculpin exceeded 40,000 ppm, and values for arctic cod exceeded 161,000 ppm (Tornberg et al., 1980).

The heavy fraction of the drilling muds and cuttings that accumulate on the bottom near the discharge site may contain high amounts of barium and chromium. In laboratory studies, demersal fish showed no significant accumulations of these metals over a long period of time (Tillery and Thomas, 1980; Payne et al., 1982; Neff et al., 1985).

A limited number of studies have been performed on the toxicity of formation waters (Menzie, 1982). Ten species of freshwater fish obtained 96-hour LC_{50} values of 43,000 to 112,000 ppm for exposures to brine wastes. Other studies with two species of shrimp, barnacles, and one marine-fish species (crested blenny) resulted in 96-hour LC_{50} values between 8,000 and 408,000 ppm.

The total amount of drilling muds and cuttings expected to be discharged in the exploration and delineation phase of the base case is about 26,000 short tons of drilling muds and about 33,000 short tons of cuttings. A discharge-concentration model for drilling muds and cuttings in Beaufort Sea conditions predicted a decrease in the concentrations of suspended solids by three to four orders of magnitude within 100 m. Solids deposition was predicted to be almost 100 percent within 100 m. Dilution factors of the dissolved portions of these discharges were predicted to be between about 70 and 500 within 100 m. Modeling of formation-water discharges has not been reported; however, rates probably would be similar to those associated with the dissolved portion of the drilling-fluid discharge (Jones and Stokes Associates, Inc., 1983). The area in which concentrations would exceed acute-lethal-toxicity values consequently would be limited. Considering the low densities and mobile behavior of marine-fish species, the likelihood of exposures to even sublethal concentrations is small. Therefore, discharges of drilling fluids would produce very low effects on the fish resources of the Sale 126 area during the exploration phase of the base case.

c. Effects of Seismic Disturbance: Exploration plans often include seismic surveys to map out prospective petroleum areas or ocean-floor characteristics. Airguns, assumed to be the main seismic source for the Sale 126 area, are relatively harmless to fish (Weaver and Wienhold, 1972; Falk and Lawrence, 1973). Airguns may harm the small percentage of fish eggs that are within 0.5 m from the source (Kostyuchenko, 1973). Waterguns, which may be used for high-resolution surveys, produce much less energy than airguns and are not known to have any effect on fish.

During the exploration phase of the base case, 39 exploration and delineation wells would be drilled over a period of 7 years (1992-1998). Oil spills, drilling discharges, construction (rig placement), and seismic surveys would be the principal events with potential to adversely affect fish. Of these, oil spills are predominant. A total of two oil spills of ≥ 1,000 bbl are estimated for the base case, with the average-size spill about 22,000 bbl. The spilled oil, however, would rapidly dilute/dissipate and weather in the water, nontoxic to an extent that it would soon be at levels harmless to fish during both the winter and ice-free summer seasons (Sec. IV.C.4.a).

Exploration and delineation drilling would discharge about 59,000 short tons of drilling muds and cuttings over a 7-year period. These discharges would have only a limited effect on fish, since the area they affect is limited to a small radius from the benthic discharge point (Sec. IV.C.4.b).

About 7,055 trackline km of seismic-survey lines would be required to implement exploration and delineation drilling. The acoustic-energy source now most commonly employed for this work, the airgun, has essentially no effect on adult fish. The sound may cause temporary disturbance to some adult pelagic fish, and there is some evidence that pelagic fish eggs and larvae in close proximity to the discharge part of the gun may be injured; but overall the effect is expected to be very low (Sec. IV.C.4.).

Exploration and delineation drilling would entail the siting of 26 drilling locations in the offshore Chukchi Sea over a 7-year period. The presence of these structures could initially cause temporary disturbance to or displacement of pelagic and benthic fish. Over time, however, the temporary presence of the structure may provide shelter for some fish, and food for others as the structure accumulates sessile marine organisms. The effect of the exploration-delineation phase of the base case on fish is expected to be very low.

The development and production phase of the base case would utilize six platforms along with onshore support facilities, including a pipeline to transport produced oil to the TAP. Oil would be transported to shore via a 325-km buried pipeline.

Oil spills from drilling or transportation could have an adverse effect on pelagic (including anadromous) and benthic fish, including their eggs and larvae. These potential adverse effects are analyzed in Section IV.C.4.a. Two oil spills of ≥ 1,000 bbl are estimated to occur during both the exploration and delineation/development and production phases of this project. Even though very large oil spills tend to have limited adverse effects on fish, adult fish have the mobility to avoid oil and the ability to detect it (Weber, 1981). Eggs and larvae in pelagic waters are vulnerable to the toxic effects of oil over relatively short periods. The oil spill itself has only a limited areal extent in comparison with the total fish habitat of the Chukchi Sea; and the toxic effects of oil on fish are rapidly reduced via dilution and weathering.

Drilling discharges during development and production would total about 23,540 to 149,800 short tons of drilling muds and 197,950 short tons of cuttings. As analyzed in Section IV.C.4.b, the effects of these discharges on fish are limited to the immediate area from the discharge point.

d. Effects of Construction Activities: Implementation of the development and production base case would require the construction of manmade berms for bottom-founded drilling units and 325 km of subsea pipelines. It is assumed that bottom-founded drilling units would be employed for field development. The amount of construction needed for berms for these units can vary depending on water depth; some units must be placed within 22 m of the ocean surface. It is assumed that the main pipeline would come onshore at Point Belcher. Sand and gravel movement for offshore-pipeline trenching and burial construction would be on the order of 28,090 million m^3. The total area disturbed by the offshore-pipeline construction would be 2,838 hectares. Within Peard Bay, a channel 5 m deep may be needed to accommodate support vehicles for the shorebase. Since the channel is already 6 m deep for most of its length and the arctic-area tide range is small, dredging probably would not be necessary.

Dredging effects on the fish of this region are addressed in a generic discussion in the Proposed Arctic Sand and Gravel Lease Sale FEIS (USDOI, MMS, 1982) and are incorporated by reference. Dredging operations associated with these construction projects generally would result in short-term, localized effects on fish by introducing sediments into the water column and by entraining adult fish or larvae in the suction head of the dredge. Dredging could produce lethal effects through entrainment; increased sediments could produce sublethal responses by inhibiting respiration or feeding activities through increased turbidity. Fish densities are extremely low in the offshore marine zone where these activities would take place. Further, coastal waters in this region frequently are naturally turbid.

Adult fish will generally move away from construction and dredging activities with no effect on the populations, and they will probably return after construction. Larvae of anadromous and marine fish that occur in the area of dredging could be entrained in large numbers. However, the effect of these deaths may not be measurable because of natural fluctuations in recruitment. Therefore, the dredging- and construction-induced effects on fish populations in the Sale 126 area are expected to be very low.

Summary: Under the development and production phase of the base case, the fish resources of the Sale 126 area would very likely be affected by oil spills, drilling discharges, construction activities, and seismic disturbance; however, the magnitude and duration of these effects would vary for each of the causal agents.

Oil spills would produce a variety of lethal and sublethal responses in the fish that occur in the Sale 126 area. Offshore oil spills are expected to have a low effect on fish, given the relatively broad distribution of fish, the low concentrations of oil associated with slicks, and the low probabilities of offshore spills contacting important fish habitats. Moderate effects, however, are possible for some anadromous fish (salmon, rainbow smelt, and arctic char) and capelin if spawning-year individuals, aggregated multiage assemblages, or a year-class of young were affected by a spill in nearshore waters. Conditional probabilities, however, show a <0.5-percent chance that oil spills of ≥ 1,000 bbl would contact during the summer (ice-free) season, when these species are in these waters in some numbers (Appendix C: Table C-6).

A large spill from the estimated onshore pipeline is likely to have a high effect on fish by affecting overwintering and rearing habitat, sensitive lifestages, and/or concentrations of fish. A very high effect on fish is possible if the Colville River were contaminated. To compute the probability of a spill contacting the Colville River, the spill rate for the existing TAP was used. Given the length of the pipeline (640 km), the number of spills (188), the probability of at least one spill of ≥ 2 bbl contacting the Colville River or other major river tributary is 95 percent. Over the 19-year production life of the Sale 126 base case, 121 minor onshore oil spills (about 6 bbl), 45 moderate onshore oil spills (about 98 bbl), and 22 major oil spills (about 1,500 bbl) are estimated to occur. These probabilities indicate a very high potential to affect the fishes of the major rivers traversed by the proposed onshore pipeline.

Drilling discharges could affect fish in a limited area around the discharge point. Considering the low densities and the mobile behavior of fish, the low toxicities of drilling discharges, and the rapid dilution and dispersion of drilling fluids and cuttings, these effects on fish in the Sale 126 area are expected to be very low.

Offshore-construction activities in the Sale 126 area would cause suspended sediments and entrainment of some adult, juvenile, and larval fish. Considering the low densities of fish and their high tolerance to suspended sediments, the effects of offshore-construction activities on the fish resources of the Sale 126 area expected to be very low.

Under the development and production phase of the base case, 7,055 trackline km of seismic line would be surveyed. Seismic disturbance to fish could be caused by airguns, which are commonly used for seismic surveys. Considering that only a small number of fish eggs could be harmed in the immediate vicinity of the energy release, the effects of seismic disturbance on the fish resources of the Sale 126 area are expected to be very low.

CONCLUSION: The effects of the base case on fishes as a result of exploration and development and production are expected to be VERY LOW in marine habitats and VERY HIGH in freshwater habitats.

5. Effects on Marine and Coastal Birds: Several million migratory birds occur on coastal, marine, and tundra habitats within or adjacent to the proposed Sale 126 area. Among the most abundant species that may be affected by the proposal are common and thick-billed murres; black-legged kittiwake; arctic tern; glaucous and Ross' gulls; king and common eiders; Pacific brant; oldsquaw; northern pintail; red phalarope; and four sandpiper species. Important habitat areas include Kasegaluk Lagoon; Peard Bay; the Wainwright/Kuk River area; Capes Lisburne, Lewis, and Thompson; Ledyard Bay; and Point Hope Lagoon (refer to Sec.III.C.5 and Graphic No. 1).

The primary adverse effects on marine and coastal birds from OCS activities in the proposed Sale 126 area would come from oil pollution of the marine environment, manmade disturbance of bird populations, and degradation of habitats resulting in altered distribution or diminished productivity. The effects of oil pollution on birds are well documented. Discussion of the nature of these effects is given by Hansen (1981), Holmes (1984), and Leighton (1983). In the following analyses, potential levels of effect on regional populations of marine and coastal birds (those breeding or summering in or migrating through Chukchi Sea coastal areas) are defined in terms of time required for the population to return to its former status of abundance and/or distribution (Table S-2). It is assumed that no oil spills will occur during the exploration phase of development.

a. <u>Effects of Oil Spills</u>: Direct oil contact with birds usually is fatal. Oiling of birds causes death from hypothermia, shock and/or drowning. Oil ingestion through preening of oiled feathers significantly reduces reproduction in some birds and causes various pathological conditions. Oil contamination of eggs by oil-fouled parent birds significantly reduces hatching of eggs.

Indirect effects of oil pollution include reduction, contamination, and displacement of food sources, as well as contamination of shoreline habitats. A sudden, local, oil-spill-related adverse effect on major food sources that occurs during a migration stopover or during the nesting period could lower reproduction and survival of bird populations that depend on the affected food source. Long-term, low-level contamination of food sources and habitats could lead to chronic toxicity effects in birds through the accumulation of hydrocarbon residues that may adversely affect their physiology and behavior.

The effects of an oil spill on birds in the Sale 126 area would depend on many factors including the season of occurrence; volume, nature, and duration of the spill; species and numbers occurring in the areas affected; and physiological condition of the birds. Spills that occurred during the winter would have no immediate effect on birds unless oil entered the recurrent flaw-zone lead that may extend from Point Hope to Barrow after spring migrants had started moving into the area. There is little evidence to suggest that substantial numbers of birds overwinter in this lead. This could be due in part to the lead often being less than 1 km wide and open only 50 percent of the time during winter. Oil remaining in the ice after winter-cleanup efforts could directly affect birds during the following spring-breakup period or indirectly affect them through changes or reduction in food availability.

<u>Site-Specific Oil-Spill Effects</u>: Oil-spill-contact probabilities referred to in this section (see Appendix C) assume the occurrence of development to the extent estimated in Section II.A.2. Spill trajectories used in this analysis are modeled for a 30-day period for spills occurring during the summer season (16 June-31 October), and for a period extending through the entire winter for spills occurring during the winter season (1 November-15 June). Modeled probabilities of oil spills occurring during the summer and winter seasons and contacting important marine and coastal bird habitats are shown on Figure IV-C-1.

Under the base case, the probabilities of oil-spill occurrence and contact that occur in Migration Corridors A and B, the Peard Bay Area, and the Wainwright Subsistence/North Kasegaluk Lagoon Area during the summer open-water season range from 18 to 44 percent. In the Point Lay/South Kasegaluk Lagoon Area the probability is 7 percent. However, bird density in the offshore-migration corridors (A and B) probably is relatively low during most of the open-water season (Fadely et al., 1989); and the model boundaries of the other three areas extend well offshore into the sale area, with the result that occurrence and contact appears much more likely than would be expected were a spill to traverse the greater distance to the high-bird-density nearshore-lagoon areas they include. In this regard, the probability of actual shoreline contact from spills occurring in the sale area is 1 percent along the entire coastline adjacent to the sale area. However, in the vicinity of Point Belcher, a proposed pipeline landfall is likely to elevate the probability of spill contact. A spill entering a coastal-nearshore area during the open-water season may not be prevented by barrier islands from entering a sensitive lagoon (e.g., Kasegaluk), since there are numerous passes as well as the potential for transport in by storm surge. Any spill entering a lagoon is likely to remain a threat to bird populations for some time, since weathering processes are slow in these protected waters. The chance of a spill occurring and contacting the area surrounding Cape Lisburne, frequented by large numbers of foraging seabirds, is 1 percent.

Farther offshore, the probability of spill occurrence and contact at Sea/Ice Segments 4 through 6 of 21 to 82 percent suggests that Ross' gulls passing through the ice front in the northern sale area, especially between mid-September and mid-October, could be at considerable risk. However, their movement in the northern and central Chukchi Sea primarily is in association with the ice edge, and thus occurs over the relatively short period when the advancing ice edge moves through the sale area.

Oil spills occurring during the winter season potentially pose about the same risk of contact with the Peard

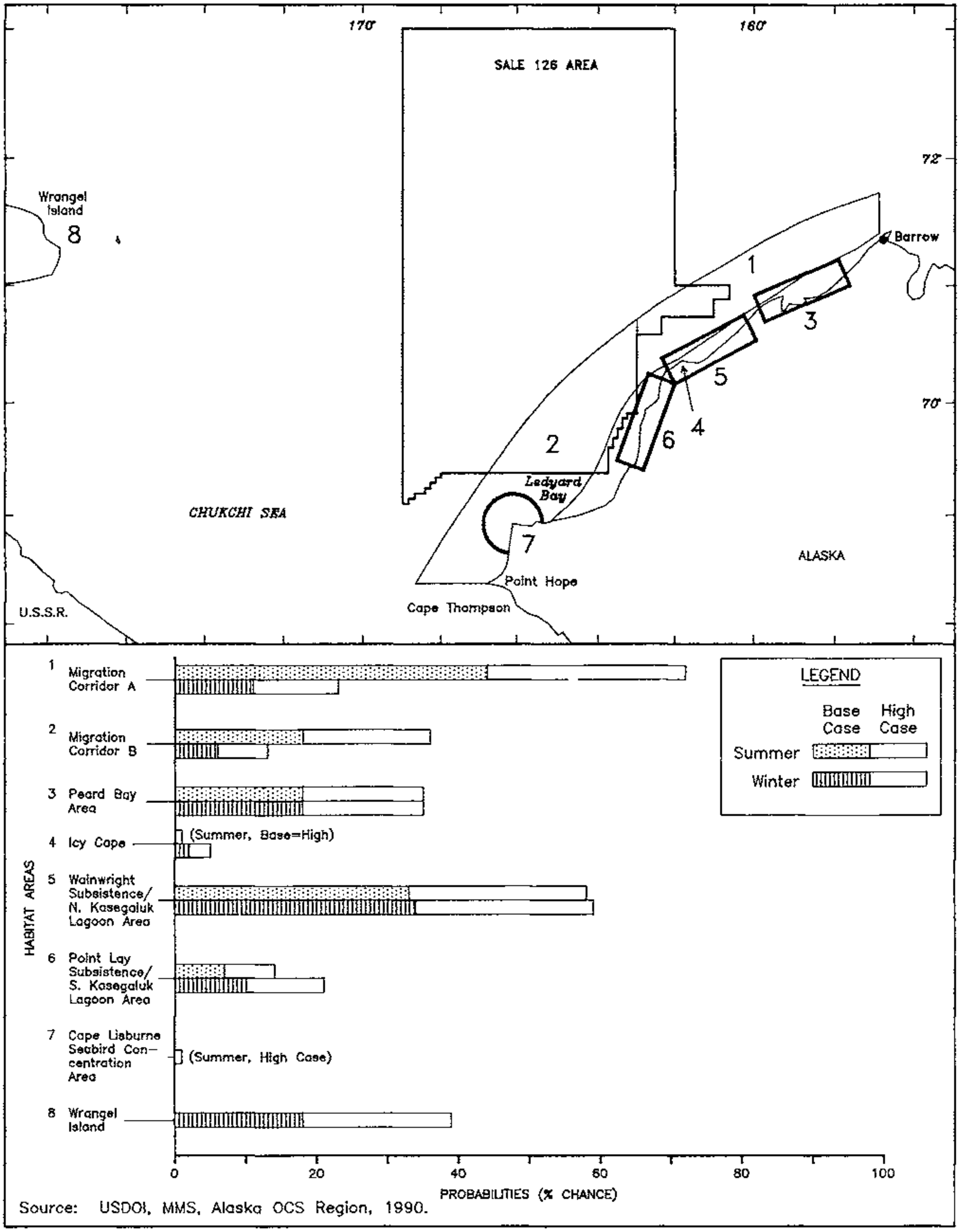


Figure IV-C-1. Combined Probabilities of Oil-Spill Contact to Marine and Coastal Bird Habitats during Summer and Winter Seasons

Note: Probabilities of one or more spills ≥1,000 bbl occurring and contacting marine and coastal bird habitats within 30 days during the summer season (16 June–31 Oct.) and during the entire winter season (1 Nov.–15 June), for base and high cases over the life of the field. Probabilities for environmental resource/habitat areas with <0.5-percent chance of contact are not shown.

Bay, Wainwright Subsistence/North Kasegaluk, Icy Cape, and Point Lay Subsistence/South Kasegaluk Areas as spills occurring and contacting during the summer season, although winter spills occurring offshore of the lagoons are not likely to contaminate Kasegaluk Lagoon, Peard Bay, or other important lagoon and river-mouth bird habitats because shorefast ice and the barrier islands could prevent an oil slick from actually entering the lagoons. However, ice override of the barrier islands or ice-blocked passes could transport some ice-entrained oil into the lagoons to be released during the spring melting period. In fact, since relatively few birds overwinter in this region, one of the principal threats to bird populations from winter spills is the release of ice-entrained oil into restricted open-water areas (e.g., migration-corridor leads, river mouths) during the spring melting period, when many thousands of migrant birds may be present. However, during this period, any oil spill in the sale area is likely to move farther offshore to the west, as suggested by the reduced probability in winter of occurrence and contact in Migration Corridors A and B (Fig. IV-C-1) and thus is not likely to contact large concentrations of birds.

Under the base case, two oil spills of ≥ 1,000 bbl are estimated for the 30-year life of the field. Adverse effects would be most severe if the spill occurred during May through November, when marine and coastal birds are common or abundant in coastal habitats near the Sale 126 area. If a spill occurred specifically near Kasegaluk Lagoon or Icy Cape, several hundred to a few thousand eiders or oldsquaw in the Icy Cape area could be killed. If the spill entered the lagoon and inundated the shallow lagoon waters and saltmarshes, especially in late summer or early fall, greater numbers of birds--including shorebirds and large numbers of brant--could be killed or indirectly affected through the contamination and loss of food sources. Recent (1989) observation of at least 40,000 brant in the northern Kasegaluk Lagoon area in August (Johnson, 1989, oral comm.) corroborates the high risk to which this species would be exposed if a spill entered the lagoon during the fall-migration period. However, with a 2-percent chance of spill occurrence and contact within 30 days, such an event is unlikely. If a spill occurred within a lead near the Cape Thompson or Cape Lisburne colonies during spring, when thousands of murres and other colonial birds were rafting on the open water, greater numbers of birds could be lost; but the probability of spill occurrence and contact in these areas is 1 percent or less.

In general, oil spills that may occur as a result of the proposed action could kill several hundred to several thousand birds over the 30-year life of the field. The numbers of birds lost from populations of oldsquaw and common eider are likely to be replaced through recruitment within one generation (1 or 2 yr)--a low-level effect. Larger numbers of brant could be contacted if oil entered the northern portion of Kasegaluk Lagoon during southward staging and migration, resulting in a moderate effect; however, the probability of spill occurrence and contact here is very low.

The loss of several thousand murres in the Cape Lisburne colony (150,000-250,000 murres) could require a generation for replacement because of their low reproductive rate. However, the presence of nonbreeding murres or failed breeders from the current season could speed the replacement. Few kittiwakes are likely to be lost as the direct result of an oil spill because they spend relatively little time in the water. However, an oil spill could affect the local distribution of sand lance (an important prey item of both kittiwakes and murres) near the Cape Lisburne colony by, for example, causing decreased productivity in this kittiwake population, and thus a potentially low level of effect. During the open-water season, flocks of Ross' gulls along the pack-ice front, especially in the central and northern Chukchi Sea (Divoky et al., 1988), are at some risk to oil-spill contact. However, because this species is not likely to come into prolonged contact with the oil, feeding mainly by hovering and brief plunges (Divoky, 1976), and oil-spill effects on its pelagic food are likely to be local and temporary near spill sites, effects of the base case on Ross' gulls are likely to be low.

The probability of a spill occurring in the sale area and contacting Wrangel Island (winter/spring season only) is 18 percent. During the winter, the principal risk would be to seabirds and seaducks overwintering in polynyas or other open water in the area. With the onset of melting and pack-ice breakup in spring, release of any oil entrained in the ice could represent a significant threat to the thousands of lesser snow geese that may occupy open-water areas (river mouths, leads) prior to opening of the inland breeding grounds and to the substantial numbers of seabirds that gather in open water prior to occupation of the colony cliffs.

However, since most goose activity is concentrated inland, and seabirds are less abundant along the eastern portion of the island facing the sale area than elsewhere on this island, the probability of contact is relatively low; and effects exceeding low are not expected.

Indirect effects of oil spills through loss of available food are very likely to be local (near the spill site) and of short-term duration--one season or less, with low-level effects. Oil contamination of sensitive habitats such as saltmarshes could have long-term, local effects; but the chance of spill contact with saltmarshes is almost nil. Affected habitats are likely to represent a small portion of any bird population's food source. The combined oil-spill effects of Sale 126 on marine and coastal birds from direct contact with oil and indirect seasonal loss of food sources are likely to be low, with bird populations recovering from spill mortalities and seasonal loss of food sources within a generation.

Onshore-Oil-Spill Effects: An estimated 188 small oil spills (averaging from 6 to 1,500 bbl) could be associated with the base case. An onshore-pipeline spill would contaminate some tundra vegetation and freshwater ponds and streams, killing all or virtually all mosses and above-ground parts of vascular plants as well as aquatic plants and invertebrate organisms at the spill sites (McKendrick and Mitchell, 1978). This could alter or destroy local feeding and nesting habitat of some landbirds, waterfowl, and shorebirds as well as oiling individual birds. Local contamination at spill sites may persist for several years if not rehabilitated but probably represents an insignificant effect on the overall availability of wetland- and tundra-bird habitats due to the abundance of uncontaminated habitats. Control and cleanup operations (ground vehicles, air traffic, and personnel) at the spill site could drive birds (including avian predators) away from the spill site, thereby reducing the likelihood of birds feeding on the oiled vegetation or contaminated prey organisms, although the reproductive effort of nesting individuals would be lost if they were displaced for more than just a short period. The probability of at least one spill >239 bbl occurring and contacting a major river tributary is 29 percent. A substantial oil release from a pipeline at a major river crossing conceivably could reach vulnerable marsh areas along the river course or estuaries at the arctic coast and, if during a migration or molting period, could adversely affect many hundreds of eiders, oldsquaw, or arctic-breeding geese; however, for most of these numerous populations, losses likely to occur still would represent a low effect (potentially moderate in the case of brant). Overall, onshore oil spills are not likely to affect more than a small number of birds, even if the spills contaminated some aquatic habitats, and thus are likely to represent a low effect level.

b. Effects of Disturbance: Activities associated with oil exploration and development, especially air traffic near nesting waterfowl and seabirds, could reduce productivity of some species and may cause temporary displacement of birds from important nesting, feeding, and staging areas. Low-flying aircraft passing near bird colonies often frighten most or all adult birds off their nests, displacing many eggs and young from the ledges by their panic departure and leaving those remaining vulnerable to exposure and predation (Jones and Petersen, 1979). Repeated disturbance could significantly reduce hatching and fledgling success (Scott, 1976). Studies in the arctic indicate that arctic terns, black brant, and common eiders all show less nesting success in disturbed areas (Gollup, Goldsberry, and Davis, 1972). Responses of molting and staging brant to disturbing stimuli suggest that during these energy-demanding periods, disturbance could increase the length of time required to complete these critical annual-cycle phases and could adversely affect survivorship of individual brant, although clarification of these points will require further study (Derksen et al., 1989; Ward et al., 1988). Bird responses to human disturbances are highly variable and depend at least on the species; the physiological state of the birds; distance from the disturbance; and type, intensity, and duration of the disturbance.

Within the Chukchi Sea area, disturbance of seabird colonies at Capes Lisburne and Lewis could result in substantial losses in annual productivity. Eiders and terns nesting on barrier islands may be disturbed by aircraft and boat traffic, and some disturbance of molting and/or staging eiders, oldsquaw, brant, and shorebirds on Peard Bay and Kasegaluk Lagoon is likely to occur. However, although Johnson (1982a) reported that oldsquaw may temporarily change their local distribution in response to disturbance, studies by Ward and Sharp (1973) and Gollup, Goldsberry, and Davis (1972) suggest that long-term displacement or abandonment of important molting and feeding areas by oldsquaw due to occasional aircraft disturbance is unlikely. Sustained activities (e.g., maintenance of facilities or pipeline) could cause abandonment of local areas for the duration of the activity. Disturbance of nesting birds along the northern part of the Sale 126 area near Point Belcher is likely to occur but would not involve large numbers. Disturbance resulting from any oil-spill-cleanup activities also is likely to be localized and relatively short-term. Nests of most waterfowl and shorebirds are widely dispersed over the coastal tundra; thus, disturbance of local tundra-nesting birds probably would have little effect on North Slope populations as a whole.

Site-Specific-Disturbance Effects: Helicopter-support traffic between Barrow or Wainwright and drilling units would reach a maximum of 150 round trips/month during exploration (assumed 3-month drilling season), 100/month during development (annual drilling season), and 48/month during production. This activity would be the primary source of disturbance to marine and coastal birds. If production takes place, a pipeline terminal facility and airstrip would be built at Point Belcher. During exploration, goods would be barged to Point Belcher. A maximum of 5 drilling units would be used in the summer during exploration. Production platforms would be supported by 1 or 2 icebreaking supply boats per platform.

The greatest disturbance is likely to be caused by aircraft flying near bird-feeding and -molting concentrations at Kasegaluk Lagoon and Peard Bay (Graphic No. 1). Because of frequent low visibility due to fog, aircraft may not be able to avoid disturbing areas of bird concentration during the summer-fall period. For example, aircraft--especially helicopters--flying at low altitudes along the coast could greatly disturb larger flocks of several thousand to perhaps tens of thousands of molting and/or feeding waterfowl, particularly in August and September. Aircraft flying directly from the Barrow, Wainwright, and Point Belcher airstrips to offshore platforms are less likely to disturb several thousand birds than aircraft paralleling the coast. On occasion, offshore flights may briefly disturb foraging flocks of seabirds numbering in the hundreds to a few thousand, with little or no lasting effects. Such disturbance may disrupt migratory birds as they are acquiring the energy necessary for successful migration.

Low-altitude overflights of the Capes Lisburne and Lewis seabird colonies during the nesting season (June-September) could cause the direct loss of eggs and nestlings and might cause substantial reductions in the productivity of these seabird populations if disturbance incidents were frequent. However, because air support is likely to be based out of Barrow and Wainwright and is not likely to pass near Capes Lisburne and Lewis on flight paths crossing directly over open water to the platforms, disturbance of these colonies would not occur. The overall effect on marine and coastal birds from aircraft disturbance associated with the proposal is likely to be low.

Low-frequency sounds emitted from drilling operations and vessels have not been shown to displace seabird-foraging activities from active oil-development areas along the California coast or in Cook Inlet and are not expected to displace birds in the sale area and vicinity. During development and production, vessel traffic to and from Point Belcher could briefly disturb flocks of fewer than 100 to several thousand birds when the boats pass nearby. As the vessels pass near the birds, short-term diving or flight responses probably would represent very low effects. Use of small boats or hovercraft in or near coastal lagoons could disturb large flocks of feeding and molting birds, with effects similar to those caused by low-flying aircraft. In general, however, disturbance of rafting and foraging birds by vessels is likely to be very brief (a few minutes) and probably have very low effects. The overall effects on marine and coastal birds of noise and disturbance from aircraft, boat traffic, and drilling activities associated with the base case are likely to be low, and not differ significantly between exploration and development/production phases due to the similar levels of these activities.

c. Effects of Construction Activities:

Offshore Construction: Under the base case, 2 to 5 exploration-drilling units would be used at one time. Dredging may be required to prepare the seafloor for a maximum of 6 bottom-founded production platforms, and for trenching and burial of 325 km of offshore trunk pipeline coming ashore at Point Belcher. Perhaps several hundred birds could be temporarily displaced (for one season) near platform and pipeline sites. Displacement could occur because of noise disturbance and temporary disruption or removal of food sources from dredging at the platform or pipeline sites (USDOI, MMS, 1982). Disturbance of birds from dredging and platform installation would be short-term (one summer season or less); and disruption of food sources would be very local, within a few kilometers of the pipeline route, and temporary (one season). Therefore, specific effects on marine and coastal birds from construction associated with the base case are likely to be low.

Onshore Construction: Other factors that may directly affect birds include shoreline alteration associated with the shorebase (25-30 hectares), the 640-km onshore pipeline and support road, 10 to 12 helicopter pads along the pipeline corridor, and gravel mining (500,000 m^3).

During the exploration phase of the base case, these effects are likely to be very low because no permanent facilities would be built. Of primary concern during the development phase, however, would be the permanent loss of 25 to 30 hectares of habitat from siting the shorebase at Point Belcher and approximately 64 km^2 of habitat in the pipeline corridor, including the 10 to 12 helicopter pads and the support road connecting Point Belcher with the existing TAP corridor. Road construction along the pipeline corridor would reduce nesting and feeding habitats along the road through gravel burial of tundra and changes in water drainage. Water impoundments created by road construction can affect the availability of insect prey for some shorebirds near these facilities (Connors, 1983). The pipeline probably would be located along the 600-foot contour line across the NPR-A between the Colville River and the lake district and would cross the Colville near Umiat and connect with the TAP at Pump Station No.2. Sixty-four square kilometers of low- to medium-density tundra habitat of various waterfowl and shorebirds (0.4-5.8 ducks/km^2) would be destroyed or altered along the pipeline corridor. Because this habitat loss would be a very small percentage of the available tundra habitat, effects on birds from onshore development associated with the proposal are likely to be low.

Summary: The direct effects of two offshore oil spills and many small onshore-pipeline spills on marine and coastal birds may include the loss of several hundred to several thousand sea ducks and murres and small numbers of other birds over the 30-year life of the field. However, the chance of oil spills contacting coastal concentrations of tens of thousands of birds is very low--less than 3 percent--under the base case. The loss of several thousand oldsquaw, common eiders, and murres would represent a low effect because recruitment would replace lost individuals within 1 or 2 years or within one generation or less. Indirect oil-spill effects through loss of available food sources are very likely to be local near the spill site and last for one season or less (low effect). Oil contamination of sensitive habitats, such as saltmarshes and tundra ponds, from onshore spills may have long-term effects lasting several years; but the chance that any estimated spill would contact marine saltmarshes is nil, and local contamination of tundra ponds and wetlands near the spill sites is not expected to have any measurable effect on the availability of these habitats and food sources to marine and coastal birds due to the abundance of uncontaminated habitats.

The 150 (exploration), 100 (development), and 48 (production) helicopter trips per month to and from platforms, particularly low-altitude flights along the coast of the Sale 126 area, could be the greatest cause of disturbance to birds. Aircraft disturbance of large flocks of feeding waterfowl (such as oldsquaw, eiders, and Pacific brant) and shorebirds in the Kasegaluk Lagoon and Peard Bay habitats could temporarily displace these molting and migratory birds as they are acquiring the energy necessary for successful migration and may result in higher migration mortality and lower winter survival of affected birds. However, the frequency of aircraft-caused disturbance of birds in the sale area alone is not likely to have more than low effects, because most aircraft would fly directly to the platforms and not disturb coastal concentrations. Aircraft disturbance of large, nesting seabird colonies at Capes Lisburne and Lewis (over 150,000 birds, mostly murres and kittiwakes) is not likely to occur because aircraft traffic centered out of Barrow and Wainwright would fly directly to the offshore platforms and not pass near these or any other large colonies. Most disturbance of birds by vessel traffic is likely to be very brief and have an inconsequential effect on the well-being of birds involved (very low effects). Overall effects on marine and coastal birds from air- and vessel-traffic disturbance associated with the base case are likely to be low.

Offshore installation of 6 production platforms, trenching and burial of 282 km of offshore pipeline; and onshore construction--including a 25- to 30-hectare shorebase at Point Belcher, a 640-km onshore-pipeline corridor with a support road and 10 to 12 gravel helicopter pads--is likely to temporarily disturb and displace some birds from local habitat areas that would be altered or destroyed by these activities. Offshore dredging, pipelaying, and platform construction would have local, short-term, or low, effects on birds. Construction of the onshore pipeline corridor to the TAP would alter approximately 64 km^2 of bird tundra habitat along the pipeline route and represent a minor habitat loss (a very small percentage of habitat available) to bird populations. The overall effects of oil spills, noise disturbance, and habitat alteration due to construction activities on the marine and coastal birds of the Sale 126 area are likely to be low and not differ significantly between exploration and development/production phases.

CONCLUSION: The effect of the base case on marine and coastal birds as a result of exploration and development and production is expected to be LOW.

6. Effects on Pinnipeds and Polar Bear: Four pinniped species--Pacific walrus; ringed, spotted, and bearded seals--and the polar bear commonly occur throughout the proposed Sale 126 area and are likely to have some interaction with OCS activities. Oil pollution, noise and disturbance, and habitat changes due to construction activities associated with the base case could adversely affect these marine mammal populations in the sale area. It is assumed that no oil spills will occur during the exploration phase of development. This analysis discusses the general effects of oil and disturbance on individual animals, followed by the site-specific effects these adverse factors could have on their regional populations. Pertinent analysis contained in Section IV.B.6 of the Chukchi Sea Lease Sale 109 FEIS (USDOI, MMS, 1987b) is incorporated by reference.

a. Effects of Oil Spills: Effects of direct contact with spilled oil are variable among marine mammals, depending on factors such as sensitivity of the species, age, and physiological status of the animal (Hansen, 1985). Polar bears and newborn seal pups (initially covered with fine hair) are likely to suffer direct mortality from oiling through loss of insulation and subsequent hypothermia. Oiling also may increase other physiological stresses, particularly in younger animals, and may contribute to the death of some individuals, especially during periods of elevated natural stress (Duval, Martin, and Fink, 1981). Adult and subadult ringed, spotted, and bearded seals and walrus, which rely on thick layers of blubber for insulation, may suffer some temporary adverse effects such as eye and skin irritation, with possible infection if contact with oil occurs (Geraci and Smith, 1976b; Geraci and St. Aubin, 1980, 1988). Direct contact with dispersants, like oil, may destroy the insulative properties of the coat of fur-bearing marine mammals and result in death from hypothermia. However, the available evidence does not indicate that dispersants or dispersant/oil mixtures are likely to have significantly greater effects than direct exposure to oil alone (Tetra Tech, Inc., 1985).

Oil ingestion by marine mammals consuming contaminated prey, or as a result of grooming or nursing, could have various pathological effects depending in part on the ability of the animal to excrete and/or detoxify the hydrocarbons. Death may occur if a large amount of oil is ingested, or aspirated into the lungs, particularly by polar bears (Engelhardt, 1981; Geraci and St. Aubin, 1988; Oritsland et al., 1981). Bears will eat oil-contaminated seals and also will ingest oil groomed from their oil-fouled fur. Seals apparently can metabolize small quantities of ingested oil and detoxify hydrocarbons (Engelhardt, 1982, 1983; Geraci and St. Aubin, 1982; Geraci and Smith, 1976b) and, thus, may not suffer any serious physiological effects if they consume small quantities of oil.

Contact with oil may cause marine mammals to abandon, at least temporarily, specific habitats that become contaminated. Migrating marine mammals following a specific route may have little choice but to move through an area contaminated with oil.

(1) Indirect Effects of Oil: Indirect effects of oil pollution on marine mammals primarily would be those associated with changes in availability or suitability of food resources. Potential effects of oil on some prey species are discussed in Sections IV.C.3 and IV.C.4. During heavy ice years, low plankton productivity may result in decreased populations of benthic invertebrates and arctic cod, limiting food resources of seals and walrus over a portion of the Chukchi Sea (Frost and Lowry, 1981). A major spill during such a period could intensify this effect and temporarily result in decreased local ringed and bearded seal productivity and concurrent altered polar bear distribution. Thus, any of these species might temporarily abandon an area of local prey depletion; but the effect probably would persist for no more than one season.

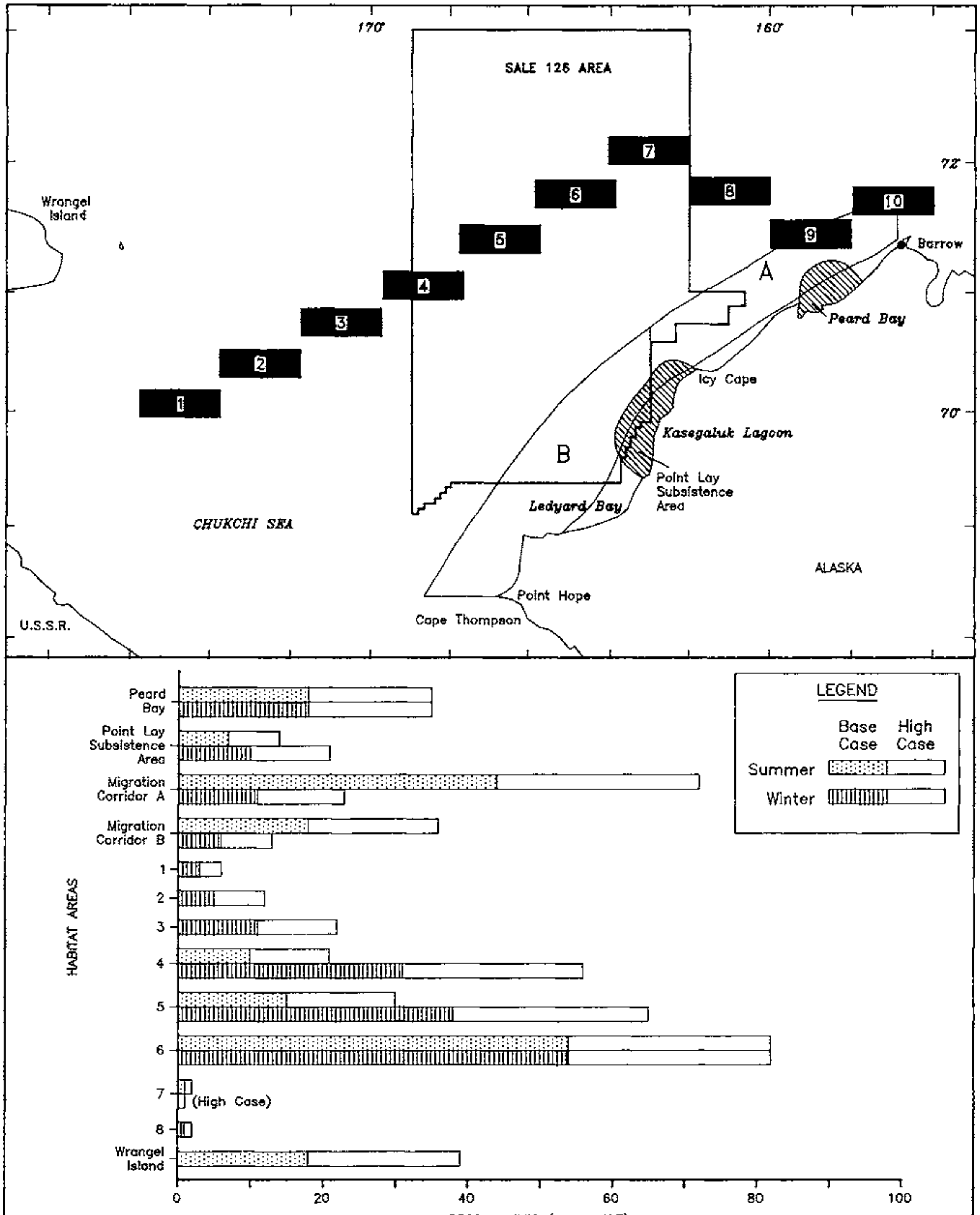
(2) Site-Specific Oil-Spill Effects: In the following discussion, potential levels of effect on regional populations of pinnipeds and polar bear are defined in terms of time required for the population to return to its former status of abundance and/or distribution (Table S-2). The probabilities of oil spills occurring and contacting important marine mammal habitats during the winter ice-cover season (1 November-15 June) and summer open-water season (16 June-31 October) are shown in Figure IV-C-2 (probabilities of <3% are not discussed). Probabilities used to describe chance of occurrence and contact following winter spills are generated by an oil-spill-model trajectory period lasting the entire winter; in summer, model spill trajectories used are those tracked for 30 days. It is estimated that two oil spills of ≥ 1,000 bbl could occur in the Chukchi Sea over the 30-year life of the field.

The probability of a spill occurring and contacting the drifting-pack-ice habitats of bearded and ringed seals and polar bear west and northwest of Icy Cape in winter (including some west of the sale area) ranges from 3 to 54 percent (Sea-Ice Segments 1-6). Ice habitats farther west near Wrangel Island (Land Segments 27-30)--an important denning area for polar bear--have an 18- percent probability of occurrence and contact, while the probability of occurrence and contact with Migration Corridors A and B/Point Lay Subsistence Area (ringed and bearded seal and polar bear habitat) in the southeast sale area ranges from 6 to 11 percent (Fig. IV-C-2). It is important to note that oil spilled in winter under the ice is likely to be frozen into the drifting pack ice within a short period and to remain so until meltout in June; thus, the probability that animals occupying a particular area in winter or spring will encounter spilled oil is likely to be less than the probability of a spill simply occurring and contacting the area. Any oil remaining on the surface of the ice would become at least partially weathered within a short time.

The probability of a spill occurring and contacting the typical pack-ice-front habitats of ringed and bearded seals, walrus, and polar bear northwest of Icy Cape during the summer, represented as Sea-Ice Segments 4 through 6, ranges from 10 to 54 percent, while Migration Corridors A and B and the Point Lay Subsistence Area have a 7- to 44-percent chance of occurrence and contact (Fig. IV-C-2). Occurrence and contact risk to shoreline habitats of spotted seals such as Kasegaluk Lagoon (Land Segment 21) within 30 days is 1 percent. The chance of occurrence and contact in the Peard Bay area, also important habitat for spotted seals during this season, is 18 percent.

The above values suggest that ringed, spotted, and bearded seals; walrus; and/or polar bear occupying the drifting pack ice of the northwestern sale area (e.g., Sea-Ice Segment 6), where there is more than an even chance of oil-spill occurrence and contact in winter or spring, could be at substantial risk of contact by oil released from ice entrainment during breakup in late spring and early summer. Outside this area, the probability of occurrence and contact declines quite rapidly in all directions except towards Wrangel Island, where it is still 18 percent (Fig. IV-C-2). During the open-water season, encounter probability could be higher in the northwestern sale area and Migration Corridors A and B than elsewhere prior to substantial melting and breakup of the pack ice that is used for hauling out by these species. Later in the summer, oil-spill risk to spotted seals occupying coastal habitats in the vicinity of Peard Bay would decline.

A winter or spring spill of 22,000 bbl is likely to contact relatively small numbers of ringed, spotted, and bearded seals since they do not concentrate in large groups (densities generally lower than $3/km^2$); and most oil would be trapped in the ice when populations of these species are most vulnerable (young present). Any adults contacted are likely to experience only sublethal effects unless severely weakened or stressed by (e.g.)



Source: USDOI, MMS, Alaska OCS Region, 1990.

Figure IV-C-2. Combined Probabilities of Oil-Spill Contact to Marine Mammal Habitats during Winter and Summer Seasons

Note: Probabilities are for one or more spills ≥1,000 bbl occurring and contacting marine mammal habitats (Wrangel Island, Migration Corridors A and B, Sea/Ice Segments 1-8, Point Lay Subsistence Area, Peard Bay) during the entire winter season (1 Nov.-15 June), and within 30 days during the summer season (16 June-31 Oct.) over the life of the field. Probabilities for environmental resource/habitat areas with less than 0.5-percent chance of contact are not shown.

disease or severe weather; pups contacted are likely to die. Ringed seals occupying landfast ice in and adjacent to the sale area are not likely to experience significant contact or pup mortality with oil-spill occurrence and contact risk at ≤ 18 percent (e.g., Peard Bay, Point Lay Subsistence Area). Thus, overall seal mortality is expected to be slight, probably fewer than 100 individuals, and to require a recovery period of less than one generation--representing a low level of effect. When released at meltout (late June), such a spill may sweep an area of 2,200 km^2 in the 30 days following a 60-day ice-dispersion period; but the actual area covered by thick oil probably would be limited to 3 km^2 (Appendix L, Table L-1). However, most seals will not be found where the pack ice is dispersing (melting and breaking up). Likewise, a summer spill of 22,000 bbl may sweep an area of 1,100 km^2 over a period of 30 days (Table L-1), but few seals will be occupying open-water habitat.

An oil spill released from ice or occurring in summer and contacting the migration corridor between Point Hope and Point Barrow, the pack-ice front west of Barrow, or the western Chukchi Sea, could contact perhaps several hundred to a few thousand walrus, resulting in irritation of sensitive tissues or inhalation of hydrocarbon vapors for a short period of time. Although there is no evidence to indicate that walrus would be killed by direct contact with oil, such temporary effects might reduce the survival of adults and young calves experiencing increased environmental stress from elevated population numbers and possible food depletion, as current evidence suggests may be occurring in the Pacific walrus population. The death of relatively small numbers of walrus that may be stressed from oil contact would be considered a low effect on this population requiring less than a generation for replacement.

Most of the oil from a spill occurring in winter and contacting the drifting pack ice in and near the proposed sale area and ice habitats near Wrangel Island would remain encapsulated until meltout during late June. By this time, for example, the estimated 200 to 250 female polar bears and cubs denning on Wrangel Island would have dispersed away from this concentration area onto the pack ice, thereby avoiding most risk of large-scale oil-spill contact to this segment of the population. Taylor et al. (1987) indicate that the population can sustain a 1.6-percent loss of females annually, or perhaps 32 individuals in a population of 2,000. This number probably already is exceeded by natural and subsistence-caused mortality, so any additional substantial spill-related mortality could have severe consequences. However, the coincidence of areas of most probable oil-spill occurrence and contact and areas of elevated bear density probably occurs less frequently than in the Beaufort Sea. This situation is likely to prevail for much of the year in the Chukchi Sea because of the widespread dispersion of areas of new ice formation that tend to concentrate favored prey (seals), as well as the rather random movement of water and pack ice that provides oil-spill transport. In May and June, polar bears may be concentrated along the spring lead system of the eastern Chukchi (April-June), as well as in the shorefast ice zone where ringed seals are most dense, and thus may be vulnerable to elevated effects from any oil spill occurring in or released during this period.

During summer, some female bears and cubs could encounter oil from a spill along the pack-ice front, in leads, or on isolated floes in open water potentially far from the pack ice (Amstrup, 1990, oral comm.); but their density generally is low in the Chukchi Sea, suggesting that the number is likely to be small, with replacement of lost individuals requiring a generation or less. There may be a possibility of polar bears being attracted to the area of a spill, but there is no specific evidence available to support this suggestion. During the fall season, formation of new ice habitat along the advancing pack-ice edge could attract and expose to an oil spill seals and thus polar bears in greater numbers--especially females with young--than generally would be the case in the thick pack ice (Amstrup, 1990, oral comm.). However, this condition may be quite transient through the sale area and vicinity, and thus the probability of coincidence of a spill and elevated bear density is not significantly greater than expected in other habitats. Polar bears also may concentrate in the fall at several localities along the coast (e.g., Point Franklin, Point Belcher, Point Lay); however, the probability of a spill occurring and contacting these shoreline areas is ≤ 1 percent. As a result of these aspects of polar bear distribution and abundance, substantial mortality from the two oil spills estimated for the life of the field is considered an unlikely prospect.

Most of the oil from a spill occurring in winter and contacting the drifting pack ice in and near the proposed sale area and ice habitats near Wrangel Island would remain encapsulated until meltout during late June. By this time, for example, the estimated 200 to 250 female polar bears and cubs denning on Wrangel Island would have dispersed away from this concentration area onto the pack ice, thereby avoiding most risk of large-scale oil-spill contact to this segment of the population. Taylor et al. (1987) indicate that the population can sustain a 1.6-percent loss of females annually, or perhaps 32 individuals in a population of 2,000. This number probably already is exceeded by natural and subsistence-caused mortality, so any additional substantial spill-related mortality could have severe consequences. However, with the possible exception of the fall period, the widespread dispersion of conditions likely to concentrate favored prey (seals) and thus polar bears in the Chukchi Sea, as well as the rather random movement of water and pack ice providing oil-spill transport, suggests that coincidence of areas of most probable oil-spill occurrence and contact and areas of elevated bear density--where oil-spill contact could result in substantial mortality--occur less frequently than in the Beaufort Sea. In May and June, polar bears may be concentrated along the spring lead system of the eastern Chukchi (April-June), as well as in the shorefast ice zone where ringed seals are most dense, and thus may be vulnerable to elevated effects from any oil spill occurring in or released during this period. During summer, some female bears and cubs could encounter oil from a spill along the pack-ice front, in leads, or on isolated floes in open water potentially far from the pack ice (Amstrup, 1990, oral comm.); but their density generally is low in the Chukchi Sea suggesting that the number is likely to be small, with replacement of lost individuals requiring a generation or less. There may be a possibility of polar bears being attracted to the area of a spill, but there is no specific evidence available to support this suggestion. During the fall season, formation of new ice habitat along the advancing pack ice edge could attract, and expose to an oil spill, seals and thus polar bears in greater numbers, especially females with young, than generally would be the case in the thick pack ice (Amstrup, 1990, oral comm.). However, this condition may be quite transient through the sale area and vicinity, and thus the probability of coincidence of a spill and elevated bear density is not significantly greater than expected in other habitats. Polar bears also may concentrate in fall at several localities along the coast (e.g., Point Franklin, Point Belcher, Point Lay); however, the probability of a spill occurring and contacting these shoreline areas is ≤ 1 percent. As a result of these aspects of polar bear distribution and abundance, substantial mortality from the two oil spills estimated for the life of the field is considered an unlikely prospect.

Some minor reduction in the availability of food resources (e.g., arctic cod) near a spill site could occur and affect local marine mammals such as breeding ringed seals. However, rapid prey recruitment from adjacent habitats after the spill has dispersed probably would result in this being a short-term occurrence. Oil-spill effects on the benthic prey of walrus and bearded seals may be more persistent on a local level, where hydrocarbon contaminants could be incorporated into sediments. However, very low concentrations of oil would reach bottom sediments and benthic habitats; and this contamination is not likely to significantly affect clam resources in important feeding areas. Overall effects of food reduction are not expected to exceed a low level.

b. Effects of Disturbance: Sources of disturbance to seals, walrus, and polar bear include aircraft; supply, seismic and icebreaking vessels; installation and operation of offshore production facilities, drilling operations, and dredging; construction and operation of onshore facilities; human presence including oil-spill-cleanup activities; and snowmachines and other vehicles.

Low-flying aircraft are known to panic hauled-out seals and walrus (Johnson, 1977a; Salter, 1979). The stampede of walrus nursery herds hauled out on the ice may result in the death or injury of calves from trampling by disturbed adults. Secondary effects may include elevated physiological stress and disruption of mating or other activities including haulout and pup-feeding periods, any of which could make the animals more susceptible to environmental stresses or the effects of oiling. Other sources of airborne noise are likely to disturb pinnipeds and polar bear within a few kilometers; but sensitivity of individuals is quite variable, possibly depending upon the frequency of exposure and ambient background-noise level (e.g., Kelly, Quackenbush, and Rose, 1986), as well as physiological status, stage of annual cycle, and prior exposure. Frequent or sustained disturbance may cause pinnipeds and polar bears to avoid or abandon an area, at least for the duration of the disturbing activity. For example, recent observations suggest that the presence of icebreaking vessels may cause walrus to retreat to areas with lower noise and activity levels (Brueggeman et al., 1990). Ringed seals may depart or even abandon lairs when disturbed by close approach of human activity (Kelly, Quackenbush, and Rose, 1986). Also, in the event of a spill, activities associated with containment and cleanup could have similar effects for short periods. However, in the case of pinnipeds, the presence of substantial numbers of individuals in the vicinity of intensive fishing operations suggests that at least some of these species can habituate to fairly high levels of human activity (although the level of tolerance in such cases may be due in part to the presence of an abundant food source), and Brueggeman et al. (1990) note that walrus appeared to reoccupy habitat near a drillship from which they had been displaced by icebreaking operations once this activity ceased, even though drilling continued. Industrial activities and human presence near polar bear dens could result in significant disturbance. Polar bears also may be attracted to sites where industrial activity, or oil-spill-cleanup activity are taking place. If this results in a hazardous situation, some bears may have to be moved from the area.

Underwater noise originating from the sources listed above could affect pinnipeds and polar bears over a wider area, since sound travels at greater velocity in this medium. In addition to the potential for alarm, it may interfere with or mask pinniped communication or echolocation signals, or may interfere with reception of other sounds from the environment (Terhune, 1981). The low-frequency sound emitted by seismic devices currently in use (e.g., airguns) generally is well below the sensitivity range of pinnipeds and thus is unlikely to cause damage to them, although these devices may cause some level of disturbance. Likewise, noise levels measured 15 m from drilling platforms generally are well below those known to disturb pinnipeds (Gales, 1982). The playback of recorded industrial drilling, seismic, and track-vehicle noises in the presence of breeding ringed seals indicated no reduction in ringed seal vocalizations (Cummings, Holliday, and Lee, 1984).

Some seals, walrus, and polar bears could be displaced from within a few kilometers of the six platforms in the sale area by activities associated with their installation and operation. Likewise, displacement of these species from the vicinity of air- and vessel-support corridors, as well as pipeline routes during dredging and laying operations, appears to be a likely outcome. The duration of such an effect may vary from temporary, as in the latter case while pipe is being laid, to as long as the field is in operation; but in no case is the amount of habitat removed expected to represent a significant proportion of that available to any species. Onshore development of a pipeline terminal could temporarily displace some spotted and ringed seals and polar bears from within a few kilometers of its location at Point Belcher; but habitat alteration would be extremely localized, few individuals are expected to be affected, and overall population effects would be insignificant. Greater numbers of polar bears could be affected if individuals were attracted to sites of industrial activity.

(1) Site-Specific-Disturbance Effects: Helicopter-support traffic between Barrow or Wainwright and drilling units would reach a maximum of 150 round trips/month during exploration (assumed 3-month drilling season), 100/month during development (annual drilling season), and 48/month during production. This activity would be the primary source of disturbance to spotted seals hauled out in summer on beaches along Icy Cape, Kasegaluk Lagoon, and Peard Bay, and to walrus, bearded and ringed seals, and polar bear on the ice during winter and/or spring. Because of frequent low visibility due to fog, aircraft may not be able to avoid disturbing walrus, seals, and polar bears in these areas. Although instances of this type of disturbance would be very brief, the effect on individual walrus, particularly calves, could be severe. Because the walrus-nursery herds are widely distributed along the ice front and lead system during the spring and summer, helicopter flights to and from drilling platforms are not likely to disturb a major proportion of the walrus population. However, injury or death of a small portion of the calf population is possible. Aircraft disturbance of seals or polar bears is not likely to result in significant death or injury, although increases in physiological stress caused by the disturbance may reduce the longevity of some individuals if disturbances are frequent. Effects of aircraft disturbance on seals, walrus, and polar bear, whether during the exploration phase or the development/production phase, are likely to be low, and are not expected to differ significantly due to the similar levels of these activities.

Exploration drilling would be conducted during the open-water season (approximately 90 days) and supported by 6 ice-management vessels per year. These vessels would enter the sale area when the pack ice retreats between late June and August and leave the area when freezeup occurs in October/November. Such traffic (maximum of 20 trips/month) may coincide with walrus, seal, and polar bear movements in the vicinity of the sale area and could temporarily interfere with their local movements or migrations within a lead system or displace some individual animals (especially as a result of icebreakers actively moving through ice). Although the presence of icebreaking vessels may displace walrus from the immediate vicinity of drilling operations, there is no evidence to indicate that vessel traffic would block or significantly delay marine mammal migrations or result in greater than low-level effects on their movements or distribution. Vessel activity also may destroy a few ringed seal lairs and pups or displace some polar bears denning on the sea ice, but the numbers affected would be few and would not exceed a low effect on their populations.

Seismic surveys during exploration and development phases in the Sale 126 area will be conducted from boats during the open-water season (7,055 trackline km for exploration and 10,329 trackline km for development). Thus, ringed seal pupping in shorefast-ice habitats would not be affected by seismic exploration in the sale area. However, seismic activities could startle nearby seals and walrus during the open-water season. This disturbance response is likely to be brief, with the affected animals returning to normal behavior patterns within a few hours after cessation of activities. Seismic operations near Kasegaluk Lagoon or other spotted seal-haulout sites could interfere with movements of the seals to and from these important areas; however, since blocks that may be leased are at least 5 km from the coast, disturbance of seals is not likely to occur. Seismic activities in the sale area are likely to have only low disturbance effects on pinnipeds, and are not expected to differ significantly between exploration and development phases.

c. Effects of Drilling Discharges: The drilling of 28 exploration, 11 delineation, and 214 production wells would result in the deposition of up to 407,000 dry metric tons of drilling muds and cuttings over the 30-year life of the field. These discharges could have local effects on the benthic prey of walrus and bearded seal within about 100 m of drilling units. However, the proportion of benthic prey affected is likely to be less than 1 percent of that available to these species in the sale area and would not appreciably reduce the availability or suitability of prey organisms. Thus, the effect of drilling discharges on pinnipeds and polar bear in the Sale 126 area is likely to be very low, and is not expected to differ significantly between exploration and production phases.

Summary: In the base case, adverse effects on spotted, ringed, and bearded seals; walrus; and polar bear could result from oil pollution, disturbance, and habitat degradation.

Analysis of oil-spill information suggests there is a relatively high probability that these species occupying drifting pack ice of the northwestern sale area and vicinity could encounter spilled oil, particularly in late spring and early summer as breakup is proceeding. During the summer season, the probability remains high in the northwestern sale area and is substantial in Migration Corridors A and B. Contact with substantial numbers of seals in the winter/spring period is unlikely because of their low-density occurrence, and because any released oil is likely to be ice-entrained until breakup. In summer, ringed and bearded seals maintain similar densities and thus are not particularly vulnerable, while spotted seals concentrate at coastal haulout areas where the probability of oil-spill occurrence and contact most areas adjacent to the sale area is minimal. Oiling of adult seals is not likely to result in lethal effects; however, pups may die if oiled during their first few weeks. Overall seal mortality from oil spills is not expected to exceed a low level of effect.

An oil spill entering the lead system/migration corridor in spring and early summer may contact up to a few thousand walrus, mainly cows with calves, migrating northward at this time. Although there is no evidence of walrus killed by oil contact, irritation of sensitive tissues might reduce survival of individuals experiencing other environmental stress. The death of small numbers of walrus would represent a low effect on the present population.

Contact with oil is likely to be fatal to polar bears, and any substantial spill-related mortality could have severe consequences in this slowly reproducing species. However, unless concentrated by a food supply or other factors, their typically wide dispersion in the Chukchi region is likely to mitigate against significant mortality from oil spills, and effects exceeding a low level.

Frequent or sustained disturbance may cause pinnipeds and polar bears to avoid or abandon an area for the duration of the activity. This could have significant adverse consequences if involving a migration corridor, feeding area, or breeding area; for example, adult walrus may trample calves if startled, and female polar bears may abandon dens if disturbed. However, the low probability of fatalities from disturbance and the generally small proportion of these populations likely to be disturbed suggest that disturbance factors are not likely to exceed a low level of effect or differ significantly between exploration and development/production phases due to the similar levels of these activities.

CONCLUSION: The effect of the base case on pinnipeds and polar bear as a result of exploration and development and production is expected to be LOW.

7. Effects on Endangered and Threatened Species:

a. Bowhead and Gray Whales: This analysis addresses the likely effect of industrial noise and crude oil on bowhead and gray whales for the base case. The majority of this information was obtained through field and laboratory studies funded by MMS and various Canadian agencies. There have been few documented observations of bowhead and gray whales responding to industrial noise or crude oil in Alaskan waters; nearly all such documentation has come from Canadian sources or from other geographic areas. However, the essential information pertaining to the likely effect of industrial noise and crude oil on cetaceans in Alaskan waters was readily available.

This analysis is based on (1) the likely effect of industrial noise and crude oil on bowhead and gray whales (Secs. IV.B.7.a(1) and IV.C.7.a(3)), and (2) the likelihood of whales encountering industrial noise and crude oil in the base case (Secs. IV.C.7.a(2) and IV.C.7.a(4)). Bowhead and gray whales are discussed together due to similarities in their response to similar stimuli. Since the sources of noise (vessels, aircraft, drilling, and dredging) are the same during both exploration and development/production, their effect on whales is discussed without reference to either. However, since it is likely that the rate of whales encountering industrial noise would differ during exploration and development/production, encounter scenarios are discussed separately for exploration and development/production.

This analysis assumes that whales do not respond (in the adverse sense) to noise of any kind until it is perceived as either a threat or an annoyance, although the noise may be heard at great distances. The response zone is defined as the range of distances where a behavioral response (attributable to the industrial noise) can be expected from about one-half of the whales in the vicinity of a given source of industrial noise (based on Miles, 1984, 1986, 1987). One-half was selected because it has the least amount of variability, and the highest probability for valid cause-and-effect determinations in the relationship between industrial noise and whales.

Hence, for the purposes of this discussion, encounters with industrial noise occur when one-half of the whales near a source of industrial noise are responding, or would be expected to respond, to the noise. On the basis of studies findings to date (many of which are discussed in this evaluation), the effect of industrial noise on bowhead whales in or near to the spring lead system is likely to be similar to that anywhere else, since the stimuli are the same. However, if an industrial operation occurred in the spring lead system, the rate of bowheads encountering industrial noise would likely be higher than elsewhere (assuming the spring migration is restricted to the spring lead system).

(1) Likely Effect of Industrial Noise: Section IV.B.7.a(1) analyzed the effect of industrial noise on bowhead and gray whales in or near the sale area. The studies referenced in Section II.B.7.a(1) indicate that industrial noise has only local, short-term effects on some whales. Hence, that

information is incorporated into the following analysis by reference; and the following analysis focuses on the likely rate of bowhead and gray whales encountering these agents in the base case.

(2) Likelihood of Encountering Industrial Noise: This section discusses the expected level of interaction between endangered whales and industrial equipment associated with the base case for the exploration and the development/production phases. The base case involves a larger number of activities than those estimated for the low case and, hence, a larger number of probable encounters with industrial noise. Consequently, this analysis focuses on the likely rate of bowhead and gray whales encountering these agents in the base case.

(a) Exploration: The exploratory phase for the base case, estimated to occur in years 2 through 8 (1992-1998), involves a total of 26 exploration operations (2-5/yr); and 312 supply-vessel trips, 2,340 helicopter trips, and 7,055 trackline km of seismic surveys. Exploratory operations in the Arctic typically require 1 drill rig and 2 to 4 support vessels to be onsite continuously and 1 to 3 aircraft intermittently. Exploratory operations in the sale area are generally limited by ice to the mid-July-to-October period. Hence, the spring bowhead migration would not encounter noise associated with exploration, since it has already passed through the area by that time, and the sale area is essentially outside of the spring-lead system. Gray whales tend to concentrate nearshore and seldom use the sale area (Fig. III-B-6). Hence, gray whale encounters with exploration noise are expected to be low. Encounters with aircraft noise are not expected as long as aircraft remain at or above the response zone of 457 m.

Based on prior sightings, the width of the fall bowhead migratory corridor in the sale area is very broad and appears to include the entire sale area (Fig. III-B-5). Assuming there are 7,800 bowhead whales in the Western Arctic stock, and that they are an evenly distributed along a line (about 337°NNW. from Point Lay) perpendicular to the average fall bowhead heading (about 247° [Ljungblad et al., 1988], the width of the corridor in the sale area would be roughly 320 km (200 mi) and would contain about 24 whales/km (39 whales/mi). Assuming further that 5 exploratory operations are evenly distributed along this line with 5 vessels per operation (seismic, drilling, support, icebreakers), having average zones of 8 km (5 mi) in diameter per vessel, exploratory operations could affect about 200 km (125 mi), or 62.5 percent of the migratory corridor. During the years of exploratory activity (1992-1998), this could result in about 4,875 bowheads entering industrial-response zones per year. Based on the predictive model and the definition of an industrial-response zone, about half these whales (2,438)--or about 31 percent of the bowhead population--would be expected to respond to industrial noise once within a response zone.

However, it is noteworthy that, to date, only 0 to 2 exploratory operations per year have occurred on the arctic OCS, with 2 to 5 vessels per operation. On the basis of the above assumptions, 2 exploratory operations per year (a more likely number) with 5 support vessels per operation could have resulted in 25 percent of the population (1,950 whales) entering industrial-response zones, or only about 12.5 percent of the population (975 whales) actually responding to exploratory noise. For this reason, and due to the conservative nature of the above assumptions, the more likely rate of bowheads encountering industrial noise in the base case ranges from zero to about 15 percent for exploration noise (2 exploration operations/yr).

It is probable that some bowhead whales would encounter exploration noise associated with the base case. However, encounters with industrial noise are expected to be brief, since whales are typically in a migratory mode in the Sale 126 area. The actual rate of bowhead whales encountering exploration noise would vary depending on the number of whales in the bowhead population, the number of exploratory operations per year, annual ice conditions, and unknown factors associated with migratory-path selection within the greater fall migratory corridor. However, on the basis of the studies discussed in Section IV.A.1, whales that encounter exploration noise are likely to exhibit only local, short-term responses to it. Hence, only minimal effects on the timing or route of the fall bowhead or gray whale migrations is expected. Any effect of industrial noise on migrating whales is likely to be minimal. Therefore, exploration noise associated with the base case is not likely to have a measurable effect on bowhead or gray whale populations, although a few whales would be affected.

(b) Development/Production: The development/production phase, estimated to occur in years 10 through 31 (2000-2021), involves a total of 6 production platforms, and 21,486 helicopter flights, and 10,329 trackline km of seismic surveys. Each production platform would likely involve the intermittent use of a supply vessel and a helicopter. Production operations in the sale area would not be limited by ice conditions and would continue year around. Hence, they would occur during both the spring and fall bowhead migrations. However, the sale area is essentially outside of the spring migratory corridor; hence, most bowheads are not likely to encounter production noise in the spring. Gray whales are not likely to encounter production noise, since they tend to concentrate shoreward and typically are in very low numbers in the sale area. Encounters with aircraft noise are not expected as long as aircraft remain at or above the response zone of 457 m. Concerning the number of bowheads that might encounter production noise in the fall, if it is again assumed that there are 7,800 bowhead whales in the Western Arctic stock and that they are evenly distributed along a line (about 337°NNW. from Point Lay) perpendicular to the average fall bowhead heading (about 247° [Ljungblad et al., 1988]), the width of the corridor in the sale area would be roughly 370 km (200 mi), and would contain about 24 whales/km (39 whales/mi). Assuming further that 6 production platforms are evenly distributed along this line with response zones averaging 8 km (5 mi) in diameter, production operations could affect about 48 km (30 mi)--or 15 percent--of the migratory corridor each year. This could result in about 1,170 bowheads entering industrial-response zones in the sale area. Based on the definition of an industrial-response zone, about half of these whales (585)--or about 7.5 percent of the bowhead population--would be expected to respond to production noise once within a response zone. Intermittent supply-vessel trips might increase the total number of encounters slightly if they occurred when bowheads were in the vicinity.

It is probable that some bowhead whales would encounter production noise associated with the base case. However, encounters with industrial noise are expected to be brief, since whales in the Sale area are typically in a migratory mode in the Sale 126 area. The actual rate of bowhead whales encountering production noise would vary depending on the number of whales in the bowhead population, the number of production operations per year, annual ice conditions, and unknown factors associated with migratory path-selection within the greater fall migratory corridor. However, on the basis of the studies discussed in Section IV.A.1, whales that encounter production noise are likely to exhibit only local, short-term responses to it. Any effect of industrial noise on whales is likely to be minimal. Therefore, production noise associated with the base case is not likely to have a significant effect on bowhead or gray whale populations, although some whales could be affected.

Summary: Studies to date indicate that industrial noise (vessel, aircraft, drilling, and dredging) has only a local, short-term effect on some whales. The likely rate of bowheads encountering industrial noise in the base case ranges up to about 15 percent. Most gray whales are not likely to encounter industrial noise associated with Sale 126, since they tend to concentrate shoreward and/or outside of the Sale 126 area. Encounters with aircraft noise are not expected as long as aircraft remain at or above the response zone at 457 m.

(3) Likely Effect of Crude Oil: Any adverse effect of crude oil on bowhead or gray whales in or near the sale area is predicated on the following basic assumptions: (1) an oil spill occurs; (2) the spill is not contained, collected, or eliminated; (3) the spill occupies an area of sufficient size to contact some portion of the bowhead or gray whale habitat; (4) the spilled oil is present during the period when whales are present; (5) some portion of the population is in the immediate vicinity of the spill; (6) these whales do not avoid the spill; (7) these whales are frequently in contact with relatively fresh, nonweathered oil (oil that has been on the surface for several hours); and (8) these whales repeatedly inhale or ingest fresh oil or contaminated food resources. The following analysis also assumes that the ability of free-ranging bowhead whales to clean oil-fouled baleen is not greater than that which was simulated under laboratory conditions.

The effect of crude oil on whales has been evaluated on the basis of laboratory investigations using whale parts (baleen and skin) and observations of whales and other cetaceans in the presence of oil. Studies to date have involved bowhead, gray, right, humpback, fin, sei, belukha, and sperm whales (or parts thereof) and dolphins. These studies focused on the effects of oil contact, ingestion or inhalation of toxic substances, blowhole and/or baleen fouling, contamination or reduction of food resources and bioaccumulation, and possible changes in the population behavior or distribution in response to oil industry activities. Although bowhead and gray whales have not been involved in many of these studies (bowhead materials were usually unavailable), the data for the cetaceans studied has consistently lead to similar conclusions. Further, many of the whales involved in the studies, such as the bowhead and right whale, are closely related and are likely to have similar responses to crude oil. Consequently, the available information is considered adequate to determine the likely effect of crude oil associated with the base case on bowhead and gray whales.

(a) Oil Contact: The effect of crude oil on whale skin has been investigated on the basis of experiments with dolphins, humans (for comparison), and a sperm whale. In these experiments skin surfaces were subjected to gasoline and crude oil for prolonged periods (up to 75 min). Contact with the hydrocarbons was maintained by small, cup-like disks that were attached to skin surfaces for predetermined periods of time. The affected skin areas were carefully observed for up to 7 days, and biopsy samples were taken for histological and ultrastructural examination. Regarding the effect of crude oil on dolphin skin, Geraci and St. Aubin (1982) indicate they found that dolphin skin exposed to crude oil turned pale gray but otherwise showed no evidence of damage or loss of integrity.

Regarding the effect of gasoline on dolphin skin, Geraci and St. Aubin (1982) indicate that morphological changes were reversible, even after prolonged exposure (75 min) in gasoline. In some cases, the exposed skin had a faint hobnail texture that disappeared within 5 minutes, but normal color was always restored within 2 hours. At no time was there any swelling, hemorrhage, or break in the continuity of the skin associated with exposure to gasoline. Similar experiments with crude oil were conducted on a dying sperm whale that had become stranded in Brit Bay on the northeast coast of Newfoundland. Geraci and St. Aubin (1982) indicate that there were no observable changes in sperm whale skin exposed to crude oil. After 17 hours of exposure to crude oil, the contact sites were normal in appearance and the skin was only mildly affected. Although the whale died during the experiment (due to causes unrelated to the experiment), Geraci and St. Aubin indicate that the death did not affect the experimental results.

In order to determine if there were any differences between the healing of cetacean wounds exposed to crude oil and those not exposed to crude oil, these same investigators inflicted wounds on dolphins and deliberately contaminated the wounds with either crude oil or gasoline for extended periods of time. Regarding these experiments, Geraci and St. Aubin (1982) indicate that there were no differences in healing of uncontaminated wounds and contaminated wounds after being exposed to gasoline or crude oil for up to 75 minutes.

Free-ranging cetaceans would experience an even smaller effect from contacting crude oil since they probably would be exposed to the oil from an oil spill for a shorter period of time, probably would be exposed to the less volatile weathered oil most of the time, and would not be exposed to gasoline at all. Regarding prolonged exposure to the most volatile substance tested--gasoline, Geraci and St. Aubin (1982) state the following regarding the effect of gasoline on sperm whale and dolphin skin: "The rapid recovery of exposed skin both grossly and histologically, confirms the sublethal nature of the injury and is indicative of full restoration."

Thus, effects associated with oil contacting the skin surfaces of whales may be minimal and may not result in a significant effect on bowhead or gray whales in the sale area.

(b) Inhalation and Ingestion of Toxic Substances: The effect of petroleum-vapor inhalation on whales has been investigated on the basis of experiments conducted on humans, domestic and laboratory animals, and dolphins. In these experiments the subjects were exposed to various concentrations of petroleum vapors for differing periods of time. Responses to the vapors were recorded (sometimes for weeks or months); and further investigations were conducted to determine the internal results. Case histories of human deaths due to accidental exposure to concentrated petroleum vapors were factored into the evaluation. Hypothetical vapor concentrations that could occur at sea during an oil spill also were calculated. These calculations were based on worst-case assumptions that the vapors were at either 5°C or 25°C, that all volatile substances in a 5-millimeter slick evaporated instantly into a 1-m layer of static air, and that the whales would then breathe these concentrated vapors.

Concerning the effect of inhalation on cetaceans, Geraci and St. Aubin (1982) indicate that the dolphins they tested had to surface through a persistent oil sheen and were thus exposed to low concentrations of petroleum vapors. However, no skin or lung pathology was observed that could be attributable to the oil. They went on to say that if a whale or dolphin were unable to leave the immediate area of the source of the spill, or were confined to a contaminated lead or bay, it would undoubtedly inhale some vapors, enough perhaps to cause some damage; but the effect would depend more on the susceptibility of the animal, since the theoretically attainable concentrations of vapor are not high enough to pose a threat.

The effect of crude oil ingestion on whales has been investigated on the basis of experiments conducted on domestic and laboratory animals, dolphins, and seals. In these experiments the subjects ingested various quantities of oil, their reactions were recorded over weeks or months, and further investigations were conducted (when necessary) to determine the internal results. The hypothetical quantities of oil that cetaceans would have to ingest to be at risk also were calculated. Petroleum residues in free-ranging fin, sei, and sperm whales; narwhal; belukha; walrus; bearded seal; and certain prey species also were determined. In these experiments various tissues and baleen samples were analyzed, and the level (if any) of petroleum residue was quantified.

Concerning the effect of crude oil ingestion on cetaceans, Geraci and St. Aubin (1982) indicate that small quantities of ingested hydraulic oil do not cause overt signs of toxicity. No liver damage was detected biochemically during the ingestion period, and histologic study failed to demonstrate any degenerative changes that are usually associated with toxic agents. In attempting to calculate the amount of fuel oil that cetaceans would have to consume to be at risk, these authors indicate that the quantities are well beyond the limits of what might be accidentally consumed by a cetacean at sea (except small species or immature animals).

The above effects associated with inhalation and ingestion of toxic substances are predicated on the inhalation and ingestion of fresh, nonweathered oil. Bowhead and gray whales exposed to weathered oil (volatile toxic fractions are essentially absent) are not expected to experience even this level of effect, since fresh oil requires only a few hours to reach the point where it is essentially nontoxic to cetaceans (Geraci and St. Aubin, 1982); and it is improbable that it would affect a large number of whales. Additionally, the possibility of whales being trapped in an ice lead and being unable to escape fresh oil is remote. Regarding bottom feeding by gray whales, evaporation, weathering, and the size of gray whale feeding areas make it improbable that gray whales would ingest significant amounts of crude oil that may have settled on the bottom.

Thus, effects associated with the inhalation and/or ingestion of oil are expected to be minimal and are not expected to result in a significant effect on bowhead or gray whales in the sale area.

(c) Blowhole and/or Baleen Fouling: The effect of blowhole and/or baleen fouling due to crude oil has been evaluated by investigators on the basis of (1) observations of free-ranging baleen whales that were feeding and moving about in oil slicks and other areas, and (2) laboratory experiments using the baleen (hair-like filaments in the mouth that filter prey from the water) of fin, sei, gray, and humpback whales. The experiments involved the use of mechanical devices that simulated the flow of water and oil through the baleen of free-ranging whales. Other laboratory experiments subjected baleen directly to oil to determine (by tensiometry, X-ray diffraction, and elemental analysis) if there were any structural changes in baleen exposed to oil.

Concerning the effect of blowhole fouling in cetaceans, Geraci and St. Aubin (1980) indicate that it is improbable that cetacean blowholes would become clogged by oil. Additionally, Richardson et al. (1983) indicate that the musculature that is adapted to exclude water would exclude oil equally well. Regarding the effect of baleen fouling, Geraci and St. Aubin (1982) monitored water flow through gray whale-baleen plates before and after contaminating them with three types of crude oil. Light- to medium-weight oils caused transient changes in water flow, which returned to normal within 40 seconds. Repeated oiling with the same preparation produced no additive effect. A heavy residual oil (Bunker C) restricted water flow for up to 15 minutes. These investigators found that light oils were undetectable on the baleen plates after 1 hour of flushing, whereas the heavier fractions persisted for 15 to 20 hours. They also designed a system to measure absolute changes in flow resistance after oil fouling (Geraci and St. Aubin, 1985). Regarding the effect of Bunker C and crude oil on fin, sei, gray, and humpback whale baleen, these authors indicate that more than 70 percent of the oil was removed within 30 minutes, and less than 5 percent of the initial coating remained after 24 hours. They concluded that this level of fouling is not likely to impair feeding efficiency in the living whale and that crude oil has a relatively short-term effect on baleen function.

Based on the differences in sei, humpback, fin, and bowhead baleen, there is no reason to expect that the feeding efficiency of the bowhead whale would vary significantly from that of the whales studied to date (Geraci, 1986, oral comm.). In a similar--but less comprehensive--experiment using crude oil on bowhead whale baleen, Braithwaite, Aley, and Slater (1983) also indicate that the filtration efficiency of bowhead whale baleen could be reduced, but not to a high degree. In terms of free-ranging cetaceans, it also is noteworthy that there are no recorded sightings of a whale with its baleen fouled by oil (this includes baleen whales that were observed to be actively feeding in oil slicks).

Concerning the effect of oil on the structural properties of baleen, Geraci and St. Aubin (1982) indicate that prolonged exposure to petroleum substances does not seem to have any dramatic effects on the integrity of baleen plates and that there is no evidence to suggest increased fragility. Regarding prolonged exposure of baleen to crude oil, St. Aubin, Stinson, and Geraci (1984) indicate that seawater can rinse oil from fouled plates to the extent that it cannot be detected, and that it is unlikely that exposure to spilled crude oil would lead to deterioration of baleen plates.

Thus, effects associated with blowhole or baleen fouling are expected to be minimal and are not expected to result in a significant effect on bowhead or gray whales in the sale area.

(d) Contamination or Reduction of Prey and Bioaccumulation: The effect of contamination or reduction of cetacean food resources and bioaccumulation has been evaluated by investigators on the basis of (1) the information gained from the techniques discussed above regarding blowhole and/or baleen fouling; (2) laboratory experiments where plankton (euphausiids) were exposed to the water-soluble fractions of industrial oil; and (3) estimates of plankton mortality based on (1) and (2) that would occur during a "worst-case" spill in the Beaufort Sea. Concerning the effect of oil on zooplankton, and subsequent cetacean bioaccumulation of such organisms, Richardson et al. (1983) indicate that most cetaceans feed on pelagic fish or zooplankton, which are generally unaffected by oil spills (except for localized areas). Thus, indirect effects of oil on cetaceans via reduction of food supply or bioaccumulation of petroleum hydrocarbons are unlikely to be of significance for most cetaceans.

Additional evidence that supports Richardson's statements was published in a study by Fishman, Caldwell, and Vogel (1985). Since euphausiids are a major food source for bowhead whales, the study was designed to determine the sensitivity of Thysanoessa raschii (the bowhead's primary euphausiid prey) to the water-soluble fraction of crude oil. These investigators then utilized a "worst-case" oil-spill scenario on T. raschii regarding the type and amount of oil and the location, timing, and duration of the spill. Based on the results of their experiments, they indicate that the effect of the hypothetical oil spill would be negligible to minor, and that the greatest effect would be that a specific group of individuals of a population in a localized area would be affected for a short period of time. They conclude that euphausiid mortalities resulting from the oil spill would be minimal and that bowhead whale food supplies would not be severely affected. Because the bowhead's other major food source (copepods) is also widely distributed in localized areas of the Beaufort Sea, it is likely that such a spill would result in only a short-term, localized reduction of this bowhead food supply as well. Further, since bowheads do not typically feed in or adjacent to the Sale 126 area, an oil spill associated with Sale 126 would not be likely to significantly affect bowhead whales. Due to the wide distribution of gray whale food resources and their benthic location, a large oil spill would not be likely to significantly affect gray whales either.

Regarding free-ranging marine mammals, Geraci and St. Aubin (1985) discuss a 5-year study to determine if petroleum residues accumulate in marine mammals that ingest contaminated food organisms. Regarding bioaccumulation in fin, sperm, sei, and belukha whales and narwhals, these authors indicate that the highest petroleum levels were noted in odontocete blubber--particularly blubber from arctic belukhas and narwhals, which are top-level predators in an environment known to retard hydrocarbon metabolism in fish. The lowest levels were observed in mysticetes, which generally feed at a lower-trophic-level on organisms that tend to have lower petroleum residues. Analyses of petroleum residues in baleen fibers failed to yield any evidence of contamination in any of the 27 whales examined.

The foregoing information suggests that effects associated with contamination and/or reduction of cetacean food resources due to oil and cetacean bioaccumulation of petroleum residues are likely to be insignificant and, further, that any effect that might occur would be predicated on repeated ingestion of nonweathered oil. However, repeated ingestion could occur only if whales somehow became trapped in oil and could not escape, or if they were forced to consume only freshly contaminated food resources over extended periods of time. The chance of either situation occurring is remote. If either situation did occur, it would affect relatively few bowhead whales for a short period of time. Regarding the above entrapment scenario, Geraci and St. Aubin (1982) indicate that most whales are not likely to be threatened by a crude oil spill but that that some (trapped or sick) animals could be killed.

Thus, effects associated with contamination or reduction of food resources and bioaccumulation are expected to be minimal and are not expected to result in a significant effect on bowheads or gray whales in the sale area.

(e) Behavior and Distribution: Effects associated with behavior and distribution have been evaluated by investigators on the basis of (1) observations of free-ranging whale (and other cetacean) behavior while swimming through in and out of oil slicks, (2) whale distribution in areas of the migratory corridor where natural oil slicks have reoccurred for centuries, and (3) knowledge gained from all of the above regarding the effect of oil on whales.

On the basis of studies conducted to date, it is not clear whether free-ranging bowhead or gray whales would avoid oil or not. Regarding gray whales that were approaching a naturally occurring oil slick, Kent, Leatherwood, and Yohe (1983) indicate that on most occasions the whales observed showed apparent indifference and that, in the vast majority of observations from aircraft (greater than 90%), the whales showed no detectable change in behavior that could be attributed to the presence of oil. Regarding whales that seemed to respond to the oil slick (less than 10%), Geraci and St. Aubin (1982) indicate that the change in behavior was not accompanied by any change in respiratory pattern or swimming speed and, in fact, may not have been a response to oil. Typically, the whales would swim through oil, modifying their swimming speed but without a constant pattern. Regarding a dolphin's response to various oils (crankcase oil, mineral oil/black oil paint, clear mineral oil) on the surface, Geraci and St. Aubin (1985) indicate that dolphins are able to detect and avoid a variety of oils both during the day and at night by relying on vision and tactile senses. These authors further indicate that these senses would serve the dolphins well in any encounter with oil spills at sea. As close as the dolphins were to oil during these experiments, their overwhelming response was to avoid it (at least during their confinement for this study).

Regarding gray whale breaching and courtship behavior, Kent, Leatherwood, and Yohe (1983) state: "Breaching and courtship behaviors were observed from aircraft, vessel, and shore in both oil dense and oil free areas, suggesting that the presence of oil does not inhibit occurrence of these two behaviors." Following the sinking of the Liberian freighter Regal Sword in 1979, Goodale, Hyman, and Winn (1981) reported that many humpback, fin, and possibly right whales, as well as hundreds of dolphins, were seen feeding inside and outside the resulting oil slick. Concerning the behavior of these cetaceans while in the oil slick, Goodale, Hyman, and Winn (1981) state that "The behavior we saw in the oil slick was the same as behavior seen outside the oil slick."

Consequently, based on observations to date, the presence of oil has not affected the distribution of bowhead or gray whale populations. For centuries gray whales have migrated through naturally occurring oil slicks. In 1969, gray whales migrated through a large oil spill off the coast of Santa Barbara, California. Analysis of gray whale tissues taken from whales stranded in the vicinity of the spill indicated that crude oil was not present (Brownell, 1971). Again in 1989, gray whales migrated through a large spill in the vicinity of Prince William Sound, Alaska, during their spring migration. In each case there was no apparent effect on the whales (the gray whale population now exceeds pre-exploitation levels) or the annual distribution of the gray whale population.

Thus, it is unclear whether free-ranging bowhead and gray whales would or would not avoid an oil slick. Assuming that there is a spill and whales are in the vicinity, some whales may make minor course deflections in order to avoid the spill, while others may not. If any whales did enter an oil slick, it is possible that some might spend less time on the surface and might temporarily modify their respiratory pattern and swimming speed while in the oil. However, due to the mild transient nature of behavioral modifications while in oil, and no apparent effect on population distribution, crude oil associated with the base case is not expected to have a significant affect on bowhead or gray whale populations.

(4) Likelihood of Encountering Crude Oil: This section discusses the estimated level of interaction between whales and crude oil associated with the base case for the exploration and development/production phases.

(a) Exploration: The base case estimates that there would be 26 exploration operations over the life of the proposal (to occur in years 2 through 8 [1992-1998]). During the period of 1971 through 1983 (the period for which statistics are available), over 18,000 exploratory wells were started from Federal offshore leases; however, no oil was spilled as a result of an exploration-drilling blowout, and <1,000 bbl were spilled as a result of nondrilling blowouts (USDOI, MMS, 1988). Hence, a large oil spill is very unlikely and whales are not expected to encounter crude oil during this phase.

(b) Development/Production: The base case estimates that there would be 6 production operations over the life of the proposal (1991-2021 [30 yr]). The development/production phase is estimated to occur in years 10 through 30 (2000-2021) and to produce 1,610 MMbbl of crude oil, which would be transported by pipeline. The most likely number of ≥ 1,000-bbl spills estimated to occur over the 30-year life of the proposal is two for the base case. Combined probabilities describe the probability of one or more spills occurring and contacting a given area (whale habitat in this case) over the life of the proposal. Bowhead whales migrate through the sale area (Fig. III-B-5) during the late summer/fall period (September-November). During this time, the combined probability (summer trajectories) of an oil spill occurring and contacting whale habitat (Fig. IV-C-3) within 10 days is: 5, 4, and 50 percent for Sea Segments 4 through 6; 44 and 3 percent for Migration Corridors A and B; and 18, 33, and 1 percent for the Peard Bay, Wainwright, and Point Lay Subsistence Areas. Although there would be some overlap (primarily in the migration-corridor areas), fall-migrating bowhead whales would be most likely to encounter crude oil in Sea Segments 4 through 6, whereas gray whales would be most likely to encounter crude oil in Migration Corridors A and B and in the subsistence areas.

In the winter/spring period (April-June), most bowhead whales are believed to migrate inshore of the sale area through the spring ice leads. During this time, the combined probability of an oil spill occurring and contacting bowhead habitat within 10 days (winter trajectories) is: 3, 17, 23, and 53 percent for Sea Segments

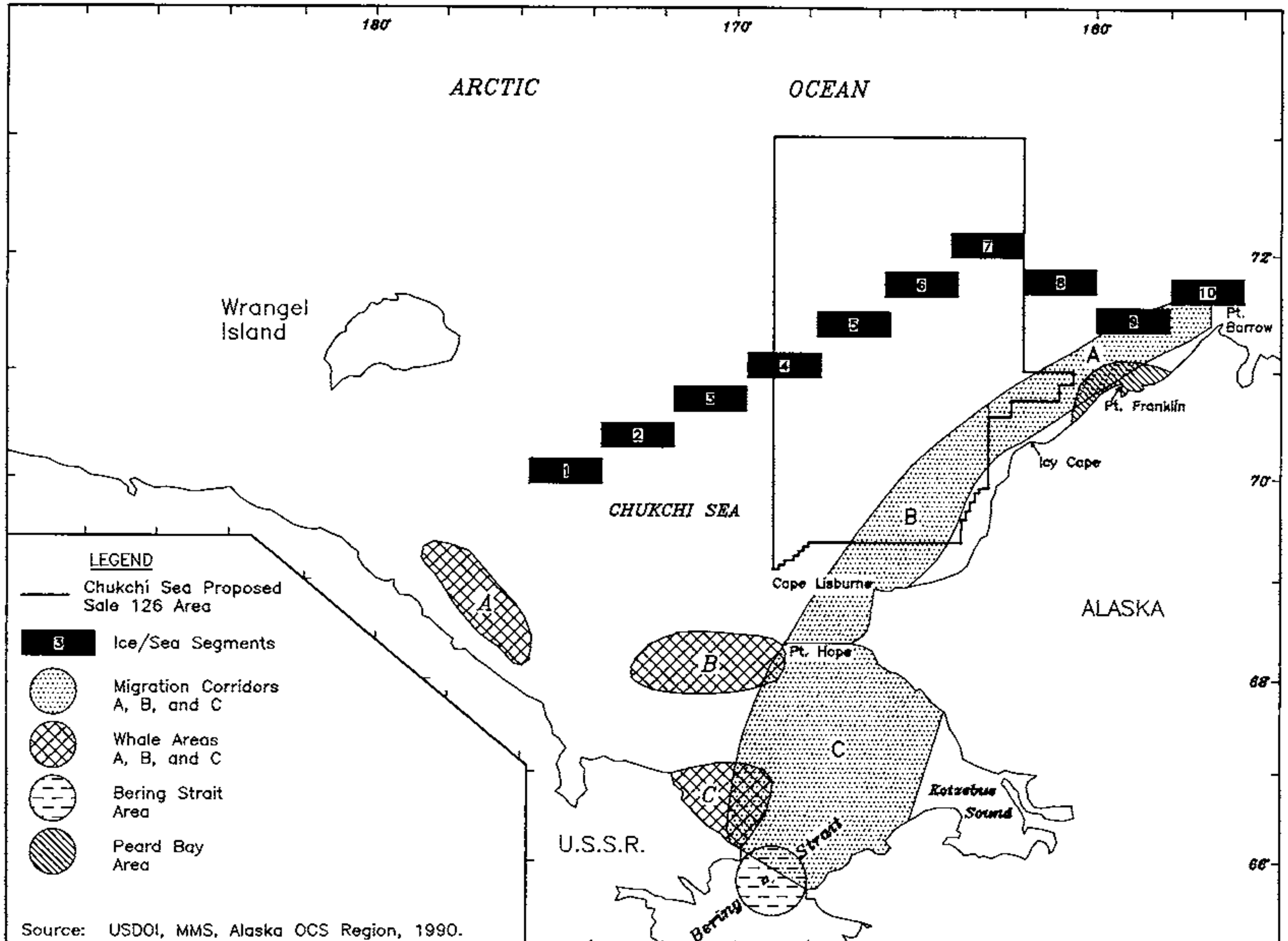


Figure IV-C-3. Environmental Resources Considered in Oil-Spill-Risk Analysis of Effects on Endangered Species

3 through 6; 10 and 4 percent for Migration Corridors A and B; and 18, 34, and 8 percent for the Peard Bay, Wainwright, and Point Lay Subsistence Areas. As indicated, bowhead whales would be most likely to encounter crude oil in offshore locations, whereas gray whales would be most likely to encounter crude oil in nearshore locations. The probability of bowhead and gray whales actually encountering crude oil would be lower than these estimates, since these values represent occurrence and contact with whale habitat--rather than contact with whales.

The spring-lead system, most of which is believed to be shoreward of the sale area, is also used to some extent by bowhead whales for calving and mating. A prolonged spill that entered the spring-lead system (where whales tend to be more concentrated) at the start of the spring migration would increase the likelihood of whales encountering crude oil. However, unless whales stopped to feed in the area of a spill, or were trapped in a lead into which oil was spilled, contact with oil would be brief. Even a spill of 22,000 bbl under open-water conditions is estimated to produce a continuous slick that would cover only about 3 km^2 and would be only 0.8 mm thick after 10 days (Appendix L: Table L-1). Assuming that the slick is in the path of migrating bowhead or gray whales, most whales swimming at average speeds would be expected to pass through the oiled area in about 30 minutes. Since whales spend about 90 percent of their time underwater, most of the whales swimming through this area would be exposed to a thin layer of weathered crude oil for less than 5 minutes.

The actual rate of bowhead and gray whales encountering an oil spill would depend on the size, duration, and timing of the spill; the density of the whale population in the area of the spill; and the whales' inclination to avoid contact with oil. If there were a large spill associated with the base case, it is likely that some bowhead or gray whales in localized areas would encounter crude oil for relatively short periods of time.

Exploration: Exploratory operations are not likely to affect bowhead whales in the spring, since it is estimated that they would occur after bowheads have passed through the area. Based on the assumptions discussed in the text, in each year of the exploration period, the base case could result in about 31.25 percent of the bowhead population responding to exploration noise (from 5 exploration operations). However, due to the conservative nature of the assumptions used in the text, the more likely rate of bowheads encountering industrial noise in the base case ranges from zero to about 15 percent for exploration noise (2 exploration operations/yr). The actual rate of bowheads encountering exploration noise would vary depending on the actual number of whales in the bowhead population, the number of exploratory operations per year, annual ice conditions, and unknown factors associated with path selection within the greater fall migratory corridor.

Development/Production: Since the sale area is offshore from the majority of the spring lead system (the area believed used by bowheads for their spring migration), spring-migrating bowheads are not likely to encounter noise associated with production operations. Based on the assumptions discussed in the text, in each year of the development/production period, the base case could result in about 7.5 percent of the bowhead population responding to production noise (from 6 production operations). However, due to the conservative nature of the assumptions used in the text, the more likely rate of bowheads encountering industrial noise in the base case ranges from zero to 2.5 percent for production noise (2 production operations/yr). The actual rate of bowheads encountering production noise would vary depending on the actual number of whales in the bowhead population, the number of exploratory operations per year, annual ice conditions, and unknown factors associated with path selection within the greater fall migratory corridor.

Cetacean crude oil studies to date have focused on the effects of oil contact, ingestion or inhalation of toxic substances, blowhole and/or baleen fouling, contamination or reduction of food sources and bioaccumulation, and possible changes in the behavior or distribution of whale populations in response to oil industry activities. Any effect of crude oil on bowhead or gray whales is predicated on the assumptions that an oil spill occurs; it is not contained, collected, or eliminated; it occupies some portion of the bowhead or gray whale habitat; it is present when whales are present; and whales in the vicinity of the spill do not avoid it, are frequently in contact with fresh oil, and repeatedly inhale or ingest it or contaminated food. Assuming further that some animals became trapped in oil-contaminated waters (such as in a lead) and could not escape, it is possible that some--primarily the young or those in poor physical condition--might die from inhalation or ingestion. However, the occurrence of a chain of events like this is considered improbable. Further, much of the bowhead whale migration does not occur in lead systems; gray whales do not migrate through lead systems at all; and the likelihood of a large number of whales encountering an oil spill is small. Most importantly, studies have yet to demonstrate a significant adverse effect of crude oil on a cetacean. Investigators have repeatedly found that, at its worst, crude oil has only minimal, short-term effects on cetaceans and often has no effect at all.

The estimated combined probability of an oil spill occurring and contacting bowhead or gray whale habitat during summer and winter in 10 days in the base case ranges from 2 to 53 percent. The probability of bowhead or gray whales actually being contacted by crude oil would be less than this. If there were a large spill associated with the base case, it is likely that some bowhead or gray whales in localized areas would encounter crude oil. However, whales encountering an oil spill are expected to be in contact with oil for only minutes, since they spend most of the time underwater and are in a migratory mode. The actual rate of bowhead and gray whales encountering an oil spill would depend on the size, duration, and timing of the spill; the density of the whale population in the area of the spill; and the whales' inclination to avoid contact with oil.

Consequently, on the basis of studies findings to date, industrial noise and crude oil associated with the base case are likely to have minor, short-term effects on some bowhead and gray whales and no effect on most whales. No significant effect on the timing or route of the spring or fall bowhead and gray whale migrations is expected. Whale migrations are not likely to be blocked or delayed by industrial noise or crude oil. Any effect of the base case on bowhead or gray whales is likely to be insignificant in comparison to natural variation on habitat use, migratory path selection, and whale behavior.

Conclusion: The effect of the base case on the bowhead and gray whale populations is expected to be very low.

b. Arctic Peregrine Falcon: The threatened arctic peregrine falcon is an occasional visitor to the western Alaskan coast adjacent to the sale area. Peregrines are most sensitive to disturbances when nesting, from approximately late April to mid-August. Peregrines typically nest on cliffs and bluffs overlooking rivers and along coastal areas. The Colville River drainage has been identified as the center of peregrine distribution on the North Slope. Although the bluffs along the Chukchi Sea coast, adjacent to the Sale 126 area, are not known as nesting habitat for peregrine falcons, a few nests have been reported. Peregrines have been reported from the Kivalina area north to Icy Cape. Vessel- and air-support-traffic corridors are likely to extend from Barrow and Wainwright to offshore sites. Peregrines have not been reported in Chukchi Sea coastal areas this far north; consequently, it is not expected that peregrines would be disturbed by aircraft or vessel operations associated with the base case.

Effects from oil spills could occur from direct contact or via contaminated prey. If seabirds died as a result of oil contact, a reduction of peregrine prey would occur. However, Seabird-Concentration Area I (Fig. IV-C-1) has a $\leq$ 0.5-percent probability of an oil spill occurring and contacting within 10 days. For this reason, and since peregrine falcons are not common in this area, effects due to reduced food availability are expected to be minimal.

The development and production phase of the base case includes a pipeline from Point Belcher to TAP Pump Station No. 2. At this time, only a hypothetical corridor has been identified. The corridor has the potential to pass within close proximity to some peregrine falcon-nesting locations. Consultation with the USFWS will likely be reinitiated at the time of actual pipeline-corridor planning. At this time, it is assumed that pipeline-construction activities in the vicinity of any peregrine falcon-nesting locations would occur during the fall and winter seasons, when falcons are not present. As a result, pipeline construction should not disturb peregrine falcon-nesting or -foraging activities; and the presence of an unattended or sparsely attended pipeline in the vicinity of nesting sites would be expected to disturb few nesting pairs.

Consequently, the base case is likely to have insignificant effects on the arctic peregrine falcon population.

Conclusion: The effect of the base case on the arctic peregrine falcon population is expected to be very low.

CONCLUSION: The effect of the base case on endangered and threatened species as a result of exploration and development and production is expected to be VERY LOW.

8. Effects on Belukha Whale: This analysis addresses the effect of industrial noise and crude oil on the belukha whale. Although belukhas tend to respond to sounds of higher frequencies than bowhead and gray whales, the effect of industrial noise and crude oil associated with Sale 126 on belukha whales is expected to be essentially the same (minor, short-term effects on some animals) as that already discussed for bowhead and gray whales (Sec. IV.C.7.a); hence, that information is incorporated by reference.

This analysis assumes that whales do not respond (in the adverse sense) to noise of any kind until it is perceived as a threat, even though the noise may be heard at great distances. This analysis also assumes that a threat is perceived when whales begin to respond to the source of noise and that this distance from the source of noise represents the outer limit of the response zone. Hence, for the purposes of this discussion, an encounter with industrial noise occurs when whales enter the zone where they begin to respond to industrial noise. An encounter with crude oil occurs when whales are contacted by oil. Under the base-case exploration and development scenario, a maximum of 26 exploration platforms and 6 oil production platforms could be operating in the sale area over the life of the proposal. The base case estimates that there would be two oil spills ($\geq$ 1,000 bbl) over the 30-year life of the proposal.

Belukha whales are common inshore of the Sale 126 area, but some (primarily in the fall) also occur inside the sale area. During the spring (April-May), some belukhas migrate from the Bering to the Beaufort Sea, while others spend the summer months in the bays and estuaries of Kotzebue Sound and along the northern Chukchi Sea coast. In the fall (September-October), many of the belukhas in the Beaufort Sea migrate through the sale area while on their way to the Bering Sea. Since spring/summer belukha habitat is relatively distant from the sale area, belukhas are not likely to be in areas where industrial operations are occurring. In the fall, when belukhas are migrating through the sale area, they are widely dispersed but may encounter industrial operations infrequently. Hence, belukhas are not likely to encounter industrial operations often, although those in the vicinity may hear industrial noise. Belukhas encountering industrial operations would experience the same minor, short-term effects discussed for other whales in IV.B.7.a(1). In inshore areas of the Chukchi Sea, where belukhas are more concentrated during the summer, some may be temporarily displaced along the pipeline path during trenching and laying operations. However, the amount of displacement or change in habitat use due to industrial operations is likely to be very small.

The path of the belukha's spring migration is through ice leads (similar to that of bowheads) and is essentially outside the sale area. Oil spills could contact belukhas in the spring as they migrate through the lead system between Point Hope and Point Barrow; during the summer, when they feed and calve in nearshore areas; and during the fall as they migrate through the sale area toward the Bering Sea. During the spring migration, the combined probability of an oil spill occurring and contacting whale habitat within 10 days (winter ice-cover season, November-mid-June) is: 10 and 4 percent for Migration Corridors A and B; 18 percent for the Peard Bay Subsistence Area; and 34 and 8 percent for the Wainwright and Point Lay Subsistence Areas. During the summer/fall open-water period (mid-June-November), the combined probability for contacting whale habitat within 10 days is 5, 4, and 50 percent for Sea Segments 4 through 6; 44 and 3 percent for Migration Corridors A and B; 18 percent for the Peard Bay Subsistence Area; and 33 and 1 percent for the Wainwright and Point Lay Subsistence Areas. Because spring/summer belukhas are primarily inshore of the sale area, any oil arriving there would be weathered oil (toxic volatile fractions absent). In the fall, when belukhas are migrating through the sale area, they would be more likely to encounter nonweathered oil if an oil spill occurred. The probability of a crude oil spill actually occurring and contacting belukha whales would be even lower than these figures, since it reflects the probability of oil-spill occurrence and habitat contact--rather than contact with whales.

The number of belukhas contacted after a spill would also depend on the size, duration, and timing of the spill, and the whales' inclination to avoid contact with oil. If there were a large spill associated with the base case, it is likely that some belukha whales in localized areas would encounter crude oil for relatively short periods of time. The possibility of belukhas being trapped in some way and unable to escape an area where oil is concentrated is remote. The actual effect of crude oil on belukha whales is expected to be minor, short-term effects on some whales, and no effect on most whales, as discussed for bowhead and gray whales. Any effect of the base case is likely to be insignificant in comparison to natural variation in habitat use, migratory-path selection, and whale behavior. Consequently, the base case is likely to have insignificant effects on the belukha whale population.

Summary: The effect of industrial noiseand crude oil associated with the base case on the belukha whale is likely to be similar to that expected for other whales (minor, short-term effects on a small percentage of the population). Due to the distance of spring/summer belukha habitat from the sale area, and the dispersed nature of the fall belukha migration through the sale area, belukhas are not likely to interact with industrial operations often; and the probability of contact with crude oil is relatively low. Displacement of belukhas due to pipeline construction is not likely to occur. Any effect of the base case on belukha whales is likely to be insignificant in comparison to natural variation in migratory-path selection and whale behavior. Consequently, the base case is likely to have insignificant effects on the belukha whale population.

CONCLUSION: The effect of the base case on the belukha whale population as a result of exploration and development and production is expected to be VERY LOW.

9. Effects on Caribou: Among the terrestrial mammals that occur in coastal areas adjacent to Sale 126, the Western Arctic caribou herd (with current population at 250,000) is most likely to be affected by activities associated with the base case. The primary effects of OCS activities on caribou would result from onshore support and development activities adjacent to the Sale 126 area and, possibly, oil spills. The primary concerns are disturbance of caribou and habitat changes. Human activities can cause temporary and potentially permanent displacement of caribou, particularly cows and calves, from important habitats such as calving grounds, insect-relief areas, and preferred feeding habitats (see Fig. IV-C-4).

a. Effects of Disturbance:

General Effects: Caribou can be disturbed briefly by low-flying aircraft, fast-moving ground vehicles, and construction activities (Calef, DeBock, and Lortie, 1976; Horejsi, 1981). The response of caribou to potential disturbance may range from no reaction to violent escape reactions, depending on their distance from the source and speed of approaching object; frequency of disturbance; sex, age, and physiological condition of the animals; size of the caribou group; and season, terrain, and weather. Cow and calf groups appear to be the most sensitive to vehicle traffic, especially during the summer months, while bulls appear to be least sensitive during that season.

Tolerance of air and ground-vehicle traffic and other human activities has been reported in several studies of hoofed-mammal populations in North America, including caribou (Davis, Valkenburg, and Boertje, 1985; Johnson and Todd, 1977; Singer and Beattie, 1986; Valkenburg and Davis, 1985). The variability and instability of the arctic ecosystem dictate that caribou have the ability to adapt behaviorally to some environmental changes. Consequently, repeated exposure to human activities, such as those associated with oil exploration and development, over several hundred square kilometers of summer range has led to some degree of tolerance by caribou of the Central Arctic herd. Some groups of caribou that overwinter and have been exposed continually to disturbance in the vicinity of Prudhoe Bay and near Camp Lonely on the NPR-A apparently have become accustomed to human activities; however, the majority of North Slope caribou herds that overwinter south of the Brooks Range are less tolerant of human activities to which they are seasonally or intermittently exposed than some caribou that overwinter on the arctic coast.

Some displacement of the Central Arctic caribou herd from a small portion of the calving range near

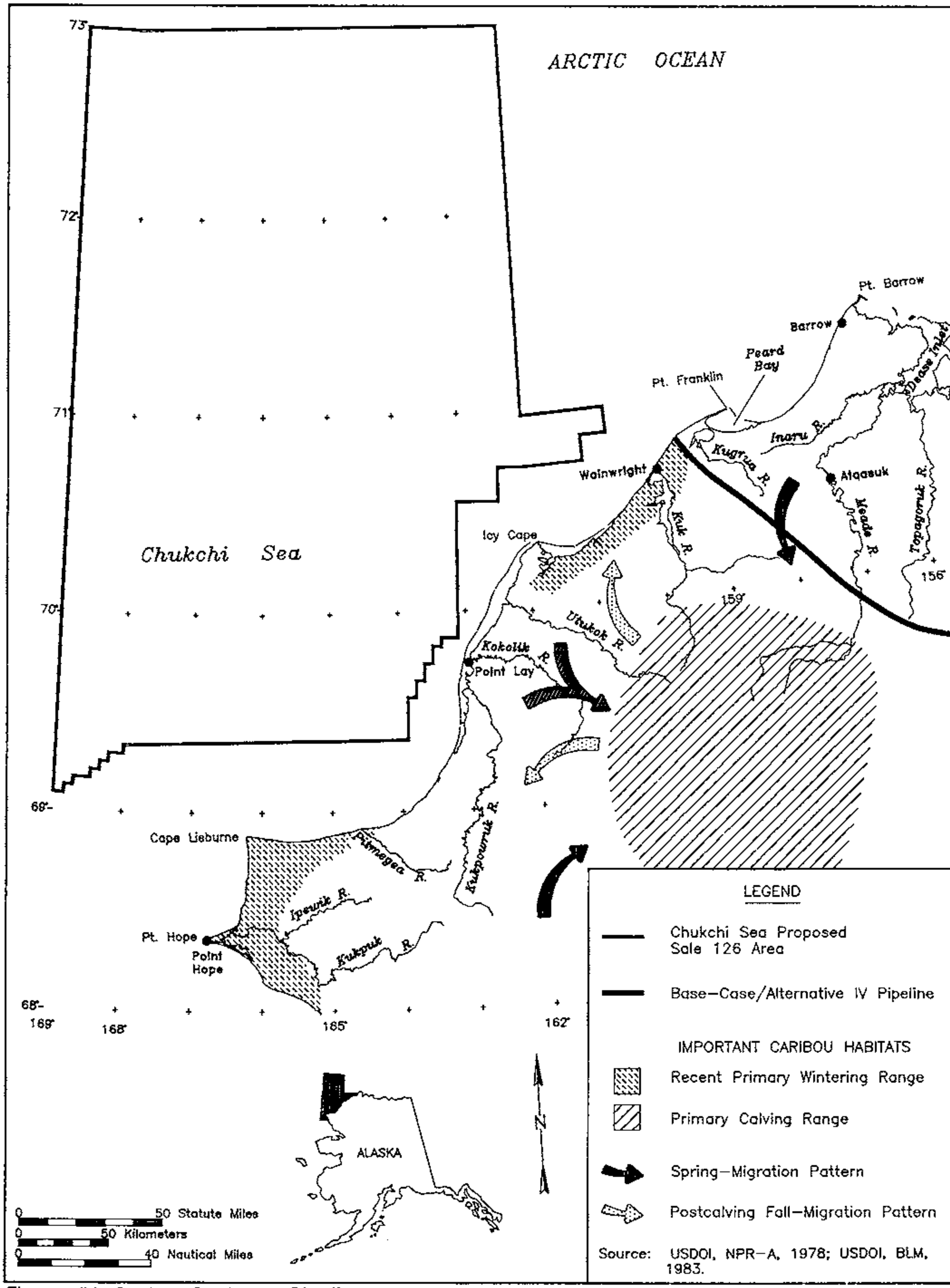


Figure IV—C—4. Onshore—Pipeline Route Across the Range of the Western Arctic Caribou Herd

Prudhoe Bay facilities has occurred (Cameron, Whitten, and Smith, 1981, 1983). This displacement of some caribou cows and calves has occurred within about 4 km (2.5 mi) of some oil facilities (Dau and Cameron, 1986). However, the use of specific calving sites within the broad calving area varies from year to year; and the amount of displacement is probably of secondary importance due to the low density of caribou on the calving range and the abundance of calving habitat for the Central Arctic herd.

Disturbance Effects Associated with Pipelines: Recent studies (Roby, 1978; Cameron, Whitten, and Smith, 1981, 1983) indicate significant seasonal avoidance of habitat near Prudhoe Bay facilities by cows and calves during calving and postcalving periods (May-August). Cameron, Whitten, and Smith (1983) also reported that caribou cow/calf groups avoid the 200-km northern portion of the TAP/Dalton Highway (haul-road) corridor, particularly during the postcalving period. However, caribou cow/calf groups may be avoiding the TAP corridor because it runs primarily along the riparian habitat of the Sagavanirktok River valley, a habitat type that cows and calves normally avoid during the postcalving season, apparently due to the possibility of hidden predators such as wolves (Carruthers, Jakimchuk, and Ferguson, 1984). These investigators report no significant differences in cow/calf distribution between the TAP corridor and other riparian habitats on the summer range of the Central Arctic herd. Also, caribou cow/calf groups did not avoid a portion of the TAP corridor on the North Slope that is separated (4 km away) from riparian habitat and the Dalton Highway. These investigators concluded that differences in the distribution of caribou cows with calves along the TAP corridor reported by Cameron, Whitten, and Smith (1983) simply reflect the avoidance of riparian habitats, on which most of the corridor is located. However, Carruthers, Jakimchuk, and Ferguson (1984) did not investigate the question of whether caribou cows with calves avoid the Dalton Highway during periods of heavy truck traffic. The mere physical presence of the pipeline and associated facilities may have little effect on the behavior, movement, or distribution of caribou, except perhaps when heavy snowfall prevents some animals from crossing under the pipeline in local areas. Human activities associated with transportation routes, particularly road traffic, can have short-term effects on the behavior and movement of caribou (Singer and Beattie, 1986).

Vehicle traffic (particularly high traffic levels such as 40-60 vehicles/hr) on a road adjacent to a pipeline has the greatest manmade influence on caribou behavior and movement while they are crossing the Prudhoe Bay and Kuparuk oil fields and pipeline corridors (Murphy and Curatolo, 1984). A decline in the frequency at which caribou cross pipeline corridors is attributed to high traffic levels on the adjacent road and the frequency of severe disturbance reactions exhibited by caribou during crossing (Curatolo, 1984). Caribou generally hesitate before crossing under an elevated pipeline and may be delayed in crossing a pipeline and associated road for several minutes or hours during periods of heavy road traffic, but successful crossing does occur. Buried pipelines appear to present no barrier to movements.

Aircraft overflights associated with the pipeline corridor or other onshore facilities, if intermittent, of brief duration, and above the minimum altitude causing panic response, are not likely to result in serious injury, fatalities, or abandonment of important habitat.

Site-Specific Effects: This analysis assumes that transportation activities associated with exploration would be centered out of Barrow and Wainwright, and no roads would be built during exploration (see Sec. II.A.2). Other exploration-support activities are assumed to occur by offshore barges located near the drilling sites. Therefore, exploration alone in the proposed Sale 126 area would not substantially increase industrial development on the North Slope, nor would it disturb caribou or cause noticeable habitat effects.

Oil from the proposed Sale 126 area is assumed to be transported by offshore trunk pipelines coming ashore at Point Belcher on the Chukchi Sea coast. From there, the 640-km onshore pipeline and support road would cross the NPR-A south of the lake district (but probably north of the Colville River) and connect with TAP Pump Station No. 2. The onshore pipeline and support road would transect movements of the Western Arctic caribou herd from wintering habitat south of the Brooks Range to the Beaufort Sea coast and also would transect the southward spring migration of from several thousand up to about 60,000 caribou that overwinter north of the caribou-calving range and along the arctic coast (Fig. IV-C-4). The pipeline would not cross the calving range of the Western Arctic herd. Caribou that winter on the North Slope apparently do not use well-defined migration routes to the calving range. The pipeline would not cross the major well-defined migration routes through the Brooks Range mountain passes south of the calving area, where the majority of the Western Arctic caribou herd overwinters (see Fig. IV-C-4).

Construction of the onshore pipeline could temporarily interfere with the movements of some caribou north of the calving range--particularly cows and calves--during construction activities (about 2 yr) and during periods of heavy vehicle traffic (perhaps 40-60 vehicles/hr or a total of several hundred vehicles/day). Vehicle traffic could affect the local seasonal distribution and movement of the Western Arctic herd within about 4 km of the pipeline corridor if it acts as a temporary barrier to cow/calf movements. However, caribou-migration movements would not be blocked; and successful crossings would occur throughout the summer and migration period. Caribou successfully cross the TAP and Dalton Highway, the Dempster Highway in Canada, and other highways in Alaska. Caribou have returned after displacement from disturbed habitat after construction was complete in other development areas with little restriction in movements (Hill, 1984; Northcott, 1984). Development of the Sale 126 pipeline corridor across the NPR-A would increase hunter access to the Western Arctic caribou herd, thereby increasing hunter pressure on the population, and thus could lead to over harvest and decline of the herd. However, current regulation of the caribou harvest should prevent over hunting of this herd, which is increasing at an annual rate of 7 to 17 percent. The road traffic along the pipeline corridor and daily aircraft surveillance of the pipeline (1 helicopter flight/day) would cause brief flight reactions by some caribou and would temporarily delay--for perhaps a few hours or no more than a few days--caribou movements across the pipeline corridor. This would represent a low effect on the caribou of the Western Arctic herd.

b. Effects of Habitat Alteration:

General Effects: The construction of pipelines and other onshore facilities on the North Slope necessitates the use of large quantities (several million tons) of gravel. With the construction of roads and gravel pads for building sites, small areas of tundra vegetation are excavated at the gravel-quarry sites; and several square kilometers of caribou tundra grazing habitat are destroyed where the gravel is deposited. However, the amount of grazing habitat destroyed by onshore development represents a very small percentage of the range habitat available to the caribou herd. The construction of roads and gravel pads provides the caribou with additional raised insect-relief habitat, particularly when there is little or no road traffic.

Site-Specific Effects: Onshore development associated with the base case would include a 640-km pipeline and road and 10 to 12 helicopter pads that would alter about 64 km^2 of Western Arctic herd grazing habitat on the North Slope. The shorebase at Point Belcher would remove about 25 to 30 hectares of rangeland near Point Belcher, and the 1,900-m airstrip at this location would require about 500,000 m^3 of gravel. These facilities would destroy or alter less than 1 percent of the available grazing habitat of the Western Arctic herd and represent very low habitat effects on caribou.

c. Effects of Oil Spills:

General Effects: Caribou sometimes frequent barrier islands and shallow coastal waters during periods of heavy insect harassment and may possibly become oiled or ingest contaminated vegetation. External oiling also could occur if a pipeline spill occurred at a river crossing during a period of caribou migration. Caribou that become oiled are not expected to suffer any lethal effects as a result of hair contamination, although those oiled in river crossings could experience hypothermia. Oiled caribou hair would be shed during the fall before caribou grow their winter coat. Toxicity studies of crude-oil ingestion in cattle (Rowe, Dollahite, and Camp, 1973) suggest that anorexia (significant weight loss) and aspiration pneumonia leading to death are possible adverse effects of oil ingestion in caribou. However, caribou frequent coastal areas to avoid insects rather than to graze and thus are not likely to be feeding on coastal or tidal plants that may become contaminated. In the event of an onshore oil spill that contaminated tundra habitat, caribou probably would not ingest oiled vegetation because of their particular foraging habits (Kuropat and Bryant, 1980).

Site-Specific Effects: This section assumes the occurrence of development to the extent estimated in Section II.B. Two oil spills are estimated to occur under the base case. During the summer, there is <0.5 percent chance of an oil spill occurring and contacting coastal spits, barrier islands, or other coastline habitats used by caribou for insect relief within 30 days.

If circumstances during an oil spill in the open-water season resulted in oil coming ashore, caribou that frequent coastal habitats--such as in the Icy Cape or Ledyard Bay areas--could be directly exposed along the beaches and in shallow water during periods of insect-pest-escape activity. However, only a small number of animals are likely to be exposed to the oil and to die as a result--an effect that is likely to be insignificant for the Western Arctic caribou herd.

Any oil-spill cleanup activities could disturb individual groups of caribou seeking insect relief on beaches during the summer, but it is unlikely that this interaction would cause significant adverse effects since relatively small numbers use this type of habitat.

Onshore-Oil-Spill Effects: In the event of an onshore-pipeline spill, some tundra vegetation in the pipeline corridor would become contaminated. An estimated 188 small oil spills averaging from 6 to 1,500 bbl could be associated with the base case. However, caribou probably would not ingest oiled vegetation because of their reluctance to eat contaminated vegetation. If a pipeline spill occurred, it is likely that control and cleanup operations (ground vehicles, air traffic, and personnel) at the spill site would frighten caribou away from the spill and prevent caribou from grazing on the oiled vegetation. Thus, onshore oil spills associated with the base case are not likely to directly affect caribou through ingestion of oiled vegetation.

Onshore oil spills on wet tundra may kill all or virtually all mosses and above-ground parts of vascular plants at the spill sites (McKendrick and Mitchell, 1978). Thus, pipeline oil spills can destroy or alter the local grazing habitat along the pipeline corridor. Damage to oil-sensitive mosses may persist for several years if the spill sites are not rehabilitated (McKendrick and Mitchell, 1978). For the most part, onshore oil spills would be very local and would contaminate tundra in the immediate vicinity of the pipeline; these spills would not be expected to significantly contaminate or alter caribou range within the pipeline corridor.

The probability of at least one spill occurring and contacting a major river is 95 percent, and 65 percent that 67 spills of ≥ 24 bbl or greater would occur and contact a major river. External oiling could occur if a pipeline spill entered a river above a crossing point during a period of caribou migration; however, the coincidence of a spill into a river and a major crossing by migrating caribou is considered unlikely. Although there is no evidence available, it would seem that caribou oiled in river crossings could experience hypothermia. Oiled hair would be shed during the fall before caribou grow their winter coat. The effect of onshore oil spills on caribou is therefore expected to be low.

Summary: The primary source of disturbance to caribou of the Western Arctic herd on their summer range is vehicle traffic associated with the construction and presence of the 640-km onshore pipeline and support road from a shorebase facility at Point Belcher to TAP Pump Station No. 2. Cows and calves of the Western Arctic herd are particularly sensitive to disturbance during the calving and postcalving seasons and would be especially disturbed during periods of heavy traffic. Approximately 20 percent of the Western Arctic caribou herd that winters on the North Slope may be temporarily disturbed by vehicle traffic along the pipeline corridor during spring migration, while other caribou could be disturbed during summer movements.

Disturbance of caribou along the pipeline route would be most intense during the construction period (about 2 yr), when vehicle and air traffic would be most frequent, but would subside after construction is complete and over the remainder of the 30-year life of the field. Caribou movements across the pipeline corridor could be retarded or delayed--for perhaps a few hours or no more than a few days--during periods of heavy traffic, but caribou are likely to resume crossing the pipeline corridor with little restriction in movements after construction is complete. Vehicle and air traffic along the pipeline corridor are likely to cause flight reactions by some caribou. This would represent a low effect on caribou of the Western Arctic herd.

Caribou distribution and/or abundance are not likely to be significantly affected by this development.

The onshore pipeline, support road, and 10 to 12 helicopter pads associated with the proposal would alter or destroy about 64 km^2 of the Western Arctic herd's range, while the associated shorebase would cover 25 to 30 hectares near Point Belcher. The habitat altered or destroyed by these facilities represents less than 1 percent of the available range of the Western Arctic herd. Any offshore oil spill is likely to contaminate few caribou due to the very low probability of shore contact and low numbers of caribou in this habitat. The small onshore oil spills estimated for the base case would contaminate very local areas near the pipeline, unless entering a stream, and would not significantly affect the availability of caribou range.

CONCLUSION: The effect of the base case on caribou as a result of exploration and development and production is expected to be LOW.

10. Effects on the Economy of the North Slope Borough: Analysis of economic effects resulting from the base case is limited to effects on the North Slope Borough. The information that follows is from the Rural Alaska Model, prepared for MMS by the Institute for Social and Economic Research, and from the North Slope Borough Census (North Slope Borough, In Press).

a. NSB Revenues and Expenditures: Under existing conditions, total property taxes in the NSB and NSB revenues are in general projected to steadily decline, as discussed in Section III.C.1. As also discussed in this section, these revenues will be determined by several different factors; therefore, the revenue projections should be used with the understanding that many uncertainties exist about these factors. The proposed sale is projected to increase property taxes starting in 1993. This value is expected to reach a maximum of 26 percent above the declining existing-condition levels in the year 2010. The average percentage change is expected to be approximately 11 percent. Also, under existing conditions, the two expenditure categories that affect employment--operations and the Capital Improvements Program (CIP)--are projected to steadily decline. Of these two categories, only expenditures on operations would be affected by the proposed sale's effects on taxable property value. Those CIP expenditures that have generated many high-paying jobs for residents would not be affected.

The base case is projected to increase operating revenues, anywhere from 1 percent in 1999 to a high of 20 percent in 2010, above the declining existing-condition level. The percentage change in operating revenues is expected to average 9 percent. The population effect of sale-induced employment would affect NSB revenues by allowing collection of additional intergovernmental and property-tax operating revenues that are proportional to the NSB population. The percentage effect on operating revenues would begin to rise again after 2005 because of the expected declining existing-condition levels and the induced-population effect on revenues.

b. Employment: The gains in direct employment associated with the base case would include jobs in petroleum exploration, development, and production, and jobs in related activities. The estimated peak employment would be 3,200 jobs in the year 2002 (see Appendix H, Table H-2), of which 2,844 would be offshore and 358 would be onshore. Additionally, throughout the production phase, total employment would average about 1,474 jobs, of which approximately 212 would be onshore. All of these jobs would be filled by commuters who would be present at the work sites approximately half of the days in any year. Most workers would commute to permanent residences in the following three regions of Alaska--Southcentral; Fairbanks; and, to a much smaller extent, the North Slope. Some workers would commute to permanent residences outside of Alaska, especially during the exploration phase. Because economic effects in other parts of Alaska would be insignificant, only employment increases in the North Slope region are discussed.

The proposed sale is projected to affect employment of the region's permanent residents in two ways: (1) more residents would obtain petroleum-industry- related jobs as a consequence of Sale 126 exploration, development, and production activities, and (2) more residents would obtain NSB-funded jobs as a result of higher NSB expenditures, as discussed above.

While the proposed sale is projected to generate a large number of industry jobs in the region, the number of jobs filled by permanent residents of the region is not projected to be large. The predominant factor in the decline of employment in both cases is declining NSB expenditures. Total base-case resident employment is expected to average about 9 percent above existing-condition employment. For the years 1993 through 1999, resident employment is expected to change by less then 4 percent in each of these years. Resident employment in the year 2000 is projected to be 7 percent above the existing conditions forecast and will continue to increase afterwards in each of the years following until 2010, the horizon for this forecast. The average percentage change for the years 2001 through 2010 is expected to be 14.5 percent. The range of this average is from 12 percent to 19.5 percent. Much of this increase in resident employment would be due to changes in NSB revenues that would be used to create new jobs. Few direct oil industry jobs are expected to be filled by NSB residents. The increasing level of resident employment, especially in the latter years, is the result of increases in property taxes to the NSB. This employment is expected to help offset other declines in employment and should prevent the outmigration of some residents.

Figure IV-C-5 presents a comparison of total resident employment for the no-sale and base cases. Figure IV-C-6 presents total resident Native employment for both the no-sale and base cases. It is assumed that all of the direct industry employment of residents is filled by Natives. As can be observed, most of the sale-induced employment is not with the petroleum industry; and the number of sale-induced petroleum-industry jobs would drop as a percentage of sale-induced employment. In addition to the constraints on industry employment of Native residents discussed in Section III.C.1, the projected small, sale-induced effect can be attributed to a combination of an already historically high level of industry employment assumed under existing conditions and declining petroleum-related employment in the region. As industry employment declines in the region, there probably would be less effort made to recruit and retain Native workers.

As for the case under existing conditions, the unemployment rate for Natives is projected to rise from 0 percent in the year 1985 to 50 percent by the year 2002 and to remain at that level until the end of the projection period in the year 2010. While the unemployment rates are about the same for both cases, the sale case is projected to have a larger number of unemployed and a larger labor force, which results in similar rates. As under existing conditions, non-Native residents who lose their jobs are assumed to leave the region.

c. Effects of Subsistence Disruptions on the NSB Economy: Disruptions to the harvest of subsistence resources could affect the economic well-being of NSB residents in a number of ways. Adverse effects would be felt primarily through the direct loss of subsistence resources. In addition, loss of subsistence resources would increase demand for store-bought goods and result in an inflation of prices. In the case of an oil spill, a strain on infrastructure resulting from the influx of spill workers could occur.

Subsistence activities are an integral component of the NSB economy as well as the culture. If one or more subsistence resources became unavailable for harvest, the economic well-being of NSB residents would be harmed. There are two components to the economic well-being associated with subsistence resources--the value of subsistence resources as a source of food and the cultural value of the resources. Both of these values can be represented as a direct source of economic well-being for NSB residents. Subsistence resources, very simply, enter into household income as a food source that does not have to be purchased in the marketplace. This food source is a substitute for income earned in the marketplace that would have to be used to purchase food. Subsistence activities, and the value derived from these pursuits, however, go beyond a substitute for food bought in the market. As a way of life, there is a real, measurable economic value gained from NSB residents having access to such activities. Although there have been no studies to measure this value for NSB residents, studies that measured the recreational-hunting values and existence values of natural resources in other parts of the U.S. give a rough indication of the magnitude of such values (see, e.g., Brookshire, Eubanks, and Randall, 1983). A disruption of a subsistence harvest would result in a

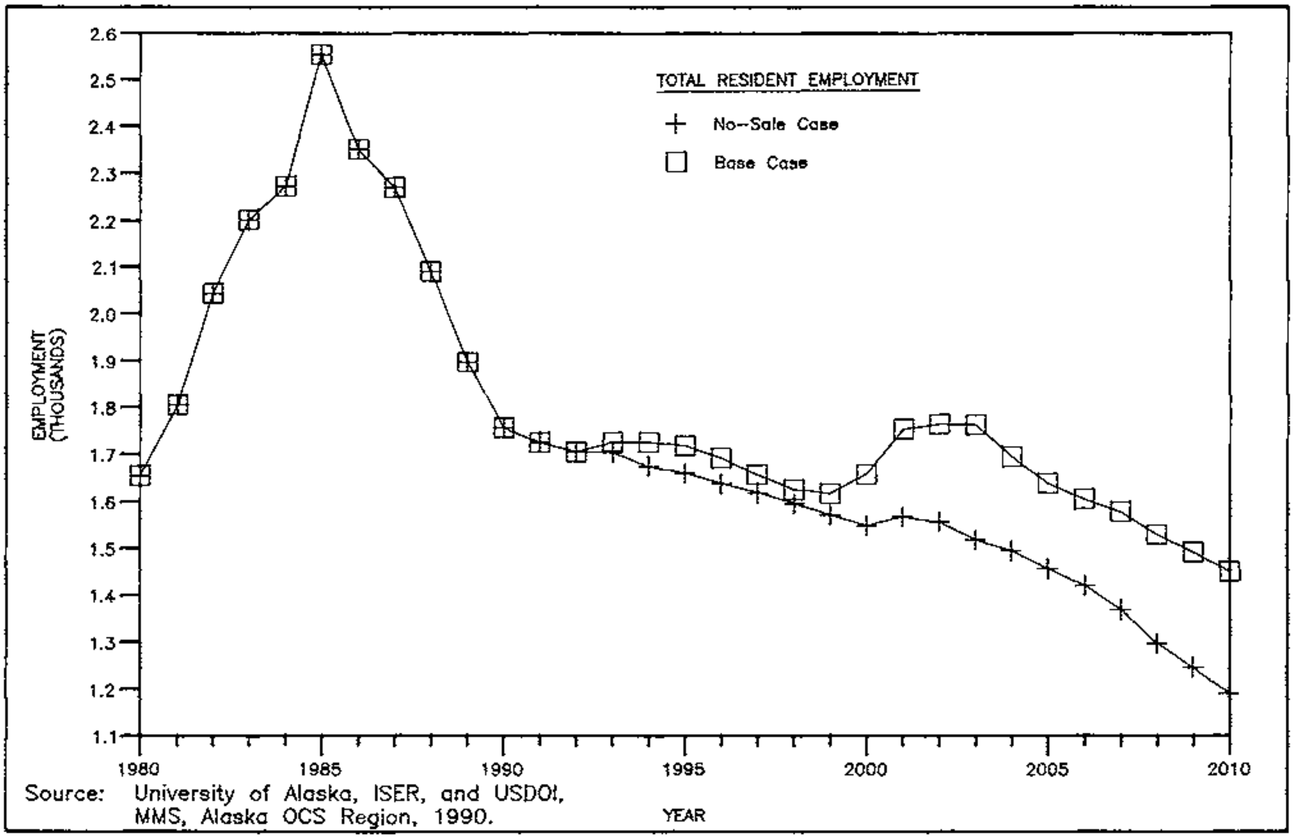


Figure IV-C-5. North Slope Borough Total Resident Employment, Comparison of Base and No-Sale Cases

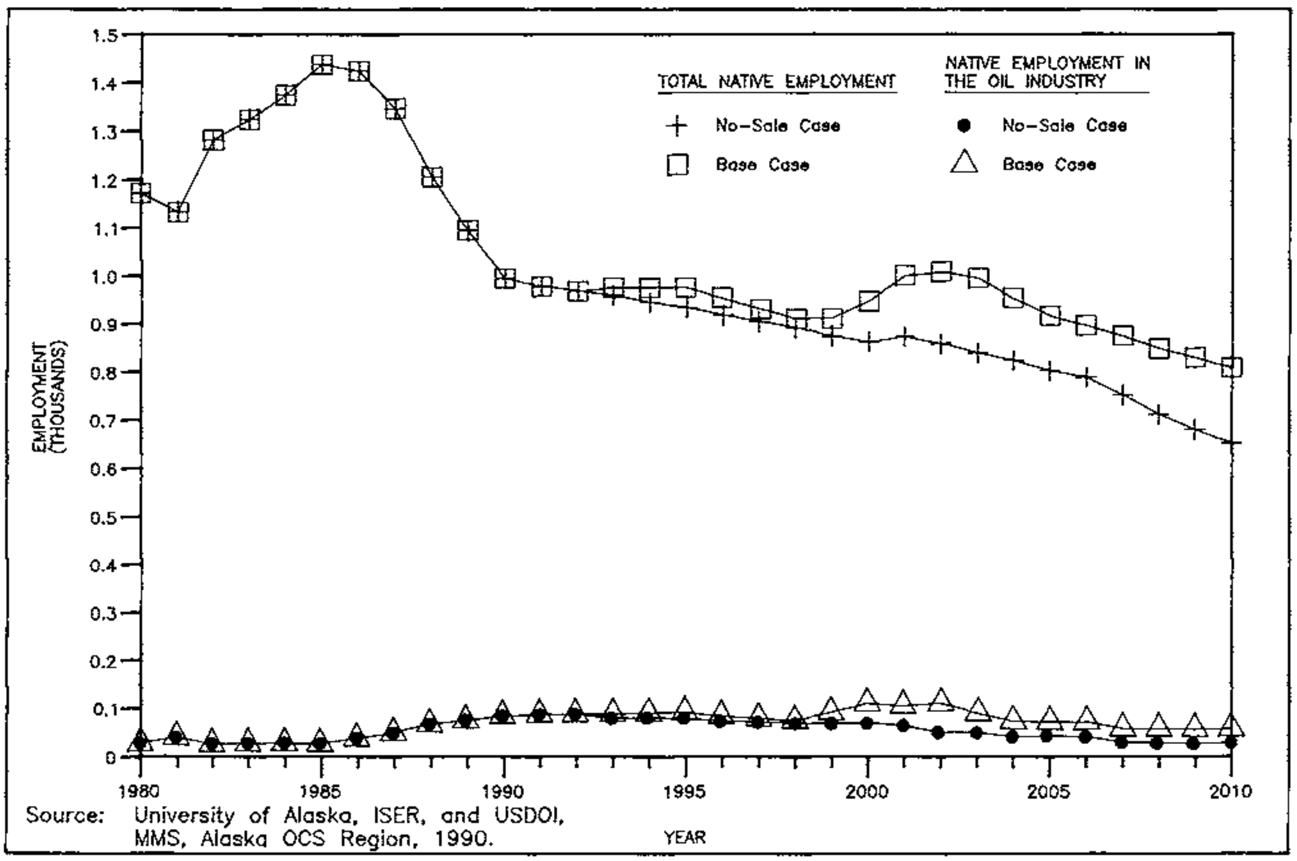


Figure IV-C-6. North Slope Borough Total Native Employment, Comparison of Base and No-Sale Cases real loss of economic well-being to residents.

The interaction between the "Western" market-oriented economy and subsistence activities is a complex relationship that does not fit neatly into standard economic theory. Much of the reason for this is because the unit of analysis in standard economic theory is the household, whereas the extended-kinship network is important for economic decision making in the Inupiat culture of the NSB. The kinship-sharing network that is characteristic of Inupiat culture distorts the standard economic outlook on an economy. For example, jobs in the market economy are often held in order to support subsistence activities. Earnings from these jobs frequently are not earned by the principal harvester of subsistence resources but rather are contributed by the market-wage earner to the harvester's subsistence effort. Likewise, subsistence resources are contributed to those engaged in market-oriented activities. This, however, is only one possible combination of the relationship between the market economy and subsistence activities. Market-wage earners may also directly engage in subsistence activities. Furthermore, the sharing of resources among the kinship network is not a simple trade of equally valuable goods. Rather, it is based on tradition and status among the individuals within the network.

Because of this extensive subsistence user/kinship network, a disruption to a subsistence resource caused by, for example, an oil spill could have ramifications that extend beyond the immediate family of the subsistence harvester to households that, by all appearances, principally engage only in market-economy activities. For example, an MMS survey research project on the North Slope found that for six North Slope communities (Barrow, Wainwright, Nuiqsut, Point Hope, Anaktuvuk Pass, and Kaktovik), about 70 percent of all households (regardless of ethnicity) obtained the majority of meat and fish in their diet from subsistence activities. A loss of a subsistence resource would be a loss of income to the entire community. This loss of income would result from the loss of the value of the food, plus the loss of the cultural value, and most likely could not be compensated for by the market economy through purchases of Western foods. There is considerable evidence that Western foods are not considered equivalent to Native foods (Kruse, Baring-Gould, and Schneider, 1983). Even if an equal portion of Western foods were substituted for the lost subsistence foods, there would still be a loss in well-being and in turn a loss of income because the substitute foods would be an inferior product. This aspect of the loss does not begin to address the lost value associated with having to forego participating in subsistence activities and, in general, the lost value associated with not being able to participate in the Native culture. This is not to deny the possibility of additional income to local residents earned through cleanup jobs; however, cleanup opportunities are not expected to fully compensate for the lost value resulting from being denied use of subsistence resources.

In addition to the loss of value and, in turn, income associated with a loss of subsistence resources as the result of an oil spill, there would also be an effect on the NSB resulting from an influx of oil-spill-cleanup workers. This could manifest itself through inflationary pressures as the influx of workers compete with locals for goods and services and bid up prices. It is also expected that a strain would be placed on local infrastructure that would force local governments to expend additional, unbudgeted resources. All of these factors could have a negative effect on the local economy.

Following is a brief summary of the resources and communities that could be affected by subsistence-harvest disruptions. For a more detailed discussion, see Section IV.C.11. Following this summary is an analysis of the effects of harvest disruptions as a result of oil spills, noise and traffic disturbance, and construction activities on the local economy.

(1) Barrow: The Peard Bay area is particularly important for Barrow subsistence harvesters. Barrow residents harvest bowhead and belukha whales off the northeast edge of Peard Bay. According to Section IV.A.1, assuming that an oil spill occurred at hypothetical Spill Site J33 during the summer, there is a >99.5 (conditional) probability that oil will contact the bowhead whale migration area off Peard Bay (Migration Corridor A) within 10 days. If we consider the probability of an oil spill occurring in conjunction with the probability of the oil contacting an environmental resource (combined probability), there is an estimated 44-percent probability of an oil spill occurring sometime during the lease

term and contacting bowhead Migration Corridor A within 10 days. This would have a moderate effect on the bowhead whale harvest. Noise and traffic are not expected to have an effect on the bowhead harvest and construction activities are considered too distant to cause more than very low effects.

The effect of an oil spill on Barrow's belukha whale harvest is expected to be low because the probability of oil contacting Barrow belukha-harvest areas is low. Both the conditional probability and the combined probability for this environmental resource are <0.5 percent. In addition, noise, traffic, and construction activities are too distant to have more than short-term, temporary effects.

According to Section IV.C.11, the low probability of an oil spill (<0.5%) occurring and contacting the Barrow subsistence-harvest area would cause very low effects on caribou. Furthermore, noise and traffic along the Sale 126 pipeline corridor are not expected to cause a reduction in the caribou harvest. However, noise and traffic could cause some temporary delays in caribou-movement patterns that could result in a greater degree of difficulty in harvesting caribou. This could increase both the time and money spent on the caribou subsistence-harvest, for a low effect.

Barrow residents harvest bearded and hair seals as far south as the Peard Bay area. The conditional probability (that is, assuming an oil spill occurs) of oil contacting Peard Bay subsistence resources is >99.5 percent. The combined probability (the probability of an oil spill occurring and contacting the environmental resource) is 18 percent. It is expected that seals will be contaminated; but only a portion of the harvest would be reduced, resulting in low effects. The walrus, however, is harvested only during a short period of time; and a reduction during this period would reduce the entire year's harvest, for a moderate effect on the subsistence harvest. Noise, traffic, and construction disturbance could affect both seals and walrus, resulting in a low effect on the seal harvest and a moderate effect on the walrus harvest.

Section IV.C.11 concludes that the effect of an oil spill on fish harvested by Barrow residents would be low. This assumes that Barrow residents are able to replace fish contaminated in the Peard Bay area with fish caught elsewhere. Effects from noise and traffic disturbance and construction activities on fish would be very low.

Likewise, the effects on the harvest of birds is expected to be very low. Oil has a <0.5-percent conditional probability of contacting Barrow's bird-harvest areas, and traffic and noise disturbance and construction activities would be too widely dispersed to have significant effects.

Polar bear harvests in the Barrow subsistence-harvest area could be reduced by oil spills that contaminated the polar bears or their main food source-- seals. The effect of the base case on Barrow's polar bear subsistence harvest is expected to be low.

In 1988, marine mammals accounted for 149,340 kg of edible meat harvested by Barrow residents. This represented 56 percent of the total edible weight harvested. Forty percent of the total edible weight harvested was bowhead whale, 7.6 percent was walrus, 7.6 percent was seal, and 1 percent was polar bear. During the same year, 32 percent of total edible meat harvested came from terrestrial mammals. Twenty-eight percent of total edible meat harvested came from caribou and 4 percent came from moose. In addition, fish provided 8 percent of total meat harvested and birds provided 4 percent (Stephen R. Braund and Assoc. and UAA, ISER, 1989a.) The MMS' Social Indicators Study estimates that 41 percent of all Barrow households (regardless of ethnicity) obtain greater than 50 percent of the meat in their diets from subsistence resources (this figure would be higher if just Native residents were considered). Disruptions to the subsistence harvest, as discussed in this section, could have a very significant effect on a major food source in the Barrow economy. For example, there is a high likelihood of an oil spill eliminating the bowhead harvest for 1 year. An oil spill could also reduce the harvest of seals, walrus, polar bear, and fishes. These resources contributed 64 percent to the total amount of edible harvest. A loss of just one whaling season would have major adverse effects on the economy of Barrow. New food sources would have to be found, increases in cash income would be necessary or savings depleted, and the NSB infrastructure would be stressed. In addition, there would be a significant loss in value due to Natives being forced to consume inferior products, i.e. Western foods. These effects would carry over to other areas of the NSB and the rest of Alaska because of the extensive kinship/gifting networks. In the event of an oil spill, the significant effect on the economic well-being of Barrow residents is expected to be high.

(2) Wainwright: A pipeline landfall and shorebase is expected to be located at Point Belcher, in the vicinity of Peard Bay. Peard Bay is an important subsistence-harvest area for Wainwright for all marine resources except the bowhead whale, which is harvested off Point Belcher. Because of the concentration of noise and traffic disturbances and construction activity, and the high probability of oil contacting environmental resources, Wainwright is expected to experience a higher level of effects than other communities.

As presented in Section IV.A.1, the conditional probability of an oil spill occurring and contacting the Peard Bay area in 10 days is >99.5 percent. The combined probability for Peard Bay is 18 percent, which means that there is an 18-percent chance of an oil spill occurring during the summer and contacting Peard Bay within 10 days. In addition, the summer conditional probability for oil contacting Migration Corridor A within 10 days is >99.5 percent and the summer combined probability is 44 percent. Oil spills in these areas would have a moderate effect on the Wainwright bowhead whale harvest because hunters would have to move to new locations, thus shortening the season. Construction activities associated with the landfall and shorebase at Point Belcher are expected to cause high effects, disrupting the bowhead whale harvest for more than 1 year and making the harvest of bowheads more difficult.

According to Section IV.C.11, although the belukha whale is found in an area with a high probability of being contaminated with oil, the effect on the harvest of belukhas would be low. This is due to the relatively long harvest period. Noise and traffic disturbance are likewise expected to have low effects on belukha whale harvesting. However, the construction activities at Point Belcher may affect the presence of belukha whale, thus making them unavailable for a year and resulting in a moderate effect.

Effects from oil spills and sale-related activities on seal, fish, bird, caribou, and polar bear harvests are all expected to be low. The seal harvest occurs throughout the year; therefore, only a portion of the harvest would be affected. Fishing in other locations could allow residents to make up harvests lost in the Peard Bay area. The effect on the polar bear is expected to be localized and short-term.

An oil spill that occurred during the time when the walrus is harvested could cause the walrus to become unavailable for 1 year because of the short timeframe in which it is harvested--resulting in a moderate effect.

In 1988, marine mammals accounted for 80,079 kg. of edible meat harvested by Wainwright residents. This represented 70 percent of total edible weight harvested. Forty percent of the total edible weight harvested was bowhead whale, 18 percent walrus, 7.7 percent seal, and 1 percent polar bear. During the same year, 24 percent of total edible meat harvested came from terrestrial mammals, 23 percent from caribou. In addition, fish provided 4 percent and birds 2 percent of total meat harvested (Stephen R. Braund and Assoc. and UAA, ISER, 1989b.) The MMS' Social Indicators Study estimates that 60 percent of all Wainwright households (regardless of ethnicity) obtain >50 percent of the meat in their diets from subsistence resources. Disruptions to the subsistence harvest, as discussed in this section, could have a very significant effect on a major food source in the Wainwright economy. For example, there is a high likelihood of an oil spill eliminating the bowhead harvest for 1 year. An oil spill could also reduce the harvest of seals, walrus, polar bear, and fishes. These resources contributed 71 percent to the total amount of edible harvest. A loss of just one whaling season would have major adverse effects on the economy of Wainwright. New food sources would have to be found, increases in cash income would be necessary or savings would be depleted, and the NSB infrastructure would be stressed. In addition, there would be a significant loss in value resulting from Natives having to consume inferior products, i.e., Western foods. These effects would carry over to other areas of the NSB and the rest of Alaska because of extensive kinship/gifting networks. In the event of an oil spill, the significant effect on the economic well-being of Wainwright residents is expected to be high.

Adverse effects could also result from general industrial activity. As discussed earlier, noise, traffic, and construction activities could disrupt the bowhead whale harvest for more than 1 year, resulting in a high effect. In conjunction with low effects on caribou, seals, and walrus, the significant effect on the economic well-being of Wainwright residents is expected to be very high.

(3) Point Lay: A large portion of Point Lay's marine-harvest area lies within the Sale 126 area (the remainder lies shoreward of the Federal/State 3-mile territorial line).

Point Lay residents do not harvest the bowhead whale; however, the belukha whale is a culturally important marine resource, since it is hunted through a communal effort. Since the belukha is harvested during a relatively short period of time, an oil-spill during harvest time could preclude a portion of the harvest, resulting in a moderate effect on the Point Lay belukha whale harvest. Noise and traffic disturbance during harvest period would also have a moderate effect on the harvest.

As in the case of Wainwright, the harvests of caribou, seals, fishes, and polar bear are expected to experience low effects resulting from oil spills or other OCS activities.

An oil spill that occurred during the time when walrus are harvested could cause the walrus to become unavailable for 1 year because of the short timeframe in which they are harvested-- resulting in a moderate effect.

(4) Point Hope: A large portion of Point Hope's marine-subsistence-harvest area lies adjacent to the Sale 126 area. According to Section IV.C.11, Point Hope would experience low or very low effects on its subsistence harvests due to the proposal. The subsistence area is too distant from the Point Belcher/Peard Bay area to experience noise and traffic disturbances or disruption related to construction activities. There is also a <0.5 percent combined probability of oil contacting the Point Hope subsistence area during summer within 10 days.

(5) Atqasuk: Effects on the Atqasuk subsistence-harvest area are expected to be low for most resources, except for moderate effects on the bowhead whale and walrus harvests. The residents of Atqasuk harvest marine resources in conjunction with Barrow's harvest; thus, any effects on Barrow's harvest would also affect Atqasuk's harvest. This is due to the high likelihood of oil contacting these environmental resources and because of disruptions due to noise, traffic, and construction activities.

(6) Nuiqsut: All of Nuiqsut's subsistence-harvest area lies outside of the Sale 126 area except for the caribou, which could be affected by the onshore pipeline. Section IV.C.11 concludes that the pipeline corridor is expected to have a low effect on the caribou harvest of Nuiqsut residents because, even if the harvest is made more difficult, the total harvest would not be reduced.

Summary: Subsistence-harvest disruptions can have a direct adverse effect on the NSB economy. Not only are subsistence resources a large portion of total meat for households directly engaged in subsistence harvesting, but the resources are shared widely. Furthermore, a large percentage of NSB households engage directly in subsistence activities. Disruptions from industrial activities or an oil spill would have significant effects on the economic well-being of NSB residents. The value of subsistence resources can be translated into monetary units that reflect potential effects on household income. The use of these resources by NSB residents enters into household income in two ways. Firstly, they are a substitute for store-bought foods that allows cash to be used for other needs. Secondly, there is value derived from enjoyment of the use and value in the cultural aspects of these resources. These are real values that affect the economic well-being of NSB residents and are empirically quantifiable.

Construction activities at Point Belcher could disrupt the bowhead whale harvest for both Barrow and Wainwright for more than 1 year (40% of total edible meat in Barrow and Wainwright comes from this source). Low-level effects resulting from construction and industrial activities are also expected for harvesting caribou, walrus, and seals. An oil spill would also disrupt the bowhead whale harvest for at least 1 year for both Wainwright and Barrow. In addition, walrus would become unavailable for an estimated 1 year for Wainwright and Barrow. Walrus contributes 18 percent and 8 percent, respectively, to the Wainwright and Barrow total edible harvest. Other subsistence resources are expected to experience low-level effects. The economic well-being of NSB residents would be diminished due to the loss of a major source of food and the loss in value placed on that food both from a dietary standpoint and from a cultural standpoint. This would be a real loss in income to NSB residents. The effect of subsistence-harvest disruptions on the economy of the NSB is expected to be high.

Economic effects on the North Slope region are expected to be moderate as a result of the projected change in resident employment, which will increase above 10 percent per annum for at least 5 years with an average change in resident employment of about 9 percent. Sale-related effects on Native and non-Native-resident employment would be slightly higher and slightly lower, respectively. However, the unemployment rate for Native residents should still reach 50 percent by 2002, with or without the sale. In addition, NSB property taxes will increase an average 11 percent and operating revenues will increase an average 9 percent.

Economic benefits from new jobs, income, and taxes that could result from the base case are expected to occur after the level of petroleum activities on the North Slope (e.g., Prudhoe Bay) has begun to decline. This decline would not be reversed by the expected effects of proposed Sale 126.

CONCLUSION: The effect of the base case on the economy of the NSB as a result of exploration and development and production is expected to be HIGH.

11. Effects on Subsistence-Harvest Patterns:

a. Introduction: Section III.C.2 (1) describes the subsistence-harvest patterns characteristic of Inupiat communities adjacent to the Sale 126 area, (2) outlines the important seasonal subsistence-harvest patterns by community and by resource, (3) provides figures depicting the areal extent of each community's general subsistence-harvest area and the timing of harvests, and (4) presents estimated quantities of subsistence resources harvested. Sections IV.C.11.b through IV.C.11.h below summarize the subsistence-harvest patterns. Sections III.C.2 and III.C.3 demonstrate that significant aspects of each community's economy, culture, social organization, normative behavior, and beliefs interact with, and depend on, patterns of subsistence harvest. The sociocultural aspects of effects on subsistence are addressed in Section IV.C.12.

This section analyzes the effects of the base case on the subsistence-harvest patterns of communities near the Sale 126 area. This analysis is organized by subsistence resource and discusses effects on subsistence-harvest patterns as a result of oil spills, noise and traffic disturbance, and construction activities. Following this analysis is a discussion of effects on subsistence-harvest patterns that is organized by community.

b. Effects on Subsistence Resources:

(1) Whales: This analysis indicates that because whaling activities are localized and occur within a short time period, an untimely oil spill could disrupt a community's subsistence effort for an entire season. Since few bowhead whales are harvested, any reduction might eliminate a community's harvest for 1 year. In the event of an oil spill that occurred and contacted the bowhead whale migration, it is also possible that the Native bowhead whale hunt could be suspended by the IWC, NOAA, or AEWC.

Industrial activity is not expected to result in distributional changes in the bowhead population (Sec. IV.B.7). However, support vessels and platforms in the vicinity of the subsistence-harvest area could disturb the harvest without disturbing the general bowhead population. Exploration drillships and their associated support activities are not likely to affect bowhead whaling in the Sale 126 area because bowhead whaling occurs in the spring, when narrow leads are formed and little open water exists. Noise from bottom-founded exploration drilling units, production platforms, support vessels, or ice-breakers associated with the platforms could--but is not likely to--disrupt the whaling effort. Whaling usually occurs in the open-water area between the pack ice and the fast ice or the shore at a time when the length and width of the open-water area is restricted. If disturbed, bowheads might move into the pack ice and thus might become unavailable to whalers, although the disruption is likely to be temporary (for a discussion of industrial- and vessel-noise effects on cetaceans, see Sec. IV.B.7). During the development and construction phase, an offshore pipeline to Point Belcher might disturb Wainwright's bowhead whale hunt since Point Belcher lies in the center of an important bowhead whaling area (see Fig. III-C-6). Noise and traffic disturbance would be concentrated in this harvest area.

Since belukha whales may avoid areas where oil is present, oil spills are not likely to affect the belukha whale population; however, if a belukha were oiled or ingested oil, it would likely be rendered inedible or be perceived as such and consequently would be unharvestable, at least during the affected season. The harvest could also be hindered by oil-spill-cleanup efforts if cleanup were conducted during the harvest. This statement would be appropriate not only for cetaceans but also for other marine-subsistence species.

Belukha reactions to industrial and vessel noises are likely to be short-term in duration and thus would not significantly affect harvest levels. Point Belcher lies several miles from Peard Bay--an important belukha whale-harvesting area for Wainwright residents. During construction of the shorebase and offshore pipeline at Point Belcher, the belukha whale hunt could be disturbed in that area by repeated vessel passes close (within 1-4 km) to both hunters and cetaceans, although such occurrences are likely to be alleviated by agreements between the NSB and industry covering support-vessel movement and by provisions of the Marine Mammals Protection Act.

Exploration-phase effects on cetaceans are expected to be very low. Primary effects-causing agents that could affect cetaceans--oil spills, heavy support-aircraft and boat traffic, and offshore-pipeline emplacement--would be nonexistent.

(2) Caribou: Noise and vehicle-traffic-disturbance effects on caribou are more likely to result from the construction of the projected 640-km onshore pipeline from Point Belcher to TAP Pump Station No. 2 and the associated support road. Effects would also occur throughout the life of the project as a result of traffic along the pipeline corridor. This pipeline would not cross major calving areas of the Western or Central Arctic herds. Because arctic pipelines are constructed to allow for the passage of caribou, the mere physical presence of the pipeline, support road, and associated facilities probably would have no lasting effect on the behavior, movement, or distribution of caribou (see Sec. IV.B.9). During construction, caribou movement could be temporarily blocked and crossings might be slower; but successful crossing would still occur (see Sec. IV.B.9). Although traffic associated with a support road might serve as a temporary barrier to cow/calf movements, it would not block migration movements. Development of the pipeline corridor would increase hunter access to the Western Arctic caribou herd and thus increase pressure on the population, but current regulation of the harvest should prevent over hunting. There may also be some disturbance from aircraft surveillance of the pipeline, but this would cause only brief flight reactions of some caribou and is not likely to delay movement for more than a few hours to a few days (see Sec. IV.B.9). Such might temporarily disrupt the hunt, with possible short-term reductions of the season's harvest; but caribou would not become locally unavailable.

The exploratory phase of the proposed action would not affect the caribou hunt because the primary onshore effects-causing agent, an overland pipeline, would not be in existence during that stage of development.

The caribou contributes to an estimated over-50 percent of the subsistence diets of Barrow, Wainwright, Atqasuk, Point Lay, and Nuiqsut, and 30 percent of Point Hope's. All these communities hunt caribou from the Western Arctic herd. Nuiqsut and Barrow also hunt caribou from the Central Arctic herd (see Sec. IV.B.9). Caribou that move to barrier islands and shallow coastal waters in summer could become oiled or could ingest contaminated vegetation. Since only a small number of animals are likely to be involved, effects on the population would be insignificant (Sec. IV.B.9). Onshore oil spills would be localized and are not expected to significantly contaminate or alter the caribou range within the pipeline corridor. According to Section IV.A.1.b(2)(c), the total oil spilled as a result of onshore-pipeline leaks is estimated at 38,140 bbl. This spillage would occur as a result of 188 separate leaks--22 of which would equal 33,000 bbl.

(3) Fishes: Their reliability and year-round availability make fish an important subsistence staple. In the Sale 126 area, fish provide an estimated 7 to 10 percent of the total annual subsistence harvest (Table III-C-9; see Fig. III-C-10 for harvest areas). However, there currently is no data on proportions of specific fish species harvested. The nearshore area of the Chukchi Sea, particularly the fish-overwintering areas in and near the major river estuaries in Peard Bay (Barrow's and Wainwright's subsistence-use area), Kasegaluk Lagoon (Point Lay's subsistence-use area), and Ledyard Bay would be the most sensitive to oil spills. Moderate biological effects could occur on chum and pink salmon smolts, arctic cod, and capelin if a spill occurred during the open-water (summer) season, and on rainbow smelt if a spill occurred during the winter (Sec. IV.B.4). The combined probability, <0.5 percent (low) in a 10-day period of an oil spill occurring and contacting the aforementioned fish resource areas outside of Peard Bay (see Sec. IV.B.4) indicates that it is unlikely that an oil spill would affect the subsistence harvest of fish in these areas. If a large oil spill occurred and contacted the Peard Bay area, effects on fish-subsistence harvests could be low--not only because of the biological consequences (see Sec. IV.B.4) but also because of a fear of tainting (Ellanna, 1980; Luton, 1985). However, even if fish in the Peard Bay area were oiled, the variety of fish harvested, the number of different areas for harvesting fish, and the longer season for harvesting fish would enable Wainwright residents to harvest other subsistence fishes, or the same fish in other areas.

Noise and traffic disturbance are expected to have insignificant effects on subsistence-fish stocks (see Sec. IV.B.4). Disturbance from seismic activity associated with Sale 126 would occur more than 5 km (3 mi) from subsistence-fishing areas, with boat noise having only a transitory effect on fishes.

Onshore-pipeline-oil spills could contaminate at least one of the approximately 10 major rivers (Sec. IV.A.1.b(2)(c)) that would be crossed by the projected 640-km pipeline from Point Belcher to the TAP. Of these rivers, Atqasuk and Barrow residents fish the Meade River; Nuiqsut residents fish the Colville River; and Barrow residents fish the Chipp River, into which the Ikpikpuk River drains. Atqasuk residents also fish in the Usuktuk River. Although a spill from the onshore pipeline would occur upstream 80 to 161 km away from primary fish-harvest areas, the oil could move downstream into primary subsistence-harvest areas. According to Section IV.A.1.b(2)(c), twenty-two spills in excess of 1,000 bbl may occur over the life of the field. It is unlikely that a spill of that magnitude could occur without detection. It is likely that before the remnants of the spill reached primary fisheries, there would be time to institute some type of protective measures. However, within the tributary in which the spill moved there would be increased mortality within adult and juvenile fish. This increased level of mortality, and associated perception of tainting, would reduce the available harvest of fish from that particular tributary river and, in general, would reduce the availability of that resource to the affected community. However, one spill incident would not be sufficient to eliminate a community's fish harvest because the resource would be available from other undisturbed rivers.

Exploratory-phase effects on fishes would be very low. There are no major onshore projects expected with this phase of oilfield activity or expected oil spills.

(4) Seals: Bearded and hair seals comprise between 3 and 15 percent of the total subsistence-resource harvests for the communities in the Sale 126 area (Sec. III.C.2 [Table III-C-8]; see Fig. III-C-8 for harvest areas). An oil spill could cause some contamination of seals, loss of the subsistence and economic value of contaminated seal hides, and loss of some of one season's young pups in affected areas. Even if only a small number of seals were heavily affected by an oil spill in the area, seals that were oiled would likely be rendered inedible or perceived as such and consequently would be unharvestable. Tables C-13 and C-16 in Appendix C indicate 18- and 33-percent combined probabilities, respectively, of an oil spill occurring and contacting the Peard Bay and Wainwright Subsistence Areas within 10 days (summer and winter trajectories). The seal harvest occurs over a longer period of time (harvests are possible during

the entire year [see Sec. III.C.2]) than harvests of other subsistence resources. Although the potential effects on seals from an oil spill associated with Sale 126 might cause harvesters to hunt longer or take extra trips, these effects should not cause more than low effects on the communities' seal harvests; harvests may be reduced during a portion of the seal-hunting season, but seals would not become unavailable during the year.

Seals are somewhat susceptible to noise and disturbance from aircraft and vessel traffic. However, industrial activity associated with the base case is not expected to result in distributional changes in seal populations (Sec. IV.B.6). Disturbance from aircraft or vessels could cause short-term, localized effects on seals and some short-term disruption to the seal harvest; however, this would not affect annual harvest levels, and seals would not become unavailable during the year. Construction of a shorebase at, and an offshore pipeline to, Point Belcher might disturb the hunting of ringed, spotted, and bearded seals by Barrow and Wainwright residents. Point Belcher lies several kilometers from Peard Bay, an important area for harvesting spotted seals. Ringed and bearded seals also are harvested at Point Belcher and along the coast. A landfall at Point Belcher would concentrate noise and traffic disturbance in this harvest area. If construction occurred during peak harvest periods (June and July), the harvests of bearded and ringed seals could be affected in the Wainwright subsistence area. However, the long seal-harvest period would enable residents to harvest seals during other times of the year.

Exploration-phase effects on seals are expected to be very low. Primary effects-causing agents that could affect seals--oil spills, heavy support-aircraft and boat traffic, and offshore-pipeline emplacement--would be nonexistent.

(5) Walrus: The walrus comprises an estimated 18.5 percent (86 walrus) of the total annual subsistence harvest (estimated 20-yr average) (Table III-C-8; see Fig. III-C-9 for harvest areas). In Barrow and Point Hope, walrus is a less important component (see Table III-C-8); no data are available for Point Lay or Atqasuk. Atqasuk harvests walrus in conjunction with Barrow; thus, any effects on Barrow's walrus harvest would also apply to Atqasuk's. Although oil spills could cause some contamination of walrus and the loss of some of one season's young in affected areas, the walrus is not expected to be affected by oil spills to any great extent. However, oiled walrus likely would be rendered inedible or perceived as such and consequently would be unharvestable except for its ivory. Barrow's, Wainwright's, and Point Lay's walrus-harvest areas, particularly the Peard Bay area, are most sensitive to oil spills due to the higher probability of oil spills contacting the areas. An oil spill that contaminated the annual walrus harvest of Barrow, Atqasuk, Wainwright, or Point Lay would cause the walrus to become locally unavailable for no more than 1 year.

Noise and traffic disturbance generally do not affect walrus-distribution patterns (Sec. IV.B.6); however, noise and disturbance from aircraft can have localized, short-term effects that would cause some disruption to the harvest but would not cause the walrus to become unavailable. The construction of an offshore pipeline to, and a landfall at, Point Belcher would concentrate noise and traffic disturbance in this subsistence-harvest area. This may temporarily disturb walrus hunting in the Point Belcher-Peard Bay area for one season.

Exploration-phase effects on the walrus-subsistence harvest are expected to be very low. Primary effects-causing agents that could affect walrus--oil spills, heavy support-aircraft and boat traffic, and offshore-pipeline emplacement--would be nonexistent.

(6) Waterfowl: Waterfowl, important during spring and summer and because they are a preferred food, comprise less than 3 percent of the total annual subsistence harvest over 20 years (0.9% or 3,636 kg of meat in Barrow; 0.3% or 545 kg of meat in Wainwright; 3.2% or 5,682 kg of meat in Point Hope; no data are available for other villages [Table III-C-8]).

According to Section IV.B.5, if an oil spill occurred during breakup or the open-water period--the seasons when bird hunting takes place, it would likely have immediate effects on birds. Eider and oldsquaw would be most likely to suffer direct mortality; brant and other waterfowl could be harmed indirectly through contamination of saltmarshes.

The important bird-habitat areas where seabird harvests occur are Icy Cape (Fig. IV-A-1: Land Segment 21), south Kasegaluk Lagoon (Land Segment 19), Cape Lisburne, and Cape Thompson. Wainwright and Point Lay residents use Icy Cape for bird hunting; Point Lay residents use South Kasegaluk Lagoon; and Point Hope residents use Capes Lisburne and Thompson (Seabird Concentration Areas I and II). The combined probabilities of one or more spills occurring and contacting any of these areas within 10 days in summer are <0.5 percent (low). This indicates that bird harvests in Wainwright, Point Lay, and Point Hope are unlikely to be affected by an oil spill. In addition, since most eider hunting occurs on the oceans and along the coasts during 2 spring months and most brant hunting occurs along the coasts during 2 fall months, the probability that an oil spill would affect subsistence-bird hunting--even if oil contacted these bird habitat areas--is lower than the probability of contact for that resource area. On the other hand, because of the short hunting season, oil contact could reduce the harvest levels of birds for an entire season. If an oil spill occurred and contacted the Wainwright, Point Lay, and Point Hope bird-hunting areas, birds would become unavailable for no more than a year.

An onshore-pipeline-oil spill from the pipeline near Point Belcher to the TAP would contaminate tundra vegetation and freshwater ponds. Oil-spill cleanup at the spill site would frighten waterfowl and shorebirds away from the spill site, although only a small number of birds may be affected. Effects would be localized and are not expected to significantly contaminate or alter bird wetland or tundra habitats on the North Slope. While there would be some effect on birds, it is not expected to affect the harvest of birds.

The noise caused by construction of both offshore and onshore oil facilities may disturb waterfowl feeding and nesting activities. Construction of offshore pipelines also may disrupt waterfowl food sources but is likely to result in only local and temporary effects. Such low-level biological effects would be too brief to have significant effects on bird harvesting by the communities in the Sale 126 area.

Exploration-phase effects on the waterfowl-subsistence harvest are expected to be very low. Primary effects-causing agents that could affect walrus--oil spills, heavy support-aircraft and boat traffic, and large-scale offshore/onshore construction activities--would be nonexistent.

(7) Polar Bear: The polar bear contributes less than 1 percent to the total annual subsistence harvest for community residents near the Sale 126 area (see Table III-C-8 and Sec. III.C.6). Oil spills could cause some contamination of seals (polar bear prey), loss of the subsistence and economic values of polar bear hides, and loss of some of one season's young in affected areas. Prey contamination also could cause some mortality in the polar bear population. Such effects are most likely to occur in Barrow's, Wainwright's, and Point Lay's polar bear-harvest areas but could affect bears available to any of the coastal communities. While the effects that may occur on polar bear from an oil spill associated with Sale 126 might cause residents to hunt longer or take extra trips, these effects would not reduce harvests for an entire year. The polar bear could experience short-term, localized aircraft-noise-disturbance effects that would cause some disruption in the polar bear harvest but would not affect annual harvest levels.

Exploration-phase effects on the polar bear-subsistence harvest are expected to be very low. Primary effects-causing agents that could affect walrus--oil spills, heavy support-aircraft and boat traffic, and offshore-pipeline emplacement--would be nonexistent.

c. Exploration-Phase Effects: The exploration phase of the proposal is expected to have a very low effect on the subsistence harvests of the communities affected by Sale 126. The primary effects-causing agents that could affect the subsistence harvest, namely large-scale offshore/onshore construction projects, significant levels of support-boat and helicopter traffic, and the possibility of an oil spill, are not expected to occur during the exploratory phase.

d. Effects on Subsistence Resources by Community: Subsistence-resource areas for Barrow, Wainwright, Point Lay, and Point Hope are shown in Figure IV-C-7 to indicate important marine mammal-harvest areas used by communities that would be vulnerable if an oil spill occurred and contacted

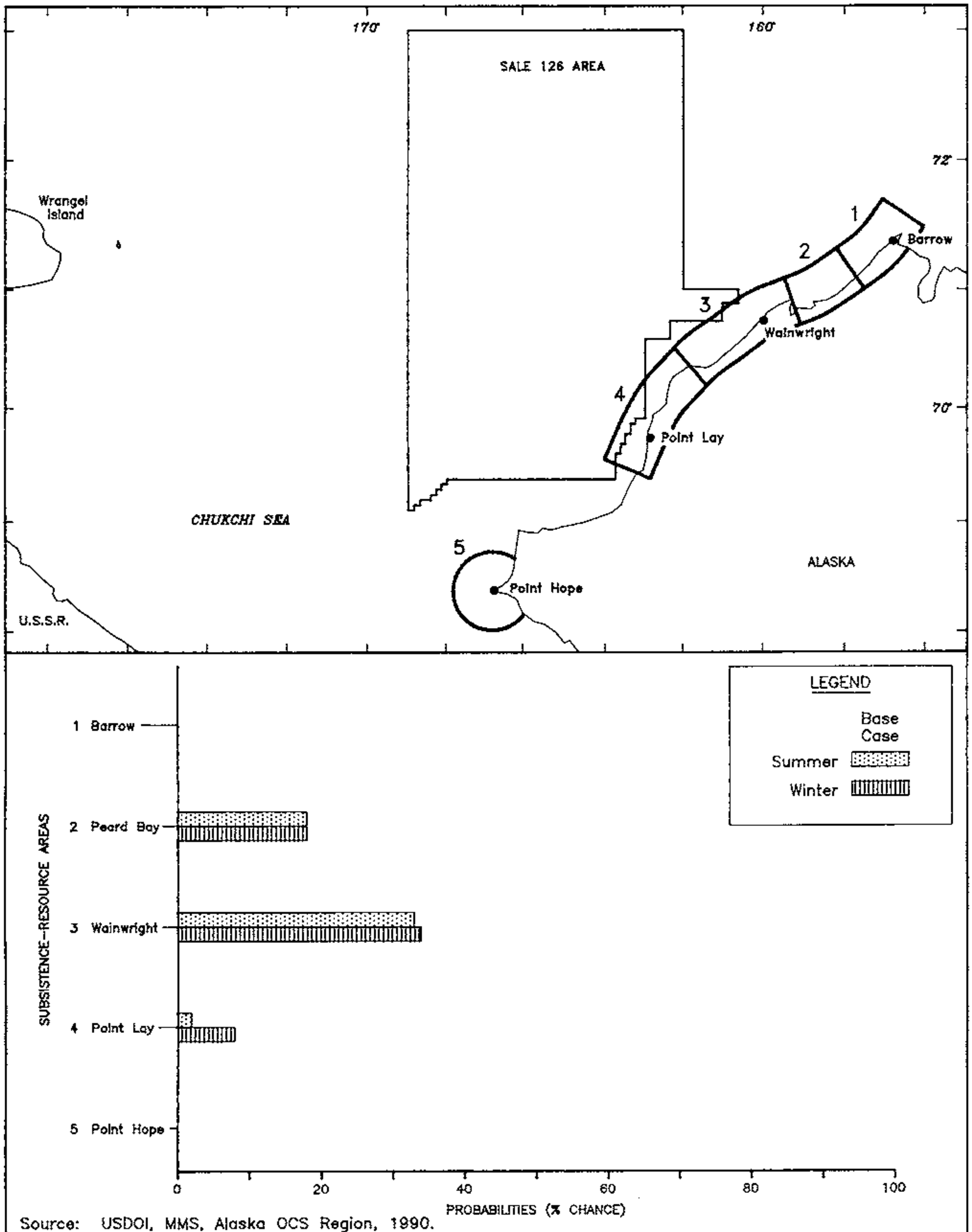


Figure IV–C–7. Combined Probabilities of Oil–Spill Occurrence and Contact to Subsistence–Resource Areas during the Open–Water Season in Comparison to the Entire Winter Season

Note: Probabilities of one or more spills of ≥1,000 bbl occurring and contacting Subsistence–Resource Areas 1 through 5 during the summer (open–water) season in comparison to the winter season within 10 days over the life of the field.

these areas.

(1) Barrow: A portion of Barrow's subsistence-harvest area lies within the Sale 126 area. Barrow residents use the Peard Bay area to some extent for harvesting marine resources. The Peard Bay area has an 18-percent chance of an oil spill occurring and contacting the area (summer and winter combined probabilities, 10-day period). It is more likely that the Peard Bay area will be affected by noise, traffic disturbance, and activities associated with construction of the pipeline landfall and the Point Belcher shorebase. These construction activities and related effects may have some effects on Barrow's subsistence harvests.

The probability (a combined probability of 44% during the open-water season within 10 days [Appendix C: Table C-13) of an oil spill occurring and contacting the Barrow bowhead-harvest area, and the hypothetical quantity of oil spilled (Sec. IV.A.1.b.), indicate that moderate effects due to oil spills on the bowhead harvest could be expected primarily due to the reluctance to hunt bowheads in oiled waters. Noise and traffic would not affect Barrow bowhead whaling because drilling units, production platforms, vessels, and icebreakers would not be in the vicinity of the Barrow bowhead-harvest areas.

Construction activities in Peard Bay are too distant from the bowhead-harvest area to cause more than very low effects. The overall effect on Barrow's bowhead-subsistence harvest as a result of activities associated with the base case is expected to be moderate.

Barrow's belukha-harvest area extends only to the northeastern edge of the Peard Bay area--too distant for noise and traffic or construction activities to affect belukha whaling on more than a short-term, temporary basis. Noise and traffic disturbance would be expected to cause some effects but would not cause the harvest to become unavailable (low effects). Further, there is a <0.5-percent probability of an oil spill occurring and contacting Barrow's subsistence-resource areas outside of Peard Bay. The overall effect on Barrow's belukha-subsistence harvest as a result of activities associated with the base case is expected to be low.

The <0.5-percent probability of an oil spill occurring and contacting the Barrow subsistence-harvest area during summer and winter within 10 days (see Fig. IV-C-7) would cause very low effects on caribou. Noise and traffic along the Sale 126 pipeline corridor would disturb caribou and could cause some temporary delays in caribou-movement patterns that could affect the harvest; however, the annual harvest would not be reduced. Effects on the caribou harvest due to noise and traffic disturbance are expected to be low. Caribou may temporarily avoid the pipeline-construction area, which would cause low effects on the caribou harvest for the duration of the construction. Potential onshore-pipeline spills are not expected to influence harvest levels, since the effect of a spill on the caribou's grazing range is expected to be very low given the overall extent of the range. The overall effect on Barrow's caribou-subsistence harvest as a result of activities associated with the base case is expected to be low.

Bearded and hair seals are harvested by Barrow residents as far south as the Peard Bay area. Even though seals may be contaminated by an oil spill, the harvest would not become unavailable because seal harvests occur throughout the year; thus, only a portion of the harvest might be reduced, resulting in low effects. In contrast, the walrus is harvested during a very short period from early June through late August; and a reduction of the harvest during this period would result in a reduction of the entire harvest. Consequently, the walrus-subsistence harvest could experience moderate effects from oil contamination during that period. Seals and walrus could be affected by aircraft noise and traffic disturbance that results in only short-term, localized effects. Both seals and walrus are also likely to be disturbed by the high concentration of activity associated with construction of the pipeline landfall at Point Belcher. This would produce low effects on seals, again because of the longer hunting season, and moderate effects on walrus due to the shorter hunting season. Overall, effects on Barrow's seal-subsistence harvest are expected to be low, with moderate effects on the walrus-subsistence harvest.

Oil offshore is not expected to affect fishing in the Barrow subsistence-harvest area, with the exception of the

Peard Bay area. However, even if fish in the Peard Bay area were oiled, fishing is conducted in a wide area and the overall harvest would not be affected. Effects on fish harvests due to oil spills are expected to be low. Other effects due to noise and traffic disturbance and construction activities would be very low because these activities do not substantially affect fish. Onshore oil spills from the pipeline could affect Barrow's fish-subsistence harvest; but the spills are likely to be quickly detected and generally less then 100 bbl in quantity. Should an oil spill occur along a major interior river used for fishing, the effects could be greater--especially if the spill were large and went undetected. However, the combination of a spill being (a) large, (b) undetected, and (c) along a principal subsistence-fishing river is unlikely (for Barrow's and other communities' fisheries resources). Therefore, the overall effect of the base case on Barrow's fish-subsistence harvests is expected to be low.

Oil is not expected to cause more than very low effects on Barrow's bird harvest due to the <0.5 percent probability of an oil spill occurring and contacting Barrow's bird-harvest areas. Although birds may be affected by noise and traffic disturbance and construction activities, these effects would be too widely dispersed to have significant effects on a community's bird harvest in the sale area. The effect of the base case on Barrow's bird-subsistence harvest is expected to be very low. Polar bear harvests in the Barrow subsistence-harvest area could be reduced by oil spills that contaminated the polar bears or their main food source--seals. The effect of the base case on Barrow's polar bear-subsistence harvest is expected to be low.

<u>Conclusion</u>: The effect of the base case on Barrow's subsistence-harvest patterns is expected to be moderate.

(2) <u>Wainwright</u>: A pipeline landfall and shorebase for Sale 126 is expected to be located at Point Belcher, in the vicinity of Peard Bay. Peard Bay is an important subsistence-harvest area for Wainwright for all marine resources except the bowhead whale, which is harvested off Point Belcher. Oil spills, concentration of noise and traffic disturbance, and construction activities in the Peard Bay area are expected to cause more effects on the marine and terrestrial subsistence harvests in Wainwright than in other communities. Oil spills in the Wainwright subsistence-harvest area (33% probability of an oil spill occurring and contacting the Wainwright Subsistence Area during summer within 10 days and a 44% probability of a spill occurring and contacting Whale Migration Route A during summer within 10 days [Appendix C: Table C-13]) would cause moderate effects on the bowhead whale harvest because bowhead whaling activities are localized and occur within a short time period. An oil spill would force hunters to move to a new location and thus would shorten the whaling season. The harvest of whales could be reduced by generally only one or two animals. Noise and traffic disturbance from icebreakers, support vessels, or platforms in or near the bowhead whaling area could cause short-term avoidance behavior by the bowheads, making it more difficult for the hunters to track them. Construction activities associated with the landfall and shorebase at Point Belcher also could cause high effects by disrupting the bowhead whale harvest for more than 1 year and by making harvesting of bowheads more difficult. As a result of high effects from construction activities in the Point Belcher area, the overall effect of the base case on Wainwright's bowhead whale-subsistence harvest is expected to be high.

Only a small portion of the belukha whale population is likely to be affected by an oil spill in the Wainwright belukha-subsistence-harvest area. The longer period of time during which the belukha is available ensures that the belukha-harvest season would not be eliminated. Noise from platforms, vessels, or icebreakers could cause short-term effects but should not cause harvest levels to be reduced (low effects). Construction activities at Point Belcher would also include noise and traffic in Peard Bay--an important area for belukha whale hunting. This activity could affect their presence in Peard Bay and cause the belukha to become unavailable for a year (moderate effects). As a result of moderate effects from construction activities, the overall effect of the base case on Wainwright's belukha-subsistence harvest is expected to be moderate.

A portion of the caribou herd hunted by Wainwright grazes along the barrier islands and shallow coastal lands. Although some of these caribou could ingest oil, not all of these caribou would be affected. The caribou harvest may experience low effects from an oil spill. Effects from noise and traffic disturbance and pipeline-construction activities are expected to be low on the Wainwright caribou harvest, as on Barrow's.

The overall effect of the base case on Wainwright's caribou-subsistence harvest is expected to be low.

Oil spills and construction activities would cause low effects on the Wainwright seal harvest and moderate effects on the walrus harvest. Even though seals may be contaminated by an oil spill, the harvest would not become unavailable because seal harvests occur throughout the year; thus, only a portion of the harvest might be reduced, resulting in low effects. In contrast, the walrus is harvested during a very short period in the summer; and an oil spill that occurred during the peak harvest could cause the walrus to become unavailable for 1 year or less--a moderate effect. Very low effects would occur from noise and traffic disturbance on both seals and walrus. The overall effect of oil spills is expected to be low on Wainwright's seal harvest and moderate on the walrus harvest.

Oil spills in the Peard Bay area and the Kugrua River could affect Wainwright's fish harvests; however, the ability to fish in other areas could enable residents to make up some of the loss. Annual fish harvests could be affected by oil spills; but fish would not become locally unavailable, causing low effects. As in Barrow, fish are not susceptible to disturbances from noise, traffic, and construction activities; and these activities are expected to cause very low effects on Wainwright's fish harvests. The overall effect of the base case on Wainwright's fish harvest is expected to be low.

If an oil spill occurred and contacted the Wainwright seabird-harvest area (Fig. IV-A-1: Land Segment 21), the effects could cause a reduction in the annual harvest because the bird-hunting season is quite short. Since the probability of such an event occurring and contacting Wainwright's bird-harvest area is <0.5 percent (very low, within 10 days), effects from oil spills are expected to be low. As in Barrow, noise and traffic disturbance and construction activities are expected to cause very low effects on Wainwright's bird harvest. The overall effect of the base case on Wainwright's bird harvest is expected to be low.

Wainwright's polar bear harvest could also be reduced by oil spills through contamination of the polar bear and its main food source--seals. The polar bears may also experience short-term, localized effects from aircraft disturbance. The overall effect of the base case on Wainwright's polar bear harvest is expected to be low.

Conclusion: The effect of the base case on Wainwright's subsistence-harvest patterns is expected to be high.

(3) Point Lay: A large part of Point Lay's marine-harvest area lies within the Sale 126 area (the remainder lies shoreward of the Federal/State 3-mile territorial line). Point Lay's subsistence-harvest area is expected to be more susceptible to effects from oil spills than either Point Hope's or Barrow's. Noise and traffic in the vicinity may also affect some species. However, the Point Lay area is far enough away from Point Belcher that it would not experience effects from noise and traffic disturbance or construction activities in the Point Belcher/Peard Bay area.

Point Lay residents do not harvest the bowhead whale; however, the belukha whale, their most important marine resource, holds the most cultural significance since it is hunted through a communal effort. The belukha is harvested in a short period of time. Although the belukha may avoid areas where oil is present and thus is unlikely to be affected by oil spills, it is likely to be rendered inedible or perceived as such if contacted by oil. Oil-spill-cleanup efforts could also hinder the harvest. For this reason, an oil spill that occurred and contacted the belukha-harvest area could cause moderate effects on the harvest by making belukhas locally unavailable for a portion of the harvest period. If noise and traffic disturbed the harvest during this short period, the belukha harvest could be reduced, thus causing moderate effects. The overall effect of the base case on the Point Lay belukha-subsistence harvest is expected to be moderate.

Point Lay residents also harvest some caribou from the Western Arctic herd. As in Wainwright, the effects from oil spills on Point Lay's caribou harvest would be low. The effects of noise and traffic disturbance and construction activities are expected to be very low because of the distance of the Point Lay caribou-harvest area from the Sale 126 pipeline corridor. The overall effect of the base case on Point Lay's caribou-subsistence harvest is expected to be low.

As in Barrow and Wainwright, oil spills in the Point Lay subsistence-harvest area are expected to cause low effects on the Point Lay seal harvest and moderate effects on the walrus harvest. (The combined probability of oil occurring and contacting the Point Lay Subsistence Area within 10 days during winter is 8% [Fig. IV-C-7]). Even though some seals may be contaminated by an oil spill, the harvest would not become unavailable because seal harvests occur throughout the year; thus, only a portion of the harvest might be reduced, resulting in low effects. In contrast, the walrus is harvested during a very short period in the summer; and an oil spill that occurred during the peak harvest could cause the walrus to be unavailable for 1 year. Noise and traffic disturbance are expected to cause low effects on both resources. Construction activities are expected to cause very low effects because of the distance from Point Lay to Peard Bay. The overall effect of the base case is expected to be low in Point Lay's seal-subsistence harvest and moderate on the walrus-subsistence harvest.

Oil spills are expected to cause low effects on fish in the Point Lay subsistence-harvest areas; however, the diversity of fish harvested, the large area where fishing is possible, and the 8 percent probability (low) of an oil spill occurring and contacting the resource indicate an expectation of very low effects on fish harvests due to oil spills. Fish are not susceptible to noise and traffic disturbances or construction activities. The overall effect of the base case on Point Lay's fish harvest is expected to be very low.

If an oil spill occurred and contacted the Point Lay seabird-harvest area (Fig. IV-A-1: Land Segment 19), moderate effects could occur; however, the probability of such a spill occurring and contacting this area during summer and winter within 10 days is <0.5 percent (low). The overall effect of noise and traffic disturbance and construction activities associated with the base case on the bird-subsistence harvest in Point Lay is expected to be very low. Point Lay's polar bear harvests could be reduced through oil-spill contamination of the bear's main food source--seals. The polar bear also may experience short-term, localized effects from aircraft disturbance. The overall effect of the base case on the Point Lay polar-bear subsistence harvest is expected to be low.

<u>Conclusion</u>: The effect of the base case on Point Lay's subsistence-harvest patterns is expected to be moderate.

(4) <u>Point Hope</u>: A large part of Point Hope's marine-subsistence-harvest area lies adjacent to the Sale 126 area. However, Point Hope's subsistence harvests are not as likely to experience as many effects as Wainwright and Point Lay because of its distance from the Point Belcher/Peard Bay area, where most of the noise and traffic disturbance and construction activities would occur, and because of the <0.5 percent combined probability (low) of an oil spill occurring and contacting Point Hope's subsistence-harvest area. Oil spills would have very low effects on the harvest of all Point Hope subsistence resources, with the exception of migratory birds. Noise and traffic disturbance would have very low effects on all harvests. Construction activities would also have very low effects on all Point Hope harvests.

The bowhead harvest is numerically small (usually 1 bowhead). In a year with extremely severe ice conditions, any effect that disrupted the hunt of even one animal could eliminate the bowhead harvest. Noise from icebreakers or other vessels could produce such an effect, but the likelihood is very low. Industrial and vessel noises could also disturb the belukha hunt, but the belukha response to vessel noise should exhibit itself through short-term avoidance behavior (see Sec. IV.B.7). The longer belukha-harvest period would reduce the overall effect of the base case on Point Hope's belukha harvest to low.

Point Hope residents harvest caribou from the Western Arctic herd. This herd could be affected by noise and traffic disturbance and construction activities associated with the onshore pipeline corridor; but these effects would not occur in the Point Hope caribou hunting area. Consequently, the overall effect of the base case on the Point Hope caribou harvest is expected to be very low.

The overall effects of the proposal on Point Hope's seal and walrus harvests are expected to be very low because of the low probability of an oil spill occurring and the low biological effects expected from noise and traffic disturbance.

Very low effects on fish harvests are expected in Point Hope. The risk of an oil spill occurring and contacting the area is <0.5 percent (low), and fish are not susceptible to noise and traffic disturbance.

The probability of an oil spill occurring and contacting the Point Hope seabird-harvest area (Seabird Concentration Areas I and II) is <0.5 percent (low, 10-day summer and winter probabilities), and effects from oil spills are expected to be low. Bird harvests are expected to experience very low effects from noise and traffic disturbance and construction activities. The overall effect of the base case on Point Hope's bird-subsistence harvest would be very low.

Oil spills would have very low effects on seals (the polar bear's main food source) and consequently very low effects on the polar bear. Because Point Hope is distant from anticipated noise and traffic disturbance and construction activities, these activities would be either nonexistent or short-term and temporary, resulting in very low effects on Point Hope's polar bear-subsistence harvest. The overall effect of the base case on the Point Hope polar bear harvest is expected to be very low.

Conclusion: The effect of the base case on Point Hope's subsistence-harvest patterns is expected to be low.

(5) Atqasuk: The residents of Atqasuk, an interior community, harvest marine resources only in conjunction with Barrow's harvests. Atqasuk was re-established as a community in the mid-1970's by families from Barrow. The ties between the communities remain strong, and since Atqasuk has no marine-harvest area strictly of its own, its residents hunt marine resources with their Barrow relatives in their ancestral hunting areas. Therefore, any effects on Barrow's marine-resource harvests would also affect Atqasuk's. Low effects are expected on all marine mammal harvests in Barrow, except for moderate effects expected on bowhead and walrus harvests as a result of oil spills and construction activities in the Peard Bay area. The caribou is the only subsistence resource that could be affected by noise and traffic disturbance related to the Sale 126 pipeline corridor. Chronic low-level effects from traffic along the pipeline-support road could affect the caribou over the length of the road; however, the overall biological effects on the caribou would be low and characterized by temporary disturbance of caribou and short-term delays in caribou movements across the pipeline corridor. The pipeline would not cross major calving areas of the Western Arctic herd and would not be a physical barrier to the caribou because its design would allow passage of herds. During construction of the pipeline, movements of the caribou could be temporarily blocked and could slow down crossings; but successful crossings would still occur. While the subsistence harvest of caribou may be affected, caribou would not become locally unavailable at anytime, resulting in low effects. Should a large oil spill occur in the Meade River from the onshore pipeline, moderate effects on fisheries resources could result. However, since this is unlikely (see Sec. IV.C.11.c(1)), very low effects on Atqasuk's subsistence harvest of fish are expected as a result of the base case. All other Atqasuk subsistence harvests are expected to experience low effects from the base case.

Conclusion: The effect of the base case on Atqasuk's subsistence-harvest patterns is expected to be moderate.

(6) Nuiqsut: Nuiqsut's subsistence-harvest area lies outside of the Sale 126 area; however, the onshore-pipeline corridor from Point Belcher to the TAP would pass through some of Nuiqsut's caribou-harvest area and over the Colville River. The caribou may be affected by noise and traffic disturbance and construction activities associated with the pipeline; thus, the Nuiqsut caribou harvest could experience low effects from these activities. Oil spills would not affect the caribou harvest because Nuiqsut is too distant from the sale area. High effects would result on Nuiqsut's fish harvest if a large, onshore-pipeline oil spill occurred in the Colville River; however, because such a spill is unlikely (see Sec. IV.C.11.c.(1)), very low effects on Nuiqsut's fish harvest are expected.

Conclusion: The effect of the base case on Nuiqsut's subsistence-harvest patterns is expected to be low.

CONCLUSION: The effect of the base case on subsistence-harvest patterns as a result of exploration and development and production is expected to be HIGH in Wainwright; MODERATE in Barrow, Atqasuk, and Point Lay; and LOW in Point Hope and Nuiqsut.

12. Effects on Sociocultural Systems: This discussion is concerned with those communities that could be affected by Chukchi Sea Sale 126. Under the scenario for the Base case, Barrow and Wainwright could host air-support facilities for offshore petroleum industry activities (see Sec. II.A.2). Wainwright is also close to the projected enclave at Point Belcher, the location for the offshore-pipeline landfall and shorebase facilities. The primary aspects of the sociocultural system covered in this analysis are social organization and cultural values (see description in Sec. III.C.3.). Effects on social organization and cultural values could occur at the community level through industrial activities that increase population and employment and affect subsistence-harvest patterns. Potential effects are evaluated in terms of the magnitude and duration of support or disruptions of existing systems of organization by introduced social forces.

a. Introduction:

(1) Parameters of This Analysis: This analysis of the social organization considers how people are divided into social groups and networks. Social groups are built on kinship and marriage systems as well as on nonbiological alliance groups based on such characteristics as age, sex, ethnicity, and residence. Kinship relations and nonbiological alliances serve to extend and ensure cooperation within the society. Social organization could be affected by an influx of new population that causes growth in the community and/or change in the organization of social groups and networks. Disruption of the subsistence cycle could also change the way these groups are organized. Activities such as the sharing of subsistence foods are profoundly important to the maintenance of family ties, kinship networks, and a sense of community well-being (see Sec. III.C.3). In rural Alaskan-Native communities, task groups associated with subsistence harvests are important in defining social roles and kinship relations. The individuals with whom one cooperates help define kin ties; the distribution of specific tasks reflects and reinforces the roles of husbands, wives, grandparents, children, friends, etc. (see Sec. III.C.3). Disruption of the subsistence cycle could undercut the system of traditional leadership and threaten a community's stability. It might also create a disruption of family ties, kinship networks, and a community's sense of well-being, which would damage the social bonds that hold a community together. Any serious disruption of sharing networks could appear in a community as a threat to the way of life itself and could set off an array of emotions--fear, anger, frustration, and a sense of loss and helplessness. A perceived threat to subsistence activity--and the psychological importance of subsistence in these sharing networks--is an important source of the anxieties about oil development.

An analysis of cultural values examines conceptions of what is desirable that are shared explicitly or implicitly by members of a social group. Forces powerful enough to change the basic values of an entire society occur when an incoming group imposes fundamental cultural change on a residing group or when a series of fundamental technological inventions change the physical and social conditions. Such changes can occur slowly and imperceptibly or suddenly and dramatically (Lantis, 1959). Cultural values in the sale area include strong ties to Native foods, the environment and its wildlife, the family, the virtues of sharing the proceeds of the hunt, and independence from the outside (see Sec. III.C.3). A chronic disruption of subsistence-harvest patterns could alter these cultural values. For example, if the system of sharing is to operate properly, some households must be able to produce, rather consistently, a surplus of subsistence goods. Since it is more difficult for a household to produce a surplus than to meet its own needs, the supply of subsistence foods in the sharing network may be more sensitive to harvest disruptions than the consumption of these foods by active producers.

(2) Effect Agents: The agents associated with the base case that could affect the sociocultural systems in communities near the sale area include industrial activities, changes in population

and employment, and effects on subsistence-harvest patterns.

(a) Industrial Activities: During the exploration phase (see Sec. II.A.2.a), Barrow and Wainwright would be used as air-support bases. Personnel and air freight would be transferred to helicopters at either airport. One helicopter trip per day per platform is assumed for exploration (see Table II-A-1); four to six helicopters would service the Sale 126 area. The existing facilities at Barrow and Wainwright are adequate to handle projected needs during exploration. Overall support-boat and aircraft traffic for the exploration phase would equal about 8 percent of traffic volumes expected for the development and production phase. During the development and production phase, air support would gradually shift to the shorebase facility at Point Belcher. The Barrow and Wainwright airports and facilities would continue to provide alternatives in case of emergencies and also would enable the shift from existing to new infrastructure to occur more gradually, but in sufficient time to prevent overtaxing the infrastructure in those communities (see Sec. II.A.2.b). Point Belcher is the assumed location of the enclave for shorebase facilities for the offshore-pipeline landfall and the onshore pipeline to the TAP. The enclave would be approximately 20 to 25 km from Wainwright. During development, a road would be constructed between Wainwright and Point Belcher. Since the creation of the NSB CIP in the 1970's, both Barrow and Wainwright have become accustomed to housing even larger nonresident-labor forces. Point Lay, Point Hope, Atqasuk, and Nuiqsut may contribute some workers for oil field employment; however, these communities are located geographically too far from the Point Belcher enclave and the related pipeline for their sociocultural systems to be directly affected by industrial activities.

(b) Population and Employment: The base case is projected to affect the NSB population through two types of effects on employment in the region: (1) more petroleum industry-related jobs as a consequence of exploration, development, and production activities and (2) more NSB-funded jobs as a result of higher NSB operating revenues and expenditures (see Sec. IV.B.10.a). Employment projections as a consequence of the base case are provided in Section IV.B.10.b. Exploration-phase employment would be short-term and dominated by offshore positions. Exploration-related workers would be enclaved and would have few contacts with North Slope residents since workers would travel out of the area with each shift change. Due to the limited scale of exploratory activities it is unlikely that the employment regimes of the affected communities would be altered.

Increased resident-employment opportunities would partially offset expected declines in other job opportunities and thereby delay expected outmigration. The base case is expected to increase the NSB population by less than 10 percent above the baseline-projects level until 2005 and by over 20 percent by 2008. As a consequence of increased employment due to the base case, the Native proportion of the population is not expected to change (86%) and Native employment is expected to improve. Barrow is most likely to benefit from sale-related employment increases. Wainwright's proximity to the shorebase at Point Belcher may also encourage more Wainwright and Point Lay residents to apply for sale-related jobs (see Sec. IV.B.10).

Point Lay, Point Hope, Atqasuk, and Nuiqsut are not expected to experience much of an increase in sale-related employment, although there may be some degree of sale-induced employment. By enabling local residents to find employment near their communities in lieu of migrating to look for work, these changes in employment may mitigate--to some degree--the effects (loss of jobs and cash) on the sociocultural systems of these communities that would otherwise be experienced due to the decline of the NSB CIP.

(c) Effects on Subsistence-Harvest Patterns: The importance of subsistence to the Inupiat sociocultural system cannot be overstated (see Sec. III.C.3 for a detailed description and Sec. IV.C.11 for a discussion of effects). A discussion of subsistence and sociocultural systems is contained in Sec. IV.C.12.a(1). Effects on community subsistence-harvest patterns as a result of exploratory activities are expected to be very low. For the development and production phase, high effects are expected on Wainwright's subsistence-harvest patterns as a result of effects on its bowhead whale harvest. Moderate effects are expected in Barrow, Atqasuk, and Point Lay as a result of effects on walrus, fish, and cetacean harvests; low effects are expected in Nuiqsut and Point Hope.

b. Effects on Barrow, Wainwright, Point Lay, Point Hope, Atqasuk, and Nuiqsut: The relatively homogenous nature of these communities, all predominantly Inupiat, indicates that changes would be similar in the communities. The exception to this may be Barrow, which is larger, has a larger percentage of non-Natives, and has already experienced more change than the other, smaller North Slope communities (see Sec. III.C.3). For the exploratory phase, very low effects are forecast for all communities under study. This conclusion is based on the levels of industrial activity (low levels of workboat and helicopter activity, the very limited risk of a major spill event, and the lack of large onshore-construction projects) and exploration-phase employment. Exploration-phase workers would be largely transitory, with onshore positions few in number and restricted to an enclave situation. Thus, the potential for the exploratory phase of the proposed action affecting the social organization of the communities under study is very low. The balance of this section deals with the development and production phase of the proposal and analyzes the effects of industrial activities, population and employment, and subsistence-harvest patterns on North Slope social organization, cultural values, and other issues. This discussion focuses on the North Slope as a whole, with a discussion of each community where necessary.

(1) Social Organization: The social organization of Sale 126 communities includes typical features of Inupiat culture: kinship networks that organize much of a community's subsistence production and consumption, informally derived systems of respect and authority, strong extended families, and stratification between families focused on success at subsistence endeavors (see Sec. III.C.3).

From 1970 through 1985, Barrow's Inupiat population declined from 91 to 61 percent (see Sec. III.C.3). Beginning in the early 1980's, there has been an increased number of "strangers" present in Wainwright (i.e., construction workers working on new buildings for the community). The difference between Barrow and Wainwright is that Barrow's non-Native population is permanent (see Sec. III.C.3). This trend would continue in both communities under the base case which would bring in additional non-Native oil technicians and administrative personnel. Barrow's and Wainwright's social organization would not be disrupted by temporary or permanent population growth related to the sale since such growth would not significantly differ from that already occurring as a result of NSB-CIP development. The NSB-CIP programs resulted in the influx of permanent non-Native residents. The construction of a road between Wainwright and the shorebase at Point Belcher (a distance of 20-25 km) would increase social interaction between Wainwright residents and oil industry workers, as would the employment of local residents in the oil industry. Such interactions can create respect and understanding or play on ingrained prejudices. In general, the presence of the oil workers might be more stressful in a small community such as Wainwright (population 507 in 1985) than in a large community such as Barrow (population 3,075 in 1985) with a larger proportion of non-Natives (39%). However, in both cases, interaction with nonresident industry workers has been long-term. Point Lay, Point Hope, Atqasuk, and Nuiqsut are not expected to experience any influx of permanent non-Native residents since they are not located close to sale-related industrial activities and thus would experience insignificant, indirect population and employment growth.

Cultural Values: Subsistence is important to Inupiat social organization through sharing, task groups, crew structure, and strengthening social bonds. Effects on Wainwright's and Nuiqsut's subsistence-harvest patterns are expected to be high; effects on Barrow's are expected to be moderate; and effects on Point Hope's and Point Lay's are expected to be very low (see Sec. IV.B.10). Since subsistence is a naturally cyclical activity and resource availability varies substantially from year to year, numerous species are hunted in order to compensate. For this reason, multiyear disruptions to even one resource, particularly the bowhead whale, could in the long run disrupt sharing networks and subsistence task groups. For example, if whaling crews consistently failed in their hunting efforts, crews could lose status; their activities might eventually be viewed as trivial or impotent; sharing networks could be disrupted; and the community's sense of well-being could be damaged. It is unlikely that, in a system adapted to large shifts in resource availability, a disruption of 2 or 3 years would lead to changes in task-group structures or sharing networks. On the other hand, since this system is so culturally important, such disruptions would cause high levels of tension and anxiety within the communities directly affected and among those communities with which they share (see Sec. IV.B.11.b(3)). In the case of manmade disruptions, when the source is "identifiable" and considered "at fault," community reactions would be mixed with anger and finger-pointing.

The Wainwright subsistence area has a 34-percent probability (see Appendix C: Table C-16) of being contacted by any single oil spill, should one occur. Point Lay has an 8- to 10-percent probability of contact should an oil spill occur, while the OSRA analysis indicates that the subsistence areas of Point Hope and Barrow have a ≤ 0.5-percent probability of an oil spill occurring and contacting these area (see Appendix C: Table C-16). However, Peard Bay, an important subsistence area for both Wainwright and Barrow, has an 18-percent probability of being contacted by a spill should one occur. Oil-spill estimates are based on spills of ≥ 1,000 bbl occurring during winter and contacting environmental resources within 10 days. If either Wainwright's or Point Lay's subsistence-harvest zones are affected by an oil spill, it would not be a multiyear event. One or more species may be unavailable or undesirable to harvest in a single year; however, no species should be unavailable or undesirable for harvest in consecutive years.

An oil-spill event, in itself, could also diminish community well-being by being the causal agent in increased antisocial behavior; i.e., alcoholism, increased drug use, and increased levels of community/family violence. As has been seen in isolated/rural communities affected by a major oil spill, an immediate reaction to such an event has been shock followed by a sense of mourning and loss. This series of reactions was particularly evident in the community of Cordova following the Prince William Sound spill incident. The perceived loss of a way of life, even if temporary, would cut across the cultural and political fabric of any community and cause the relationships that bind the community network together to be stressed and/or changed. Moderate effects on social organization are expected in Wainwright. Effects due to disruptions in Barrow, Point Lay, Point Hope, Atqasuk, and Nuiqsut are expected to be low.

(2) Other Issues: Increases in social problems--rising rates of alcoholism, drug and alcohol abuse, domestic violence, wife and child abuse, rape, homicide, and suicide (as described in Sec. III.C.3.d)--are also issues of concern to this analysis.

Effects on sociocultural systems are often evidenced in rising rates of mental illness, substance abuse, and violence. This has proven true for Alaskan Natives who have been faced since the 1950's with increasing acculturative pressures. The rates of these occurrences far exceed those of other American populations such as Alaskan non-Natives, American Natives, and other American minority groups (Kraus and Buffler, 1979). While such behaviors are individual acts, the rates at which they occur vary among different groups and through time. These changing rates are recognized as the results of a complex interaction of interpersonal, social, and cultural factors (Kraus and Buffler, 1979; see also Kiev, 1964; Murphy, 1965; and Inkeles, 1973). As a community grows, the rates of all types of mental illness appear to increase because rates of mental illness are higher ". . .in larger rural Native towns than in the more traditional Native villages" (Foulks and Katz, 1973; Kraus and Buffler, 1979). Native communities help buffer the individual by providing a sense of continuity and control (for further discussion, see the Sale 97 FEIS [USDOI, MMS, 1987a]).

Several salient points should be made. First, change itself--even though induced primarily by forces outside the communities--does not necessarily cause the levels of psychic stress that lead to pathology (for a general discussion, see Inkeles, 1973). Second, and related to the first point, not all sociocultural change (directly or indirectly related to oil development) may be negative. Higher levels of employment, better health programs, and improved public services must be viewed as possible positive sociocultural effects from oil development on the North Slope. Employment of the underemployed resident Inupiat in oil industry operations could assist in filling the economic vacuum created by decreasing North Slope revenues, although major dependence on a nonrenewable-resource-based economy could cause long-term social costs at the time of resource depletion. Third, rapid and wide-ranging sociocultural effects are significant, not only because a way of life is altered but also because these alterations can come with high social costs. These costs include growing alienation; increasing rates of mental illness, suicide, homicide, and accidental death; growing disruption of family and social life; and substance abuse. Fourth, the conditions that make sociocultural change stressful must be viewed as ongoing. If the stressful conditions alter, the society can make successful adjustments to the changes that have occurred; and the rates of violence, suicide, and substance abuse will drop.

Under the proposed scenario, the non-Native-population component of the North Slope will range from 9.5 to 17 percent (88 to 130 persons) during the production period over the population forecast for the no-sale Case. It is probable that these residents would be primarily located in either Wainwright or Barrow. Considering both communities' demonstrated abilities to adjust to much larger numbers of nonresident workers under the NSB CIP, these workers should not create significant new stresses in these communities. Under the base case, approximately 164 resident jobs will be created on the North Slope. The majority of those filling these positions will be Native Alaskans located in either Wainwright or Barrow. This employment may help mitigate some of the social effects of the decline of the NSB CIP. On the other hand, it is not a large enough figure to substantially change the area's economic outlook and, hence, should not have a large social effect--either positive or negative. The road between Wainwright and the shorebase at Point Belcher may create a unique situation for Wainwright because of the increased presence of oil workers in the community. For example, this situation may increase the area's access to alcohol and drugs, which could be disruptive to social well-being in the community. While the oil industry forbids consumption of alcohol and drugs when the workers are in camp, consumption does occur and could become a source of conflict and stress for Wainwright. A similar situation occurred in Wainwright in the 1960's during the construction of the DEW-Line facility until the community elders--in concert with the DEW-Line operators--moved to restrict access. If similar problems occurred due to the hypothesized access road, Wainwright might act constructively again.

Summary: Effects on the sociocultural systems of communities near the Sale 126 area would occur as a result of industrial activities, changes in population and employment, and effects on subsistence-harvest patterns. These effect agents would affect the social organization, cultural values, and social health of the communities near the Sale 126 area. Barrow and Wainwright are the communities most likely to be affected by Sale 126 due to their proximity to the shorebase at Point Belcher and their use as air-support bases. Sale-related increases in population and employment predicted for the Sale 126 area are expected to occur primarily in Barrow and Wainwright. Because of Barrow's larger size and Wainwright's community stability and past successful encounters with large numbers of nonresident workers, sociocultural effects are expected to be moderate on Wainwright and low on Barrow. For all other North Slope communities, very low sociocultural effects are expected.

CONCLUSION: The effect of the base case on sociocultural systems as a result of exploration and development and production is expected to be MODERATE.

13. Effects on Archaeological Resources: The two categories of prehistoric and historic archaeological resources identified in the Sale 126 area are (1) offshore resources , and (2) onshore resources. Archaeological resources in the sale area could be affected by base-case (1,610 MMbbl) offshore exploration and by construction of onshore support facilities; construction of offshore pipelines to shore; recreational visits by OCS-related employees (employed directly by oil companies and indirectly by many types of support companies) to archaeological sites; and development, production, and other oil-related activities such as oil-spill cleanup.

a. Effects on Offshore Resources: Archaeological resources in the sale area could be affected by base-case (1,610 MMbbl) offshore exploration. No comprehensive baseline study exists for the area for prehistoric or historic resources. Because of this, it is perhaps most useful to refer to areas as either "having potential" for archaeological resources or "not having potential." The areas that would have a potential for containing prehistoric archaeological resources would be those shoreward of the 40-m bathymetric contour, which would have been exposed as dry land in 12,000 B.P., the earliest undisputed date for the presence of prehistoric man in the Arctic. Areas that which have been documented as having been severely affected by ice gouging or other geological processes would be considered as not having prehistoric archaeological potential. To date, only ice gouging has been documented in published sources on the Chukchi Sea as an erosional force in the study area that can be mapped. Therefore, prehistoric archaeological resources could occur on blocks located in water depths of 40-m or less depths and where ice gouging either is not severe or does not extend down below the Holocene sediments (see Appendix G, MMS Prehistoric Resource Analysis). Overall, the effects of the base case on offshore prehistoric resources are expected to be moderate.

In addition to prehistoric resources, there are also known historic shipwrecks in the Chukchi Sea. In the deeper waters offshore of Point Belcher, about 40 ships went down in the 1800's (See Appendix G, Shipwreck Update Analysis). Several factors affect the accuracy of shipwreck locations, making it somewhat difficult to pinpoint the location of even a known shipwreck without a survey. These factors include: inaccuracy in the original reported location, the possibility that the shipwreck has moved due to natural shelf processes, and the fact that many shipwrecks break up and scatter over time.

Activities associated with exploration could have a moderate effect on historic resources. Activities associated with production platforms, and pipelines near Point Belcher--where about 28 ships went down in 1871--could have a high effect. It is assumed that 325 km of pipelines from the platforms would converge offshore and come onshore at Point Belcher. Any excavation for pipeline trenches on the offshore sea bottom and for onshore trenches would disturb archaeological resources if they were located in the path of the pipeline. Base-case activities such as platform and pipeline installation would have moderate effects. However, surveys on blocks where the archaeological stipulation is invoked could locate evidence of shipwrecks exposed at the seafloor prior to lease activities, thereby making avoidance possible. Such survey evidence of whaling-fleet shipwrecks would have a positive effect by increasing archaeological knowledge of whaling (1800 to early 1900's), which was of great importance to the U.S. economy. Therefore, development would have a moderate effect on offshore archaeological resources.

b. Effects on Onshore Resources: Archaeological resources in the sale area could be affected by base-case onshore activities including construction of onshore support facilities; construction of offshore pipelines to shore; recreational visits by OCS-related employees (employed directly by oil companies and indirectly by many types of support companies) to archaeological sites; and development, production, and other oil-related activities such as oil-spill cleanup. One of the important onshore archaeological sites near the sale area is the Shipwreck City Historic Site. Over 40 ships were wrecked somewhere offshore of Point Belcher in September 1871 and September 1876; and the 1,219 survivors (including families of crew members) of the wrecks on September 7, 1871, spent the night at the onshore location now referred to as the Shipwreck City Historic Site (State of Alaska, DNR, 1990). Construction and maintenance activities associated with the 640 km of onshore pipelines and facilities projected for the base case would disturb these resources and their in situ context. Such disturbance could be caused by plowing, digging, and dirt removal during construction and, later, during maintenance.

Onshore archaeological resources are likely to be disturbed by activities associated with the 640 km of pipelines and the facilities constructed onshore. The OCS employees who visit archaeological sites may inadvertently disturb these sites; and a contact with irreplaceable archaeological resources during exploration and/or development activity, however unlikely, would cause high effects on onshore resources.

Total oil spilled from the onshore pipeline is estimated to be 37,455 bbl (Table II-A-1). Oil spills could indirectly affect archaeological resources when waterspraying equipment is used for beach cleanup and when bulldozers, trucks, and other heavy equipment are moved to the oil-spill-cleanup area. Personnel and equipment transported over archaeological sites during cleanup could cause high levels of effects on sites located in OSRA Land Segments 14 through 24 (Fig. IV-A-1).

Concentration areas for bowhead and belukha whales, seals, fishes, and migratory birds near Point Hope and Wainwright are also likely places of prehistoric human habitation because of their location near food and freshwater (Kotani and Workman, 1980). The conditional probabilities of an oil spill contacting archaeological resources (Land Segments 14-22) during summer and winter within 10 days are all < 0.5 percent (see Appendix C: Table C-5 and C-11).

The effects of the base case on the Ipiutak Historic Site are expected to be low due to the site's location at the boundary of the Sale 126 area.

The effects of the base case on the Cape Krusenstern National Monument and the Bering Land Bridge National Preserve are expected to be low due to their locations outside of the area of activity related to Sale 126.

CONCLUSION: The effect of the base case on offshore and onshore archaeological resourcesas a result of exploration and development and production is expected to be MODERATE.

14. Effects of Land Use Plans and Coastal Management Programs: Onshore activities and some offshore activities resulting from Sale 126 would be subject to the North Slope Borough (NSB) Comprehensive Plan and Land Management Regulations (LMR's) and the Alaska Coastal Management Program (ACMP). The LMR's are applied to all activities occurring on private and State lands. Activities that would take place in these areas are portions of the onshore pipeline/corridor east of the NPR-A, the offshore pipeline within State waters, and the road between Point Belcher and Wainwright. The support base near Point Belcher probably would be located within the boundaries of the NPR-A. However, if the shorebase were constructed south of Point Belcher on lands held by the Wainwright village corporation, it would be subject to the NSB LMR's. Any development that occurred within the coastal boundaries of the ACMP or affected the uses or resources of the coastal zone would be subject to the enforceable policies of the ACMP, which includes the statewide standards and the NSB district policies. This includes even those activities that also would be subject to the LMR's. Activities assumed to follow this lease sale that would be assessed for consistency with the ACMP would be the shorebase, the offshore pipeline, those portions of the onshore pipeline/corridor within approximately 40 km of the coast or within a 1-mile corridor along the Colville River downstream from the confluence of the Etivluk River, and activities described in exploration or development and production plans. The policies of each of these management programs are assessed in the following section for potential conflicts between the policies and the potential effects identified in Sections IV.C.1 through IV.C.12. The first part assesses the NSB LMR's and the second assesses the statewide standards and NSB district policies of the ACMP.

a. North Slope Borough Comprehensive Plan and Land Management Regulations: During exploration, most onshore support would be based in existing facilities at Barrow and Wainwright. Any permits that are requested probably would be conditional-use permits for specific temporary activities; these are permissible in the Conservation District. The extensive and more permanent development associated with production would require that a master plan be prepared describing anticipated activities and that non-Federal land be rezoned from the Conservation District to the Resource Development District or Transportation Corridor. Onshore and nearshore developments are assumed to occur near Point Belcher and continue east to TAP Pump Station No. 2.

Area-wide policies in the revised LMR's are the same as those for the NSBCMP policies. The primary difference would be the process used for implementation and the geographic areas covered. The LMR's have been applied to all lands within the NSB that are not in Federal ownership. Policies in the ACMP cover only activities within the coastal zone, but can be applied to Federal lands in many instances (see Sec. IV.C.14(b)). Therefore, development assumed to occur following this lease sale would be subject to the Area-Wide/Coastal Management Policies in most instances. To avoid duplication, potential conflicts with the LMR Area-Wide Policies are included with the NSBCMP policies in the analysis of the ACMP rather than here.

Policies considered in this section are those in the other LMR policy categories--Villages, Economic Development, Offshore Development, and Transportation Corridors. Potential conflict with these policies is limited to some extent by the locations assumed for the development that accompanies this lease sale. No development is anticipated to occur within Village boundaries; therefore the four policies directly related to developing within NSB communities would not be applicable.

Offshore Development Policies also regulate an area not assumed to be developed by this lease sale. These policies relate to the portion of the Beaufort Sea within the NSB boundary. Sale 126 contains leases only in the Chukchi Sea.

Several development features are recognized by the NSB as beneficial impacts and are awarded special consideration during land-use reviews under the Economic Development policies (NSBC 19.70.030[A] through [G]). Economic Development policies foster hiring practices favorable to NSB businesses and residents--including special work schedules for those who pursue subsistence activities--and generate excess tax revenues over demand for expenditures. Two features assumed in the Sale 126 scenario would be viewed favorably. First, the proximity of the development to the community of Wainwright may facilitate local employment in sale-related jobs (Sec. IV.C.10). Second, the project would provide an excess of tax revenues over demand for expenditures (Sec. IV.C.10).

The last category of policies covers the Transportation Corridor. To date, the only area included in this district is the Dalton Highway. It is assumed that if a pipeline corridor were built between Point Belcher and TAP Pump Station No. 2, the area would become zoned as a Transportation Corridor and these policies would apply as the pipeline crossed NSB land. Conflict with these policies is not inherent in the scenario, but developers would be held responsible for minimizing airport use, proper sand and gravel extraction and reclamation, buffering stream banks, locating away from active floodplains, avoiding sensitive habitats, and identifying and documenting archaeological sites prior to construction (NSBMC 19.70.060.C, D through F, G, H, I, and J, respectively).

In conducting reviews for other development projects in the NSB that have some features comparable to those anticipated for the pipeline corridor, the NSB has established special conditions to assure conformance with several land use policies. Policy areas of concern in the past related to deposition of toxic materials and untreated solid wastes, emissions, subsistence resources, sensitive areas, pollution, habitat changes and disturbance, and permafrost.

b. Coastal Management Programs: Coastal management policies apply to the lease sale and to all subsequent activities that affect uses or resources of the coastal zone. The State reviews all exploration and development and production plans to verify that activities that could affect the use or resources of the coastal zone are consistent with the ACMP. In this section, statewide standards and NSB district policies of the ACMP are related to the scenario and to potential effects identified throughout Section IV. As noted in Section IV.C.14.a, the NSBCMP policies have been incorporated into the LMR's. Therefore, the corresponding LMR policy number is listed following that of the NSBCMP policy. Unless otherwise noted, the effects are those associated with development and production activities.

This analysis is not a consistency determination pursuant to the Coastal Zone Management Act of 1972, as amended, nor should it be used as a local planning document. It is unlikely that all of the hypothesized events would occur exactly as assumed in this EIS. Changes made by lessees as they explore, develop, and produce petroleum products from leases offered in this sale would affect the applicability of this assessment.

(1) Coastal Development (6 AAC 80.040): Water dependency is a prime criterion for development along the shoreline (6 AAC 80.040[a]). The intent of this policy is to ensure that onshore developments or activities that can be placed inland do not displace activities dependent upon locations along limited shoreline areas. The only OCS developments or activities hypothesized in the scenario that would require a shoreline location follow exploration and include the landfall sites for the pipeline, barges, and support vessels, and, possibly, limited marine-support facilities within Peard Bay. Other developments are expected to be located either inland or offshore. No conflicts with this policy are inherent

in the scenario.

State standards also require that the placement of structures and discharge of dredged material into coastal waters comply with the regulations of the U.S. Army Corps of Engineers (COE) (6 AAC 80.040[b]). All offshore and much of the onshore development hypothesized in the scenario would be subject to COE regulations. Developments assumed in the scenario that would require COE permits include dredging and the possible burial of offshore pipelines, emplacement of a bottom-founded structure offshore, construction of the shorebase, and construction of a pipeline/road system to TAP Pump Station No. 2. None of these projects is necessarily allowed or disallowed under the provisions of the COE regulations. Site-specific environmental changes pursuant to such development would be assessed, as they were for the Endicott and Lisburne projects, and permitted depending on the attendant effects. Potential effects noted elsewhere in Section IV.C would be subject to close analysis once the details of the development were established.

(2) Geophysical-Hazard Areas (6 AAC 80.050): State policies require coastal districts and state agencies to identify areas in which geophysical hazards are known and in which there is a substantial probability that geophysical hazards may occur. Development in these areas is prohibited until siting, design, and construction measures for minimizing property damage and protecting against loss of life have been provided. A variety of hazards are evident in the lease-sale area. Sea ice is the principal physical hazard to the development of the oil resources in the sale area. However, drilling and completing wells in the Arctic is possible with existing technology (Sec. IV.A.3); and conformance with 30 CFR 250, Oil and Gas and Sulphur Operations in the OCS, ensures that development is sited, designed, and constructed using best available and safest technology (BAST). The BAST requirements ensure conformance with this statewide standard and NSBCMP Policy 2.4.4.b (NSBMC 19.70.050.I.2). Superstructure icing would be a greater risk to work boats and service vessels than to the drilling units. Although this could occur from June through November, it is most likely to occur during September and October. Since the conditions that cause superstructure icing are known, regulations require that the risks be assessed and actions be taken to protect against loss of life.

Development assumed for the proposal avoids floodplain areas depicted in the NSBCMP graphics (NSBCMP 2.4.5.1[k] and NSBMC 19.70.050.J.11). It would, however, cover extensive areas of permafrost. Concerns about pipeline safety with respect to offshore hazards, permafrost, and aufeis would apply along the route from the platforms to the TAP regardless of whether the pipeline were within or outside of the coastal zone. Pipeline development would be guided by several NSBCMP policies. Policy 2.4.4(h) (NSBMC 19.70.050.I.8) specifies that pipelines be designed to withstand geophysical hazards, and Policy 2.4.6(f) (NSBMC 19.70.050.L.6) requires that development be sited, designed, and constructed to minimize loss of life or property. Current and emerging technologies are considered adequate to meet the concerns (Sec. IV.A.3).

(3) Energy Facilities (6 AAC 80.070): Statewide standards require that decisions concerning energy-related facilities be based, to the extent feasible and prudent, on 16 policies. These policies require that facilities be (1) sited to minimize adverse environmental and social effects while satisfying industrial requirements, and (2) compatible with existing and subsequent uses (6 AAC 80.070[1] and [2]). The shorebase at Point Belcher and the pipeline to the TAP may not be compatible with existing uses. In fact, a base at Point Belcher would be a major shift in land use that could affect both subsistence resources and access to subsistence resources. Therefore, prior to construction, these adverse social effects must be minimized.

Other ACMP policies require that facilities be consolidated and sited in areas of least biological productivity, diversity, and vulnerability (6 AAC 80.070[3] and [13]). Development assumed for this sale could create severe conflicts with these policies. The proposed landfall and shorebase would be located near Peard Bay, a biologically productive area used extensively by gray whales, some belukha whales, seals, walrus, fishes, and marine and coastal birds. Bowhead whales use the lead system in proximity to Point Belcher in the spring. However, the analyses in Sections IV.C.4 through IV.C.8 indicate that the biological effects of oil spills and construction in this area would be local and of short duration. Effects on benthic organisms, however, could be very high if species are restricted in their distribution to Peard Bay. Therefore, the potential for conflict with these elements of the energy-facility-siting standard is present, especially if dredging activity occurs in Peard Bay and leads to long-term changes in distribution.

Facilities must be designed to permit free passage and movement of fish and wildlife with due consideration for historic migratory patterns (6 AAC 80.070 [12]). No causeway is hypothesized for this development; however, berms may be used to bring pipelines ashore and could generate comparable concerns. However, analyses in this EIS indicate that offshore pipelines should pose no barriers to migrating fish and wildlife.

The NSBCMP has three other policies listed under this standard (SOA, 1985). Policy 2.4.4(f) (NSBMC 19.70.050.I.6) requires that plans for offshore drilling include "a relief well drilling plan and an emergency countermeasure plan" and describes the content of such plans. Policy 2.4.4(g) (NSBMC 19.70.050.I.7) requires "offshore drilling operations and offshore petroleum storage and transportation facilities. . .to have an oil spill control and clean-up plan" and describes what the plan should contain. An "intent" statement accompanying these two policies states that these policies "are not intended to establish new regulations for offshore facilities. They restate and highlight requirements of existing regulations. Industry will not be required to go to considerable additional effort as a result of these policies." Because considerable additional effort is not considered necessary for conformance, no conflict is anticipated; compliance with sale stipulations and MMS operating requirements (30 CFR 250) should assure that the NSBCMP requirements are met.

Construction associated with energy-related facilities resulting from Sale 126 also must comply with siting policies that apply to all types of development. These more general policies are discussed under Habitats (Sec. IV.C.14.b(7)) and Air, Land, and Water Quality (Sec. IV.C.14.b(8)).

(4) Transportation and Utilities (6 AAC 80.080): The State standard requires that routes for transportation and utilities be compatible with district programs and sited inland from shorelines and beaches. The pipeline corridor is assumed to cross the shore and continue to the east; no pipeline construction parallel to the shore is anticipated. The road between Point Belcher and Wainwright would parallel the coast. However, constraints imposed by natural forces along the coast make it likely that the road would be sited inland from the shoreline.

The NSBCMP contains several additional policies related to transportation that are relevant to this analysis. All but one are "Best Effort Policies" and subject to some flexibility if (1) there is a significant public need for the proposed use and activity, (2) all feasible and prudent alternatives have been rigorously explored and objectively evaluated, and (3) all feasible and prudent steps have been taken to avoid the adverse effects the policy was intended to prevent (NSBCMP 2.4.5 and NSBMC 19.70.050.J). Pipeline construction "which significantly obstructs wildlife migration" is subject to the three criteria (NSBCMP 2.4.5.1[g] and NSBMC 19.70.050.J.7). However, interference with caribou movements is expected to be temporary, and regional distribution and numbers are not expected to be affected (Sec. IV.C.9). Therefore, no conflict with this policy is anticipated.

No duplicative transportation corridors are anticipated from Sale 126. As noted in the previous standard for energy facilities, transportation facilities are expected to be consolidated to the maximum extent possible. Therefore, no conflict is likely with either NSBCMP 2.4.5.1(i) (NSBMC 19.70.050.J.9), which discourages duplicative transportation corridors from resource-extraction sites, or NSBCMP 2.4.5.2(f) (NSBMC 19.70.050.K.6), which requires that transportation facilities and utilities be consolidated to the maximum extent possible. Although the NSBCMP limits support facilities for tankering oil to market (NSBCMP 2.4.5.1[h] and NSBMC 19.70.050.J.8), the scenario indicates that a pipeline will be used; therefore, no conflict is likely.

The final policies fall under the category of "Minimization of Negative Impacts." NSBCMP 2.4.6(b) (NSBMC 19.70.050.L.2) requires that alterations to shorelines, water courses, wetlands, and tidal marshes and significant disturbance to important habitat be minimized. In the discussion of habitats, it is recognized that alterations to wetland habitat and ponds and lakes will occur and could have LOW effects on birds. This policy also requires that periods critical for fish migration be avoided. Conformance with this policy can be determined only at the time of development. NSBCMP 2.4.6(d) (NSBMC 19.70.050.L.4) requires helicopter pads, such as those that would be constructed along the pipeline route, to minimize impacts on wildlife. These requirements identify constraints for the siting, design, construction, and maintenance of transportation and utility facilities; conflict with these is not inherent in the assumed activities.

(5) Mining and Mineral Processing (6 AAC 80.110): The ACMP standards require that mining and mineral processing be compatible with the other standards, adjacent uses and activities, State and national needs, and district programs (6 AAC 80.110[a]). Sand and gravel may be extracted from coastal waters, intertidal areas, barrier islands, and spits when no feasible and prudent noncoastal alternative is available to meet the public need (6 AAC 80.110[b]).

Extraction of sand and gravel is a major concern on the North Slope, and development from Sale 126 would require a major commitment of gravel. Gravel would be needed to construct the berm to bring the pipeline onshore, develop the shorebase and airfield at Point Belcher, and construct the pipeline and associated road and helipads to TAP Pump Station No. 2. Gravel sources are extremely limited for most of the area.

The ACMP policies for gravel extraction would apply to the onshore pipeline from the Chukchi Sea coast to the TAP because the nearshore area as well as several river crossings are either within the coastal boundary or could have a direct effect on uses in the coastal zone. Given the national importance of developing oil reserves within the U.S., these developments would conform to the first criterion for exemptions--that there be a significant public need for the development. Constraints imposed by NSBCMP policies, especially Policy 2.4.5.1(j) (NSBMC 19.70.050.J.10), which prohibits substantial alternation of shoreline dynamics, and Policy 2.4.5.2(a) and (d) (NSBMC 19.70.050.K.1 and 4), which identify specific constraints in floodplains and require minimizing environmental degradation, should ensure that effects are minimized. Although industry's preferences for gravel sources and the CMP policy may diverge on occasion from those indicated by CMP policies, conflict is not inherent in the scenario.

(6) Subsistence (6 AAC 80.120): The State standard guarantees opportunities for subsistence use of coastal areas and resources. Subsistence uses of coastal resources and maintenance of subsistence way of life are primary concerns of the residents throughout the NSB. The prevalence of subsistence use of land in the NSB is evident in the NSB Land Management Regulations, in which all lands outside the Village, Barrow, and Resource Development Districts are designated as within the Conservation District. The intent of that designation is to conserve the natural ecosystem needed to support subsistence (NSBMC 19.40.070). This assessment of potential conflicts with the statewide standard and district policies is based on the analysis of the effects of the base case on Inupiat subsistence in Section IV.C.11.

The NSB set standards for development that established a threshold for effects on subsistence. During the bowhead whale migration season, development shall not significantly interfere with subsistence activities or jeopardize the continued availability of the bowhead whale for subsistence purposes (NSBCMP 2.4.3[b] and NSBMC 19.70.050.B). Wainwright's subsistence harvest of bowhead whales may be affected by activities associated with this lease sale. The potential for effects is greatest during those years with severe ice conditions. These conditions can be identified in advance of the whaling season. As a result, conflict with this policy is possible but avoidable.

All subsistence resources are protected with two additional policies. The more restrictive policy requires that "when extensive adverse impacts to a subsistence resource are likely and cannot be avoided or mitigated, development shall not deplete subsistence resources below the subsistence needs of local residents of the Borough." To implement this policy, the NSB would need to document subsistence needs and establish evidence indicating that a project would deplete a subsistence resource below the level necessary to meet those needs (NSBCMP 2.4.3[a] and NSBMC 19.70.050.A). A less restrictive standard applies if development is likely to "result in significantly decreased productivity of subsistence resources or their ecosystems" (2.4.5.1[a] and NSBMC 19.70.050.J.1). Decreased subsistence harvests are possible in Wainwright, Barrow, Atqasuk, and Point Lay. However, these reductions in harvest are due to perceived effects on resources and temporal limits to harvests rather than effects on the resource populations. Therefore, conflict with these policies is not expected.

Finally, "development cannot preclude reasonable subsistence user access to a subsistence resource" (NSB 2.4.3[d] and NSBMC 19.70.050.D). The intent statement that accompanies Policy 2.4.3(d) (NSBMC 19.70.050.D) distinguishes it from the "Best Effort Policy" 2.4.5.1(b) (NSBMC 19.70.050.J.2) by the degree to which access is limited. The former applies if access is totally precluded; the latter applies if access is diminished or restricted. In that instance, access can be restricted if there are no feasible and prudent alternatives. Development is assumed to occur at Point Belcher--a prime access point for Wainwright's bowhead whaling activities. Access for whaling could be affected if provisions were not made for (1) continued use of Point Belcher as a launching site and (2) protection of the cultural landmarks used by Wainwright residents during their bowhead whale hunt. Such effects are likely to create high levels of conflict with the statewide standard and the NSB district policies for subsistence.

(7) <u>Habitats (6 AAC 80.130)</u>: The Statewide standard for habitats contains an overall policy plus specific policies for offshore areas; estuaries; wetlands and tidal flats; rocky islands and seacliffs; barrier islands and lagoons; exposed high-energy coasts; rivers, streams and lakes; and important upland habitat. The NSBCMP contains a district policy that reiterates the applicability of the Statewide standard (NSBCMP 2.4.5.2[g] and NSBMC 19.70.050.K.7), plus several others that augment the overall policy or can be related to activities within a specific habitat.

The ACMP statewide standard for all 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 NSBCMP district policy requiring development "to 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" (NSBCMP 2.4.5.2[b] and NSBMC 19.70.050.K.2). In addition, "vehicles, vessels, and aircraft that are likely to cause significant disturbance must avoid areas where species that are sensitive to noise or movement are concentrated at times when such species are concentrated" (NSBCMP 2.4.4 [a] and NSBMC 19.70.050.I.1). The analyses in Sections IV.C.3 through IV.C.9 indicate that resources should not be subjected to significant disturbance except when fog obscures visibility. In the event of significant disturbance, horizontal and vertical buffers are required where appropriate, consistent with human safety (NSC CMP 2.4.4 [a] and NSBMC 19.70.050.I.1). Conflict is not inherent in the scenario, although it may arise as specific proposals are brought forward at the time of development.

Activities affect several of the habitats identified in the statewide standard, including offshore; rocky islands and seacliffs; barrier islands and lagoons; wetlands; rivers, lakes, and streams; and uplands. Effects in each habitat are related to the applicable policies in the following paragraphs.

The offshore habitat is designated a fisheries conservation zone (6 AAC 80.130.[c][1]). In the Arctic, marine mammals--an important offshore resource--are included in the analysis of the offshore habitat. Some serious effects in the offshore habitat could occur in the unlikely event that an oil spill occurred during a sensitive time, or development affected special benthic communities in Peard Bay. In the important offshore seabird-feeding area near Point Barrow, an oil spill could have moderate effects on some bird populations. However, most offshore effects are expected to be lower. This level of effects would not preclude offshore development, assuming the developer has undertaken all feasible and prudent steps to maximize conformance. Offshore seismic exploration is subject to specific constraints; NSBCMP 2.4.6(g) (NSBMC 19.70.050.L.7) requires that seismic exploration be conducted in a manner that minimizes its impact on fish and wildlife. Again, analyses of effects on the natural resources do not indicate negative effects as a result of seismic activity. Conflict with this district policy is not anticipated.

Rocky-island and seacliff habitat is represented by Capes Lisburne, Lewis, and Thompson. This habitat standard requires that these areas be managed to avoid harassment of wildlife, destruction of important habitat, and introduction of competing or destructive species and predators (6 AAC 80.130[c][4]). No new species or predators are likely as a result of Sale 126. Concerns focus on the potential for disturbance and oil spills to affect the birds that use these areas. Because most activity assumed with the sale would occur north of the seacliff habitat, significant effects are not expected. As a result, little conflict is anticipated with this element of the habitat policy.

Lagoon habitats are managed to assure that sediment and water conditions are maintained so that neither infilling of lagoons nor erosion of barrier islands occurs. Activities that might decrease the use of the barrier islands by coastal species, including polar bears and nesting birds, are discouraged (6 AAC 80.130[c][5]). Use of Peard Bay for marine support could cause a conflict with this policy if dredging of the bay led to erosion or subsidence of the islands, spit, or mainland, or to changes in benthic-invertebrate distribution or abundance. Kasegaluk Lagoon, identified in the NSBCMP as an Area Meriting Special Attention (AMSA), is one of the most important sensitive habitats along the Chukchi Sea coast and is specially protected by NSBCMP Policy 2.4.3(c) (NSBMC 19.70.050.C). Of particular concern would be disturbance of birds that nest offshore of the lagoon and belukha whales and seals as they move to and from the lagoon. However, the potential for oil and oil-related developments to affect the lagoon is small and effects on resources in the lagoon are expected to be low or very low. No conflict with these policies is anticipated.

Much of the upland habitat in the NSB has been classified by the COE as wetlands. Therefore, much of the onshore development would fall within the wetland classification. Section IV.C.15 concludes that the effect of these developments on wetlands would be highly localized, would produce severely changed conditions, and would persist for many years. When exact locations for onshore developments are being selected, an ACMP policy requires that development be designed and constructed to avoid adverse effects on the natural-drainage patterns, destruction of important habitat, and discharge of toxic substances (6 AAC 80.130[c][3]). In Section IV.C.5 and IV.C.9, the amount of North Slope tundra habitat that would be used for developing the road and pipeline is considered insignificant to the bird populations and the caribou herds of the North Slope. Wildlife is further protected by the NSB policy that requires roads and pipelines provide unimpeded crossings (NSBCMP 2.4.6[e] and NSBMC 19.70.050.L.5). Assuming that all feasible and prudent steps have been taken to minimize potential adverse effects, wetland and upland habitats should be protected. Restrictions on storing toxic substances are covered more completely under the ACMP standard for Air, Land, and Water Quality (Sec. IV.C.14.b.[8]).

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]). The probability that oil spilled offshore would enter the stream and affect riverine habitat is low. However, rainbow smelt would be vulnerable in late winter when adults aggregate off the mouths of spawning rivers. River habitat also might be affected if an oil spill occurred along the upland-pipeline route, especially where it crosses streams and rivers. A large spill that contacted a major river is likely to have a significant effect on fishes.

River, lake, and stream habitats also could be affected by construction activities and gravel extraction. Uplands and abandoned stream channels are the most likely sources of gravel. Although gravel extraction is regulated under specific policies described earlier in the discussion of mining (Sec. IV.C.14.b[5]), gravel-extraction activities also would need to be conducted in a manner consistent with this policy to ensure that the riverine habitat and fish resources are protected. Assuming that all feasible and prudent steps are taken to protect the river, lake, and stream habitats, conflict with this standard can be avoided.

(8) 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 Alaska Department of Environmental Conservation. 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. For example, NSBCMP 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." Only if formation waters were discharged into the water would these standards be exceeded (Sec. IV.C.2).

As a precaution against accidental spills, the NSBCMP requires the use of impermeable lining and diking for fuel storage units with a capacity greater than 660 gallons (NSBCMP 2.4.4[k] and NSBMC 19.70.050.I.11). In addition, development within 1,500 feet of the shoreline of the coast, lake, or river "that has the potential of adversely impacting water quality (e.g., landfills, or hazardous-materials- storage areas, dumps, etc.)" must meet the conditions of the "Best Effort Policies" (NSBCMP 2.4.5.1[e] and NSBMC 19.70.050.J.4). These conditions are: (1) there must be a significant public need, (2) the developer has rigorously explored and objectively evaluated all feasible and prudent alternatives and cannot comply with the policy, and (3) all feasible and prudent steps have been taken to avoid the adverse effects the policy was intended to prevent. There is no inherent conflict between these policies and the assumptions used for the proposed action.

Solid wastes disposed of offshore also are regulated through Federal permits and restrained further by Annex V of the MARPOL Convention, approved in 1988 by the United States Congress. Because these discharges are so carefully regulated, no conflict is anticipated with the Statewide standard or NSBCMP 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." Onshore development associated with this sale also must meet the Statewide standard and the district policy related to solid-waste disposal. There is no inherent conflict between the proposed activities and the ACMP water-quality provisions.

The district CMP also contains a policy that requires development without a central sewage system to impound and process effluent to meet State and Federal standards (NSBCMP 2.4.4[e] and NSBMC 19.70.050.I.5). This is the current practice aboard drilling vessels and production platforms and has been the practice of the major developments on the North Slope. There is no inherent conflict with this district policy.

Air quality also must conform with Federal and State standards (6 AAC 80.140, NSBCMP 2.4.3[h] and 2.4.4[c], and NSBMC 19.70.050.H and I.3). The analysis in Section IV.C.1 indicates that conformance is anticipated, and no conflict between air quality and coastal policies should occur.

(9) Statewide Historic, Prehistoric, and Archaeological Resources (6 AAC 80.150): The ACMP Statewide standard requires that coastal districts and appropriate State agencies identify areas of the coast that are important to the study, understanding, or illustration of National, State, or local history or prehistory. Many areas along the coast have been identified as archaeologically important sites (North Slope Borough, 1984).

The NSBCMP (North Slope Borough, 1989) provides clear guidance to ensure protection of its heritage. NSBCMP Policy 2.4.3(e) (North Slope Borough, 1990: NSBMC 19.70.050.E) requires that development "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." NSBCMP 2.4.3(g) (NSBMC 19.70.050.G) goes on to require that "development shall not cause surface disturbance of newly discovered historic or cultural sites prior to archaeological investigation." Traditional activities at cultural or historic sites also are protected under the NSBCMP Policies 2.4.3(f) (NSBMC 19.70.050.F) and 2.4.5.2(h) (NSBMC 19.70.050.K.8). As noted in the discussion of policies related to subsistence, the latter is a "Best-Effort Policy" that requires protection for transportation to subsistence-use areas as well as cultural-use sites.

Development is assumed to be centered near Point Belcher. The shorebase is not expected to be extensive; however, there are numerous historic sites around Point Belcher. Historically, Point Belcher has been used as the launching site for subsistence whaling and still is used by present-day whalers who rely on cultural landmarks located there (Luton, 1985, oral comm.). Prehistoric-human habitation of Point Belcher is likely because of its proximity to food and water. Point Belcher was used by the survivors of a major disaster in 1871, and a Shipwreck City Historic Site has been identified onshore.

Extraordinary care would need to be exercised in placing even minimal facilities near Point Belcher. Archaeological, cultural, and historic sites have been identified (North Slope Borough, 1989: Appendix C; North Slope Borough, 1984: Map 2). Numerous shipwrecks could be affected by the offshore pipeline. Extensive pipeline surveys should be instrumental in locating any of the remains and some modification in pipeline routes and siting onshore may be required to avoid conflicts.

Summary: Major changes in land use would result from development associated with Sale 126. Because no industrial development currently exists along the Chukchi Sea coast, the shorebase and 640 km of onshore pipeline would be placed in areas currently used only for subsistence hunting. The location of the shorebase and landfall at Point Belcher could be highly incompatible with the current use of the area as a base for subsistence hunting of bowhead whales. This also would lead to conflicts with at least two NSB LMR's, the ACMP statewide standard for subsistence, and the NSBCMP policies that prohibit significant interference with the bowhead whale hunt and require access to subsistence resources. Because Point Belcher traditionally has been the launching site for whaling, the potential also exists for effects on the cultural resources of the area; therefore, conflict with policies designed to protect these resources is possible. While the assumed pipeline/road system could be constructed to conform to most NSB land use and CMP policies, access of Wainwright residents to the North American road system and vice versa via the pipeline/road to the Dalton Highway may generate additional problems and benefits that would need to be assessed if the road became public. These problems relate to economic and social changes and greater access to subsistence resources by all hunters. Potential conflicts also are evident with the statewide standard for energy facilities if dredging activity occurs in Peard Bay and leads to long-term changes in biological distributions, for lagoon and river habitats in the event of an oil spill, and for water quality if formation waters are discharged into the Chukchi Sea. During exploration, low levels of effects on biological resources are related primarily to noise and disturbance. Potential conflicts with ACMP standards and policies would be more limited than those that are associated with development and production.

CONCLUSION: For the base case, the potential for conflict with land use plans and coastal management programs is expected to be HIGH.

15. Effects on Wetlands: Wetlands encompass most of the North Slope coastal plain near the proposed sale area and include several hundred square miles of a mosaic of tundra-wetland types from coastal tundra dominated by sedges, grasses, and dwarf shrubs to more inland tundra wetlands dominated by sedge and moss communities in wet sites and by tussock-sedge communities with dwarf shrubs, mosses, and lichens in moist sites. These wetlands are important summer habitats for millions of waterfowl, shorebirds, and land birds. The wetlands and associated ponds and lakes are important habitats for a variety of freshwater fish and invertebrates that provide food for the birds and small mammals.

The proposal could affect wetlands as a result of the extraction of gravel fill for road, pipeline, support-facility, and helicopter-pad construction, from dust along the road associated with vehicle traffic, from thermokarst associated with changes in permafrost related to construction, and from onshore oil spills that are expected to occur over the life of the field.

a. Effects of Gravel Fill: Under the base case, approximately 64 km^2 of wetland would be filled in along the 640-km-long pipeline and haul road from Point Belcher to the TAP pump station assumed to be developed. The pipeline-road-corridor route crosses a mosaic of tundra wetlands classified by vegetation type. Coastal tundra wetlands that the pipeline-road would cross south and east of Point Belcher are dominated by sedges, grasses, mosses, and dwarf shrubs. Inland portions of the coastal plain that the pipeline road would cross eastward to TAP Pump Station No. 2 are dominated by sedge and moss communities in wet sites and tussock-sedge communities with dwarf shrubs, mosses, and lichens in moist sites. The pipeline corridor is assumed to follow the 200-m-elevation contour across NPR-A and cross the

Colville River near Umiat to Pump Station No. 2, avoiding most of the lakes and ponds of the wet tundra zone north of the Kigalik and Colville Rivers and Maybe Creek (see Graphic No. 3). This route would avoid crossing the high-density waterfowl and shorebird-nesting and -feeding habitats on the wet tundra region of the coastal plain. Pipeline-road construction would alter or destroy about 64 km^2 of low- to medium-density bird habitat (0.4-5.8 ducks/km^2) and would create water impoundments along the corridor, altering other wetland habitats (see Sec. IV.C.5). The construction of 10 to 12 helicopter pads along the corridor would destroy an additional few square kilometers of wetlands. The total amount of wetlands destroyed or altered by the pipeline is expected to be less than 1 percent of the coastal-plain wetlands on the North Slope.

b. Effects of Dust: During the summer season, when the haul-road surface along the pipeline corridor is dry and not frozen, large amounts (probably several tons) of dust would be deposited along the 640-km road from Point Belcher to the TAP. This dust will be concentrated along the prevailing leeward side of the road, depending on wind direction and speed. Most dust would be deposited within 100 m of the road. The effect on wetlands would involve changes in vegetation and food availability to birds. Plants most affected by the dust are expected to be mosses, some of which are intolerant to dust. Heavy dust accumulation along parts of the Dalton Highway has eliminated sphagnum moss from plant communities along the roadway (Spatt and Miller, 1982). However, other moss and other plant species benefit from nutrients leached from the roadway. Dust along the corridor is expected to speed up snowmelt along the leeward side of the road during the spring/early summer. The resultant early plant growth in the dust areas would attract waterfowl that feed on the emerging vegetation. The overall effect of dust on wetlands is expected to be minimal.

c. Effects of Thermokarst: Thermokarst is the settling or caving in of the ground due to melting of ground ice or permafrost. Manmade disturbance or alteration of tundra wetlands due to construction of the pipeline-road corridor is expected to result in some thermokarst, particularly along the flat, thaw-lake plains habitats. Thermokarst results in the formation of ponds in the latter habitat and alters plant communities along the corridor. Thermokarst associated with offroad disturbance of the tundra vegetation and surface soils results in long-term scarring of the tundra wetlands that would persist for many years as an aesthetic effect on the appearance of the wetlands but would have little effect on the productivity of the habitat. In some cases, the productivity of the disturbed wetlands for common nesting and feeding birds is expected to increase over that of undisturbed areas due to increased diversity of habitat from the thermokarst (Troy, 1990). The overall effect of thermokarst associated with the pipeline-road corridor is expected to be minimal and alter less than 1 percent of the wetland habitat on the North Slope.

d. Effects of Onshore Oil Spills: An estimated 188 small oil spills (averaging from 6-1,500 bbl) could be associated with the base case. Onshore oil spills would contaminate some wetland-tundra vegetation, ponds, and streams, killing all or virtually all mosses and above-ground parts of vascular plants as well as submerged aquatic plants and most invertebrate organisms at the spill sites (McKendrick and Mitchell, 1978). These local effects on wetlands could persist for several years depending on how effective spill-cleanup efforts are and how successful rehabilitation is (replanting of vegetation and the application of phosphorus fertilizers at the spill sites after cleanup). The oil industry has been fairly successful in cleanup and rehabilitation efforts, even though some oil may persist in the soil.

Where onshore spills occur in underground portions of the pipeline or where the spill penetrates the soil, oil is expected to persist for several years; but the removal of all contaminated soil in such cases is likely to result in greater effects than those from the residual oil. In general, if phosphorus is applied to the spill site, onshore oil spills are expected to have substantial local effects on wetland plant and invertebrate communities along the pipeline corridor, from which recovery of vegetation is expected to occur within a few years. Where tundra ponds are contaminated, subtle effects on invertebrate communities are expected to persist for several years.

Summary: Wetlands encompass most of the North Slope coastal plain near the proposed sale area and include several hundred square miles of a mosaic of tundra-wetland-vegetation types that are important nesting and feeding habitat for millions of waterfowl, shorebirds, and land birds and that are habitat for a variety of fresh-water fish and invertebrates. The base case could have local effects on wetlands from extraction of gravel fill along the pipeline-road corridor, from road-traffic dust along the corridor, from thermokarst (local melting of permafrost) along the road, and from onshore oil spills along the pipeline.

Along the 640-km-long pipeline road, an estimated 64 km^2 of wetlands are expected to be filled in. This wetlands loss is less than 1 percent of the wetlands on the coastal plain. However, the local effect on vegetation and topography is expected to persist for many years. Road-traffic dust deposited along the pipeline-road corridor is expected to have local effects on some plant communities along the road, with the replacement of some moss species near the road. This local effect is expected to persist over the life of the field; but other plants are expected to benefit from nutrients leached from the road, and feeding birds would be attracted to early snowmelt areas created by the dust. Thermokarst along portions of the road is expected to change local topography and have an aesthetic effect that will persist for many years but have no significant effect on plant or animal productivity. Several small (6-1,500-bbl) onshore oil spills are expected to occur over the life of the pipeline and have local effects on plant and invertebrate communities for several years. Spill cleanup and rehabilitation (application of phosphorus fertilizer) would allow the plants to recover in a few years, but subtle effects on invertebrate communities in tundra ponds that become contaminated are expected to persist for several years. The combined effects of oil spills, road dust, thermokarst, and gravel on wetlands are expected to be very local along the pipeline-road corridor, with less than 1 percent of the coastal tundra wetlands being affected, although some of these effects are expected to persist for many years.

CONCLUSION: The effects of the base case on wetlands from oil spills, road dust, thermokarst, and gravel-fill extraction is expected to be localized along the pipeline-road corridor, with less than 1 percent of the coastal tundra wetlands of the North Slope being severely damaged. Some effects on plant and invertebrate communities, topography, and visual aesthetics are expected to persist for many years due to dust and traffic.

D. Alternative I - High Case

Alternative I would offer for leasing about 4,319 blocks of the Chukchi Sea Planning Area, with the high case representing the maximum resource volume of hydrocarbons likely to be present in commercial quantities (see Appendix A). The MMS estimates the oil resources to be about 3,540 MMbbl for the high case. The types and levels of activities associated with the high case include (1) drilling 53 exploration and delineation wells (1992-2001), (2) installing 12 production platforms (2000-2002) and drilling 472 production and service wells (2001-2005), (3) installing 200 mi of offshore pipeline and 400 mi of onshore pipeline (2000-2002), and (4) producing 3,540 MMbbl of oil (2003-2021). A more detailed discussion of the types and levels of activities associated with the high case is presented in Section II.B.3.a.

This section presents the analyses of the potential effects that the high case for Alternative I might have on the physical and biological resources, socio-cultural systems, and programs in and adjacent to the planning area.

1. Effects on Air Quality: Air quality standards and regulations are addressed in Section IV.B.1.a. Under the high case, peak emissions from exploration would be from drilling 6 exploration and 4 delineation wells drilled from 6 rigs. Peak emissions from development and production would include concurrent drilling of 140 production wells and 297 MMbbl of oil produced from 12 platforms and transported by pipeline. Exploration, development, and production activities are assumed to occur at least 18.5 km off Point Lay. Table IV-D-1 lists estimated uncontrolled- pollutant emissions for the peak-exploration, peak-development, and peak-production years. Under the Federal and State of Alaska PSD regulations, since the estimated annual uncontrolled NO_x emissions for peak exploration and peak development and production would exceed 250 tons per year, the lessee would be required to control NO_x emissions through application of BACT to emissions sources to reduce NO_x emissions (Table IV-B-2). In addition, the lessee would have to employ BACT to the emission sources to reduce emissions of all regulated pollutants during the exploration phase and the development and production phase because these emissions would exceed the de minimis levels. An air quality analysis performed using the OCD Model for air pollutants emitted for exploration in the base case due to Sale 126, showed that maximum NO_x concentration, averaged over a year, would be 1.29 and 0.46 μ/m^3 for peak exploration and peak production, respectively, at the shoreline: 5.2 and 1.8 percentiles of the available Class II increment for NO_x (Table IV-D-2).

a. Exploration: The highest NO_x value calculated by the OCD model indicates a concentration of 1.29 $\mu g/m^3$, an exceedance of the 1-$\mu g/m^3$ significance increment for NO_x (Table IV-D-2). The lessee would be required to reduce emissions through application of BACT to the emission sources. Existing ambient concentrations are not measured but are expected to be small (Sec. III.A.5). The modeled NO_x concentration would be 5.2 percent of the PSD increment of 25 $\mu g/m^3$ (annual) and 1.3 percent of the national air quality standard of 100 $\mu g/m^3$ (annual). The OCD model indicates a TSP concentration of 0.01 (annual) and 0.16 (24-hour) $\mu g/m^3$; therefore, the significance increment for TSP would not be exceeded (Table IV-D-2). The existing air quality would be maintained. The modeled TSP concentration would be 0.05 percent of the 19 $\mu g/m^3$ (annual) and 0.4 percent of the 37 $\mu g/m^3$ (24-hour) PSD increment and 0.02 percent of the 60 $\mu g/m^3$ (annual) and 0.1 percent of the 150 $\mu g/m^3$ (24-hour) of the national air quality standard. Concentrations of criteria pollutants at the shoreline due to exploration are expected to be >5 percent but <20 percent of available national standards or PSD increments.

Development and Production: The highest NO_x value calculated by the OCD model indicates a concentration over land of 0.91 $\mu g/m^3$ (annual); therefore, the significance increment for NO_x would not be exceeded (Table IV-D-2). The modeled NO_x concentration would be 1.8 percent of the PSD increment of 25 $\mu g/m^3$ (annual) and 0.5 percent of the national air quality standard of 100 $\mu g/m^3$ (annual). The OCD model indicates a TSP concentration of 0.02 (annual) and 0.22 (24-hour) $\mu g/m^3$; therefore, the significance increment for TSP would not be exceeded (Table IV-D-2). The modeled TSP concentration would be 0.1 percent of the 19 $\mu g/m^3$ (annual) and 0.6 percent of the 37 $\mu g/m^3$ (24-hour) PSD increment and 0.03

Table IV-D-1
Estimated Uncontrolled Emissions for the Chukchi Sea Sale 126 High Case
(metric tons per year)

	Pollutant[1/]				
	CO	NO_x	TSP	SO_2	VOC
High Case[2/]					
Peak Exploration Year	4,301	8,704	933	316	299
Peak Production Year	6,519	8,763	502	66	1,648

Source: MMS, Alaska OCS Region, 1990. Computed from factors in Form and Substance, Inc., and Jacobs Engineering Group, Inc., 1983.

1/ CO = Carbon Monoxide
NO_x = Nitrogen Oxides (assumed predominately NO_2)
TSP = Total Suspended Particulates (includes most particulate matter less than 10 μm in aerodynamic diameter)
SO_2 = Sulfur Dioxide
VOC = Volatile Organic Compounds (excluding nonreactive compounds such as methane and ethane)

2/ Assumes 10 exploration wells drilled in peak exploration year, 2 platforms installed and about 322 km (200 mi) of pipeline laid and 20 production wells drilled in the peak development year, and 144 MMbbl of oil produced from 6 platforms and 63 production wells drilled in the peak production year. Exploration drilling and production platforms are assumed to be located 18.5 km offshore Point Lay. Peak exploration and production emissions are given as a sum for each phase of exploration through production.

Table IV-D-2
Comparison of Modeled Air-Pollutant Concentrations with Regulatory Limitations
(measured in micrograms per cubic meter)

Averaging Time	PSD Class II Increment[1/]	Maximum Modeled Concentration Over Land[2/]	Air Quality Standard
High-Case Exploration			
NO_x			
annual	25	1.29	100[3/]
24-hour			
8-hour			
3-hour			
1-hour			
High-Case Production			
NO_x			
annual	25	0.46	100[3/]
24-hour			
8-hour			
3-hour			
1-hour			

Source: USDOI, MMS, Alaska OCS Region, 1990.

1/ Increment above ambient concentration allowed in a designated PSD area. Ambient baseline concentration for PSD not established for this area.
2/ Offshore and Coastal Dispersion Model.
3/ Annual arithmetic mean.
4/ Annual geometric mean.

percent of the 60 $\mu g/m^3$ (annual) and 0.1 percent of the 150 $\mu g/m^3$ (24-hour) of the national air quality standard. Since the exemption level for VOC would be exceeded, a lessee would be required to reduce emissions through application of BACT to the emission sources. These methods are summarized in Table IV-C-3. The existing air quality would be maintained. Concentrations of criteria pollutants at the shoreline due to development and production are expected to be <5 percent of available national standards or PSD increments.

Other Effects on Air Quality: For a more detailed discussion of the potential effects of air pollution--other than those effects addressed by standards, see Sections IV.B.1.b and IV.C.1.c. The coastal tundra ecosystem has a high susceptibility to acidic pollution. Concentrations of NO_2 and SO_2 onshore would be approximately the same as for the base case due to the larger number of platforms and atmospheric dilution. These concentrations are well below the amounts required to affect the tundra, even on a local or short-term basis.

Accidental emissions result from gas blowouts, evaporation of spilled oil, and burning of spilled oil. Under the high case, the probability of experiencing one or more blowouts in drilling the 472 exploration and production wells would be 79 to 87 percent (USDOI, MMS, 1990b). The emissions from a given gas blowout would be quickly diffused and would seldom last longer than a day. For additional information on gas blowouts, see Section IV.C.1.b.

Oil spills are another accidental source of gaseous emissions. Under the high case, the most likely number of spills of ≥ 1,000 bbl is four. More than one such spill in any single year is not anticipated under the high case. Smaller spills of <1,000 bbl occur more frequently than larger spills. The number of small spills estimated for the high case is 830. The VOC released by spills would be scattered spatially and temporally and would occur about 18.5 km (11.5 mi) or more offshore.

The burning of spilled oil under the high-case scenario would not differ appreciably from the base case. There would be 15 production platforms as opposed to 6 in the base case; however, the platforms would be widely distributed and none would be closer to shore than 18.5 km (11.5 mi). Prevailing winds would blow smoke plumes parallel to the coastline or offshore. For any given fire, it is expected that any smoke reaching the shore would be dispersed, short-term, and limited to a local area, resulting in a low effect.

Summary: Effects from air emissions in the high case due to Sale 126 on onshore air quality are expected to be less than 20 percent of the maximum allowable PSD Class II increments and would not make the concentrations of criteria pollutants in the onshore ambient air approach the air quality standards. Consequently, effects of pollutant emissions on air quality--with respect to standards--are expected to be low.

CONCLUSION: The effect of the high case on air quality is expected to be LOW.

2. Effects on Water Quality: A wide range of water quality degradation could occur as a result of oil activities associated with the high case. Degradation could result from discharges, construction activities, and accidental hydrocarbon discharges due to spills, blowouts, and chronic small-volume spills. These agents and their generic effects are described in Section IV.B.2 of the Sale 109 FEIS (USDOI, MMS, 1987b) and are incorporated by reference. In the context of this analysis, LOCAL refers to an area of less than 1,000 km^2 while REGIONAL refers to an area of at least 1,000 km^2.

a. Discharges: Exploration and production platforms would be expected to discharge bulk quantities of drilling muds and cuttings. Other discharges (Sec. IV.B.2.b) are not expected to be significant pollutant sources. Discharges from platforms would be regulated through a general NPDES permit from the EPA (see Sec. IV.B.2).

Drilling Muds and Cuttings: The quantity of muds and cuttings discharged into the environment is dependent on the number of wells drilled and the depth of each well. During the exploration period (1992-2001), about 34,980 short tons of muds and 45,050 short tons of cuttings would be discharged. During the development period (2000-2005), from 51,900 to 330,400 tons of muds, and 436,600 tons of cuttings would be discharged into the environment. For information on the fate of discharged muds, see Section IV.B.2.a.

Federal water quality regulations (Clean Water Act, Sec. 4O3(c)) allow a 100-m-radius mixing zone for initial dilution of effluent. At the edge of the mixing zone, acute (1-hour average concentration) water quality criteria must be met. Acute criteria are applicable to instantaneous releases or short-term discharges of pollutants such as drilling mud discharges (see Sec. IV.B.2.a). Table IV-B-3 compares the acute, total-recoverable-marine-water quality criteria with predicted total-, particulate-, and dissolved-trace-metal concentrations at the edge of the 100-m-radius mixing zone (see Sec. IV.B.2.a and Appendix J). Direct estimates or measurements of total recoverable concentrations of metals in discharged drilling muds are not available (Appendix J). The dissolved concentrations of all trace metals considered by EPA to be the best estimator of the total-recoverable concentration are below the acute marine-water quality criteria, at 100 m from the discharge point. Long-term leaching of metals from deposited muds would be slight and no water quality criteria would be expected to be violated (USEPA, 1989).

During exploration and delineation activities, six rigs could be present at any time; thus, a maximum of 0.18 km^2 of the sale area would have impaired water quality during the drilling periods (1992-2001). This impairment would exist only during periods of actual discharge and would rapidly dissipate upon completion. During production drilling, twelve platforms would be in operation. Assuming that maximum discharge rates are limited by EPA to the same extent during production as during exploration, instantaneous discharges would be of the same order of magnitude in production as in exploration. About 0.36 km^2 of the sale area could have impaired water quality during the production-well-drilling period (2000-2005). The effect on local and regional water quality is expected to be very low.

Formation Waters: Formation waters are produced from wells along with the oil. Over the life of the field, the volume of formation waters produced is equal to 20 to 150 percent of the oil-output volume (Collins et al., 1983). On this basis, the production of formation waters over the life of the field can be estimated at 708 to 5,310 MMbbl. Discharge of formation waters would require an EPA permit and would be regulated so that water quality criteria, outside an established mixing zone, would not be exceeded. For additional information on formation waters, see Section IV.C.2.a.

If formation waters were reinjected or injected into different formations, no discharges of formation waters would occur and no effect would occur. If formation waters were discharged, the effect on water quality would be local and would continue for the life of the field. The effect on local water quality is expected to be moderate, while the effect on regional water quality is expected to be very low.

b. Construction Activities: Sediment resuspension and bottom disturbances are likely to occur as a result of siting platforms, and trenching and burial of subsea pipelines. The amount of disturbance associated with platform siting, anchor setting, and drilling would be minimal and restricted to the area immediately adjacent to the activity. Sediment levels would likely be reduced to background levels within several hundred meters downcurrent.

About 325 km of offshore pipelines connecting the twelve production platforms to an onshore pipeline to TAP Pump Station No. 2 could be emplaced between 2000 and 2002. This level of activity would be the same as identified for the base case. See Section IV.C.2.b for additional information on the effects of dredging on water quality.

Prior to any discharge, site-specific discharges of dredge or fill material into U.S. waters will be evaluated in follow-up environmental documents as required. Effects on water quality from dredging (and dumping) would be local and short-term. Effects on local water quality are expected to be low, while regional effects is expected to be very low.

c. Oil Spills: In addition to permitted discharges, accidental oil spills are likely to occur. Based on experiences in other OCS areas, four spills of 1,000 bbl or greater would be estimated to occur in arctic waters as a result of the high case. For analysis purposes, it is estimated that four spills of 22,000 bbl each would occur. This is the average size of platform and pipeline spills (see Sec. IV.A.1.b.2). In addition to the large spills, more chronic spillage of smaller volumes also would be estimated. About 830 small spills totaling 11,700 bbl are estimated to occur over the life of the field. Information on the effects of oil spills on water quality is contained in Section IV.C.2.c.

The four estimated oil spills of 1,000 bbl or greater could occur in either the summer or winter seasons. Hydrocarbon concentrations following a summer open-water spill of 22,000 bbl in the Chukchi Sea would be expected to decline rapidly in the first 30 days following the spill. The average hydrocarbon concentration after 3 days in the top 10 m of the water column below the discontinuous slick would be 0.16 ppm. The discontinuous slick would cover 57 km^2 after 3 days. The average concentration in the top 10 m of the discontinuous slick would be expected to be 0.09 ppm after 10 days and 0.04 ppm after 30 days following the spill (Appendix L: Table L-2). The mean area of the discontinuous slick would reach 260 km^2 after 10 days and 1,100 km^2 after 30 days (Appendix L: Table L-1).

A spill occurring in the winter season would be frozen in the ice and would move with the ice for the remainder of the winter. Spills in first-year ice would melt out in late spring or early summer. Spills in multiyear ice would melt out later in the summer or in subsequent summers. Spills released from the ice would be relatively unweathered and would have the characteristics of fresh oil. Before the oil was released from the ice, contaminated ice could drift for hundreds of kilometers. A 22,000-bbl-meltout spill in the Chukchi Sea (see Sec. IV.A) would have the following hydrocarbon concentrations: 0.03 ppm after 3 days, 0.05 ppm after 10 days, and 0.04 ppm after 30 days (Appendix L: Table L-2). The discontinuous slick size would cover from 1,400 km^2 after 3 days to 2,200 km^2 after 30 days (Appendix L: Table L-1).

Sustained degradation of water quality to levels above State and Federal criteria from hydrocarbon contamination is unlikely. Hydrocarbon concentrations from the four oil spills of greater than 1,000 bbl could exceed the chronic criterion of 0.015 ppm total hydrocarbons on at least several thousand square kilometers for a short period of time. Concentrations above the acute criterion (1.5 ppm) are not anticipated. The persistence of individual oil slicks would be short-term (less than 1 year), but the slick--intact and unweathered in the pack ice--could drift for hundreds of kilometers. The 830 small spills under 1,000 bbl estimated to occur over the life of the field would result in local chronic contamination. Effects of an oil spill on water quality are expected to be moderate locally and low regionally.

<u>Summary</u>: In the high case, water quality in the Chukchi Sea would be affected by discharges (muds and cuttings and formation waters), construction activities (drilling, and platform and pipeline placement), and oil spills.

Discharges of muds and cuttings are regulated by the EPA such that water quality criteria must be met at the edge of an EPA-established mixing zone. The effect of exploration and production drilling muds and cuttings discharges would persist only during actual discharge within the 100-m-radius mixing zone around each discharge point. Concentrations of trace metals would not exceed the acute marine-water quality criteria at the edge of the mixing zone. The effect on local and regional water quality is expected to be very low.

The production of formation waters over the life of the field can be estimated at 708 to 5,310 MMbbl. If formation waters were discharged, the effect on water quality would be local and would continue for the life of the field. The effect on local water quality is expected to be moderate, while the effect on regional water quality is expected to be very low.

Effects on water quality from dredging (and dumping) would be local and short-term. Turbidity would increase over a few square kilometers in the immediate vicinity of dredging operations only during actual dredging. Effects on local water quality are expected to be low, while regional effects are expected to be very low.

Sustained degradation of water quality to levels above State and Federal criteria from hydrocarbon contamination is unlikely. Hydrocarbon concentrations from the four estimated oil spills of 1,000 barrels or greater could exceed the chronic criterion of 0.015 ppm total hydrocarbons on at least several thousand square kilometers for a short period of time. Concentrations above the acute criterion are not anticipated. Effects of an oil spill on water quality are expected to be low both locally and regionally.

CONCLUSION: The effect of the high case on water quality is expected to be MODERATE locally and LOW regionally.

3. Effects on Lower-Trophic-Level Organisms: Exploration drilling under the high case would commence in 1992 with a total of 53 exploration and delineation wells drilled over a 10-year period. During the exploratory-drilling phase, drilling discharges, offshore construction (principally rig placement), and minimal seismic surveys would have the potential to adversely affect lower-trophic-level organisms.

Drilling discharges under the high-case level of exploration and delineation drilling would total about 80,000 short tons. These discharges would affect lower-trophic-level organisms to no more than 100 m from the discharge point (Chukchi Sea Sale 109 FEIS, Appendix I [USDOI, MMS, 1987b]). This limited area of potential adverse effect would not result in any significant adverse total-population effect, since Chukchi Sea lower-trophic-level organisms are widely distributed and large in number and generally have relatively high rates of reproduction.

Under the high case, offshore construction during the exploration phase would be limited to temporary installation of the exploration and delineation-drilling rig. Some lower-trophic-level organisms might be temporarily displaced; however, in some cases the increased substrate afforded by the rig itself might enhance habitat for some organisms.

Seismic surveys, which now utilize airguns or related acoustic-energy sources, are essentially noninjurious to marine life. Any adverse effects are usually limited to no more than 1 to 2 m from the discharge point (Falk and Lawrence, 1973).

Development/production under the high case would involve installation of 12 platforms and drilling of 472 production/service wells (Table II-A-1). A total of four oil spills of ≥ 1,000 bbl are projected to occur over both the exploration/delineation and the development/production phases of the high-case level scenario. Oil would be transported to shore at Point Belcher by a buried pipeline and then on to the TAP via a primarily elevated pipeline.

Oil spills could have adverse effects on lower-trophic-level organisms as analyzed in Section IV.C.3. The four estimated oil spills, however, would contact only small segments of the large regional populations in this group. Even the largest oil spills are limited in areal extent relative to the large expanse of ocean. Oil in seawater tends to disperse rapidly, and thus its toxic effect on marine plants and invertebrates is reduced to a point where concentrations are below levels that could affect these organisms. Given the limited area contacted by oil and the widespread distribution of lower-trophic-level organisms, the overall effect of oil spills would be very low.

Discharges associated with the development/production phase of the high case nearly double from those of the base case; however, the number of locations also double (from 6 to 12 platforms), and material is more widely distributed. During the course of development/production, between 51,920 and 330,400 short tons of drilling muds and 436,600 short tons of cuttings would be discharged from 12 platforms. These discharges would be made over a period of 5 years. As discussed in Section IV.C.4, drilling discharges have limited spatial effect and a short period where they could have toxic effects on lower-trophic-level organisms. Drilling muds and cuttings may, to a small degree, provide some enhancement of benthic habit for some organisms as the topography of the seafloor is altered.

Construction under the development/production phase of the high case involves the installation of 12 production platforms and the laying of 325 km of offshore pipeline. These activities could cause temporary disturbance displacement of lower-trophic-level organisms, mainly through excavation of the ocean floor, with resultant turbidity. Platform placement could have a similar effect. These disruptions would be limited in area and short-term. Their localized high adverse effect would be limited, and the adverse effect on regional populations would be very low.

Given the now commonly used airgun, the 20,652 km of seismic surveys would have virtually no effect on lower-trophic-level organisms.

CONCLUSION: The effect of the high case on lower-trophic-level organisms is expected to be LOW.

4. Effects on Fishes: Exploration drilling for the high case would entail drilling 53 exploration and delineation wells over a decade (1992-2001). Drilling discharges, offshore and onshore construction, and seismic surveys could affect fish during the course of exploration- and delineation-well drilling.

Drilling discharges during the exploration- and delineation-well-drilling phase of the high case would total about 80,000 short tons. This material usually exists in concentrations toxic to fish to only tens of meters from the discharge point. Adult fish would probably move away from the discharge area; however, eggs and larvae of some fish species would have limited mobility and could be contacted by the discharged material. The limited area affected by the discharges would contact only a very limited number of the total number of eggs and/or larvae in a given species' population.

Offshore construction during the exploration phase of the high case would affect fish only during placement of the drilling rigs. The presence of these structures may afford an increase in substrate that would provide food and refuge for some fish.

During exploration, seismic surveys needed to site the drilling rig would be required. Airguns or their equivalent acoustic-energy sources are most commonly employed for this purpose today. Tests have shown that these devices are relatively harmless to adult fish and that only eggs and larvae in close proximity to the air discharge are injured. The discharge may temporarily disturb and/or displace adult pelagic fish. The effect of the exploration and delineation phase of the high case on fishes is expected to be very low.

At the development/production phase of the high case, the effects on the previously analyzed discharges, construction, and seismic surveys would all increase.

A total of four oil spills of $\geq$ 1,000 bbl are estimated to occur offshore; and up to 188 spills (average size ranging from 2-1,500 bbl) are estimated to occur from the onshore pipeline. Of the estimated high number of 188, however, the average-size spill would be 6 bbl. Offshore oil spills would average 22,000 bbl and would not contact large ocean areas or significantly large areas of fish habitat (Sec. IV.A.1.b(2)(a)). The oil also would disperse quite rapidly; this, coupled with weathering, would reduce concentrations below levels toxic to fish within a relatively small distance from the spill point and within a short period of time. Adult pelagic and benthic fish may be sensitive to oil in water and may have the mobility to avoid it (Weber et al., 1981). Eggs and larvae of pelagic and benthic fishes with limited mobility would be more subject to adverse effects from oil spills; however, these time-limited lifestages of fish are only vulnerable to oil spills during a short period annually. This, with their wide distribution in the Chukchi Sea and large regional populations, would restrict the numbers that could be contacted by oil to very small segments of the regional offshore populations. The fish in onshore-river systems contaminated by oil spills would, however, be subjected to a very high adverse effect, since the channeled flows and more shallow riverine depths would contaminate fish habitats to a larger extent, especially for those species that are relatively concentrated (e.g., in overwintering areas). The overall effect of oil spills on offshore fishes would remain low, while onshore fishes could sustain very high effects from even relatively small oil spills.

Drilling discharges for the development/production phase of the high case total 51,920 to 330,400 short tons of drilling muds and 436,600 short tons of cuttings. As analyzed in Section IV.C.4, these discharges would have a limited effect on fish due to the limited range of their dispersal; and for this phase of the high case they also are further dispersed from a larger number of locations (6 vs 12). The effect of drilling discharges on fish is assessed as very low.

Offshore construction for the development and production phase of the high case entails placement of 12 production platforms and installation of 325 km of pipeline to transport the oil onshore. This construction could temporarily displace some fish and be injurious to eggs and larvae in the immediate vicinity of the construction zone. The affected fish habitat and number of fish would, however, both be small. The drilling platforms and altered benthic substrate related to pipeline laying may enhance habitat for some fish species. The effect of offshore construction on fish is expected to be very low.

Onshore construction, principally the pipeline to transport oil from Point Belcher to the TAP, could also affect fish during its construction. Measures may be employed, however, to prevent damage to riparian fish habitats through protective measures during construction, coupled with timing of construction to minimize effects on fish, e.g., crossing streams during seasons when eggs are not present.

Seismic surveys wherein airguns or their equivalent acoustic-energy devices are employed would have an essentially very low effect on adult fish, eggs, and larvae; and any injurious effect would be limited to no more than 1 or 2 m from the discharge point (Falk and Lawrence, 1973).

CONCLUSION: The effect of the high case on fishes is expected to be LOW in marine habitats and VERY HIGH in freshwater habitats.

5. Effects on Marine and Coastal Birds: Under the high case, the number of oil spills of $\geq$ 1,000 bbl estimated to occur over the 30-year life of the field increases from two (base case) to four. Helicopter-support traffic from the shorebase to drilling units would reach a maximum of 180 round trips/month during exploration (assumed 3-month drilling season), 175/month during development (annual drilling season) and 96/month during production. Vessel-support traffic would involve a maximum of 24 trips/month. Seismic vessels would survey an estimated 9,631 and 20,652 trackline kilometers during exploration and development, respectively. A general discussion of oil-spill, disturbance, and other effects is contained in Section IV.C.5.

The principal result of elevated oil-spill risk at a higher resource level would be to increase the likelihood of potential effects in coastal and offshore habitats used by marine and coastal birds. Also, the potential exists for a population to experience multiple oil-spill contacts that could elevate the overall level of effect. The probabilities of oil spills occurring during the summer and winter seasons and contacting important marine and coastal bird habitats are shown in Figure IV-C-1; for both, these values are elevated considerably over base case values.

The probabilities of oil-spill occurrence and contact during summer range from 35 to 72 percent in several coastal areas (Peard Bay, Wainwright Subsistence/ North Kasegaluk Lagoon Areas) and Migration Corridors A and B. These values suggest the potential for higher overall effect levels than under the base case, but bird densities in the migration corridor or offshore portions of the other areas in general are not especially high during this season; thus, effects are not likely to exceed a low level. The probability of contact and occurrence in nearshore areas or coastal lagoons, represented by the probability of 1 percent or less at Icy Cape and other oil-spill-model land segments, probably is a better reflection of the risk to vulnerable populations that use these areas during migration. Likewise, flocks of foraging birds from the Cape Lisburne colony do not seem to be at high risk. If a spill occurred specifically near Kasegaluk Lagoon or Icy Cape, several hundred to a few thousand eiders or oldsquaw could be killed. If the spill entered the lagoon and spread through shallow lagoon waters and saltmarshes, especially in late summer or early fall, greater numbers of birds--including staging shorebirds and large numbers of brant--could be killed or indirectly affected through the contamination and loss of food sources. However, risk of contact in inshore and lagoon areas is not comparably elevated (i.e., 1% at Icy Cape and <0.5% at Cape Lisburne); hence, migratory waterfowl staging in these areas in late summer and fall, or inshore foragers at the Lisburne colony, are not likely to experience the significant effects their large numbers (e.g., brant staging in northern Kasegaluk Lagoon) might suggest.

Farther offshore, the 21- to 82-percent probability of spill occurrence and contact at Sea/Ice Segments 4 through 6 suggests that Ross' gulls passing through the ice front in the northern sale area during the fall season could be at considerable risk. The loss of modest numbers from this relatively small population could represent significant mortality. However, because this species feeds mainly by hovering and brief plunges, individuals are not likely to come into prolonged contact with oil, thus any losses from oil spills are likely to be low.

Oil spills occurring during the winter season exhibit a slightly higher (2%) risk of contact with the Icy Cape area, than do spills occurring during the summer season (1%). Winter spills occurring offshore of the lagoons are not likely to contaminate Kasegaluk Lagoon, Peard Bay, or other important lagoon and river-mouth bird habitats during that season because shorefast ice and the barrier islands would prevent an oil slick from actually entering the lagoons. Farther offshore, partially within the sale area, the probability of occurrence and contact in Migration Corridors A and B is 13 to 23 percent in winter, including at least part of the breakup period, suggesting-substantial risk to the hundreds of thousands of spring migrant waterfowl that follow the major opening leads to northern breeding grounds. If a spill occurred during the spring within a lead near the Cape Thompson or Cape Lisburne colonies, when thousands of prebreeding murres and other colonial birds were rafting on the open water, substantial numbers of birds could be lost; but losses of estimated magnitude are likely to be replaced within a generation.

Overall, oil spills that may occur as a result of the high case could kill several hundred to several tens of thousands of birds over the 30-year life of the field. The numbers of birds lost from populations of oldsquaw and common eider are likely to be replaced through recruitment within one generation (1 or 2 yr)--a low-level effect. If a significant proportion of the large numbers of brant stopping in the northern portion of Kasegaluk Lagoon during southward migration were contacted, a moderate effect could result; however, the probability of spill occurrence and contact is 5 percent or less, so the expectation of this occurrence is low. The loss of several thousand murres in the Cape Lisburne colony (150,000-250,000 murres) could require a generation for replacement because of their low reproductive rate. However, the presence of surplus murres could speed the replacement.

Disturbance effects are not expected to differ substantially from the base case.

CONCLUSION: The effect of the high case on marine and coastal birds is expected to be LOW.

6. Effects on Pinnipeds and Polar Bear: Under the high case the number of oil spills estimated to occur over the life of the field increases from two (base case) to four. Helicopter-support traffic to drilling units would reach a maximum of 180 round trips per month during exploration (assumed 3-month drilling season), 175 per month during development (annual drilling season) and 96 per month during production. Vessel-support traffic would involve a maximum of 24 trips per month. Seismic vessels would survey an estimated 9,631 and 20,652 trackline kilometers during exploration and development, respectively. A general discussion of potential oil-spill, disturbance and other effects is contained in Section IV.C.6.

The principal result of elevated oil-spill risk at a higher resource level would be to increase the likelihood of potential effects in coastal and offshore habitats used by seals, walrus, and polar bear (Fig. IV-C-2). Also, the potential exists for a population to experience multiple oil-spill contacts. However, several factors would mitigate against significant elevation of effects.

Spills are most likely to occur in the open-water season when, except for concentrations of spotted seal in adjacent coastal areas, most seals, walrus, and polar bears have withdrawn with the pack ice to the northern portion of the sale area and beyond. Here, except for the vicinity of Sea/Ice Segment 6 and Migration Corridors A and B, the probability of an oil spill ≥ 1,000 bbl occurring and contacting surrounding environmental resource areas within a 30 day trajectory period is 30 percent or less (Fig. IV-C-2). Since pinnipeds are scarce in open water areas, any spill occurring there is not likely to contact substantial numbers of animals, nor is it likely to penetrate very far into the ice front or pack ice where scattered animals do occur. In addition, any spill occurring in the portion of the sale area that remains ice-covered is not likely to spread sufficiently to contact a substantial proportion of the dispersed pinniped or polar bear populations. Also during this season, juvenile seals have developed an insulative fat layer and thus presumably are not as susceptible to oiling effects as when newborn.

Polar bears remain extremely sensitive to oiling; but, as discussed under the base case, conditions that result in their concentration and thus their vulnerability in the Beaufort Sea occur less frequently in the Chukchi Sea. Concentration of polar bears at a large carcass would place larger numbers at risk, but the occurrence of such a situation coincident with an oil spill is not likely to occur frequently. The probability of spill occurrence and contact in Migration Corridors A and B (Fig. IV-C-2) is 36 to 72 percent in the open-water season, but most migratory populations (seals, walrus) would have passed through prior to breakup of the pack ice over much of the sale area. During the remainder of the summer, they would be located in the pack ice to the north, generally less vulnerable than during the breakup period, as discussed above. The probability of a spill occurring and contacting spotted seal shoreline habitat (e.g., Land Segment 21) in summer is 1 percent or less; in adjacent waters, the probability ranges up to 35 percent (e.g., Point Lay Subsistence/Kasegaluk Lagoon Area, Peard Bay) but seal density is likely to be rather low offshore.

Spills could occur during the ice-cover season (winter/spring) if the field is developed, but a substantial proportion of the oil would evaporate or become incorporated into the pack ice and thus probably would not be responsible for potentially significant effects until breakup; by this time most pinnipeds and polar bears would have dispersed from areas most likely to receive oil-spill contact, although movement of the pack ice could distribute the oil more widely. Oil remaining under the pack ice or pumped to the surface by wave action could be transferred from adult seals to nursing pups (and potentially to foraging polar bears), but this is not expected to affect sufficient numbers of individuals to have a significant effect on their regional populations. Ultimately, it appears that pinniped and polar bear populations would be subject to only low mortality from oil spills as a result of their generally scattered distribution and, in the case of pinnipeds, relatively low sensitivity to oil.

The principal result of an elevated level of support activity associated with a higher resource level would be to increase the likelihood of disturbance effects from increased vessel and aircraft traffic in important coastal and offshore habitats. However, the dispersion of pinniped and polar bear populations on the pack ice (i.e., generally low density) and timing of migratory movements (i.e., occurring primarily prior to the annual increase in vessel and aircraft activity during exploration, and vessel activity during development and production phases), as discussed under the base case, are likely to mitigate against any potentially significant effects that could result from interactions between these species and vessels or aircraft. However, it is possible that pinnipeds and polar bears would avoid the vicinity of platforms--especially during construction--and routinely used vessel and aircraft corridors, and that this could result in localized declines in abundance of these species for the duration of the activity. It is not expected that these factors would exceed a low level of effect, nor would construction and operation of a shorebase at Point Belcher result in significant disturbance of summering spotted seals since no sites used by substantial numbers of seals are known for this area.

The relatively low sensitivity of these pinniped species to oil and their general abundance and relatively low density where oil-spill-encounter probability is highest suggest that their populations would recover from the relatively minor losses expected in the event of spill contact within a generation, representing a low level of effect. Likewise, although much more sensitive to oil and much less abundant, the generally low density of polar bears in circumstances that would promote substantial oil-spill-related mortality suggests they also are likely to experience only low effects. Thus, although the effects of oil spills on these marine mammal populations under the high-resource case would be expected to exceed those of the base case, they are likely to remain in the low range. Any additional effects of disturbance are not expected to significantly elevate the overall effect level.

CONCLUSION: The effect of the high case on pinnipeds and polar bear is expected to be LOW.

7. Effects on Endangered and Threatened Species:

a. Bowhead and Gray Whales: The agents likely to affect bowhead and gray whales in or near the Sale 126 area under the high case are industrial noise and crude oil. The effect of these agents was addressed in the low-and base-case analyses (see Secs. IV.B.7.a(1) and IV.C.7.a(3)); hence, that information is incorporated by reference, and the following analysis focuses on the likely rate of bowhead and gray whales encountering these agents in the high case.

This analysis assumes that whales do not respond (in the adverse sense) to noise of any kind until it is perceived as a threat or an annoyance, although the noise may be heard at great distances. It is also assumed that the distance from the source of noise where the response occurs represents the outer limit of the response zone. The purpose is defined as the range of distances where a behavioral response (attributable to the industrial noise) can be expected from about one-half of the whales in the vicinity of a given source of industrial noise (based on Miles 1984, 1986, 1987). One-half was selected because it has the least amount of variability, and the highest probability for valid cause-and-effect determinations in the relationship between industrial noise and whales.

Hence, for the purposes of this discussion, encounters with industrial noise occur when one-half of the whales near a source of industrial noise are responding, or would be expected to respond, to the noise. On the basis of studies findings to date (many of which are discussed in this evaluation), the effect of industrial noise on bowhead whales in or near to the spring lead system is likely to be similar to that anywhere else, since the stimuli are the same. However, if an industrial operation occurred in the spring lead system, the rate of bowheads encountering industrial noise would likely be higher than elsewhere.

(1) Likelihood of Encountering Industrial Noise: The high case involves a larger number of activities than the base case and, hence, a larger number of probable encounters with industrial activities. The exploratory phase for the high case, estimated to occur in years 2 through 11 (1992-2001), involves a total of 36 exploration operations (1-6/yr) and 432 supply-vessel trips, 3,240 helicopter trips, and 9,559 trackline km of seismic surveys. Exploratory operations in the Arctic typically require 1 drill rig and 2 to 4 support vessels to be onsite continuously and 1 to 3 aircraft intermittently.

Exploratory operations in the sale area are generally limited by ice to the mid-July-to-October period. Hence, the spring bowhead migration would not encounter noise associated with exploration, since it has already passed through the area by that time and the sale area is essentially outside of the spring-lead system. Gray whales tend to concentrate nearshore and seldom use the sale area (Fig. III-B-6). Hence, gray whale encounters with exploration noise are expected to be low to zero. Encounters with aircraft noise are not expected as long as aircraft remain at or above the response zone of 457 meters.

Based on prior sightings, the width of the fall bowhead migratory corridor in the sale area is very broad and appears to include the entire sale area (Fig. III-B-5). Assuming there are 7,800 bowhead whales in the Western Arctic stock and that they are evenly distributed along a line (about 337°NNW from Point Lay) perpendicular to the average fall bowhead heading (about 247° [Ljungblad et al., 1988]), the width of the corridor in the sale area would be roughly 320 km (200 mi) and would contain about 24 whales/km (39 whales/mi). Assuming further that 6 exploratory operations are evenly distributed along this line with 5 vessels per operation (seismic, drilling, support, icebreakers), having average zones of 8 km (5 mi) in diameter per vessel, exploratory operations could affect about 240 km (150 mi), or 75 percent of the migratory corridor. During the years of exploratory activity (1992-2001), this could result in about 5,850 bowheads entering industrial-response zones per year. Based on the definition of an industrial-response zone, about half of these whales (2,925)--or about 37.5 percent of the bowhead population--would be expected to respond to industrial noise once within a response zone.

The production phase is estimated to occur in years 10 through 31 (2000-2021) and involves a total of 12 production platforms, 44,952 helicopter flights, and 20,390 trackline km of seismic surveys. Each production platform would likely involve the intermittent use of a supply vessel and a helicopter. Production operations in the sale area would not be limited by ice conditions, would continue year-round, and, hence, would occur during both the spring and fall bowhead migrations. However, the sale area is essentially outside of the spring-migratory corridor; hence, most bowheads are not likely to encounter production noise in the spring. Gray whales are not likely to encounter production noise, since they tend to concentrate inshore and typically are in very low numbers in the sale area. Encounters with aircraft noise are not expected as long as aircraft remain at or above the response zone of 457 m.

Concerning the number of bowheads that might encounter production noise in the fall, if it is again assumed that there are 7,800 bowhead whales in the Western Arctic stock and that they are evenly distributed along a line (about 337°NNW from Point Lay) perpendicular to the average fall bowhead heading (about 247° [Ljungblad et al., 1988]), the width of the corridor in the sale area would be roughly 320 km (200 mi) and would contain about 24 whales/km (39 whales/mi). Assuming further that 12 production platforms are evenly distributed along this line with response zones averaging 8 km (5 mi) in diameter, production operations could affect about 60 miles, or 30 percent of the migratory corridor, each year. This could result in about 2,340 bowheads entering industrial-response zones in the sale area. Based on the definition of an industrial-response zone, about half these whales (1,170)--or about 15 percent of the bowhead population--would be expected to respond to production noise once within a response zone. Intermittent supply-vessel trips might increase the total number of encounters slightly if they occurred when bowheads were in the vicinity. Also, in years 10 and 11 (2001-2002), exploration and production operations may occur simultaneously, in which case the collective encounter rate (based on the assumptions above) could increase to about 52.5 percent (37.5% exploration and 15% production) during those 2 years.

Oon the basis of the above assumptions, 2 production operations (a more likely number) in the bowhead migratory corridor could result in about 5 percent of the bowhead population entering industrial-response zones, or about 2.5 percent responding to the noise. For this reason, and due to the conservative nature of the above assumptions, the more likely rate of bowheads encountering production noise in the high case ranges from zero to about 2.5 percent of the population (195 whales) per year. Again, intermittent supply-vessel trips might increase the total number of encounters slightly if they occurred when bowheads were in the vicinity. Consequently, during the 2 years when there could be simultaneous exploration and production operations, the more likely collective encounter probability (based on the same assumptions) ranges from zero to about 17.5 percent (15% from exploration and 2.5% from production).

It is probable that a number of bowhead whales would encounter exploration and production noise associated with the high case. However, encounters with industrial noise are expected to be brief, since whales are usually in a migratory mode. The actual rate of bowhead whales encountering exploration or production noise would vary depending on the number of whales in the bowhead population, the number of production operations per year, annual ice conditions, and unknown factors associated with migratory-path selection within the greater fall-migratory corridor. However, on the basis of the studies discussed in Section IV.B.7.a(1), whales that encounter exploration or production noise are likely to exhibit only local, short-term responses to it. Hence, no significant effect on the timing or route of the spring or fall bowhead or gray whale migrations is expected. Therefore, industrial noise associated with the high case is not likely to have a significant effect on bowhead or gray whale populations, although some whales would be affected.

(2) Likelihood of Encountering Crude Oil: The high case involves a larger number of activities and crude oil than the base case and, hence, a larger number of whales that may encounter either

agent. The high case estimates that there would be 36 exploration and 12 production operations over the life of the proposal (1991-2021). The exploratory phase is estimated to occur in years 2 through 11 (1992-2001) and the production phase in years 10 through 31 (2000-2021). The high case is estimated to produce 3,540 MMbbl of crude oil (about twice that of the base case), which would be transported by pipeline. During the period 1971 through 1983 (the period for which statistics are available), over 13,000 exploratory wells were started; however, no oil was spilled as a result of an exploration drilling blowout, and <1,000 bbl were spilled as a result of nondrilling blowouts (USDOI, MMS, 1984b). Hence, a large oil spill due to exploration operations is not likely to occur.

The number of production spills (≥ 1,000 bbl) estimated to occur over the 30-year life of the proposal is four for the high case--twice the number estimated for the base case. Combined probabilities describe the probability of one or more spills occurring and contacting a given area (whale habitat, in this case) over the life of the proposal. Bowhead whales migrate through the sale area (Fig. III-B-5) during the late summer/fall period (September-November). During this time, the combined probabilities (summer trajectories) of an oil spill occurring and contacting whale habitat (Fig. IV-C-3) within 10 days are: 11, 8, and 79 percent for Sea Segments 4 through 6; 72 and 6 percent for Migration Corridors A and B; and 35, 58, and 1 percent for the Peard Bay, Wainwright, and Point Lay Subsistence Areas. Although there would be some overlap (primarily in the migration-corridor areas), fall migrating bowhead whales would be most likely to encounter crude oil in Sea Segments 4 through 6, whereas gray whales would be most likely to encounter crude oil in Migration Corridors A and B and in the subsistence areas.

In the winter/spring period (April-June), most bowhead whales are believed to migrate inshore of the sale area through the spring ice leads. During this time, the combined probabilities of an oil spill occurring and contacting bowhead habitat within 10 days (winter trajectories) are: 7, 33, 47, and 81 percent for Sea Segments 3 through 6; 21 and 8 percent for Migration Corridors A and B; and 35, 59, and 17 percent for the Peard Bay, Wainwright, and Point Lay Subsistence Areas. As indicated, bowhead whales would be most likely to encounter crude oil in offshore locations, whereas gray whales would be most likely to encounter crude oil in nearshore locations. The probability of bowhead and gray whales actually encountering crude oil would be lower than these estimates, since these values represent oil-spill occurrence and contact with whale habitat--rather than contact with whales.

The spring bowhead-migration corridor, most of which is believed to be inshore of the sale area, is also used to some extent for calving and mating. A prolonged spill that entered the spring-lead system (where whales tend to be more concentrated) at the start of the spring migration would increase the likelihood of whales encountering crude oil. However, unless whales stopped to feed in the area of a spill, or were trapped in a lead into which oil was spilled, contact with oil would be brief. Even a spill of 22,000 bbl under open-water conditions is estimated to produce a continuous slick that would cover only about 3 km and would be only 0.8 mm thick after 10 days (Appendix L: Table L-1). Assuming the slick is in the path of migrating bowhead or gray whales, most whales swimming at average speeds would be expected to pass through the oiled area in about 30 minutes. Since whales spend about 90 percent of their time underwater, most of the whales swimming through this area would be exposed to a thin layer of weathered crude oil for <5 minutes.

The rate of bowhead and gray whales encountering an oil spill would depend on the size, duration, and timing of the spill; the density of the whale population in the area of the spill; and the whales' inclination to avoid contact with oil. If there were a large spill associated with the high case, it is likely that a number of bowhead and gray whales in localized areas would encounter crude oil for relatively short periods of time. However, studies have shown that crude oil at its worst has from only a minor, short-term effect on whales. Hence, no significant effect on the timing or route of the spring or fall bowhead or gray whale migrations is expected. Therefore, crude oil associated with the high case is not likely to have a significant effect on bowhead or gray whale populations.

<u>Summary</u>: Studies to date indicate that industrial noise has from only a local, short-term effect on whales. Exploratory operations would not affect bowhead whales in the spring, since operations occur after bowheads

have passed through the area. Also, since the sale area is believed to be outside of the spring-lead system, most bowheads are not likely to encounter noise associated with production operations. Some bowhead whales are likely to encounter exploration or production noise during their annual fall migration (September-November). Most gray whales are not likely to encounter industrial noise associated with the high case, since they tend to concentrate inshore of the Sale 126 area.

Based on the assumptions discussed in the text, in each year of the exploration/production period, the high case could result in about 37.5 percent of the bowhead population responding to exploration noise (from 6 exploration operations), and about 15 percent of the bowhead population responding to production noise (from 12 production operations). However, due to the conservative nature of the assumptions, the more likely encounter rate for the high case ranges from zero to about 15 percent for exploration noise, and from zero to about 2.5 percent for production noise. It is probable that a number of bowhead whales would encounter industrial noise associated with the high case. However, these encounters are likely to be brief, since whales are often in a migratory mode.

Studies concerning the effect of crude oil on whales have focused on the effect of oil contact, ingestion or inhalation of toxic substances, blowhole and/or baleen fouling, contamination or reduction of food resources and bioaccumulation, and possible changes in the behavior or distribution of whale populations in response to oil industry activities. Studies to date have yet to demonstrate a significant adverse effect of crude oil on a cetacean. Investigators have repeatedly found that, at its worst, crude oil has only minimal, short-term effects on cetaceans.

Any effect of crude oil on bowhead or gray whales is predicated on assuming that an oil spill occurs; it is not contained, collected, or eliminated; it occupies some portion of the bowhead or gray whale migratory corridor; it is present when whales are present; and whales in the vicinity of the spill do not avoid it, are frequently in contact with fresh oil, and repeatedly inhale or ingest it or contaminated food. Assuming further that some animals became trapped in oil-contaminated waters (such as in a lead) and could not escape, it is possible that some--primarily the young or those in poor physical condition--might die from inhalation or ingestion. However, the occurrence of a chain of events like this is considered improbable; and the likelihood of a large number of whales encountering an oil spill is small. If there were a large spill associated with the high case, it is likely that a number of bowhead or gray whales in localized areas would encounter crude oil. However, contact with crude oil is expected to be brief, since whales are often in a migratory mode.

Consequently, industrial noise and crude oil associated with the high case are likely to have local, short-term effects on a number of bowhead and gray whales. No significant effect on the timing or route of the spring or fall bowhead and gray whale migrations is expected. Whale migrations would not be blocked or delayed by industrial noise or crude oil.

Conclusion: The effect of the high case on the bowhead and gray whale populations is expected to be very low.

b. Arctic Peregrine Falcon: Effects on the arctic peregrine falcon due to the high case are expected to be similar to those discussed for the base case. However, the high case involves an increased level of activity over that estimated for the base case and an increased probability of disturbance (particularly aircraft flights during production). The probability of crude oil contacting seabird-concentration areas is <0.5 percent in the high case; hence, effects due to reduced food availability are expected to be minimal. The higher probability of disturbance could result in increased disturbance of nesting peregrine falcons in the vicinity of the pipeline to TAP Pump Station No. 2. However, at this time, only a hypothetical corridor has been identified. Consultation with the USFWS will likely be reinitiated at the time of actual pipeline-corridor planning. At this time, it is assumed that pipeline-construction activities in the vicinity of any peregrine falcon-nesting locations would occur during the fall and winter seasons, when falcons are not present. As a result, pipeline construction should not often disturb peregrine falcon-nesting or -foraging activities, and the presence of an unattended or sparsely attended pipeline in the vicinity of nesting sites would be expected to disturb few nesting pairs.

Conclusion: The effect of the high case on the arctic peregrine falcon population is expected to be low.

CONCLUSION: The effect of the high case on endangered and threatened species is expected to be VERY LOW on the bowhead and gray whale populations and LOW on the arctic peregrine falcon population.

8. Effects on Belukha Whale: The agents likely to affect the belukha whale in or near the Sale 126 area are industrial noise and crude oil. Although belukhas respond to sounds of higher frequencies than bowhead and gray whales, the effect of industrial noise with the high case on belukha whales is expected to be essentially the same (local, short-term effects on some animals) as that already discussed for bowhead and gray whales (see Secs. IV.B.7.a(1) and IV.C.7.a(3)); hence, that information is incorporated by reference from the low and base cases. However, the high case estimates a larger number of activities (36 exploration and 12 oil production platforms) and oil spills (4) than were estimated for the base case and, hence, a larger number of probable encounters. Consequently, this analysis focuses on the likely rate of belukha whales encountering these agents in the high case.

This analysis assumes that whales do not respond to noise of any kind until it is perceived as a threat, even though the noise may be heard at great distances. This analysis assumes that a threat is perceived when whales begin to respond to the source of noise, and that this distance from the source of noise represents the outer limit of the response zone. Hence, for the purposes of this discussion, an encounter with industrial noise occurs when whales enter the zone where they begin to respond to industrial noise. An encounter with crude oil occurs when whales are contacted by oil.

Belukha whales are common inshore of the Sale 126 area, but some (primarily in the fall) occur inside the sale area as well. During the spring (April-May), some belukhas migrate from the Bering to the Beaufort Sea, while others spend the summer months in the bays and estuaries of Kotzebue Sound and along the northern Chukchi Sea coast. In the fall (September-October), many of the belukhas in the Beaufort Sea migrate through the Sale 126 area while on their way to the Bering Sea. Since spring/summer belukha habitat is relatively distant from the sale area, belukhas are not likely to be in areas where industrial operations are occurring. In the fall, when belukhas are migrating through the sale area, they are widely dispersed but may encounter industrial operations infrequently. Hence, belukhas are not likely to encounter industrial operations often, although those in the vicinity may hear industrial noise. Belukhas encountering industrial operations would experience the same local, short-term effects discussed for other whales in Section IV.B.7.a(1). In inshore areas of the Chukchi Sea, where belukhas are more concentrated during the summer, some may be temporarily displaced along the pipeline path during trenching and laying operations. However, the amount of displacement or change in habitat use due to industrial operations is likely to be very small.

The path of the belukha's spring migration is through ice leads (similar to that of bowheads) and is essentially outside the sale area. Oil spills could contact belukhas in the spring as they migrate through the lead system between Point Hope and Point Barrow; during the summer, when belukhas feed and calve in nearshore areas; and during the fall as they migrate through the sale area toward the Bering Sea. During the spring migration, the combined probabilities of an oil spill occurring and contacting whale habitat within 10 days (winter ice-cover season, November-mid June) are: 21 and 8 percent for Migration Corridors A and B; 35 percent for the Peard Bay Subsistence Area; and 59 and 17 percent for the Wainwright and Point Lay Subsistence Areas. During the summer/fall open-water period (mid-June-November), the combined probabilities for contacting whale habitat within 10 days are: 11, 8, and 79 percent for Sea Segments 4 through 6; 72 and 6 percent for Migration Corridors A and B; 35 percent for the Peard Bay Subsistence Area; and 58 and 1 percent for the Wainwright and Point Lay Subsistence Areas. Because spring/summer belukhas are primarily inshore of the sale area, any oil arriving there would be weathered oil (volatile fractions absent). In the fall, when belukhas are migrating through the sale area, they would be more likely to encounter nonweathered oil--if an oil spill occurred. The probability of crude oil actually contacting belukha whales would be even lower than these figures, since they reflect the probability of habitat contact--rather than contact with whales.

The number of belukhas contacted after a spill would also depend on the size, duration, and timing of the spill and the whales' inclination to avoid contact with oil. If there were a large spill associated with the high case, it is likely that a number of belukha whales in localized areas would encounter crude oil for relatively short periods of time. While it is not possible to determine how many belukhas would actually be contacted, the probability of contact in the high case is likely to be about twice that of the base case. The possibility of belukhas being trapped in some way and unable to escape an area where oil is concentrated is remote. If belukha whales are contacted, studies have repeatedly shown that crude oil has from only a local, short-term effect on whales. Hence, no significant effect on the timing or route of the spring or fall belukha whale migrations is expected. Therefore, crude oil associated with the high case is not likely to have a significant effect on belukha whale populations, although a few whales could be affected.

Summary: The effect of industrial noise, crude oil, and other activities associated with the high case on the belukha whale population is likely to be similar to that expected for other whales. The high case involves a larger amount of exploration and production activity than the base case and about twice the amount of crude oil produced. However, due to the distance of spring/summer belukha habitat from the sale area and the dispersed nature of the fall belukha migration through the sale area, belukhas are not often likely to interact with industrial operations. Displacement of belukhas due to pipeline construction would be short term. Consequently, the high case is likely to have minimal effects on the belukha whale population.

CONCLUSION: The effect of the high case on the belukha whale population is expected to be VERY LOW.

9. Effects on Caribou: Under the high case, helicopter-support traffic from shorebase to drilling units would reach a maximum of 180 round trips/month during exploration (assumed 3-month drilling season), 175/month during development (annual drilling season), and 96/month during production. A general discussion of potential disturbance, habitat alteration, and oil- spill effects on caribou is contained in Section IV.C.9.

The principal result of an elevated level of support activity associated with a higher resource level would be to increase the likelihood of disturbance effects from increased aircraft traffic in coastal habitats.

The primary high-case-related disturbance source to caribou of the Western Arctic herd on their summer range is vehicle and air traffic associated with the construction and presence of the 640-km onshore pipeline and support road from a 25- to 30-hectare shorebase facility at Point Belcher to TAP Pump Station No. 2. Cows and calves of the Western Arctic herd are particularly sensitive to disturbance during the calving and postcalving seasons and would be especially disturbed during periods of heavy traffic associated with the 2-year construction period. Approximately 20 percent of the Western Arctic caribou herd (that portion of the herd that winters on the North Slope) may be temporarily disturbed by vehicle traffic along the pipeline corridor during spring migration, while other caribou could be disturbed during summer movements (see Fig. IV-C-4).

Disturbance of caribou along the pipeline would be most intense during the construction period (about 2 yr) when vehicle traffic would be highest (perhaps several hundred vehicles/day) but would decline after construction is complete and over the remainder of the 30-year life of the field. Caribou movements across the pipeline corridor could be retarded or delayed during periods of heavy traffic; but caribou are likely to resume crossing the pipeline corridor after construction is complete, with little restriction in movements. Caribou have returned to other developed areas after construction was completed following displacement from disturbed habitat (Hill, 1984; Northcott, 1984). Vehicle and air traffic along the pipeline corridor would cause flight reactions by some caribou and would temporarily delay caribou movements--for perhaps a few hours or no more than a few days--across the pipeline corridor. This would represent a low effect on the caribou of the Western Arctic herd. Caribou distribution and/or abundance are not likely to be significantly affected by the high case.

The 640-km onshore pipeline, support road, and 10 to 12 helicopter pads associated with the high case would alter or destroy about 64 km^2 of range habitat of the Western Arctic herd, while the associated shorebase would cover 25 to 30 hectares of range habitat near Point Belcher. The habitat altered or destroyed by these facilities would represent less than 1 percent of the available range habitat of the Western Arctic herd--a very low habitat loss. Any oil spills are likely to contaminate few caribou due to the very low probability of spills occurring and contacting the coast and the limited time during which caribou would occupy barrier islands for insect relief--and thus probably would have very low effects. Although many small onshore oil spills are estimated for the high case, these spills would contaminate very local caribou range near the pipeline and would not significantly affect the availability of caribou habitat (very low effect). Oiling of substantial numbers of caribou, requiring the release of oil into a river coincident with a major crossing of migrating individuals, is not considered a likely event. The effect of onshore oil spills is expected to be low.

CONCLUSION: The effect of the high case on caribou is expected to be LOW.

10. Effects on the Economy of the North Slope Borough:

a. NSB Revenues and Expenditures: Under existing conditions, total property-tax value in the NSB and NSB revenues are projected to steadily decline, as discussed in Section III.C.1.a. As also discussed in this section, these revenues will be determined by several different factors; therefore, the revenue projections should be used with the understanding that there are many uncertainties about these factors. The high case is projected to increase property-tax value starting in the year 1993, when it is expected to be 0.5 percent above existing conditions. This value is expected to reach a maximum of 50 percent above the declining existing-condition levels in the year 2010. The average change in property taxes over the period of projection would be about 18 percent. In most years, the change would be between 9 and 32 percent. Also, under existing conditions, the two expenditure categories that affect employment--operations and the Capital Improvements Program (CIP)--are projected to steadily decline. Of these two categories, only expenditures on operations would be affected by the proposed sale's effects on taxable property value. Those CIP expenditures that have generated many high-paying jobs for residents would not be affected.

The high case is projected to increase operating revenues by 1 to 38 percent, averaging 14 percent above existing-condition levels. The population effect of sale-induced employment would affect NSB revenues by allowing collection of additional intergovernmental and property-tax-operating revenues that are proportional to the NSB population. The percentage effect on operating revenues would begin to rise again after 2005 because of the expected declining existing-condition level and the induced-population effect on revenues.

b. Employment: The gains in direct employment from the high case would include jobs in petroleum exploration, development, and production and jobs in related activities. The estimated peak employment would be about 3,000 jobs in each of the years 2001 and 2005. In the year 2001, the number of offshore workers would be about 3,600, with onshore workers at approximately 900. In 2005, the number of offshore and onshore workers would be about 2,700 and 300, respectively. Additionally, throughout the production phase, total employment would average about 2,800 jobs, of which approximately 300 would be onshore. All of these jobs, except for the small percentage of headquarters jobs, would be filled by commuters who would be present at the work sites approximately half of the days in any year. Most workers would commute to permanent residences in the following three regions of Alaska--Southcentral; Fairbanks; and, to a much smaller extent, the North Slope. Some workers would commute to permanent residences outside of Alaska, especially during the exploration phase. Because economic effects in other parts of Alaska would be insignificant, only employment increases in the North Slope region are discussed.

The proposed sale is projected to affect employment of the region's permanent residents in two ways: (1)

more residents would obtain petroleum-industry-related jobs as a consequence of Sale 126 exploration, development, and production activities, and (2) more residents would obtain NSB-funded jobs as a result of higher NSB expenditures, as discussed above. While the proposed sale is projected to generate a large number of industry jobs in the region, the number of jobs filled by permanent residents of the region is not projected to be large. The predominant factor in the decline of employment in both cases is declining NSB expenditures. Total high-case resident employment is expected to range from 1 percent in 1993 to 37.5 percent in 2010 above existing-condition employment. In the years 2002 and 2003, the sale is projected to increase employment by about 12 percent and 19 percent, respectively, because of concentrated sale-related construction in those years. Employment during the last 3 years of the projected period is expected to be from 29.5 to 37.5 percent above existing-condition levels as a result of increases in property taxes to the NSB. This employment is expected to help offset other declines in employment and should prevent the outmigration of some residents.

Figure IV-D-1 presents a comparison of total resident employment for the no-sale case and for the high case. Figure IV-D-2 presents total resident-Native employment for both the no-sale and high cases. As can be observed, most of the sale-induced employment is not with the petroleum industry, and the number of sale-induced petroleum-industry jobs would drop as a percentage of sale-induced employment. In addition to the constraints on industry employment of Native residents discussed in Section III.C.1.b, the expected small, sale-induced effect can be attributed to a combination of an already historically high level of industry employment assumed under existing conditions and declining petroleum-related employment in the region. As industry employment declines in the region, there probably would be less effort made to recruit and retain Native workers.

As for the case under existing conditions, the unemployment rate for Natives is projected to rise from 0 percent in the year 1985 to 50 percent by the year 2002 and to remain at that level until the end of the projection period in the year 2010. While the unemployment rates are about the same for both cases, the sale case is projected to have a larger number of unemployed and a larger labor force, which results in similar rates. As under existing conditions, non-Native residents who lose their jobs are assumed to leave the region.

c. Effects of Subsistence Disruptions on the NSB Economy: Disruptions to the harvest of subsistence resources could affect the economic well-being of NSB residents in a number of ways. Adverse effects would be felt primarily through the direct loss of subsistence resources. In addition, loss of subsistence resources would increase demand for store-bought goods and result in an inflation of prices. In the case of an oil spill, a strain on infrastructure resulting from the influx of spill workers could occur.

Subsistence activities are an integral component of the NSB economy as well as the culture. If one or more subsistence resources became unavailable for harvest, the economic well-being of NSB residents would be harmed. There are two components to the economic well-being associated with subsistence resources--the value of subsistence resources as a source of food and the cultural value of the resources. Both of these values can be represented as a direct source of economic well-being for NSB residents. Subsistence resources, very simply, enter into household income as a food source that does not have to be purchased in the marketplace. This food source is a substitute for income earned in the marketplace that would have to be used to purchase food. Subsistence activities, and the value derived from these pursuits, however, go beyond a substitute for food bought in the market. As a way of life, there is a real, measurable economic value gained from NSB residents having access to such activities. Although there have been no studies to measure this value for NSB residents, studies that measured the recreational-hunting values and existence values of natural resources in other parts of the U.S. give a rough indication of the magnitude of such values (see, e.g., Brookshire, Eubanks, and Randall, 1983). A disruption of a subsistence harvest would result in a real loss of economic well-being to residents.

The interaction between the "Western" market-oriented economy and subsistence activities is a complex relationship that does not fit neatly into standard economic theory. Much of the reason for this is because

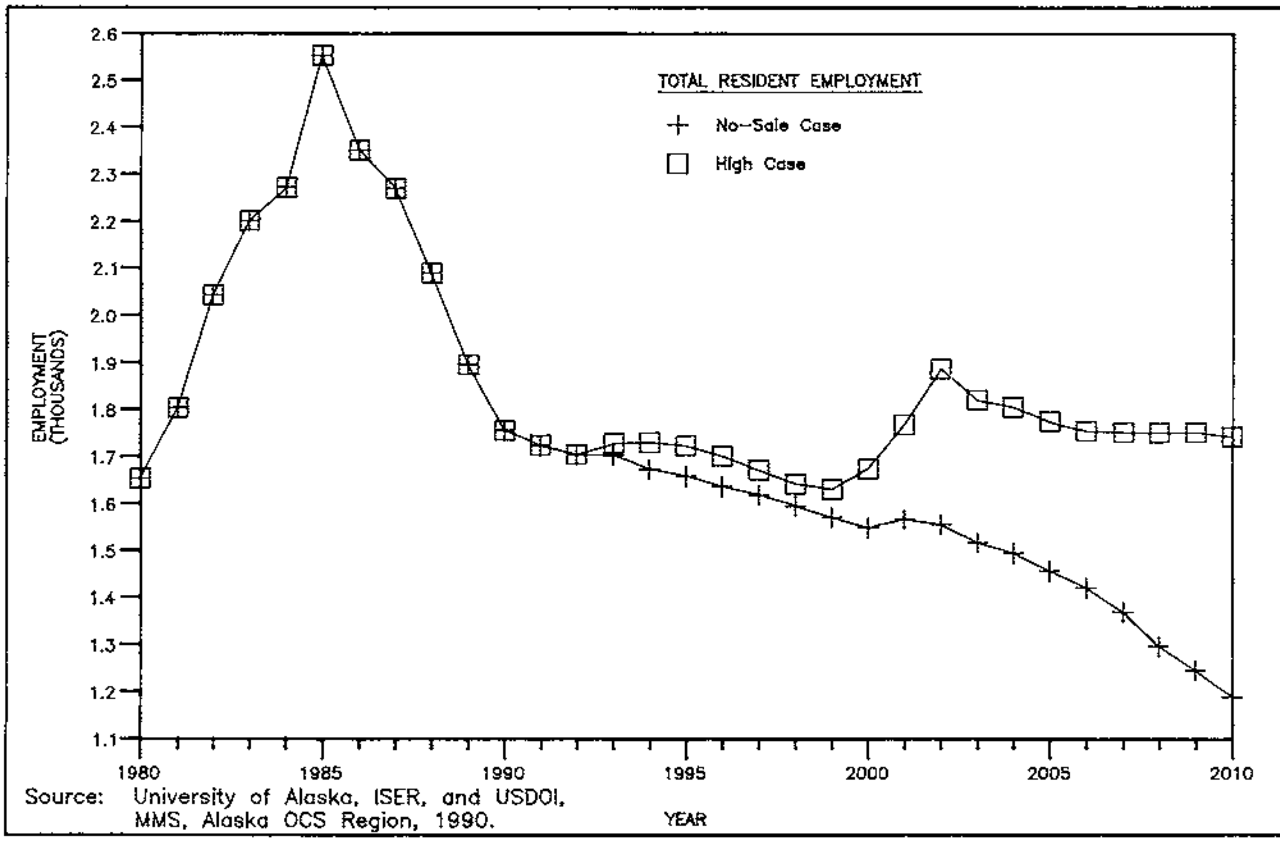


Figure IV-D-1. North Slope Borough Total Resident Employment, Comparison of High and No-Sale Cases

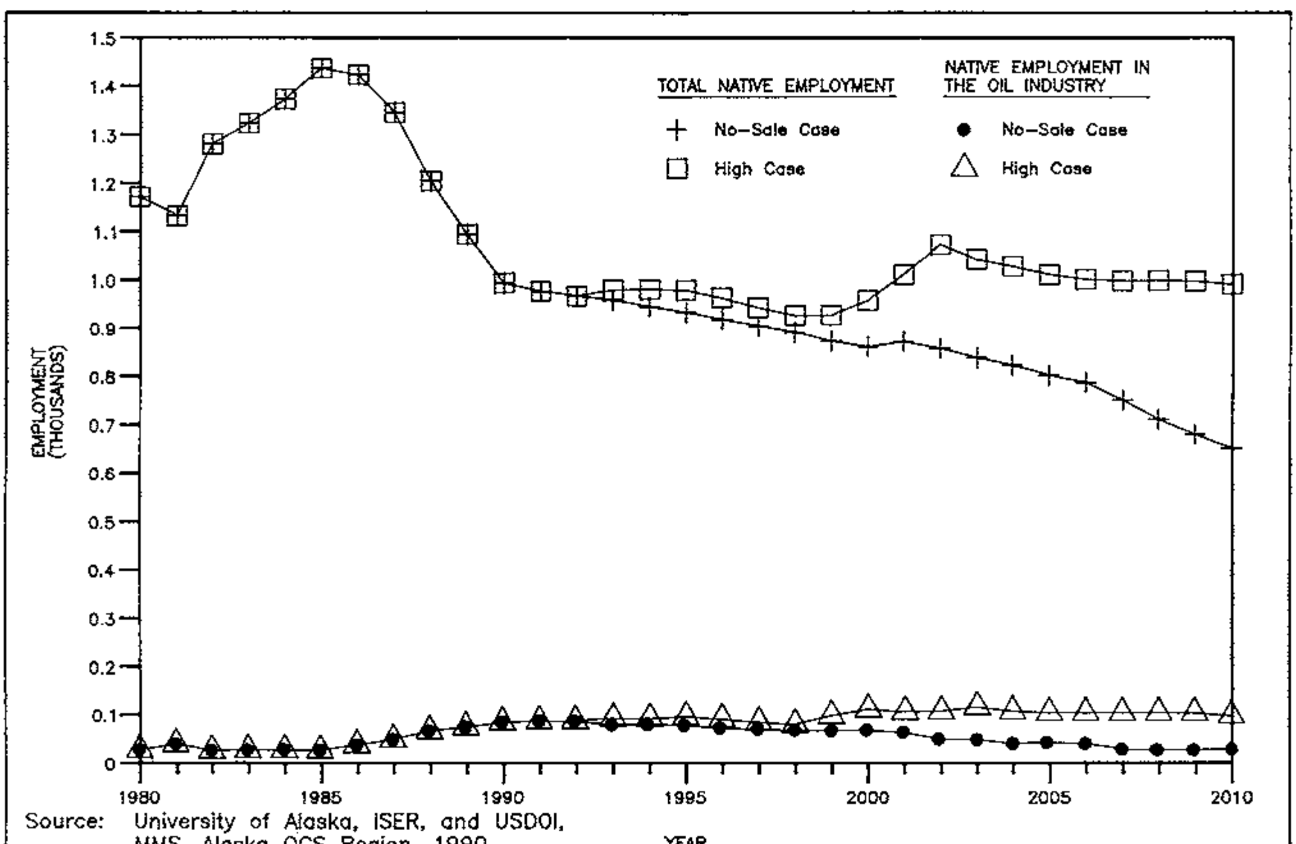


Figure IV-D-2. North Slope Borough Total Native Employment, Comparison of High and No-Sale Cases the unit of analysis in standard economic theory is the household, whereas the extended-kinship network is important for economic decision making in the Inupiat culture of the NSB. The kinship-sharing network that is characteristic of Inupiat culture distorts the standard economic outlook on an economy. For example, jobs in the market economy are often held in order to support subsistence activities. Earnings from these jobs frequently are not earned by the principal harvester of subsistence resources but rather are contributed by the market-wage earner to the harvester's subsistence effort. Likewise, subsistence resources are contributed to those engaged in market-oriented activities. This, however, is only one possible combination of the relationship between the market economy and subsistence activities. Market-wage earners may also directly engage in subsistence activities. Furthermore, the sharing of resources among the kinship network is not a simple trade of equally valuable goods. Rather, it is based on tradition and status among the individuals within the network.

Because of this extensive subsistence user/kinship network, a disruption to a subsistence resource caused by, for example, an oil spill could have ramifications that extend beyond the immediate family of the subsistence harvester to households that, by all appearances, principally engage only in market-economy activities. For example, an MMS survey research project on the North Slope found that for six North Slope communities (Barrow, Wainwright, Nuiqsut, Point Hope, Anaktuvuk Pass, and Kaktovik), about 70 percent of all households (regardless of ethnicity) obtained the majority of meat and fish in their diet from subsistence activities. A loss of a subsistence resource would be a loss of income to the entire community. This loss of income would result from the loss of the value of the food, plus the loss of the cultural value, and most likely could not be compensated for by the market economy through purchases of Western foods. There is considerable evidence that Western foods are not considered equivalent to Native foods (Kruse, Baring-Gould, and Schneider, 1983). Even if an equal portion of Western foods were substituted for the lost subsistence foods, there would still be a loss in well-being and in turn a loss of income because the substitute foods would be an inferior product. This aspect of the loss does not begin to address the lost value associated with having to forego participating in subsistence activities and, in general, the lost value associated with not being able to participate in the native culture. This is not to deny the possibility of additional income to local residents earned through cleanup jobs; however, cleanup opportunities are not expected to fully compensate for the lost value resulting from being denied use of subsistence resources.

In addition to the loss of value and, in turn, income associated with a loss of subsistence resources as the result of an oil spill, there would also be an effect on the NSB resulting from an influx of oil-spill-cleanup workers. This could manifest itself through inflationary pressures as the influx of workers compete with locals for goods and services and bid up prices. It is also expected that a strain would be placed on local infrastructure that would force local governments to expend additional, unbudgeted resources. All of these factors could have a negative effect on the local economy.

Following is a brief summary of the resources and communities that could be affected by subsistence-harvest disruptions. For a more detailed discussion, see Section IV.C.11. Following this summary is an analysis of the effects of harvest disruptions as a result of oil spills, noise and traffic disturbance, and construction activities on the local economy.

(1) Barrow: The Peard Bay area is particularly important for Barrow subsistence harvesters. Barrow residents harvest bowhead and belukha whales off the northeast edge of Peard Bay. According to Section IV.A.1, assuming that an oil spill occurred at hypothetical Spill Site J33 during the summer, there is a >99.5 (conditional) probability that oil will contact the bowhead whale migration area off Peard Bay (Migration Corridor A) within 10 days. If we consider the probability of an oil spill occurring in conjunction with the probability of the oil contacting an environmental resource (combined probability), there is an estimated 44-percent probability of an oil spill occurring sometime during the lease term and contacting bowhead Migration Corridor A within 10 days. This would have a moderate effect on the bowhead whale harvest. Noise and traffic are not expected to have an effect on the bowhead harvest and construction activities are considered too distant to cause more than low effects.

The effect of an oil spill on Barrow's belukha whale harvest is expected to be low because the probability of oil contacting Barrow belukha-harvest areas is low. Both the conditional probability and the combined probability for this environmental resource are <0.5 percent. In addition, noise, traffic, and construction activities are too distant to have more than short-term, temporary effects.

According to Section IV.C.11, the <0.5-percent probability (low) of an oil spill occurring and contacting the Barrow subsistence-harvest area would cause very low effects on caribou. Furthermore, noise and traffic along the Sale 126 pipeline corridor are not expected to cause a reduction in the caribou harvest. However, noise and traffic could cause some temporary delays in caribou-movement patterns that could result in a greater degree of difficulty in harvesting caribou. This could increase both the time and money spent on the caribou subsistence-harvest, for a low effect.

Barrow residents harvest bearded and hair seals as far south as the Peard Bay area. The conditional probability (that is, assuming an oil spill occurs) of oil contacting Peard Bay subsistence resources is >99.5 percent. The combined probability (the probability of an oil spill occurring and contacting the environmental resource) is 18 percent. It is expected that seals will be contaminated; but only a portion of the harvest would be reduced, resulting in low effects. The walrus, however, is harvested only during a short period of time; and a reduction during this period would reduce the entire year's harvest, for a moderate effect on the subsistence harvest. Noise, traffic, and construction disturbance could affect both seals and walrus, resulting in a low effect on the seal harvest and a moderate effect on the walrus harvest.

Section IV.C.11 concludes that the effect of an oil spill on fish harvested by Barrow residents would be low. This assumes that Barrow residents are able to replace fish contaminated in the Peard Bay area with fish caught elsewhere. Effects from noise and traffic disturbance and construction activities on fish would be very low.

Likewise, the effects on the harvest of birds is expected to be very low. Oil has a <0.5-percent probability of contacting Barrow's bird-harvest areas, and traffic and noise disturbance and construction activities would be too widely dispersed to have significant effects.

Polar bear harvests in the Barrow subsistence-harvest area could be reduced by oil spills that contaminated the polar bears or their main food source--seals. The effect of the base case on Barrow's polar bear subsistence harvest is expected to be low.

In 1988, marine mammals accounted for 149,340 kg of edible meat harvested by Barrow residents. This represented 56 percent of the total edible weight harvested. Forty percent of the total edible weight harvested was bowhead whale, 7.6 percent was walrus, 7.6 percent was seal, and 1 percent was polar bear. During the same year, 32 percent of total edible meat harvested came from terrestrial mammals. Twenty-eight percent of total edible meat harvested came from caribou and 4 percent came from moose. In addition, fish provided 8 percent of total meat harvested and birds provided 4 percent (Stephen R. Braudnd and Assoc. and University of Alaska, ISER, 1989a.) The MMS' Social Indicators Study estimates that 41 percent of all Barrow households (regardless of ethnicity) obtain greater than 50 percent of the meat in their diets from subsistence resources (this figure would be higher if just Native residents were considered). Disruptions to the subsistence harvest, as discussed in this section, could have a very significant effect on a major food source in the Barrow economy. For example, there is a high likelihood of an oil spill eliminating the bowhead harvest for 1 year. An oil spill could also reduce the harvest of seals, walrus, polar bear, and fishes. These resources contributed 64 percent to the total amount of edible harvest. A loss of just one whaling season would have major adverse effects on the economy of Barrow. New food sources would have to be found, increases in cash income would be necessary or savings depleted, and the NSB infrastructure would be stressed. In addition, there would be a significant loss in value due to Natives being forced to consume inferior products, i.e. Western foods. These effects would carry over to other areas of the NSB and the rest of Alaska because of the extensive kinship/gifting networks. In the event of an oil spill, the significant effect on the economic well-being of Barrow residents is expected to be high.

(2) Wainwright: A pipeline landfall and shorebase is expected to be located at Point Belcher, in the vicinity of Peard Bay. Peard Bay is an important subsistence-harvest area for Wainwright for all marine resources except the bowhead whale, which is harvested off Point Belcher. Because of the concentration of noise and traffic disturbances and construction activity, and the high probability of oil contacting environmental resources, Wainwright is expected to experience a higher level of effects than other communities.

As presented in Section IV.A.1, the conditional probability of an oil spill occurring and contacting the Peard Bay area in 10 days is >99.5 percent. The combined probability for Peard Bay is 18 percent, which means that there is an 18-percent chance of an oil spill occurring during the summer and contacting Peard Bay within 10 days. In addition, the summer conditional probability for oil contacting Migration Corridor A within 10 days is >99.5 percent and the summer combined probability is 44 percent. Oil spills in these areas would have a moderate effect on the Wainwright bowhead whale harvest because hunters would have to move to new locations, thus shortening the season. Construction activities associated with the landfall and shorebase at Point Belcher are expected to cause high effects, disrupting the bowhead whale harvest for more than 1 year and making the harvest of bowheads more difficult.

According to Section IV.C.11, although the belukha whale is found in an area with a high probability of being contaminated with oil, the effect on the harvest of belukhas would be low. This is due to the relatively long harvest period. Noise and traffic disturbance are likewise expected to have low effects on belukha whale harvesting. However, the construction activities at Point Belcher may affect the presence of belukha whale, thus making them unavailable for a year and resulting in a moderate effect.

Effects from oil spills and sale-related activities on seal, fish, bird, caribou, and polar bear harvests are all expected to be low. The seal harvest occurs throughout the year; therefore, only a portion of the harvest would be affected. Fishing in other locations could allow residents to make up harvests lost in the Peard Bay area. The effect on the polar bear is expected to be localized and short-term.

An oil spill that occurred during the time when that walrus are harvested could cause the walrus to become unavailable for 1 year because of the short timeframe in which it is harvested--resulting in a moderate effect.

In 1988, marine mammals accounted for 80,079 kg of edible meat harvested by Wainwright residents. This represented 70 percent of total edible weight harvested. Forty percent of the total edible weight harvested was bowhead whale, 18 percent walrus, 7.7 percent seal, and 1 percent polar bear. During the same year, 24 percent of total edible meat harvested came from terrestrial mammals, 23 percent from caribou. In addition, fish provided 4 percent and birds 2 percent of total meat harvested (Stephen R. Braund and Assoc. and University of Alaska, ISER, 1989b.) The MMS' Social Indicators Study estimates that 60 percent of all Wainwright households (regardless of ethnicity) obtain >50% of the meat in their diets from subsistence resources. Disruptions to the subsistence harvest, as discussed in this section, could have a very significant effect on a major food source in the Wainwright economy. For example, there is a high likelihood of an oil spill eliminating the bowhead harvest for 1 year. An oil spill could also reduce the harvest of seals, walrus, polar bear, and fishes. These resources contributed 71 percent to the total amount of edible harvest. A loss of just one whaling season would have major adverse effects on the economy of Wainwright. New food sources would have to be found, increases in cash income would be necessary or savings would be depleted, and the NSB infrastructure would be stressed. In addition, there would be a significant loss in value resulting from Natives having to consume inferior products, i.e. Western foods. These effects would carry over to other areas of the NSB and the rest of Alaska because of extensive kinship/gifting networks. In the event of an oil spill, the significant effect on the economic well-being of Wainwright residents is expected to be high.

Adverse effects could also result from general industrial activity. As discussed earlier, noise, traffic, and construction activities could disrupt the bowhead whale harvest for more than 1 year, resulting in a high effect. The effect on the economic well-being of Wainwright residents is expected to be high.

(3) Point Lay: A large portion of Point Lay's marine-harvest area lies within the Sale 126 area (the remainder lies shoreward of the Federal/State 3-mile territorial line).

Point Lay residents do not harvest the bowhead whale; however, the belukha whale is a culturally important marine resource, since it is hunted through a communal effort. Since the belukha is harvested during a relatively short period of time, an oil-spill during harvest time could preclude a portion of the harvest, resulting in a moderate effect on the Point Lay belukha whale harvest. Noise and traffic disturbance during harvest period would also have a moderate effect on the harvest.

As in the case of Wainwright, the harvests of caribou, seals, fishes, and polar bear are expected to experience low effects resulting from oil spills or other OCS activities.

An oil spill that occurred during the time when walrus are harvested could cause the walrus to become unavailable for 1 year because of the short timeframe in which they are harvested-- resulting in a moderate effect.

(4) Point Hope: A large portion of Point Hope's marine-subsistence-harvest area lies adjacent to the Sale 126 area. According to Section IV.C.11, Point Hope would experience low or very low effects on its subsistence harvests due to the proposal. The subsistence area is too distant from the Point Belcher/Peard Bay area to experience noise and traffic disturbances or disruption related to construction activities. There is also a <0.5 percent combined probability of oil contacting the Point Hope subsistence area.

(5) Atqasuk: Effects on the Atqasuk subsistence-harvest area are expected to be low for most resources, except for moderate effects on the bowhead whale and walrus harvests. The residents of Atqasuk harvest marine resources in conjunction with Barrow's harvest; thus, any effects on Barrow's harvest would also affect Atqasuk's harvest. This is due to the high likelihood of oil contacting these environmental resources and because of disruptions due to noise, traffic, and construction activities.

(6) Nuiqsut: High effects are expected on Nuiqsut's fish harvest due to oil spills in the Colville River from the onshore pipeline from Point Belcher to the TAP. A high effect on the fish harvest in Nuiqsut is expected to result in an overall high effect on Nuiqsut's subsistence-harvest pattern.

Summary: Subsistence-harvest disruptions can have a direct adverse effect on the NSB economy. Not only are subsistence resources a large portion of total meat for households directly engaged in subsistence harvesting, but the resources are shared widely. Furthermore, a large percentage of NSB households engage directly in subsistence activities. Disruptions from industrial activities or an oil spill would have significant effects on the economic well-being of NSB residents. Construction activities at Point Belcher could disrupt the bowhead whale harvest for both Barrow and Wainwright for more than 1 year (40% of total edible meat in Barrow and Wainwright comes from this source). Low-level effects resulting from construction and industrial activities are also expected for caribou, walrus, and seals. An oil spill would also disrupt the bowhead whale harvest for at least 1 year for both Wainwright and Barrow. In addition, walrus would become unavailable for an estimated 1 year for Wainwright and Barrow. Walrus contributes 18 percent and 8 percent, respectively, to the Wainwright and Barrow total edible harvest. Other subsistence resources are expected to experience low-level effects. The economic well-being of NSB residents would be diminished due to the loss of a major source of food and the loss in value placed on that food both from a dietary standpoint and from a cultural standpoint. This would be a real loss in income to NSB residents. The effect of subsistence-harvest disruptions on the economy of the NSB is expected to be high. The effect in the exploration phase on subsistence aspects of the economy is expected to be very low while the effect in the development and production phases is expected to be high.

Economic effects on the North Slope region are expected to be very high as a result of the projected change in resident employment, which will increase above 20 percent per annum for at least 5 years. The effect in the exploration phase on employment is expected to be low while the effect in the development and production phase is expected to be very high. Sale-related effects on Native and non-Native-resident employment would be slightly higher and slightly lower, respectively. However, the unemployment rate for Native residents should still reach 50 percent by 2002, with or without the sale. In addition, NSB property taxes will increase an average 18 percent and operating revenues will increase an average 14 percent.

Economic benefits from new jobs, income, and taxes that could result from the high case are expected to occur after the level of petroleum activities on the North Slope (e.g., Prudhoe Bay) has begun to decline. This decline would not be reversed by the expected effects of proposed Sale 126.

CONCLUSION: The effect of the high case on the economy of the NSB is expected to be VERY HIGH.

11. Effects on Subsistence-Harvest Patterns:

a. Introduction: Section III.C.2 (1) describes the subsistence-harvest patterns characteristic of Inupiat communities adjacent to the Sale 126 area, (2) outlines the important seasonal subsistence-harvest patterns by community and by resource, (3) provides figures depicting the areal extent of each community's general subsistence-harvest area and the timing of harvests, and (4) presents estimated quantities of subsistence resources harvested. Sections III.C.2 and III.C.3 demonstrate that significant aspects of each community's economy, culture, social organization, normative behavior, and beliefs interact with, and depend on, patterns of subsistence harvest. This section analyzes the effects of the high case on the subsistence-harvest patterns of communities near the Sale 126 area. This analysis tiers off the discussion of the base case (Sec IV.C.11). Accordingly, this analysis focuses entirely on a discussion of effects of causal agents (oil spills, noise, etc.) on community subsistence-harvest patterns and forgoes the case-by-case discussion of faunal resources that characterizes much of Section IV.C.11.

b. Effects on Subsistence Resources by Community:

(1) Barrow: A portion of Barrow's subsistence-harvest area lies within the Sale 126 area. Barrow residents use the Peard Bay area to some extent for harvesting marine resources. Under the high case, the Peard Bay area has a 35-percent chance of being contacted by an oil spill should one occur (summer and winter trajectories, 10-day period, combined probabilities). It is more likely that the Peard Bay area would be affected by noise, traffic disturbance, and activities associated with construction of the pipeline landfall and the Point Belcher shorebase. These construction activities may have some effects on Barrow's subsistence harvests.

The 72-percent combined probability (high), of an oil spill occurring and contacting the Barrow bowhead-harvest area during the open-water season and the theorized quantity of oil spilled (Sec. IV.A.1.b(2)) indicate that moderate effects due to oil spills on the bowhead harvest could be expected. Noise and traffic would not affect Barrow's bowhead whaling because drilling units, production platforms, vessels, and icebreakers would not be in the vicinity of the Barrow bowhead-harvest areas. Construction activities in Peard Bay are too distant from the bowhead-harvest area to cause more than low effects. The overall effect on Barrow's bowhead-subsistence harvest as a result of activities associated with the proposal is expected to be moderate.

Barrow's belukha-harvest area extends only to the northeastern edge of the Peard Bay area, too distant for noise and traffic or construction activities to affect belukha whaling on more than a short-term, temporary basis. Noise and traffic disturbance would be expected to cause some effects but would not cause the harvest to become unavailable (low effects). Further, there is a <0.5-percent probability of an oil spill occurring and contacting Barrow's subsistence-resource areas outside of Peard Bay (Land Segments 24, 25, and 26). The overall effect on Barrow's belukha-subsistence harvest as a result of activities associated with the high case is expected to be low.

The <0.5-percent (low) probability of an oil spill occurring and contacting the Barrow subsistence-harvest area would cause very low effects on caribou. Noise and traffic along the Sale 126 pipeline corridor would disturb caribou and could cause some temporary delays in caribou-movement patterns that could affect the harvest; however, the annual harvest would not be reduced. Effects on the caribou harvest due to noise and traffic disturbance are expected to be low. Caribou may temporarily avoid the pipeline-construction area, which would cause low effects on the caribou harvest for the duration of the construction. Potential onshore-pipeline spills are not expected to influence harvest levels, since the effect of a spill on the caribou's grazing range is expected to be very low--given the overall extent of the range. The overall effect on Barrow's caribou-subsistence harvest as a result of activities associated with the high case is expected to be low.

Bearded and hair seals are harvested by Barrow residents as far south as the Peard Bay area. Even though seals may be contaminated by an oil spill, the harvest would not become unavailable because seal harvests occur throughout the year; thus, only a portion of the harvest might be reduced, resulting in low effects. In contrast, the walrus is harvested during a very short period from early June through late August; and a reduction of the harvest during this period would result in a reduction of the entire harvest. Consequently, the walrus-subsistence harvest could experience moderate effects from oil contamination during that period. Seals and walrus could be affected by noise and traffic disturbance from aircraft that results in only short-term, localized effects. Both seals and walrus are also likely to be disturbed by the high concentration of activity associated with construction of the pipeline landfall at Point Belcher. This would produce low effects on seals, again because of the longer hunting season, and moderate effects on walrus due to the shorter hunting season. Overall, effects on Barrow's seal-subsistence harvest would be low, with moderate effects on the walrus-subsistence harvest.

Offshore oil spills are not expected to affect fishes in the Barrow subsistence-harvest area, with the exception of the Peard Bay area. However, even if fish in the Peard Bay area were oiled, fishing is conducted in a wide area and the overall harvest would not be affected. Effects on fish harvests due to oil spills are expected to be low. Other effects due to noise and traffic disturbance and construction activities would be very low because these activities do not substantially affect fish. Onshore oil spills from the pipeline could affect Barrow's fish-subsistence harvest; but the spills are likely to be quickly detected and generally <100 bbl in quantity. Should an oil spill occur in the interior along a major river used for fishing, the effects could be greater--especially if the spill were large and went undetected. However, the combination of a spill being (a) large, (b) undetected, and (c) along a principal subsistence-fishing river is unlikely (for Barrow's and other communities' fisheries resources). Therefore, the overall effect of the high case on Barrow's fish-subsistence harvests is expected to be low.

Oil is not expected to cause more than very low effects on Barrow's bird harvest due to the <0.5-percent (low) probability of an oil spill occurring and contacting Barrow's bird-harvest areas. Although birds may be affected by noise and traffic disturbance and construction activities, these effects would be too widely dispersed to have significant effects on a community's bird harvest in the sale area. The effect of the high case on Barrow's bird-subsistence harvest is expected to be very low.

Polar bear harvests in the Barrow subsistence-harvest area could be reduced by oil spills that contaminated the polar bears or their main food source--seals. The effect of the high case on Barrow's polar bear-subsistence harvest is expected to be low.

Conclusion: The effect of the high case on Barrow's subsistence-harvest patterns is expected to be moderate.

(2) Wainwright: A pipeline landfall and shorebase for Sale 126 is expected to be located at Point Belcher, in the vicinity of Peard Bay. Peard Bay is an important subsistence-harvest area for Wainwright for all marine resources except the bowhead whale, which is harvested off Point Belcher. Oil spills, concentration of noise and traffic disturbance, and construction activities in the Peard Bay area are expected to cause more effects on the marine and terrestrial subsistence harvests in Wainwright than in other communities. Oil spills during summer within 10 days in the Wainwright Subsistence-Harvest Area (a 58% chance of an oil spill occurring and contacting the Wainwright Subsistence Area and a 72% chance of a spill

occurring and contacting Whale Migration Corridor A) would cause moderate effects on the bowhead whale harvest because bowhead whaling activities are localized and occur within a short time period. An oil spill would force hunters to move to a new location and thus would shorten the whaling season. The harvest of whales, generally only one or two animals, could be reduced. Noise and traffic disturbance from icebreakers, support vessels, or platforms in or near the bowhead whaling area could cause short-term avoidance behavior by the bowheads, making it more difficult for the hunters to track them and thus resulting in effects on bowhead whaling. Construction activities associated with the landfall and shorebase at Point Belcher also could cause high effects by disrupting the bowhead whale harvest for more than 1 year and by making harvesting of bowheads more difficult (only 1 or 2 are typically harvested in Wainwright). As a result of high effects from construction activities in the Point Belcher area, the overall effect of the high case of the proposal on Wainwright's bowhead whale-subsistence harvest is expected to be high.

Only a small portion of the belukha whale population is likely to be affected by an oil spill in the Wainwright belukha-subsistence-harvest area. The longer period of time during which the belukha is available ensures that the belukha-harvest season would not be eliminated. Noise from platforms, vessels, or icebreakers could cause short-term effects but should not cause harvest levels to be reduced (low effects). Construction activities at Point Belcher would also include noise and potentially high marine and air traffic levels in Peard Bay--an important area for belukha whale hunting. This activity could affect their presence in Peard Bay and cause the belukha to become unavailable for a year (moderate effects). As a result of moderate effects from construction activities, the overall effect of the high case on Wainwright's belukha-subsistence harvest is expected to be moderate.

A portion of the caribou herd hunted by Wainwright grazes along the barrier islands and shallow coastal lands. Although some of these caribou could ingest oil, not all of these caribou would be affected. The caribou harvest may experience low effects from an oil spill. Effects from noise and traffic disturbance and pipeline-construction activities are expected to be low on the Wainwright caribou harvest, as on Barrow's. The overall effect of the proposal on Wainwright's caribou-subsistence harvest would be low.

Oil spills and construction activities would cause low effects on the Wainwright seal harvest and moderate effects on the walrus harvest. Even though seals may be contaminated by an oil spill, the harvest would not become unavailable because seal harvests occur throughout the year; thus, only a portion of the harvest might be reduced, resulting in low effects. In contrast, the walrus is harvested during a very short period in the summer; and an oil spill that occurred during the peak harvest could cause the walrus to become unavailable for 1 year or less, a moderate effect. Very low effects would occur from noise and traffic disturbance on both seals and walrus. The overall effect of oil spills is expected to be low on Wainwright's seal harvest and moderate on the walrus harvest.

Oil spills in the Peard Bay area and the Kugrua River could affect Wainwright's fish harvests; however, the ability to fish in other areas could enable residents to make up some of the loss. Annual fish harvests could be affected by oil spills; but fish would not become locally unavailable, causing low effects. As in Barrow, fish are not susceptible to disturbances from noise, traffic, and construction activities; and these activities are expected to cause very low effects on Wainwright's fish harvests. The overall effect of the high case on Wainwright's fish-subsistence harvest is expected to be low.

If an oil spill occurred and contacted the Wainwright bird-harvest area (Land Segments 21, 22, and 23), the effects could cause a reduction in the annual harvest because the bird-hunting season is quite short. Since the probability of such an event occurring and contacting is <0.5 percent, within 10-days (low), effects from oil spills are expected to be low. As in Barrow, noise and traffic disturbance and construction activities are expected to cause very low effects on Wainwright's bird harvests. The overall effect of the high case on Wainwright's bird-harvest is expected to be low.

Wainwright's polar bear harvest could also be reduced by oil spills through contamination of polar bears and their main food source--seals. Polar bears may also experience short-term, localized effects from aircraft disturbance. The overall effect of the high case on Wainwright's polar bear harvest is expected to be low.

Conclusion: The effect of the high case on Wainwright's subsistence-harvest patterns is expected to be high.

(3) Point Lay: A large part of Point Lay's marine-harvest area lies within the Sale 126 area (the remainder lies shoreward of the Federal/State 3-mile territorial line). Point Lay's subsistence-harvest area is expected to be more susceptible to effects from oil spills than either Point Hope's or Barrow's. Noise and traffic in the vicinity may also affect some species. However, the Point Lay area is far enough away from Point Belcher that it would not experience effects from noise and traffic disturbance or construction activities in the Point Belcher/Peard Bay area.

Point Lay residents do not harvest the bowhead whale; however, the belukha whale, their most important marine resource, holds the most cultural significance since it is hunted through a communal effort. The belukha is harvested in a short period of time. Although belukhas may avoid areas where oil is present and thus are unlikely to be affected by oil spills, they are likely to be rendered inedible or perceived as such if contacted by oil. Oil-spill-cleanup efforts could also hinder the harvest. For this reason, an oil spill that occurred and contacted the belukha harvest area could cause moderate effects on the harvest by making belukhas locally unavailable for a portion of the harvest period. If noise and traffic disturbed the harvest during this short period, the belukha harvest could be reduced, thus causing moderate effects. The overall effect of the high case on the Point Lay belukha-subsistence harvest is expected to be moderate.

Point Lay residents also harvest some caribou from the Western Arctic herd. As in Wainwright, the effects from oil spills on Point Lay's caribou harvest are expected be low. The effects of noise and traffic disturbance and construction activities are expected to be very low because of the distance of the Point Lay caribou-harvest area from the Sale 126 pipeline corridor. The overall effect of the high case on Point Lay's caribou-subsistence harvest is expected to be low.

As in Barrow and Wainwright, oil spills in the Point Lay subsistence-harvest area are expected to cause low effects on the Point Lay seal harvest and moderate effects on the walrus harvest. (The combined probability of an oil spill occurring and contacting the Point Lay Subsistence Area in a 10-day winter trajectory is 17%). Even though some seals may be contaminated by an oil spill, the harvest would not become unavailable because seal harvests occur throughout the year; thus, only a portion of the harvest might be reduced, resulting in low effects. In contrast, the walrus is harvested during a very short period in the summer; and an oil spill that occurred during the peak harvest could cause the walrus to be unavailable for 1 year. Noise and traffic disturbance are expected to cause low effects on both resources. Construction activities are expected to cause very low effects because of the distance from Point Lay to Peard Bay. The overall effect of the high case of the proposal is expected to be low on Point Lay's seal-subsistence harvest and moderate on the walrus-subsistence harvest.

Oil spills are expected to cause low effects on fishes in the Point Lay subsistence-harvest areas; however, the diversity of fish harvested, and the large area where fishing is possible, indicate an expectation of low effects on fish harvests due to oil spills. Fish are not susceptible to disturbances from noise and traffic disturbance or construction activities. The overall effect of the high case on Point Lay's fish harvest is expected to be very low.

If an oil spill occurred and contacted the Point Lay seabird-harvest area, moderate effects could occur; however, the probability of such a spill occurring and contacting this area is <0.5% (low). The overall effect of noise and traffic disturbance and construction activities associated with the high case on Point Lay's bird-subsistence harvest is expected to be very low. Point Lay's polar bear harvest could be reduced through oil-spill contamination of polar bears and their main food source--seals. Polar bears also may experience short-term, localized effects from aircraft disturbance. The overall effect of the high case on the Point Lay polar bear-subsistence harvest is expected to be low.

Conclusion: The effect of the high case on Point Lay's subsistence-harvest patterns is expected to be moderate.

(4) Point Hope: A large part of Point Hope's marine-subsistence-harvest area lies adjacent to the Sale 126 area. However, Point Hope subsistence harvests are not as likely to experience as many effects as Wainwright's and Point Lay's because of its distance from the Point Belcher/Peard Bay area, where most of the noise and traffic disturbance and construction activities would occur, and because of the low combined probability (<0.5%) of an oil spill occurring and contacting subsistence-harvest areas. Oil spills are expected to have very low effects on the harvest of all Point Hope subsistence resources, with the exception of migratory birds. Noise and traffic disturbance and construction activities also are expected to have very low effects on all Point Hope harvests.

The bowhead harvest is numerically small (usually 1 bowhead). In a year with extremely severe ice conditions, any effect that disrupted the hunt of even one animal could eliminate the bowhead harvest. Noise from icebreakers or other vessels could produce such an effect, but the likelihood is very low. Industrial and vessel noises could also disturb the belukha hunt, but the belukha response to vessel noise would be short-term avoidance behavior (see Sec. IV.B.7). The longer belukha-harvest period would reduce the overall effect of the high case on Point Hope's belukha harvest to low.

Point Hope residents harvest caribou from the Western Arctic herd. This herd could be affected by noise and traffic disturbance and construction activities associated with the onshore pipeline corridor, but these effects would not occur in the Point Hope caribou hunting area. Consequently, the overall effect of the high case on the Point Hope caribou harvest is expected to be very low.

The overall effects of the high case on Point Hope's seal and walrus harvests are expected to be very low because of the low probability of an oil spill occurring and the low biological effects expected from noise and traffic disturbance.

Very low effects on fish harvests are expected in Point Hope. The risk of an oil spill occurring and contacting the Point Hope Subsistence Area is <0.5 percent (low) and fish are not susceptible to noise and traffic disturbance.

The probability of an oil spill occurring and contacting the Point Hope bird-harvest area (Seabird Concentration Areas I and II) is <0.5 percent, 10-day summer and winter trajectories; and effects from oil spills are expected to be low. Bird harvests are expected to experience very low effects from noise and traffic disturbance and construction activities. The overall effect of the proposal on Point Hope's bird-subsistence harvest would be very low.

Oil spills would have very low effects on seals (the polar bear's main food source) and consequently very low effects on the polar bear. Because Point Hope is distant from anticipated noise and traffic disturbance and construction activities, these activities would be either nonexistent or short-term and temporary, resulting in very low effects on Point Hope's polar bear-subsistence harvest. The overall effect of the high case on the Point Hope polar bear harvest is expected to be very low.

Conclusion: The effect of the high case on Point Hope's subsistence-harvest patterns is expected to be low.

(5) Atqasuk: The residents of Atqasuk, an interior community, harvest marine resources only in conjunction with Barrow's harvests; therefore, any effects on Barrow's marine-resource harvests would also affect Atqasuk's. Low effects are expected on all marine mammal harvests in Barrow, except for moderate effects expected on bowhead and walrus harvests as a result of oil spills and construction activities in the Peard Bay area. The caribou is the only subsistence resource that could be affected by noise and traffic disturbance related to the Sale 126 pipeline corridor. Chronic, low-level effects from traffic along the pipeline-support road could affect the caribou throughout the length of the road; however, the overall

biological effects on caribou would be low and characterized by temporary disturbance of caribou and short-term delays in caribou movements across the pipeline corridor. The pipeline would not cross major calving areas of the Western Arctic herd and would not be a physical barrier to the caribou, since pipelines are designed to allow the passage of caribou. During construction of the pipeline, caribou movements could be temporarily blocked and crossings slowed down; but successful crossings would still occur. While the caribou- subsistence harvest may be affected, caribou would not become locally unavailable at any time, resulting in low effects. Should a large onshore-pipeline oil spill occur in the Meade River, moderate effects on fisheries resources would result. However, since this is unlikely (see Sec. IV.D.11.a(1) on Barrow), very low effects on Atqasuk's subsistence harvest of fish are expected as a result of the high case. All other Atqasuk subsistence harvests are expected to experience low effects from this sale.

Conclusion: The effect of the high case on Atqasuk's subsistence-harvest patterns is expected to be moderate.

(6) Nuiqsut: Nuiqsut's subsistence-harvest area lies outside of the Sale 126 area; however, the onshore pipeline corridor from Point Belcher to the TAP would pass through some of Nuiqsut's caribou-harvest area and over the Colville River. Caribou may be affected by noise and traffic disturbance and construction activities associated with the pipeline; thus, the Nuiqsut caribou harvest could experience low effects from these activities. Oil spills would not affect the caribou harvest because Nuiqsut is too distant from the sale area. High effects are expected on Nuiqsut's fish harvest if a large onshore-pipeline oil spill occurred in the Colville River. However, because such a spill is unlikely (see Sec. IV.D.11.a(1) on Barrow), very low effects on Nuiqsut's fish-subsistence harvest are expected.

Conclusion: The effect of the high case on Nuiqsut's subsistence-harvest patterns is expected to be low.

CONCLUSION: The effect of the high case on subsistence-harvest patterns is expected to be HIGH for Wainwright; MODERATE for Barrow, Atqasuk, and Point Lay; and LOW for Point Hope and Nuiqsut.

12. Effects on Sociocultural Systems: This discussion is concerned with those communities that could be affected by Chukchi Sea Sale 126. Under the high-case scenario, Barrow and Wainwright could host air-support facilities for offshore-petroleum-industry activities (see Sec II.A.2). Wainwright is also close to the projected enclave at Point Belcher, the location for the offshore-pipeline-landfall and shorebase facilities. The primary aspects of the sociocultural system covered in this analysis are social organization and cultural values (see description in Sec. III.C.3). Effects on social organization and cultural values could occur at the community level through industrial activities that increased population and employment and affected subsistence-harvest patterns. Potential effects are evaluated in terms of the magnitude and duration of support or disruptions of existing systems of organization by introduced social forces.

a. Introduction:

(1) Parameters of This Analysis: This analysis of the social organization considers how people are divided into social groups and networks. Social groups are built on kinship and marriage systems as well as on nonbiological alliance groups based on such characteristics as age, sex, ethnicity, and residence. Kinship relations and nonbiological alliances serve to extend and ensure cooperation within the society. Social organization could be affected by an influx of new population that causes growth in the community and/or change in the organization of social groups and networks. Disruption of the subsistence cycle could also change the way these groups are organized. Activities such as the sharing of subsistence foods are profoundly important to the maintenance of family ties, kinship networks, and a sense of community well-being (see Sec. III.C.3). In rural Alaskan-Native communities, task groups associated with subsistence harvests are important in defining social roles and kinship relations. The individuals with whom one cooperates help define kin ties; the distribution of specific tasks reflects and reinforces the roles of husbands, wives, grandparents, children, friends, etc. (see Sec. III.C.3). Disruption of the subsistence cycle could undercut the system of traditional leadership and threaten a community's stability. It might also create

a disruption of family ties, kinship networks, and a community's sense of well-being, which would damage the social bonds that hold the community together. Any serious disruption of sharing networks could appear in a community as a threat to the way of life itself and could set off an array of emotions--fear, anger, frustration, and a sense of loss and helplessness. A perceived threat to subsistence activity--and the psychological importance of subsistence in these sharing networks--is an important source of the anxieties about oil development.

An analysis of cultural values examines conceptions of what is desirable that are shared explicitly or implicitly by members of a social group. Forces powerful enough to change the basic values of an entire society occur when an incoming group imposes fundamental cultural change on a residing group or when a series of fundamental technological inventions change the physical and social conditions. Such changes can occur slowly and imperceptibly or suddenly and dramatically (Lantis, 1959). Cultural values in the sale area include strong ties to Native foods, the environment and its wildlife, the family, the virtues of sharing the proceeds of the hunt, and independence from the outside (see Sec. III.C.3). A chronic disruption of subsistence-harvest patterns could alter these cultural values. For example, if the system of sharing is to operate properly, some households must be able to produce, rather consistently, a surplus of subsistence goods. Since it is more difficult for a household to produce a surplus than to meet its own needs, the supply of subsistence foods in the sharing network may be more sensitive to harvest disruptions than the consumption of these foods by active producers.

(2) Effect Agents: The agents associated with Sale 126 that could affect the sociocultural systems in communities in the sale area include industrial activities, changes in population and employment, and effects on subsistence-harvest patterns.

(a) Industrial Activities: During the exploration phase (see Sec. II.A.2.a), Barrow and Wainwright would be used as air-support bases. Personnel and air freight would be transferred to helicopters at either airport. One helicopter trip per day per platform is assumed for exploration and development (see Table II-A-1). The existing facilities at Barrow and Wainwright are adequate to handle projected needs during exploration. During the development and production phase, air support would gradually shift to the shorebase facility at Point Belcher. The Barrow and Wainwright airports and facilities would continue to provide alternatives in case of emergencies and also would enable the shift from existing to new infrastructure to occur more gradually but in sufficient time to prevent overtaxing the infrastructure in those communities (see Sec. II.A.2.b). Point Belcher, the assumed location of the enclave for shorebase facilities for the offshore-pipeline landfall and the onshore pipeline to the TAP, is approximately 20 to 25 km from Wainwright. During development, a road would be constructed between Wainwright and Point Belcher. Point Lay, Point Hope, Atqasuk, and Nuiqsut may contribute some workers for oil field employment; however, these communities are located geographically too far from the Point Belcher enclave and the related pipeline for their sociocultural systems to be directly affected by industrial activities.

(b) Population and Employment: Sale 126 is projected to affect the population of the North Slope Borough through two types of effects on employment in the region: (1) more petroleum industry-generated jobs as a consequence of Sale 126 exploration, development, and production activities and (2) more NSB-funded jobs as a result of higher NSB operating revenues and expenditures (see Sec. IV.B.10.a). Employment projections as a consequence of Sale 126 are provided in Section IV.B.10.b.

Increased resident-employment opportunities would partially offset expected declines in other job opportunities and thereby delay expected outmigration. The high case is expected to increase the NSB population between 19 and 27 percent during the first decade of the 21st century. As a consequence of increased employment due to this sale, the Native proportion of the population is not expected to change (86%) and Native employment is expected to improve. Barrow is most likely to benefit from sale-related employment increases. Wainwright's proximity to the shorebase at Point Belcher may also encourage more Wainwright and Point Lay residents to apply for sale-related jobs (see Sec. IV.B.10).

Point Lay, Point Hope, Atqasuk, and Nuiqsut are not expected to experience much of an increase in sale-related employment, although there may be some degree of sale-induced employment. By enabling local residents to find employment near their communities in lieu of migrating to look for work, these changes in employment may mitigate--to some degree--the effects (loss of jobs and cash) on the sociocultural systems of these communities that would otherwise be experienced due to the decline of the NSB CIP.

(c) Effects on Subsistence-Harvest Patterns: The importance of subsistence to the Inupiat sociocultural system cannot be overstated. A discussion of subsistence and sociocultural systems is contained in Section IV.C.12.a(1) (see Sec. III.C.3 for a detailed description of sociocultural systems and Sec. IV.C.11 for a discussion of effects on subsistence-harvest patterns). High effects are expected on Wainwright's subsistence-harvest patterns as a result of effects on its bowhead whale harvest. Moderate effects are expected in Barrow, Atqasuk, and Point Lay as a result of effects on walrus, fish, and cetacean harvests; low effects are expected in Nuiqsut and Point Hope.

b. Effects on Barrow, Wainwright, Point Lay, Point Hope, Atqasuk, and Nuiqsut: This section discusses the effect of the high case on the communities whose sociocultural systems may be affected by Sale 126. The relatively homogenous nature of these communities--all predominantly Inupiat--indicates that changes would be similar in the communities. The exception to this may be Barrow, which is larger, has a larger percentage of non-Natives, and has already experienced more change than the other, smaller North Slope communities (see Sec. III.C.3). This section analyzes effects of industrial activities, population and employment, and subsistence-harvest patterns on North Slope social organization, cultural values, and other issues. This discussion focuses on the North Slope as a whole, with a discussion of each community where necessary.

(1) Effects on Social Organization: The social organization of Sale 126 communities includes typical features of Inupiat culture: kinship networks that organize much of a community's subsistence production and consumption, informally derived systems of respect and authority, strong extended families, stratification between families focused on success at subsistence endeavors (see Sec. III.C.3).

From 1970 through 1985, Barrow's Inupiat population declined from 91 to 61 percent (see Sec. III.C.3). Beginning in the early 1980's, there have been an increased number of "strangers" present in Wainwright (i.e., construction workers working on new buildings for the community). The difference between Barrow and Wainwright is that Barrow's non-Native population is permanent (see Sec. III.C.3). This trend would continue in both communities under the high case, which would bring additional non-Native oil technicians and administrative personnel. Assuming that Barrow's social organization would absorb the majority of new non-Native North Slope residents, Wainwright's social organization would not be disrupted by temporary or permanent population growth related to the sale since such growth would not significantly differ from that already occurring as a result of NSB-CIP development. The NSB-CIP programs resulted in the influx of permanent non-Native residents. It is of interest to note that the high case would result in an eventual 20-percent growth in the NSB's Native population and a similar 19-percent growth in the NSB's permanent non-Native population (Sec. IV.B.10). These figures could be considered a "wash" in terms of effects; however, they are not indicative of where the sale-related populations would If past trends held true--and a majority of the non-Native population settled in Barrow and the increased Native population were spatially more diffuse among North Slope communities--the percentage of non-Natives in Barrow's population would increase. This population shift could have an evolutionary effect on the subsistence practices, sharing networks, and cultural perceptions of Barrow's Native population.

The construction of a road between Wainwright and the shorebase at Point Belcher (a distance of 20-25 km) would increase social interaction between Wainwright residents and oil industry workers, as would the employment of local residents in the oil industry. Such interactions can create respect and understanding or play on ingrained prejudices. In general, the presence of the oil workers might be more stressful in a small community such as Wainwright (population 507 in 1985) than in a large community such as Barrow (population 3,075 in 1985) with a larger proportion of non-Natives (39%). However, in both cases, interaction with nonresident industry workers has been long-term. Point Lay, Point Hope, Atqasuk, and Nuiqsut are not expected to experience any influx of permanent non-Native residents since they are not located close to sale-related industrial activities and thus would experience insignificant, indirect population and employment growth.

Cultural Values: Subsistence is important to Inupiat social organization through sharing, task groups, crew structure, and strengthening social bonds. Effects on Wainwright's and Nuiqsut's subsistence-harvest patterns are expected to be high; effects on Barrow's are expected to be moderate; and effects on Point Hope's and Point Lay's are expected to be very low (see Sec. IV.B.10). Since subsistence is a naturally cyclical activity and resource availability varies substantially from year to year, numerous species are hunted in order to compensate. For this reason, multiyear disruptions to even one resource, particularly the bowhead whale, could in the long run disrupt sharing networks and subsistence-task groups. For example, if whaling crews consistently failed in their hunting efforts, crews could lose status; their activities might eventually be viewed as trivial or impotent; sharing networks could be disrupted; and the community's sense of well-being could be damaged. It is unlikely that in a system adapted to large shifts in resource availability a disruption of 2 or 3 years would lead to changes in task-group structures or sharing networks. On the other hand, since this system is so culturally important, such disruptions would cause high levels of tension and anxiety within the communities directly affected and among those communities with which they share (see Sec. IV.B.11.b(3)). In the case of manmade disruptions, when the source is "identifiable" and considered "at fault," community reactions would be mixed with anger and finger-pointing.

Oil-spill estimates are based on 10-day winter trajectories. The Wainwright Subsistence Area has a 59-percent probability of being contacted by any single oil spill should one occur (Appendix C: Table C-16). Point Lay has a 17-percent chance of contact should an oil spill occur, while the OSRA analysis indicates that the Point Hope and Barrow Subsistence Areas have a $\leq$ 0.5-percent probability of spill occurrence and contact (see Appendix C: Table C-16). However, Peard Bay, an important subsistence area for both Wainwright and Barrow, has a 35-percent probability of being contacted by a spill should one occur. If either Wainwright's or Point Lay's subsistence-harvest zones were affected by an oil spill, it would not be a multiyear event. One or more species may be unavailable or undesirable to harvest in a single year; however, no species should be unavailable or undesirable for harvest in consecutive years.

An oil-spill event, in itself, could also diminish community well-being by being the causal agent in increased antisocial behavior; i.e., alcoholism, increased drug use, and increased levels of community/family violence. As has been seen in isolated/rural communities affected by a major oil spill, an immediate reaction to such an event has been shock followed by a sense of mourning and loss. This series of reactions was particularly evident in the community of Cordova following the Prince William Sound tanker-spill incident. The perceived loss of a way of life, even if temporary, would cut across the cultural and political fabric of any community and cause the relationships that bind the community network together to be stressed and/or changed. Moderate effects on social organization are expected in Wainwright. Effects due to disruptions in Barrow, Point Lay, Point Hope, Atqasuk, and Nuiqsut are expected to be low.

(2) Other Issues: Increases in social problems--rising rates of alcoholism, drug and alcohol abuse, domestic violence, wife and child abuse, rape, homicide, and suicide (as described in Sec. III.C.3.d)--are also issues of concern to this analysis of sociocultural systems.

Effects on sociocultural systems are often evidenced in rising rates of mental illness, substance abuse, and violence. This has proven true for Alaskan Natives who have been faced since the 1950's with increasing acculturative pressures. The rates of these occurrences far exceed those of other American populations such as Alaskan non-Natives, American Natives, and other American minority groups (Kraus and Buffler, 1979). While such behaviors are individual acts, the rates at which they occur vary among different groups and through time. These changing rates are recognized as the results of a complex interaction of interpersonal, social, and cultural factors (Kraus and Buffler, 1979; see also Kiev, 1964; Murphy, 1965; and Inkeles, 1973).

As a community grows, the rates of all types of mental illness appear to increase because rates of mental illness are higher ". . .in larger rural Native towns than in the more traditional Native villages" (Foulks and Katz, 1973; Kraus and Buffler, 1979). Native communities help buffer the individual by providing a sense of continuity and control (for further discussion, see Sale 97 FEIS [USDOI, MMS, 1987a]).

Several salient points should be made. First, change itself--even though induced primarily by forces outside the communities--does not necessarily cause the levels of psychic stress that lead to pathology (for a general discussion, see Inkeles, 1973). Second, and related to the first point, not all sociocultural change (directly or indirectly related to oil development) may be negative. Higher levels of employment, better health programs, and improved public services must be viewed as possible positive sociocultural effects from oil development on the North Slope. Employment of the underemployed resident Inupiat in oil industry operations could assist in filling the economic vacuum created by decreasing North Slope revenues, although major dependence on a nonrenewable-resource-based economy could cause long-term social costs at the time of resource depletion. Third, rapid and wide-ranging sociocultural effects are significant, not only because a way of life is altered but also because these alterations can come with high social costs. These costs include growing alienation; increasing rates of mental illness, suicide, homicide, and accidental death; growing disruption of family and social life; and substance abuse. Fourth, the conditions that make sociocultural change stressful must be viewed as ongoing. If the stressful conditions altered, the society can make successful adjustments to the changes that have occurred; and the rates of violence, suicide, and substance abuse will drop.

Under the high case, the non-Native-population component of the North Slope would range from 10 to 19 percent (96 to 137 persons) over the no-sale case during the production period. These residents probably would be located primarily in either Wainwright or Barrow. Considering that both communities demonstrated abilities to adjust to much larger numbers of nonresident workers under the NSB CIP, these workers should not create significant new stresses in these communities. Under the high case, approximately 164 resident jobs would be created on the North Slope. The majority of those filling these positions would be Native Alaskans located in either Wainwright or Barrow. This employment may help mitigate some of the social effects of the decline of the NSB CIP. On the other hand, it is not a large enough figure to substantially change the area's economic outlook and, hence, should not have a large social effect--either positive or negative. The road between Wainwright and the shorebase at Point Belcher may create a unique situation for Wainwright because of the increased presence of oil workers in the community. For example, this situation may increase the area's access to alcohol and drugs, which could be disruptive to social well-being in the community. While the oil industry forbids consumption of alcohol and drugs when the workers are in camp, consumption does occur and could become a source of conflict and stress for Wainwright. A similar situation occurred in Wainwright in the 1960's during the construction of the DEW-Line facility until the community elders--in concert with the DEW-Line operators--moved to restrict access. If similar problems occurred due to the hypothesized access road, Wainwright might act constructively again.

Summary: Effects on the sociocultural systems of communities in the Sale 126 area under the high case would occur as a result of industrial activities, changes in population and employment, and effects on subsistence-harvest patterns. These effect agents would affect the social organization, cultural values, and social health of the communities in the Sale 126 area. Barrow and Wainwright are the communities most likely to be affected by Sale 126 due to their proximity to the shorebase at Point Belcher and their use as air-support bases. Sale-related increases in population and employment predicted for the Sale 126 area are expected to occur primarily in Barrow and Wainwright. Because of Barrow's larger size and Wainwright's community stability and past successful encounters with large numbers of nonresident workers, sociocultural effects on Wainwright and Barrow are expected to be moderate. For all other North Slope communities, very low sociocultural effects are expected.

CONCLUSION: The effect of the high case on sociocultural systems is expected to be MODERATE.

13. Effects on Archaeological Resources: Effects of the high case on archaeological resources would be produced by activities resulting from the exploration for and discovery of 3,540 MMbbl of oil. The

oil would be produced from 472 production and service wells on 12 production platforms. Exploration would involve the drilling of 53 exploratory and delineation wells. The effects on archaeological resources would be produced by exploration, onshore-facility construction, construction of pipelines to shore from the production platforms, employees in sale-related occupations who visit archaeological sites, and other sale-related activities.

No comprehensive baseline study exists for the area for prehistoric or historic resources. The areas that would have a potential for containing prehistoric archaeological resources would be those shoreward of the 40-m bathymetric contour, which would have been exposed as dry land at 12,000 B.P. Areas that have been documented as having been severely affected by ice gouging or other geological processes would be considered as not having prehistoric archaeological potential. Prehistoric archaeological resources could occur on blocks located in water depths of 40-m or less and where ice gouging either is not severe or does not extend down below the Holocene sediments (see Appendix G, MMS Prehistoric Resource Analysis). Overall, the effects of the high case on offshore prehistoric resources are expected to be moderate. .

Historic shipwreck resources may still be preserved in the Chukchi Sea, particularly in the deeper waters offshore of Point Belcher, where about 40 ships went down in the 1800's (see Appendix G, Shipwreck Update Analysis). Destruction of these shipwreck remains would mean the loss of some scientific data. Adverse effects on such shipwrecks could occur if oil-spill cleanup took place on or near beaches where these wrecks are located.

Pipelines from offshore platforms would converge offshore and come onshore at Point Belcher. From there, oil in the pipeline would go onshore about 640 km overland to TAP Pump Station No. 2. Trenching could affect archaeological sites in the pipeline corridor. The most likely number of spills in the high case is four, with an associated probability of 99 percent that one or more spills would occur.

CONCLUSION: The effect of the high case on archaeological resources is expected to be MODERATE.

14. Effects of Land Use Plans and Coastal Management Programs: Doubling the offshore activity and projected number of oil spills in the high case accentuates the effects on coastal resources and uses identified in the base case but rarely increases the levels of effects for coastal resources and uses from those of the base case. Onshore development remains comparable--the pipeline/road corridor would remain 640 km long and the shorebase would cover the same acreage.

The potential for significant conflicts between effects on resources and uses and the NSB LMR's and the statewide standards and NSB district policies of the Alaska Coastal Management Program (ACMP) were identified in the base case (see Sec. IV.C.14). Because effects are comparable for the high case, the potential conflicts would remain the same. The most serious areas of potential conflict are summarized below.

The location of a shorebase and landfall at Point Belcher, which could be highly incompatible with existing use of the area as a base for bowhead whale hunting, creates the greatest potential for conflict with the NSB LMR's and the statewide standards and district policies of the ACMP. Because of the importance of subsistence and cultural resources to the NSB, they are explicitly protected by specific LMR's and CMP policies (see Sec. IV.C.14: 6 AAC 80.120 and 80.150; NSBCMP 2.4.3[a] through [g], 2.4.5.1[a] and [b], and 2.4.5.2[h]; and NSBMC 19.70.050.A through G, 19.70.050.J.1 and 2, and 19.70.050.K.8).

Potential conflicts also are evident with the statewide standard for energy facilities (6 AAC 80.070) if dredging activity occurs in Peard Bay and leads to long-term changes in biological distributions, for lagoon and river habitats (6 AAC 80.130[c][5] and [7]) in the event of an oil spill, and for water and water quality (6 AAC 80.140) if formation waters are discharged into the Chukchi Sea or if NO_x standards are exceeded.

As noted in the base case, current and emerging technologies are considered adequate to meet the requirements for safe siting, design, and construction of pipelines. Therefore, no conflict is anticipated with 6

AAC 80.050 and NSBCMP policies 2.4.4[b] and [h], 2.4.5.1[k], and 2.4.6[f] (NSBMC 19.70.050.I.2 and 8, 19.70.050.J.11, and 19.70.050.L.6) that address these transportation and production issues.

CONCLUSION: For the high case, the potential for conflict with land use plans and coastal management programs is expected to be HIGH.

15. Effects on Wetlands: Under the high case, the same amount of wetland is expected to be lost or affected as under the base case because the same amount of onshore development is expected to occur with construction of the 640-km-long pipeline-road corridor from Point Belcher to TAP Pump Station No. 2. Wetlands would be covered (<1% of any wetland type available on the coastal plain) by gravel fill on the road location and along the pipeline corridor; and wetlands would be affected by thermokarst, oil spills, and road dust within 100 m along the pipeline/road, as described under the base case (see Sec. IV.C.15).

CONCLUSION: The effect of the high case on wetlands from oil spills, road dust, thermokarst, and gravel-fill extraction is expected to be localized along the pipeline-road corridor, with less than 1 percent of the coastal tundra wetlands of the North Slope being severely damaged. Some effects on plant and invertebrate communities, topography, and visual aesthetics are expected to persist for many years due to dust and traffic.

E. Alternative II - No Lease Sale

Cancellation of the proposed sale would result in effects on biological resources and social and economic systems--as described for the range of resources assumed for the low, base, and high cases of the proposal--not occurring. Even without Sale 126, however, the environment would still change; there would be effects to the environment from other natural and manmade factors.

Cancellation of the proposed sale, in part or in whole, would reduce future OCS oil and gas production in the short term, necessitate an escalation of imports of oil and gas, and/or require the development of alternate energy sources to replace the energy resources expected to be recovered if the proposed sale took place. It is anticipated that the hydrocarbons that would become available from the proposed action in the assumed time period could provide a significant contribution to this region's energy supply. If the proposed action were canceled, the following energy sources might be used as substitutes:

- energy conservation
- conventional oil and gas supplies
- coal
- nuclear power--fission
- nuclear power--fusion
- oil shale
- tar sands
- hydroelectric power
- solar energy
- energy imports
- oil imports
- natural gas imports
- liquefied natural gas imports
- geothermal energy
- other energy sources
- combination of alternative sources

Some of these sources are not feasible to produce at this time and may not be feasible during the estimated life of the proposed action. As illustration, Table II-C-1 shows the amount of energy needed from other sources to replace the anticipated oil production from the base case. The description of energy alternatives from Appendix C, Alternative Energy Sources, of Volume 3 of the Proposed 5-Year OCS Oil and Gas Leasing Program FEIS, 1987-1992 (USDOl, MMS, 1987c) is hereby incorporated by reference. Appendix I of this EIS summarizes this information.

F. Alternative III - Delay the Sale

Under this alternative, the proposed sale (Alternative I) would be delayed for a period of up to 3 years. This could delay the sale beyond the end of the present 5-Year Oil and Gas Leasing Program, which ends in June 1992. Effects associated with this alternative would be essentially the same, qualitatively, as those discussed for Alternative I (Secs. IV.B through IV.D). However, the magnitude of the effects could vary depending on the population status of the potentially affected species at the end of the delay or on initiation of activities. Delaying the sale could alter the sequence of development with respect to activities occurring in the region. However, some adverse effects could possibly be lessened because of improved oil-spill-cleanup technology. A delay would allow time for local communities to develop oil-spill-response and cleanup-contingency plans and gain the means to carry them out. These plans would include expanded emergency-medical-service facilities, airport and other transportation facilities, village public-safety-officer facilities and forces, and the ability to handle an influx of cleanup workers and supporting facilities and services. Additional research pertinent to the Chukchi Sea area could also be carried out during this period of delay. Table II-D-1 shows studies pertinent to the Chukchi Sea area that may be conducted my MMS during a 3-year delay of sale.

G. Alternative IV - Point Lay Deferral Alternative

A total area of about 8.43 million hectares (3,818 blocks) would be offered for leasing under the Point Lay Deferral Alternative (see Fig. I-3); this is 501 blocks (about 1.15 million hectares) smaller in size than the area of Alternative I. This alternative would defer leasing on 501 blocks located from about 25 to 75 miles (40 to 120 km) offshore of Point Lay.

A total of 1,610 MMbbl of oil are estimated to be discovered, developed, and produced in this alternative, representing a resource level equal in amount to the base case (see Appendix A). As shown in Table II-A-1, the types and levels of activity assumed for the deferral alternative are also assumed to be the same as for the base case, including using a pipeline connection to the TAP to transport oil to market. Natural gas resources are not assumed to be present in economically recoverable amounts and consequently would not be commercially produced (see Appendices A and B). The primary difference from the base case lies in the location of the blocks to be offered by the deferral alternative.

As in the base case, the types and levels of activities associated with the deferral alternative would include (1) drilling 39 exploration and delineation wells (1992-1998), (2) installing 6 production platforms (2000-2002) and drilling 214 production and service wells (2000-2004), (3) installing 325 km (200 mi) of offshore pipeline and 640 km (400 mi) of onshore pipeline (1999-2001), and (4) producing 1,610 MMbbl of oil (2002-2020). A more detailed discussion of the types and levels of activities associated with the base case is presented in Section II.B.3.a. The following assessment analyzes the effect of the Point Lay Deferral Alternative on physical, biological, socioeconomic, and sociocultural resources.

Deferred-Area Assumptions and Scenario: The area to be deferred (not to be offered for leasing at this time) would experience a reduction or elimination of effects from petroleum exploration and development and production activities that might occur as a result of the lease sale. To indicate the types of effects that would be avoided in the area to be deferred, the effects of petroleum exploitation in the area to be deferred on each of the major environmental resources, social systems, or programs analyzed for the deferral alternative also are analyzed for the area to be deferred and are presented at the end of the respective deferral-alternative analysis. These analyses are based on the assumption that economically recoverable oil is leased, discovered, and developed and produced in the area to be deferred. The hypothetical scenario for these assumptions includes (1) discovering a field that contains an economically recoverable amount of oil; (2) drilling at least 1 exploration well and 2 or 3 delineation wells; (3) installing a production platform and drilling the production and service wells; (4) laying a pipeline to transport the oil from the platform to a landfall at or in the vicinity of Point Belcher and then on to the TAP; and (5) once during the production life of the field, spilling a quantity of oil that is >1,000 bbl.

1. Effects on Air Quality: A full discussion of air quality regulations and procedures can be found in Section IV.B.1.a. The exploration, development, and production scenario for the Point Lay Deferral Alternative is the same as for the base case. Due to the configuration of the deferral area and existing leases, the land nearest the sale area would be 40 km (25 mi) off Point Lay. The year of peak emissions from exploration would be from drilling 6 exploration and 4 delineation wells drilled from 5 rigs. Peak emissions from development and production would include concurrent drilling of 40 production wells and 135 MMbbl of oil produced from 6 platforms and transported by pipeline. Table IV-G-1 lists estimated uncontrolled-pollutant emissions for the peak-exploration and peak-development and -production years. Under the Federal and State of Alaska PSD regulations, since the estimated annual uncontrolled NO_x emissions for peak exploration, peak development, and peak production would exceed 250 tons per year, the lessee would be required to control NO_x emissions through application of BACT to emissions sources to reduce NO_x emissions (Table IV-B-3). In addition, the lessee would have to employ BACT to emission sources because these emissions would exceed the de minimis levels. An air quality analysis performed using the OCD Model for air pollutants emitted for exploration in the base case due to Sale 126 showed that maximum NO_x concentration, averaged over a year, would be 0.44 and 0.20 μ/m^3 for peak exploration and production, respectively, at the shoreline: 1.8 and 0.8 percentiles of the available Class II increment for NO_x

Table IV-G-1
Estimated Uncontrolled Emissions for the Chukchi Sea Sale 126
Point Lay Deferral Alternative
(metric tons per year)

	Pollutant[1/]				
	CO	NO_x	TSP	SO_2	VOC
Point Lay Deferral[2/]					
Peak Exploration Year	4,301	8,704	933	316	299
Peak Production Year	3,037	4,085	234	31	765

Source: USDOI, MMS, Alaska OCS Region, 1990. Computed from factors in Form and Substance, Inc., and Jacobs Engineering Group, Inc., 1983.

[1/] CO = Carbon Monoxide
NOx = Nitrogen Oxides (assumed predominately NO_2)
TSP = Total Suspended Particulates (includes most particulate matter less than 10 μm in aerodynamic diameter)
SO_2 = Sulfur Dioxide
VOC = Volatile Organic Compounds (excluding nonreactive compounds such as methane and ethane)

[2/] Assumes 5 wells drilled in peak year.

(Table IV-G-2).

a. Exploration: The OCD model indicates a concentration of 0.44 $\mu g/m^3$; therefore, the significance increment for NO_x would not be exceeded (Table IV-G-2). The modeled NO_x concentration would be 1.8 percent of the PSD increment of 25 $\mu g/m^3$ (annual) and 0.4 percent of the national air quality standard of 100 $\mu g/m^3$ (annual). The OCD model indicates a TSP concentration of 0.00 (annual) and 0.08 (24-hour) $\mu g/m^3$; therefore, the significance increment for TSP would not be exceeded (Table IV-G-2). The modeled TSP concentration would be 0.00 percent of the 19 $\mu g/m^3$ (annual) and 0.2 percent of the 37 $\mu g/m^3$ (24-hour) PSD increment and 0.00 percent of the 60 $\mu g/m^3$ (annual) and 0.05 percent of the 150 $\mu g/m^3$ (24-hour) of the national air quality standard. Concentrations of criteria pollutants at the shoreline due to exploration are expected to be <5 percent of available national standards or PSD increments.

b. Development and Production: The highest NO_x value calculated by the OCD model indicates a concentration over land of 0.20 $\mu g/m^3$ (annual); therefore, the significance increment for NO_x would not be exceeded (Table IV-G-2). The modeled NO_x concentration would be 0.8 percent of the PSD increment of 25 $\mu g/m^3$ (annual) and 0.2 percent of the national air quality standard of 100 $\mu g/m^3$ (annual). Concentrations of criteria pollutants at the shoreline due to development and production are expected to be <5 percent of available national standards or PSD increments.

Other Effects on Air Quality: For a more detailed discussion of the potential effects of air pollution--other than those effects addressed by standards, see Sections IV.B.1.b and IV.C.1.c. The amount of air pollutants reaching the shore is expected to be very low spatially and temporally because of the small amount of emissions from exploration activities and their distance from shore. In addition, the probability of experiencing one or more blowouts in drilling the 214 wells projected for the Point Lay Deferral Alternative (same as for the base case) would be 51 to 60 percent (USDOI, MMS, 1990b). Principally because of the distance of emissions from land, the other effects of air-pollutant concentrations at the shore due to exploration and production or accidental emissions would not be sufficient to harm tundra vegetation on a more than short-term basis, even locally. A light, short-term coating of soot over a localized area could result from oil fires. Consequently, the effects of air-pollutant emissions under the Point Lay Deferral Alternative--other than with respect to standards--are expected to be very low.

CONCLUSION: The effect of the Point Lay Deferral Alternative on air quality is expected to be VERY LOW.

Deferred-Area Analysis: If blocks of the deferral area were leased and exploration, development, and production activities occurred in the area, the effects would be the same as described for the base case (Sec. IV.C.1). The base case assumes exploration and development and production 18.5 km off Point Lay. Very low effects from air pollution are expected under the base case.

2. Effects on Water Quality: Water quality degradation could occur from exploration discharges and construction activities associated with oil exploration activities as a result of the Point Lay Deferral Alternative.

a. Discharges: Exploration and development drilling would be expected to discharge bulk quantities of drilling muds and cuttings and formation waters. Other discharges (see Sec. IV.B.2) are not expected to be significant pollutant sources (USEPA, 1989). Discharges from platforms would be regulated through a general NPDES permit from the EPA (see Sec. IV.B.2).

Drilling Muds and Cuttings: The quantity of muds and cuttings discharged into the environment is dependent on the number of wells drilled and the depth of each well. During exploration, 35 exploration/delineation wells averaging 10,400 feet in depth would be drilled. During the exploration/delineation period (1992-1998), about 23,100 short tons of dry muds and 29,750 short tons of cuttings would be discharged. During the development period (2000-2004), from 22,660 to 144,200 dry short

Table IV-G-2
Comparison of Model Air-Pollutant Concentrations with Regulatory Limitations
(measured in micrograms per cubic meter)

Averaging Time	PSD Class II Increment[1/]	USDOI Significance Increment[2/]	Maximum Modeled Concentration Over Land[3/]	Air Quality Standard
Point Lay Deferral Alternative				
Exploration				
NO_x				
annual	25	1	0.44	100[4/]
24-hour				
8-hour				
3-hour				
1-hour				
Point Lay Deferral Alternative				
Development and Production				
NO_x				
annual	25	1	0.20	100[4/]
24-hour				
8-hour				
3-hour				
1-hour				

Source: USDOI, MMS, Alaska OCS Region, 1990.

1/ Increment above ambient concentration allowed in a designated PSD area. Ambient baseline concentration for PSD not established for this area.
2/ Increases in concentration above significance level require reduction of emissions by application of Best Available Control Technology.
3/ Projected concentrations attributable to the proposal as modeled by the Offshore and Coastal Dispersion Model.
4/ Annual arithmetic mean.

tons of muds and 190,550 short tons of cuttings would be discharged. During drilling, cuttings are removed from the hole, separated from the drilling muds, and discharged. Muds are discharged in bulk when the mud type is changed, during cementing operations, or at the end of drilling. Additional information on the behavior of discharged drilling muds can be found in Section IV.B.2.a.

Federal water quality regulations (Clean Water Act, Section 4O3(c)) allow a 100-m-radius mixing zone for initial dilution of effluent. At the edge of the mixing zone, water quality criteria must be met. Acute criteria are applicable to instantaneous releases or short-term discharges of pollutants such as drilling mud discharges (see Sec. IV.B.2.a). Table IV-B-3 compares the acute, total-recoverable-marine-water quality criteria with predicted total-, particulate-, and dissolved-trace-metal concentrations at the edge of the 100-m-radius mixing zone (see Sec. IV.B.2.a and Appendix J). Direct estimates or measurements of total-recoverable concentrations of metals in discharged drilling muds are not available (Appendix J). The dissolved concentrations of all trace metals considered by the EPA to be the best estimator of the total-recoverable concentration are below the acute marine-water quality criteria, at 100 m from the discharge point. Long-term leaching of metals from deposited muds would be slight and no water quality criteria are expected to be violated (USEPA, 1989).

During exploration activities, five rigs would be present at any one time. Only 0.03 km^2 would be affected by increased turbidity (or other regulated pollutants) per drilling rig (100-m radius around the discharge point); thus, a maximum of 0.15 km^2 of the sale area would have impaired water quality during the drilling period. This impairment would exist only during periods of actual discharge and would rapidly dissipate on completion. During production, six platforms would be in operation. Assuming that maximum discharge rates are limited by the EPA to the same extent during production as during exploration, instantaneous discharges would be on the same order of magnitude in production as in exploration. About 0.18 km^2 of the sale area could have impaired water quality during the production-well-drilling period (2000-2004). The effect on local and regional water quality is expected to be be very low.

Formation Waters: Formation waters are produced from wells along with the oil. Over the life of the field, the volume of formation waters produced is equal to 20 to 150 percent of the oil-output volume (Collins et al., 1983). On this basis, the production of formation waters over the life of the field can be estimated at 310 to 2,325 MMbbl. Discharge of formation waters would require an EPA permit and would be regulated so that water quality criteria, outside an established mixing zone, would not be exceeded. For additional information on formation waters, see Section IV.C.2.a.

If formation waters were reinjected or injected into different formations, no discharges of formation waters would occur and no effect would occur. If formation waters were discharged, the effect on water quality would be local and would continue for the life of the field. The effect on local water quality is expected to be moderate, while the effect on regional water quality is expected to be very low.

b. Construction Activities: The amount of bottom disturbance and sediment resuspension associated with drilling 35 exploration/delineation wells would be minimal and restricted to the area immediately adjacent to the activity. Sediment levels would likely be reduced to background levels within several hundred meters downcurrent. This disturbance would occur over a 7-year period (1992-1998)--only during exploration drilling. The effect on local and regional water quality is expected to be very low.

About 325 km of offshore pipelines connecting the six production platforms to an onshore pipeline to TAP Pump Station No. 2 could be emplaced between 2000 and 2002. This level of activity would be the same as identified for the base case. See Section IV.C.2.b for additional information on the effects of dredging on water quality.

Prior to any discharge, site-specific discharges of dredge or fill material into U.S. waters will be evaluated in follow-up environmental documents as required. Effects on water quality from dredging (and dumping) would be local and short-term. Effects on local water quality are expected to be low, while regional effects are expected to be very low.

c. Oil Spills: In addition to permitted discharges, accidental oil spills are likely to occur. Based on experiences in other OCS areas, two spills of ≥ 1,000 bbl would be estimated to occur in arctic waters as a result of this alternative. For analysis purposes, it is estimated that two spills of 22,000 bbl each would occur. This is the average size of platform and pipeline spills (see Sec. IV.A.1.b(2)). In addition to the large spills, more chronic spillage of smaller volumes also would be estimated. About 370 small spills totaling 5,100 bbl are estimated to occur over the life of the field. Information on the effects of oil spills on water quality is contained in Section IV.C.2.c.

The two estimated oil spills of ≥ 1,000 bbl could occur in either the summer or winter seasons. Hydrocarbon concentrations following a summer open-water spill of 22,000 bbl in the Chukchi Sea would be expected to decline rapidly in the first 30 days following the spill. The average hydrocarbon concentration after 3 days in the top 10 m of the water column below the discontinuous slick would be 0.16 ppm. The discontinuous slick would cover 57 km^2 after 3 days. The average concentration in the top 10 m of the discontinuous slick would be expected to be 0.09 ppm after 10 days and 0.04 ppm after 30 days following the spill (Appendix L: Table L-2). The mean area of the discontinuous slick would reach 260 km^2 after 10 days and 1,100 km^2 after 30 days (Appendix L: Table L-1).

A spill occurring in the winter season would be frozen in the ice and would move with the ice for the remainder of the winter. Spills in first-year ice would melt out in late spring or early summer. Spills in multiyear ice would melt out later in the summer or in subsequent summers. Spills released from the ice would be relatively unweathered and would have the characteristics of fresh oil. Before the oil was released from the ice, contaminated ice could drift for hundreds of kilometers. A 22,000-bbl-meltout spill in the Chukchi Sea (see Sec. IV.A) would have the following hydrocarbon concentrations: 0.03 ppm after 3 days, 0.05 ppm after 10 days, and 0.04 ppm after 30 days (Appendix L: Table L-2). The discontinuous-slick size would cover from 1,400 km^2 after 3 days to 2,200 km^2 after 30 days (Appendix L: Table L-1).

Sustained degradation of water quality to levels above State and Federal criteria from hydrocarbon contamination is unlikely. Hydrocarbon concentrations from the two oil spills of ≥ 1,000 bbl could exceed the chronic criterion of 0.015 ppm total hydrocarbons on at least several thousand square kilometers for a short period of time. Concentrations above the acute criterion (1.5 ppm) are not anticipated. The persistence of individual oil slicks would be short-term (less than 1 yr), but the slick--intact and unweathered in the pack ice--could drift for hundreds of kilometers. The 370 small spills under 1,000 bbl estimated to occur over the life of the field would result in local chronic contamination. Effects of an oil spill on water quality are expected to be moderate locally and low regionally.

Summary: Under the Point Lay Deferral Alternative, water quality in the Chukchi Sea would be affected by platform discharges (muds and cuttings and formation waters), construction activities (drilling, and platform and pipeline placement), and oil spills.

Discharges of muds and cuttings are regulated by the EPA such that water quality criteria must be met at the edge of an EPA-established mixing zone. The effect of exploration and production drilling muds and cuttings discharges would persist only during actual discharge within the 100-m-radius mixing zone around each discharge point. Concentrations of trace metals would not exceed the acute marine-water quality criteria at the edge of the mixing zone. The effect on local and regional water quality is expected to be very low.

If formation waters were discharged into the water column rather than reinjected, the effect on water quality would be local and would continue for the life of the field. The effect on local water quality is expected to be moderate, while the effect on regional water quality is expected to be very low.

Effects on water quality from dredging (and dumping) would be local and short-term. Turbidity would increase over a few square kilometers in the immediate vicinity of dredging operations only during actual dredging. Effects on local water quality would be low, while the effect on regional water quality would be very low.

Sustained degradation of water quality to levels above State and Federal criteria from hydrocarbon contamination is unlikely. Hydrocarbon concentrations from the two estimated oil spills of $\geq$ 1,000 bbl could exceed the chronic criterion of 0.015 ppm total hydrocarbons on at least several thousand square kilometers for a short period of time. Concentrations above the acute criterion are not anticipated. Effects of an oil spill on water quality are expected to be low both locally and regionally.

CONCLUSION: The effect of the Point Lay Deferral Alternative on water quality is expected to be MODERATE locally and LOW regionally.

Deferred-Area Analysis: If the deferred area were leased and exploration, development, and production activities occurred in this area, muds and cuttings, sanitary and domestic wastes, and formation waters would be discharged in these waters. As a result, water quality within 100 m of the discharge point would be degraded. Bottom disturbances and sediment resuspension associated with platform siting also would occur in the deferred area. The possibility also exists that an oil spill could originate from a platform in this area and degrade water quality.

3. Effects on Lower-Trophic-Level Organisms: Lower-trophic-level organisms, as discussed in Section III.B.1, could be affected by oil spills, drilling discharges, seismc surveys, and construction associated with the exploratory phase of the area to be offered for lease. Of these, oil spills are the principal potential hazard to lower-trophic-level organisms. Of less effect are the other listed project activities.

a. Oil Spills: Exploration drilling might result in oil spills, either from a blowout during drilling or from fuel losses. The effect of oil spills on lower-trophic-level organisms are discussed in some detail in Section IV.C.3. However, no oil spills are estimated to occur over the 7 years of the exploration phase. A maximum of 5 drilling rigs annually would be employed to drill 39 exploration and delineation wells during this period.

b. Drilling Discharges: During exploration, about 59,000 short tons of drilling muds and cuttings would be discharged during the drilling of 39 wells at 22 different sites. As analyzed in Sections IV.B.C and D, the effects of these discharges are limited in area and short-term. Drilling discharges on lower-trophic-level organisms would be limited to the immediate area from the 22 discharge sites, with only those lower-trophic-level organisms within a few tens of meters from these points affected. These affected organisms do not represent any significant segment of the total regional populations. In some instances, the increased and/or altered substrate may provide habitat or protection for organisms of this group. The quantities discharged during exploration and delineation drilling are only a small increment to the total sediment load of the Chukchi Sea Planning Area with its considerable natural turbidity.

c. Seismic Surveys: Seismic surveys would be required for purposes of well siting. Airguns or related acoustic-energy sources are most commonly employed for these surveys at this time. The acoustic energy generated by airguns is essentially of no effect to lower-trophic-level organisms--any injurious effect limited to no more than 1 or 2 m from the discharge port of each airgun (Sec. IV.C.3).

d. Offshore Construction: Lower-trophic-level organisms would be somewhat affected by offshore construction, including drilling rig placement. During platform placement and drilling operations, there would be some displacement of the population from their habitat. These effects would occur over the very limited period of time. It is possible that the drill rigs might provide refuge for some organisms while alteration of benthic substrate also might enhance habitat for other species.

The effects of exploration, drilling discharges, seismic surveys, and presence of drilling rigs in the area to be offered for lease are so limited in area and short-term that lower-trophic-level organisms are not apt to be affected in any significant number--and some of the benthic species may even benefit as changes in substrate enhance their habitat.

CONCLUSION: The effect of the Point Lay Deferral Alternative on lower-trophic-level organisms is expected to be VERY LOW.

Deferred-Area Analysis: If the deferred area were leased, a minimum level of development and production is assumed. Only one production platform would be installed and an oil spill of ≥ 1,000 bbl could occur. Given this low estimated number of oil spills, the limited distribution and toxic period of the oil in the marine environment, their effect on lower-trophic-level organism would be very low. In comparison, the regional populations of lower-trophic-level organisms are generally widely distributed over large areas of the Chukchi Sea. Then, only small, localized members of these species could be contacted and adversely affected by oil spills. The limited areal extent and time period of drilling discharges, offshore construction, and seismic surveys lead to the same conclusion.

4. Effects on Fishes: Marine fish, as discussed in Section III.B.2, could be affected by oil spills, drilling discharges, and construction associated with the exploratory phase of the area to be offered for lease. Of these, oil spills are the principal potential hazard to benthic and pelagic marine and anadromous fishes. Of less effect are the other listed project activities.

a. Oil Spills: Exploration drilling might result in oil spills, either from blowout during drilling or from fuel losses; however, no oil spills are estimated to occur over the 7 years of the exploration phase. A maximum of 5 drilling rigs annually would be employed to drill 39 exploration and delineation wells during this period. The effects of oil spills on marine fishes are analyzed in Section IV.C.4.

b. Drilling Discharges: During exploration, about 59,000 short tons of drilling muds and cuttings would be discharged during the drilling of 39 wells at 22 different sites. As analyzed in Sections IV.B.C and D, the effects of these discharges are limited in area and short-term; and in some instances the increased and/or altered substrate may provide increased food supply for the benthic fish as the organisms on which they feed proliferate on this changed substrate. The quantities discharged during exploration and delineation drilling are only a small increment to the total sediment load of the Chukchi Sea Planning Area with its considerable natural turbidity.

c. Seismic Surveys: Seismic surveys would be required for well siting. Airguns or related acoustic-energy sources are most commonly employed for these surveys at this time. The acoustic energy generated by airguns is essentially of no effect to pelagic and benthic marine fishes--limited to temporary disturbance and possible displacement for adults during the brief passage of the survey through their habitat. Pelagic eggs and larvae of benthic and pelagic fishes may be damaged by the acoustic discharge; however, only those within a meter or two of the airgun discharge would be affected (Sec. IV.C.4).

d. Offshore Construction: Pelagic and benthic marine fishes (including anadromous species) would be slightly affected by the placement of exploration drilling rigs. During rig placement and drilling operations, there would be some displacement of eggs, larvae, and adult fish. These would, however, be only small segments of the large regional populations; and the effect would be short-term. It is possible, based on offshore operations elsewhere, that the drill rigs might provide refuge for some fish species.

The effects of exploration, drilling discharges, seismic surveys, and presence of drilling rigs in the area to be offered for lease are so limited in area and short term that fish are not apt to be affected in any significant number; and some of the benthic marine fishes may even benefit as changes in substrate enhance their habitat.

CONCLUSION: The effect of the Point Lay Deferral Alternative on fishes is expected to be VERY LOW in marine habitats and VERY HIGH in freshwater habitats.

Deferred-Area Analysis: If the deferred area were leased, a minimum level of development and production is assumed. Only one production platform would be installed, and an oil spill of ≥ 1,000 bbl could occur. Given this estimated number of oil spills and the limited areal extent and toxic period of oil in the marine environment, the effect of oil spills on marine fishes would be very low. In comparison, the regional populations of marine fishes are generally widely distributed over large areas of the Chukchi Sea. Only small, localized members of these fish species could be contacted and adversely affected by oil spills. The limited areal extent and time period of drilling discharges, offshore construction, and seismic surveys lead to the same conclusion.

5. Effects on Marine and Coastal Birds: Under the Point Lay Deferral Alternative, development is expected to proceed as projected for the base case, since the exploration- and development-scenario assumptions (Table II-A-1) and schedule (Appendix B) are similar; thus, any adverse effects are expected to be essentially as discussed in Section IV.C.5, except that those associated with deferred blocks in the southeastern sale area are less likely to occur. Marine and coastal bird populations are most vulnerable to oil spills, disturbance, and the effects of habitat degradation from late spring (May-June) through the open-water season (late June-October), when large-scale movements of birds into and through the sale area and vicinity coincide with, progressively, the opening of the spring-lead system, release during breakup of any oil entrained in the pack ice, and--at least during the exploration phase--heightened industrial activity.

Deferral of blocks from the southeastern sale area would remove hypothetical platform- and pipeline-spill sites from which spilled oil could contact Migration Corridors A and B, the Wainwright Subsistence/North Kasegaluk Lagoon Area, and the Point Lay Subsistence/South Kasegaluk Lagoon Area that contain important marine and coastal bird habitats. Conditional contact probabilities for these areas from points within the deferred area range up to 27 percent for the entire winter/spring period, and up to 63 percent in the summer. However, hypothetical spill sites representing pipelines, with probabilities of contacting one or more of these areas as high as 51 percent in winter/spring and 33 percent in summer, still remain in the vicinity of the deferred blocks. Since the probability of oil released in deferred blocks contacting the coastline adjacent to the sale area is ≤ 1 percent, deferral of blocks is inconsequential in reducing risk to shoreline and nearshore habitats; also, the probability of shoreline contact by oil spilled at hypothetical pipeline-spill sites not removed by the deferral of blocks ranges up to 11 percent. Finally, the probability of a spill occurring and contacting environmental resource areas or land segments in any season is the same for this deferral alternative and the base case. Thus, the principal effect of this alternative with regard to oil pollution is to produce a minor decrease in oil-spill risk to some marine and coastal bird habitats.

Disturbance of marine and coastal birds under this alternative is not expected to differ substantially from the base case, since some vessels would pass through and helicopters would overfly the deferred blocks enroute to leased blocks, with the potential for disturbing individuals in deferred blocks. Also, since drilling units are not known to disturb birds significantly, eliminating drilling from the deferred blocks is not likely to alter overall disturbance effects.

CONCLUSION: The effect of the Point Lay Deferral Alternative on marine and coastal birds is expected to be LOW.

Deferred-Area Analysis: If the deferred blocks were leased and exploration, development, and production activities took place in this area, an oil spill could occur and produce general effects, as described in Section IV.C.5, or somewhat greater effects since the deferred area incorporates a lead system important to many species as a spring-migration corridor as well as important foraging habitat used by seabirds during the open-water season. Overall oil-spill effects are likely to decline as a result of the occurrence of fewer spills. Disturbance associated with drilling and platform and pipeline construction and operation could result in the kinds of effects described in Section IV.C.5; however, the level of disturbance would be reduced to one-sixth of that expected with development of the remainder of the sale area.

6. Effects on Pinnipeds and Polar Bear: Under the Point Lay Deferral Alternative, development is expected to proceed as projected for the base case since the exploration- and development-scenario assumptions (Table II-A-1) and schedule (Appendix B) are similar; thus, any adverse effects are expected to be essentially as discussed in Section IV.C.6, except that those associated with deferred blocks in the southeastern sale area are less likely to occur. Pinniped and polar bear populations are most vulnerable to oil spills, disturbance, and the effects of habitat degradation in late spring and early summer (May-July). During this period, females are accompanied by the more sensitive young and large-scale movements of seals and walrus through the sale area and vicinity coincide with, the opening of the spring lead system followed by many migrants, the release during breakup of any oil entrained in the pack ice and (at least during the exploration phase) heightened industrial activity with the onset of the open-water season..

Deferral of blocks from the southeastern sale area would remove hypothetical platform- and pipeline-spill sites from which spilled oil could contact Migration Corridors A and B, the Wainwright Subsistence/North Kasegaluk Lagoon Area, and the Point Lay Subsistence/South Kasegaluk Lagoon Area that contain important marine mammal habitats. Conditional probabilities for these areas range up to 27 percent for the entire winter/spring period, and up to 63 percent in the summer. However, hypothetical spill sites representing pipelines, with probabilities of contacting one or more of these areas as high as 51 percent in winter/spring and 33 percent in summer, still remain in the vicinity of the deferred blocks. Since the probability of oil released in deferred blocks contacting the coastline adjacent to the sale area is $\leq$ 1 percent, deferral of blocks probably would not reduce risk to shoreline and nearshore habitats significantly; also, the conditional probability of shoreline contact by oil spilled at hypothetical pipeline spill sites not removed by the deferral of blocks ranges up to 11 percent. Finally, the combined probability of a spill occurring and contacting environmental resource areas or land segments in any season is the same for this deferral alternative and the base case. Thus, the principal effect of this alternative with regard to oil pollution is to produce a minor decrease in oil-spill risk to some marine mammal habitats in which the extent of feeding, denning, or other activities by polar bears currently is uncertain.

Disturbance of pinnipeds and polar bears under this alternative is not expected to differ substantially from the base case, since some vessels would pass through and helicopters would overfly the deferred blocks enroute to leased blocks, with the potential for disturbing individuals in deferred blocks. Also, since drilling units are not known to significantly disturb pinnipeds and polar bears, eliminating the drilling activity from the deferred blocks is not likely to alter overall disturbance effects.

CONCLUSION: The effect of the Point Lay Deferral Alternative on pinnipeds and polar bear is expected to be LOW.

Deferred-Area Analysis: If the deferred blocks were leased and exploration, development, and production activities took place in this area, an oil spill could occur and produce general effects as described in Section IV.C.6, or somewhat greater effects since the deferred area incorporates an important pupping area for seals as well as a lead system important to many species as a spring migration corridor. Overall oil-spill effects are likely to decline as a result of the occurrence of fewer spills. Disturbance associated with drilling and platform and pipeline construction and operation could result in the kinds of effects described in Section IV.C.6; however, the level of disturbance would be reduced to one-sixth of that expected with development of the remainder of the sale area.

7. Effects on Endangered and Threatened Species:

a. Bowhead and Gray Whales: The agents that are likely to affect bowhead and gray whales in or near the Sale 126 area are industrial noise and crude oil. The effect of these agents was addressed in the low- and base-case analyses (see Secs. IV.B.7.a(1) and IV.C.7.a(3)) and is incorporated by reference. The following analysis focuses on the likely rate of bowhead and gray whales encountering these agents under the Point Lay Deferral Alternative.

The Point Lay Deferral Alternative consists of the same number of exploration and production operations as for the base case (26 exploratory operations and 6 production operations). Hence, the expected rate of bowhead and gray whales encountering industrial noise and crude oil in the Point Lay Deferral Alternative would be similar to that already discussed for the base case; however, the Point Lay Deferral Alternative omits the eastern portion of the sale area. In the winter and spring, the majority of this area typically consists of solid ice rather than leads but may be used as a migratory pathway by bowheads (their primary spring corridor is believed to be inshore of this area). Hence, the deletion of this area from the lease sale could somewhat reduce the likelihood of spring bowhead encounters with industrial noise, but would not substantially reduce the probability of crude oil contacting the spring-migratory corridor. Since fall migrating bowheads do not use the deferred area, fall bowhead encounters would be the same as for the base case (very low). Since gray whales are concentrated inshore and are only infrequent visitors to offshore areas, they also would not be affected by the Point Lay Deferral Alternative. Consequently, the Point Lay Deferral Alternative is likely to have little effect on bowhead and gray whale populations.

Conclusion: The effect of the Point Lay Deferral Alternative on the bowhead and gray whale populations is expected to be very low.

Deferred-Area Analysis: If the deferred area were leased and exploration, development, and production activities occurred in this area, the potential source of industrial noise and crude oil would be moved closer to the spring-lead system (inshore) that bowheads use during the spring, and closer to areas that gray whales may use during the spring and summer (most grays would be inshore of the deferred area). Fall-migrating bowheads do not use the deferred area to any extent but would benefit from a lower probability of encounters with crude oil, since the source of oil would be moved farther away from the bowhead's broad fall-migratory corridor. However, based on the effects discussed in Section IV.B.7.a(1) and IV.C.7.a(3), any whales that contact industrial noise and crude oil are expected to experience only local, short-term effects from such contact. Consequently, the exploration and development of this area would be likely to have little effect on the bowhead and gray whale populations.

b. Arctic Peregrine Falcon: Since the amount of exploration and production activity associated with the Point Lay Deferral Alternative is the same as that of the base case, the effect this alternative is expected to be very low (see Sec. IV.C.7.b).

Conclusion: The effect of the Point Lay Deferral Alternative on the arctic peregrine falcon population is expected to be very low.

Deferred-Area Analysis: If the deferred area were leased and exploration, development, and production activities occurred in this area, the potential source of industrial noise and crude oil would be moved closer inshore. However, this would not alter the expected effect of the Point Lay Deferral Alternative on arctic peregrine falcons. Consequently, the exploration and development of this area would be likely to have an insignificant effect on the arctic peregrine falcon population.

CONCLUSION: The effect of the Point Lay Deferral Alternative on endangered and threatened species is expected to be VERY LOW.

8. Effects on Belukha Whale: The effect of industrial noise and crude oil associated with the Point Lay Deferral Alternative on belukha whales in or near the Sale 126 area is expected to be essentially the same as that discussed for bowhead and gray whales, although belukhas are likely to respond to industrial noise of higher frequencies. Hence, the effects discussed in the low- and base-case analyses are incorporated by reference (see Secs. IV.B.7.a(1) and IV.C.7.a(3)).

The Point Lay Deferral Alternative consists of the same number of exploration and production operations as that of the base case (26 exploratory operations and 6 production operations). Hence, the estimated rate of belukha whales encountering industrial noise and crude oil in the Point Lay Deferral Alternative would be the same as that already discussed for the base case. However, the Point Lay Deferral Alternative excludes the eastern portion of the sale area, which borders the spring-lead system. In the spring the majority of this area typically consists of solid ice rather than leads and is not likely to be used by belukhas on their spring migration. Hence, the deletion of this area from the lease-sale area is not likely to reduce the number of probable spring encounters with industrial noise and crude oil. Since the source of industrial noise and crude oil would be moved farther offshore, the likely encounter rate would be slightly lower than the base case in the spring and summer and slightly higher in the fall.

Due to the dispersed nature of belukha migrations and the fact that much of the industrial activity would occur when belukhas were not in the area, belukhas are expected to encounter exploration and production noise at a relatively low rate, particularly in the spring and summer when they are closer to shore. Displacement of belukhas due to pipeline construction is unlikely, since few belukhas are likely to be in the near vicinity or are likely to perceive these activities as threatening. Consequently, the Point Lay Deferral Alternative is likely to have little effect on the belukha whale population as a whole, but could affect some whales.

CONCLUSION: The effect of the Point Lay Deferral Alternative on the belukha whale population is expected to be VERY LOW.

Deferred-Area Analysis: If the deferred area were leased and exploration, development, and production activities took place in this area, the potential source of industrial noise and crude oil would be moved closer to the spring-lead system that belukhas use during the spring. Hence, this would increase the likelihood of belukhas encountering industrial noise and crude oil in the spring. Fall-migrating belukhas would benefit from a lower encounter probability, since the source would be moved further away from their broad fall-migratory corridor. However, based on the effects discussed in the low- and base-case analyses, any whales encountering industrial noise or crude oil are expected to experience only local, short-term effects. Consequently, the Point Lay Deferral Alternative is likely to have little effect on the belukha whale population.

9. Effects on Caribou: Under the Point Lay Deferral Alternative, development is expected to proceed as projected for the base case, since the exploration-and-development-scenario assumptions (Table II-A-1) and schedule (Appendix B) are similar. Thus, any adverse effects resulting from an oil spill are expected to be essentially as discussed in Section IV.C.9, except that those associated with deferred blocks in the southeastern sale area may be less likely to occur. The probability of an oil spill occurring and contacting land where caribou could become exposed is the same for this alternative as for the base case. Likewise, helicopter traffic to which caribou might be exposed is not likely to be significantly less under this alternative than under the base case.

CONCLUSION: The effect of the Point Lay Deferral Alternative on caribou is expected to be LOW.

Deferred-Area Analysis: If the deferred blocks were leased and exploration, development, and production activities took place, an oil spill could occur and produce general effects as described in Section IV.C.9. Disturbance from helicopter-support traffic to the sale area would be reduced to one-sixth of that expected with development of the remainder of the sale area, while disturbance associated with construction and operation of an onshore pipeline would remain unchanged.

10. Effects on the Economy of the North Slope Borough: The effect of the Point Lay Deferral is expected to result from several years of exploration followed by development as described for the base case. Overall, employment generated by the deferral alternative would be less than for the base case. During the exploration phase, from 1992 through 1997, the number of workers directly employed by the industry would range from 100 to 400, averaging 187 workers. The majority of these workers will be

employed offshore. Most of the new sale-related employment would be filled by commuters from outside the region; some employment gains would be made by North Slope residents, though this would be less than 2 percent above the projected no-sale conditions.

During the production phase, effects on the economic activity of the North Slope region are expected to be moderate as a result of the projected change in resident employment, which would increase above 10 percent per year for at least 5 years with an average change in resident employment of about 9 percent. According to the definitions, this effect, for employment only, is moderate. Sale effects on Native and non-Native-resident employment would be slightly higher and slightly lower, respectively. However, the unemployment rate for Native residents would still reach 50 percent by 2002, with or without the sale. In addition, NSB property taxes would increase an average 11 percent and operating revenues would increase an average 9 percent.

Economic benefits from new jobs, income, and taxes that could result from the proposed sale are expected to occur after the level of petroleum activities on the North Slope (e.g., Prudhoe Bay) has begun to decline. This decline would not be reversed by the effects expected under the Point Lay Deferral Alternative.

Subsistence-harvest disruptions can have a direct negative effect on the economy of the NSB. The effect on subsistence-harvest aspect of the economy during the exploration phase is expected to be minimal. The effect on the subsistence-harvest aspect of the economy during the development and production phases is expected to be significant. Not only are subsistence resources a large portion of total meat for households directly engaged in subsistence harvesting, but the resources are shared widely. Furthermore, a large percentage of NSB households engage directly in subsistence activities. Disruptions from industrial activities or an oil spill would have significant effects on the economic well-being of NSB residents. Construction activities at Point Belcher could disrupt the bowhead whale harvest for both Barrow and Wainwright for more than 1 year (40% of total edible meat in Barrow and Wainwright come from this source). Low-level effects resulting from construction and industrial activities are also expected on caribou, walrus, and seals. An oil spill would also disrupt the bowhead whale harvest for at least 1 year for both Wainwright and Barrow. In addition, walrus would become unavailable for an estimated 1 year for Wainwright and Barrow. Walrus contributes 18 percent and 8 percent, respectively, to the Wainwright and Barrow total edible harvest. Other subsistence resources are expected to experience low-level effects. The economic well-being of NSB residents would be diminished due to the loss of a major source of food and the loss in value placed on that food--from both a dietary standpoint and a cultural standpoint. This would be a real loss in income to NSB residents. The effect of subsistence-harvest disruptions on the economy of the NSB would be high (see Sec. IV.G.11 for details of subsistence-harvest disruptions).

<u>CONCLUSION</u>: The effect of the Point Lay Deferral Alternative on the economy of the NSB is expected to be HIGH.

<u>Deferred-Area Analysis</u>: If the deferred area were leased and exploration, development, and production activities occurred in this area, the effects on subsistence harvests would be greater than those expected in the low case but less than those expected in the base case (see Sec. IV.G.11). Effects on marine mammals would range from low to moderate, and effects on interior-subsistence-harvest patterns would be similar to those expected for the base case due to the need for an onshore pipeline. The effect on employment and revenues in the NSB would be the same as for the base case.

11. <u>Effects on Subsistence-Harvest Patterns:</u> Section III.C.2 (1) describes the subsistence-harvest patterns characteristic of Inupiat communities near the Sale 126 area, (2) outlines the important seasonal subsistence-harvest patterns by community and resource, (3) provides figures depicting the areal extent of each community's general subsistence-harvest area and the timing of harvests, and (4) presents estimated quantities of subsistence resources harvested. Sections III.C.2 and III.C.3 demonstrate that significant aspects of each community's economy, culture, social organization, normative behavior, and beliefs interact with and depend on subsistence-harvest patterns.

The levels of resources, industry activity, and oil-spill probabilities for the Point Lay Deferral Alternative are nearly identical to those for the base case. The primary difference between the base case and Alternative IV is the spatial configuration of the proposed sale area. Implicit in Alternative IV is the deletion of 457 OCS blocks located directly offshore of Point Lay. Although the deletion of these blocks would remove industry activities from certain lead zones frequented by bowheads during their spring migration, these leads are not hunted by Wainwright, Barrow, or Point Hope hunters; and Point Lay has not had a bowhead harvest since the 1930's.

The ability of this alternative to reduce effects on subsistence activities is questionable. Even with the implementation of this alternative, the main effect agent would remain oil spills and related cleanup efforts. This alternative would not reduce the chances of an oil spill occurring and contacting the Point Lay Subsistence Area. Deletion of the blocks may cause some reduction in the noise level generated by OCS activities by keeping OCS activities and traffic farther offshore. However, this would not be enough to reduce the effect level of this alternative on the belukha population from the moderate level stated for the base case, since the potential for oil spills would remain. Point Lay hunters harvest the belukha primarily in summer (July), in very nearshore waters. The animals are usually herded into varying parts of Kasegaluk Lagoon and shot. Belukhas are hunted in the winter only if the summer belukha harvest is unsuccessful. The winter belukha hunt extends south to the leads off Cape Beaufort and sometimes (in rare cases) north to Icy Cape. In both cases, the block deletions are of limited effect since the potential winter-hunting sites are several (24-32) kilometers from OCS blocks--even in the base case.

<u>CONCLUSION</u>: The effect of the Point Lay Deferral Alternative on subsistence-harvest patterns is expected to be HIGH for Wainwright; MODERATE for Barrow, Point Lay, and Atqasuk; and LOW for Point Hope and Nuiqsut.

<u>Deferred-Area Analysis</u>: Should the deferred area be offered for lease and developed in accordance with the deferred-area-development scenario, the effects would be greater than those postulated for the low case of the proposed action but much lower than the expected effects of the base case. The change in effects would be caused principally by a reduction in the amount of estimated resources and associated infrastructure. Because of the scale of development, the effects of developing the deferred area would not be as great as those of the base case; but effects on marine mammals would range from low to moderate. In the case of a pipeline constructed to the TAP, effects on interior-subsistence-harvest patterns would be consistent with effects expected under the base case. A pipeline is a fixed entity, and a certain amount of activity and effects (i.e., road-related traffic, noise, and human presence) associated with the pipeline would persist over time, regardless of its size or the level of its initial construction effort.

12. <u>Effects on Sociocultural Systems</u>: The sociocultural analysis of the communities affected by the deferral alternative considers (1) industrial activity, (2) induced demographic changes, and (3) degree and opportunity for interaction between industry work bases and existing communities. These three factors were examined in relation to their effects on the subsistence-harvest patterns and cultural life of the six communities affected by proposed Sale 126 and found in large part not to be substantively different from those effects forecast for the base case. The level of activity and resources forecast for this alternative and the similarity in OSRA occurrence and contact probabilities indicate a similarity in effects (moderate) between the base case and this alternative. The difference between the base case and this alternative lies in the different spatial configurations of each. The large deletion of blocks offshore of Point Lay may reduce the effect of industry activities on Point Lay's belukha whale harvest and thereby relieve some degree of sociocultural stress. However, in general, the effect of this alternative--and of the base case--is expected to be low for Point Lay and all other North Slope communities, except for Wainwright, where moderate effects are expected.

<u>CONCLUSION</u>: The effect of the Point Lay Deferral Alternative on the sociocultural systems of the North Slope is expected to be MODERATE.

Deferred-Area Analysis: If the deferred area were leased and explored, development- and production-phase activities would result in a low effect level on the region's sociocultural systems. The change in effects would be caused principally by the reduced level of activity when compared with the base case. Because of the reduced scale of development, the effects on marine mammals would not be as great as those of the base case. Effects on marine mammals would range from low to moderate. Construction activities, particularly construction of a pipeline to the TAP, would result in the influx of a significant number of workers. However, the workers would largely be enclaved and would be rotated on- and offsite; and interaction with community residents would be minimal. Although there would be some potential for employment in oil field activities for Native and non-Native North Slope residents, the project size envisioned by this scenario indicates that employment opportunities would be few and would have relatively little effect on community life. The interaction between residents and oil field workers that could be stimulated by a road between the Point Belcher support base and Wainwright may result in some disruption of community cultural values. However, the extent to which this could be a problem would be dependent on the degree of cooperation between community leaders and operator representatives in curtailing potential damaging behaviors.

13. Effects on Archaeological Resources: The Point Lay Deferral Alternative would remove nearshore archaeological resources, both prehistoric and historic, from the effects of possible oil and gas leasing; but this area--especially in Land Segments 22 and 23--would be crossed by a pipeline from other parts of the Sale 126 area to the landfall at Point Belcher. Therefore, this alternative would not lower the level of effects under the base case because archaeological resources could be disturbed by construction and oil-spill-cleanup activities--both offshore and onshore. The level of effect for this alternative is expected to be the same as for the base case.

CONCLUSION: The effect of the Point Lay Deferral Alternative on archaeological resources is expected to be MODERATE.

Deferred-Area Analysis: In the event that industry found economically recoverable resources in the area to be deferred, activities would include one production platform, transportation by pipeline to shore and to the TAP, and onshore facilities as under the base case. The most likely number of spills of ≥ 1,000 bbl is zero in the Chukchi Basin. Such activity and the potential of an oil spill would affect archaeological resources, if they existed, to a small degree. However, because the area to be deferred contains only a few known shipwrecks, the effect is expected to be negligible.

14. Effects of Land Use Plans and Coastal Management Programs: With only slight variations--most notably no drilling in the deferred area--exploration, development, and production activities would be comparable to those of the base case (see Sec. IV.C.14). Major changes in land use would result from development associated with Sale 126. Because no industrial development currently exists along the Chukchi Sea coast, the shorebase and 640 km of onshore pipeline would be placed in areas currently used only for subsistence hunting. The location of the shorebase and landfall still would be at Point Belcher, which could be highly incompatible with the current use of the area as a base for subsistence hunting of bowhead whales. This would lead to conflicts with the ACMP statewide standard for subsistence that guarantees opportunities for subsistence use of coastal resources and areas (6 AAC 80.120), and the NSBCMP policies and NSB LMR's that prohibit significant interference with the bowhead whale hunt and require access to subsistence resources (NSBCMP 2.4.3(b), 2.4.3(d), 2.4.5.1(b), NSBMC 19.70.040.E, and NSBMC 19.70.050.B, D and J.2). Because Point Belcher traditionally has been the launching site for whaling, the potential also exists for effects on the cultural resources of the area; therefore, conflict with policies designed to protect these resources is possible (NSBCMP 2.4.3(g), 2.4.5.2(h), NSBMC 19.70.050.G and K.8). While the assumed pipeline/road system could be constructed to conform to most NSB land use and CMP policies, access of Wainwright residents to the North American road system and vice versa via the pipeline/road to the Dalton Highway may generate additional problems and benefits that would need to be assessed if the road became public. Potential conflicts also are evident with the statewide standards for energy facilities if dredging activity occurs in Peard Bay and leads to long-term changes in biological distributions, for lagoon and river habitats in the event of an oil spill, and for water quality if formation

waters are discharged into the Chukchi Sea.

CONCLUSION: For the Point Lay Deferral Alternative, the potential for conflict with land use plans and coastal management programs is expected to be HIGH.

Deferred-Area Analysis: In the event oil were discovered and recovered from the deferred area, effects identified in the base case would be more likely. The landfall would remain at Point Belcher, but the pipeline between the resources and Point Belcher would be nearer an area adjacent to the entrances to Kasegeluk Lagoon. Both belukha whales and the subsistence use of belukha whales in Kasegeluk Lagoon are specifically protected through NSBCMP 2.4.3[c] and NSBMC 19.70.050.C. Levels of effects would not be raised from those of the base case of the proposal but the likelihood of occurrence nearer to shore would be greater, thereby exacerbating the potential for conflict with the ACMP statewide standards and district policies.

15. Effects on Wetlands: Under the Point Lay Deferral Alternative, onshore development is expected to be the same as under the base case, with local effects on wetlands occurring along the 640-km-long pipeline-road corridor due to gravel fill, thermokarst, oil spills, and road dust. Less than 1 percent of the wetlands on the coastal plain of the North Slope are expected to be severely changed or affected by this alternative.

CONCLUSION: The effect of the Point Lay Deferral Alternative on wetlands is expected to be the same as described for the base case.

H. Cumulative Case

The analyses of the cumulative case for Sale 126 involve consideration of the potential effects on (1) the physical, biological, and social systems resources and programs from activities associated with petroleum exploration, development and production, and transportation in the three OCS arctic region planning areas (Beaufort Sea, Chukchi Sea, and Hope Basin Planning Areas shown in Fig. I-1) and the major projects listed in Table IV-A-2 and (2) migratory species from activities over their range (shown in Appendix E), including the transportation of Sale 126 oil from Valdez, Alaska, to the U.S. West Coast and from industrial activities in the Bering Sea, Gulf of Alaska, and along the Pacific Coast of Canada and the United States. Migratory species include those species or species groups that migrate to and from the Chukchi Sea and adjacent coastal plain of northern Alaska and other species in other areas that might be affected by the transportation of Sale 126 oil, especially oil spilled along the transportation route to market.

The total amount of oil estimated to be present in the three arctic region OCS planning areas is about 5,480 MMbbl (Appendix A). The MMS estimates that exploitation of this amount of oil will include (1) drilling of 68 exploration and delineation wells and (2) installing 11 production platforms and drilling 685 production and service wells (Table II-A-1 and Appendix B). The transportation of oil that might be produced as a result of previous lease sales in the Beaufort and Chukchi Sea Planning Areas generally has been hypothesized as moving via pipelines from the production platforms to the TAP. An alternative mode of transportation includes icebreaking tankers and offshore loading. There have been no OCS oil and gas lease sales in the Hope Basin Planning Area; possible transportation scenarios have not been developed for this area because of this.

For Sale 126, the major projects considered in the cumulative-effects analyses for the arctic planning areas include past and future State of Alaska (State) and OCS oil and gas lease sales, North Slope Borough (NSB) capital improvement projects, onshore mineral development, and Canadian arctic oil and gas development. These projects are listed in Table IV-A-2 and described in Appendix E. The locations of these projects are shown on Graphic 3.

Tanker transportation of oil could potentially affect migratory as well as other species in the event of an oil spill. As noted in Section II.B.2.a, any economically recoverable oil that might be discovered in the Sale 126 area would be transported through offshore and onshore pipelines to the TAP. The Sale 126 oil would be mixed with oil from other production units in Alaska's North Slope and transported through the TAP to Valdez, Alaska, where it would be loaded onto tankers for shipment to the West Coast of the United States. For the base case peak-production years--2003 through 2007--MMS estimates that Sale 126 oil would be produced at a rate of about 370 Mbbl/day (Table II-A-1). For a mid-scenario, the State estimates oil production of the North Slope could range from 830 MMbbl in 2001 to 590 MMbbl in 2005 (State of Alaska, Dept. of Revenue, 1990). Therefore, Sale 126 oil would be only a fraction of the oil transported throught the TAP and loaded onto tankers.

The migratory species could be affected by activities throughout their range and along their migration routes. These activities are listed in Appendix E.

Oil exploitation associated with Sale 126 would increase the level of activities affecting these environments and resources. The level of activities associated with potential exploitation of Sale 126 oil has been estimated in Section II.B (and Table II-A-1) and the contribution of these activities in concert with other activities associated with present and proposed projects is shown in Table IV-A-2 and Appendix E. The amount of oil that might be produced as a result of Sale 126 (Alternative I, base case = 1,610 MMbbl [1.6 Bbbl] is very low when compared to the oil (21-25 Bbbl) that is estimated to be produced in areas in and adjacent to the Chukchi Sea Planning Area. Therefore, over several decades, some of the activities--such as well drilling, helicopter flights, or tanker transport--associated with exploitation of Sale 126 oil might contribute only a relatively small amount of the total. Overall, the contribution of the Proposal, when compared with the cumulative case, would be relatively small.

This section on the cumulative case is organized into discussions on the (1) effects on resources other than migratory species and (2) effects on migratory species.

1. Effects on Resources Other Than Migratory Species: The section of the cumulative case is organized to cover the following topics: air quality; water quality; lower-trophic organisms; fishes, except Pacific salmon (addressed under migratory species); sea otter and harbor seal; economy of the North Slope Borough; subsistence-harvest patterns; sociocultural systems; archaeological resources; and land use plans and coastal management programs.

a. Effects on Air Quality: A full discussion of air quality regulations and procedures can be found in Section IV.B.1.a. For purposes of this analysis, the cumulative case includes concurrent activities as described for the Sale 126 base case and for the mean-resource case of the Chukchi Sea Sale 109 FEIS (USDOI, MMS, 1987b). Under the cumulative case, peak annual emissions from exploration would be from drilling 6 exploration and 4 delineation wells drilled from 5 rigs. Peak annual emissions from development and production assumes 15 production platforms placed at least 18.5 km offshore off Point Lay, of which 6 would be attributable to the base case, and concurrent drilling of 130 production wells. Peak cumulative annual production of 355 MMbbl of oil would be nearly 2.5 times greater than that of the base case. Table IV-H-1 lists estimated uncontrolled-pollutant emissions for the peak-exploration, peak-development, and peak-production years. Under the Federal and State of Alaska PSD regulations, since the estimated annual uncontrolled NO_x emissions for peak exploration, peak development, and peak production would exceed 250 tons per year, the lessee would be required to control NO_x emissions through application of BACT to emissions sources to reduce NO_x emissions (Table IV-B-2). In addition, the lessee would have to employ BACT to emission sources because these emissions will exceed the de minimis levels. An air quality analysis performed using the OCD Model for air pollutants emitted in the base case for exploration due to Sale 126 showed that maximum NO_x concentration, averaged over a year, would be 2.24 and 0.91 μ/m^3 for peak exploration and production, respectively, at the shoreline: 9.0 and 3.6 percentiles of the available Class II increment for NO_X (Table IV-H-2).

(1) Exploration: The highest NO_x value calculated by the OCD model indicates a concentration of 2.24 g/m^3, an exceedance of the 1-$\mu g/m^3$ significance increment for NO_x (Table IV-H-2). The lessee would be required to reduce emissions through application of BACT to the emission sources. The modeled NO_x concentration would be 9.0 percent of the PSD increment of 25 $\mu g/m^3$ (annual) and 2.2 percent of the national air quality standard of 100 $\mu g/m^3$ (annual). The OCD model indicates a TSP concentration of 0.02 (annual) and 0.25 (24-hour) $\mu g/m^3$; therefore, the significance increment for TSP would not be exceeded (Table IV-H-2). The modeled TSP concentration would be 0.1 percent of the 19 $\mu g/m^3$ (annual) and 0.7 percent of the 37 $\mu g/m^3$ (24-hour) PSD increment and 0.03 percent of the 60 $\mu g/m^3$ (annual) and 0.2 percent of the 150 $\mu g/m^3$ (24-hour) of the national air quality standard. The OCD model indicates an SO_2 concentration of 0.11 (annual), 1.53 (24-hour), and 3.06 (8-hour) $\mu g/m^3$; therefore, the significance increment for SO_2 would not be exceeded (Table IV-H-2). The modeled SO_2 concentration would be 0.6 percent of the 20 $\mu g/m^3$ (annual), 1.7 percent of the 91 $\mu g/m^3$ (24-hour), and 0.6 percent of the 512 $\mu g/m^3$ (8-hour) PSD increment and 0.1 percent of the 80 $\mu g/m^3$ (annual), 0.4 percent of the 365 $\mu g/m^3$ (24-hour), and 0.2 percent of the 1,300 $\mu g/m^3$ (8-hour) of the national air quality standard. Since the exemption level for VOC would be exceeded, a lessee would be required to fully reduce emissions through application of BACT to the emission sources. These methods are summarized in Table IV-C-3. Concentrations of criteria pollutants at the shoreline due to exploration are expected to be <5 percent (TSP and SO_2) but <20 percent of available national standards or PSD increments (NO_x).

(2) Development and Production: The highest NO_x value calculated by the OCD model indicates a concentration over land of 0.91 $\mu g/m^3$ (annual); therefore, the significance increment for NO_x would not be exceeded (Table IV-H-2). The modeled NO_x concentration would be 3.6 percent of the PSD increment of 25 $\mu g/m^3$ (annual) and 0.9 percent of the national air quality standard of 100 $\mu g/m^3$ (annual). Since the exemption level for VOC would be exceeded, a lessee would be required to fully reduce emissions through application of BACT to the emission sources. These methods are summarized in Table

Table IV-H-1
Estimated Uncontrolled Emissions for the Chukchi Sea Sale 126 Cumulative Case
(metric tons per year)

	Pollutant[1/]				
	CO	NO_x	TSP	SO_2	VOC
Cumulative Case[2/]					
Peak Exploration Year	2,162	4,794	406	1,381	307
Peak Development Year	2,442	4,175	204	272	234
Peak Production Year	3,452	4,350	165	107	8,901

Source: USDOI, MMS, Alaska OCS Region, 1990. Computed from factors in Form and Substance, Inc., and Jacobs Engineering, Inc., 1983.

1/ CO = Carbon Monoxide
NO_x = Nitrogen Oxides (assumed predominately NO_2)
TSP = Total Suspended Particulates (includes most particulate matter less than 10 μm in aerodynamic diameter)
SO_2 = Sulfur Dioxide
VOC = Volatile Organic Compounds (excluding nonreactive compounds such as methane and ethane)

2/ Assumes combined production of 302 million bbl of oil distributed evenly between 6 Sale 109 platforms and 3 Sale 126 platforms located 18 km offshore Point Lay.

Table IV-H-2
Comparison of Modeled Air-Pollutant Concentrations with Regulatory Limitations (measured in micrograms per cubic meter)

Averaging Time	PSD Class II Increment[1/]	Maximum Modeled Concentration Over Land[2/]	Air Quality Standard
Cumulative-Case Exploration			
NO_x			
annual	25	2.06	100[3/]
24-hour			
8-hour			
3-hour			
1-hour			
Cumulative-Case Production			
NO_x			
annual	25	1.14	100[3/]
24-hour			
8-hour			
3-hour			
1-hour			

Source: USDOI, MMS, Alaska OCS Region, 1990.

1/ Increment above ambient concentration allowed in a designated PSD area. Ambient baseline concentration for PSD not established for this area.
2/ Increases in concentration above significance level require reduction of emissions by application of Best Available Control Technology.
3/ Projected concentrations attributable to the proposal as modeled by the Offshore and Coastal Dispersion Model.
4/ Annual arithmetic mean.

IV-C-3. The existing air quality would be maintained. Concentrations of criteria pollutants at the shoreline due to development and production are expected to be <5 percent of available national standards or PSD increments.

Other Effects on Air Quality: For a more detailed discussion of the potential effects of air pollution--other than those effects addressed by standards, see Sections IV.B.1.b and IV.C.1.c. The coastal tundra ecosystem has a high susceptibility to acidic pollution. Concentrations of NO_2 and SO_2 onshore would be approximately the same as for the base case. However, concentrations would be well below the amounts required to affect the tundra, even on a local or short-term basis.

Accidental emissions result from gas blowouts, evaporation of spilled oil, and burning of spilled oil. Under the cumulative case, the probability of experiencing one or more blowouts in drilling the 367 exploration and production wells would be 70 to 79 percent. The emissions from a given gas blowout would be quickly diffused and would seldom last longer than a day. For additional information on gas blowouts, see Section IV.C.1.b.

Oil spills are another accidental source of gaseous emissions. Data on the probability and number of spills for the Chukchi Sea Planning Area cumulative case are not available. However, the probability of a spill is related to the rate and amount of oil production. Peak annual and total production would be approximately that of the high case. The VOC released by spills would be scattered spatially and temporally and would occur about 18.5 km (11.5 mi) or more offshore. Large and small spills could occur at a rate about the same as that for the base case. It is unlikely that the USDOI exemption criteria for VOC emissions would be exceeded.

The burning of spilled oil under the cumulative-case scenario would not differ appreciably from the base case. There would be 15 production platforms as opposed to 6 in the base case. However, the platforms would likely be widely distributed and none would be closer to shore than 18.5 km (11.5 mi). Prevailing winds would blow smoke plumes parallel to the coastline or offshore. For any given fire, it is expected that any smoke reaching the shore would be dispersed, short-term, and limited to a local area, resulting in a low effect.

Summary: Effects from air emissions in the cumulative case due to Sales 109 and 126 on onshore air quality are expected to be less than 20 percent of the maximum allowable PSD Class II increments and would not make the concentrations of criteria pollutants in the onshore ambient air approach the air quality standards. Consequently, effects of pollutant emissions on air quality--with respect to standards--are expected to be low. Because of the distance offshore of emissions and the resulting dispersion, effects of air quality--other than with respect to standards--for the cumulative case are expected to be at most short-term and local, or low.

Emissions from the base case are about 40 percent of the cumulative case and represent a significant contribution to the cumulative case.

CONCLUSION: The effect of the cumulative case on air quality is expected to be LOW.

b. Effects on Water Quality: The agents most likely to affect water quality in the Sale 126 area in the cumulative case would be discharges, construction activities, and oil spills associated with oil and gas activities.

(1) Effects of Discharges: Muds and cuttings discharges would result in only local pollution (see Sec. IV.B.2). Additional muds and cuttings from possible State sales could be discharged in State waters. Discharges from State leases and Federal leases in the Chukchi Sea Planning Area would be regulated by the EPA during both exploration- and development-well drilling. Discharges of muds and cuttings would continue for, at most, only a few years as production wells are drilled or as necessary during

any workover. The effect on local and regional water quality would be very low.

Discharge of formation waters would require an EPA permit and would be regulated so that water quality criteria, outside an established mixing zone, would not be exceeded. For additional information on formation waters, see Section IV.C.2.a.

If formation waters were reinjected or injected into different formations, no discharges of formation waters would occur and no effect would occur. If formation waters were discharged, the effect on water quality would be local and would continue for the life of the field. The effect on local water quality would be moderate, while the effect on regional water quality would be very low.

(2) Effects of Construction Activities: Causeway construction in State waters could affect local turbidity through enhanced sedimentation of suspended loads and through redirection of the flow of watermasses carrying the suspended loads. The redirection of flow also changes local temperature and salinity regimes. Major causeways are unlikely along the Chukchi Sea coast because of higher wave heights and more rapid deepening of water near the shore than occurs in the Beaufort Sea. Even in the Beaufort Sea, causeways do not extend into Federal waters.

The only dredging activity expected to affect water quality in the Sale 126 area is pipeline trenching for Federal leases. Pipelines from development in State waters would be short and in waters that are already naturally turbid over much of the summer. Almost all dredging to trench and/or bury pipelines would be associated with Sales 109 and 126. On any single day, only a few square kilometers of water would have increased turbidity as a result of dredging; and the turbidity at any location would rapidly disappear as the dredge moved onward.

Any gravel islands constructed on inshore State leases would require relatively little dumping of material compared to the above dredging, as long as causeways were not included. Turbidity effects in the vicinity of the construction activity would be short-term and local.

A gravel island would require a mined-gravel volume of 645,000 m^3 if in 15 m of water. Gravel would be carried by barge to the construction site during summer. About 20 barge loads a day, each of 1,200 m^3 of gravel, would be required over a 25- to 30-day period to construct the island. A total area of 7 km^2 could be affected by increased turbidity for some part of this time.

During its useful life, an artificial island would be protected from erosion by sandbagging. If exploration from the artificial island were unsuccessful, the sandbags would be removed and the island would be either abandoned or removed.

Removal of the island would result in a temporary increase in turbidity similar to that discussed for dredging. If the island were abandoned, storms, ice override, and ice gouging would erode the island over a period of years. During this time, ocean currents would winnow finer sediments from the island into a plume detectable for about 1 to 3 km downcurrent. The area affected would be similar to that of the construction area. Turbidity levels would be much lower than during construction, but increased turbidity could persist over several years. Abandonment rather than removal of an artificial island could result in local but persistent turbidity plumes as the island eroded.

Effects on water quality from dredging (and dumping) would be local and short-term. Effects on local water quality would be low, while regional effects would be very low.

(3) Effects of Oil Spills: In addition to permitted discharges, accidental oil spills are likely to occur. Based on experiences in other OCS areas, ten spills of ≥ 1,000 bbl would be estimated to occur in arctic waters as a result of the cumulative case. For analysis purposes, it is estimated that ten spills of 22,000 bbl would occur. This is the average size of platform and pipeline spills (see Sec. IV.A.1.b.2). Only

spills of ≥ 1,000 bbl or spills that occur in the U.S. Beaufort Sea, plus spills of any size within the Sale 109 area or in inshore waters, would affect water quality. The oil-spill-trajectory analysis for the Beaufort Sea indicates that trajectories in the most westerly portion of the Beaufort Sea Planning Area generally move westward or northwestward, avoiding most of the Sale 126 area. Information on the effects of oil spills on water quality is contained in Section IV.C.2.c and Appendix L.

On this basis, ten spills of ≥ 1,000 bbl are estimated to occur in or reach the Sale 126 area over the life of the field. Water-column concentrations of hydrocarbons following these spills could exceed the existing State water quality standards. This analysis considers 0.015 ppm to be a chronic criterion (see Sec. IV.C.2.c). Major spills generally result in peak dissolved-hydrocarbon concentrations that are only locally and marginally at toxic levels. The highest concentration observed following the Argo Merchant spill was 0.25 ppm (NRC, 1985). Volatile liquid hydrocarbons in the Ixtoc spill decreased from 0.4 ppm near the blowout to 0.06 ppm at a 10-km distance and to 0.004 ppm at a 19-km distance from the blowout (NRC, 1985). Concentrations of volatile liquid hydrocarbons--present mostly as an oil-in-water emulsion--within 19 km of the Ekofisk Bravo blowout in the North Sea--ranged up to 0.35 ppm (Grahl-Nielsen, 1978). Lesser amounts of oil (probably less than 0.02 ppm) were detectable in some samples, at a 56-km distance but not at an 89-km distance.

The ten estimated oil spills of ≥ 1,000 bbl could occur in either the summer or winter seasons. The average hydrocarbon concentrations in the top 10 m of the water column below the discontinuous slick following summer open-water spills of 22,000 bbl in the Chukchi Sea could range from 0.16 ppm after 3 days to 0.04 ppm after 30 days following the spill (Appendix L: Table L-2). The discontinuous slick would cover 57 km^2 after 3 days to 1,100 km^2 after 30 days (Appendix L: Table L-1).

Spills occurring in the winter season would be frozen in the ice and would move with the ice for the remainder of the winter. Spills in first-year ice would melt out in late spring or early summer. Spills in multiyear ice would melt out later in the summer or in subsequent summers. Spills released from the ice would be relatively unweathered and would have the characteristics of fresh oil. Before the oil was released from the ice, contaminated ice could drift for hundreds of kilometers. A 22,000-bbl-meltout spill in the Chukchi Sea (see Sec. IV.A) would have the following hydrocarbon concentrations: 0.03 ppm after 3 days and 0.04 ppm after 30 days (Appendix L: Table L-2). The discontinuous-slick size would cover from 1,400 km^2 after 3 days to 2,200 km^2 after 30 days (Appendix L: Table L-1).

Sustained degradation of water quality to levels above State and Federal criteria from hydrocarbon contamination associated with the ten estimated oil spills of ≥ 1,000 bbl unlikely. Hydrocarbon concentrations from the ten spills could exceed the chronic criterion of 0.015 ppm total hydrocarbons on at least several thousand square kilometers for a short period of time. Concentrations above the acute criterion (1.5 ppm) are not anticipated. The combined influence of the ten estimated spills of ≥ 1,000 bbl would not result in the concentration of contaminants to average more than the chronic State criterion over the life of the project. The persistence of individual oil slicks would be short-term (less than 1 yr), but the slick--intact and unweathered in the pack ice--could drift hundreds of kilometers. Small spills under 1,000 bbl that could occur over the life of the field would result in local chronic contamination. Effects of an oil spill on water quality are expected to be moderate locally and low regionally.

In summary, ten spills of ≥ 1,000 bbl are estimated to occur and contact the Sale 126 area in the cumulative case. Ten such spills could contaminate pack ice for all of the winter over long distances, which would cause a moderate local effect. Other agents--smaller spills, dredging, causeways, and construction or removal projects--and discharges would locally degrade water quality but would have no more than a moderate local effect on water quality. The overall cumulative effect on water quality would be moderate locally and low regionally. Since the proposal is the primary effects contributor in the cumulative case, the proposal contributes significantly to the overall effects on water quality.

CONCLUSION: The effect of the cumulative case on water quality is expected to be MODERATE locally and LOW regionally.

c. Effects on Lower-Trophic-Level Organisms: In the cumulative case, activities from Beaufort Sea exploration and development are considered in addition to the base case. Potential effects from planned State-oil-lease sales in the Beaufort Sea are also analyzed. Other major projects considered in cumulative-effects assessment are outlined in Appendix E.

(1) Effects of Oil Spills: In the cumulative case, the most likely number of oil spills estimated to occur in arctic region planning areas is ten $\geq$ 1,000-bbl spills (Table II-A-1). As discussed in previous sections, oil spills can have toxic effects on marine life ranging from discrete and sublethal to lethal. Metabolic processes can be reduced or otherwise altered, which, in extremis, can cause death of the affected organism. Less noticeable are the effects on the environment from oil spills, e.g., reduced food supply for some species through interdiction of the food chain. The effects expected to result from oil spills should not change appreciably from the base case, since the areal effect over time remains small and the spills would probably be distributed over an extended period. The most likely cumulative effects of oil spills on marine plants and invertebrates would be the same as for the base case--very low.

If soft-sediment areas in the nearshore were contacted by oil, they could remain contaminated for years (Gundlach et al., 1981). Benthic invertebrates found in such areas could be affected, perhaps for a number of years; but because the effects are expected to be rather localized, and the populations of invertebrates are thought to be very widespread, effects are not expected to exceed very low.

In general, based on the estimated number of spills in the Arctic (10) and the limited area affected, and the also limited period of toxic concentration, the effect of oil spills under the cumulative case would most likely be very low for marine plants and invertebrates.

(2) Effects of Drilling Discharges: Under the cumulative case, drilling discharges would increase. A total of 98,600 short tons of drilling muds and cuttings would be discharged during exploratory drilling. These discharges would be distributed over both the Beaufort and Chukchi Seas, but the area affected would remain very localized. The EPA regulates discharges through NPDES permits and frequently restricts the amount or concentration of discharges in shallow waters. Since discharged material generally becomes rapidly diluted from finite points of discharge and has low toxicity to marine plants and invertebrates (see USDOI, MMS, 1987a [Sale 97 FEIS, Appendix L]), effects are expected to be very localized and low. Kelp-bed communities are more vulnerable because of their rarity and apparently very restricted distribution. If drilling discharges occurred very close to kelp beds, moderate effects could occur because reproduction and/or recruitment could be affected. Since identified kelp beds occur in fairly shallow water (the one near Skull Cliff is in water about 13 m deep), effects from drilling discharges in OCS waters are unlikely to affect kelp beds due to the distance of these operations from the kelp beds. In general, effects on other marine plants and invertebrates are expected to remain low under the cumulative case.

(3) Effects of Construction Activities: Construction activities related to possible State leasing of nearshore tracts comprise the only addition to the cumulative case. Offshore-construction and siting activities that are part of the Red Dog Mine project will occur in the southeastern Chukchi Sea and in the vicinity of Kivalina and are not expected to affect marine plants and invertebrates in the northeastern Chukchi Sea.

Construction could involve causeways, pipelines, gravel islands, and foundations for mobile drilling units. Because they are limited both spatially and temporally, effects from these activities or structures are generally expected to be low. If construction activities occurred in Peard Bay, benthic invertebrates could incur a moderate effect since localized, long-term changes would occur; and a very high effect is possible if species are restricted in their distribution to Peard Bay.

The kelp-bed communities in the northeastern Chukchi Sea are vulnerable to effects from construction activities because they are uncommon and apparently have very spatially restricted distributions. If construction occurred within these communities, a very high effect could result. In general, however, due to their limited areal extent and period, cumulative construction activities are expected to have a low effect on most marine inverterbrates and plants in the northeastern Chukchi Sea.

(4) Effects of Seismic Disturbance: The amount of seismic exploration conducted in Arctic Region planning areas increases to 12,512 km (7,718 mi) in the cumulative case. Since seismic exploration is not known to have adverse effects on marine plants and invertebrates, any additional testing under the cumulative case is not expected to change the level of effect. Therefore, the cumulative effect of seismic exploration on marine plants and invertebrates is expected to remain very low.

The base case of the proposal would add two oil spills to the cumulative case over the near-quarter century of the Sale 126 area. which represents a significant fraction of the cumulative total projected number of oil spills. This cumulative total, however, remains insignificant when the extended time and limited area contacted are considered, i.e., ten oil spills of ≥ 1,000 bbl that could occur over a period of this many years. Likewise, drilling discharges from the base case would add about 59,000 short tons of drilling discharges, again a significant addition to the total discharge under the cumulative-case total of about 98,600 short tons. These discharges, however, would affect only a small area and the increment would not appreciably expand them. Other offshore oil and gas activities, such as seismic surveys and construction (platforms and pipelines), have virtually no effect or only a limited, short-term effect on lower-trophic-level organisms. The end result is that the base case of the proposal would not change the low effect of the cumulative case on lower-trophic-level organisms.

CONCLUSION: The effect of the cumulative case on lower-trophic-level organisms is expected to be LOW.

d. Effects on Fishes, Except Pacific Salmon: Proposed and existing development would result in cumulative activities that could affect the fish resources of the region. These activities include both onshore and offshore State and Federal oil and gas leasing in the Beaufort and Chukchi Sea region and onshore mining. Pacific salmon, as a migratory species, are considered separately in Section IV.H.2.b.1.

Onshore oil and gas development that could affect fish resources of the region includes leasing operations of the National Petroleum Reserve-Alaska (NPR-A), the Arctic Slope Regional Corporation, and the State of Alaska. Effects on fish resources from these leasing activities could result from construction activities (roads, pipelines, well pads), oil spills entering lakes or river systems, withdrawal of water from critical fish-overwintering sites, and introduction of drilling discharges into lakes or river systems. These potential effects have been detailed in the NPR-A FEIS (USDOI, BLM, 1983). Effects may be mitigated to a certain extent by measures proposed by regulatory agencies (BLM, USFWS, U.S. Army COE, State of Alaska, and NSB). Under the base case, oil spills from onshore pipelines that contacted fish in major freshwater rivers were thought likely to produce a very high effect on fishes in the oil-contaminated river systems.

Since activities projected for the NPR-A also involve an onshore pipeline with similar likelihood of an oil spill occurring and contacting a major river, a very high effect on fishes is even more likely under the cumulative case. A combination of the pipelines for Sale 126 and NPR-A increases the likelihood that a large spill could occur and contact a major river. The likelihood of fish in the Colville River being affected also increases; thus, a very high effect is more likely than under the base case.

In the cumulative case, there is only a slight increase in the likelihood that oil spills from proposed and existing Federal leases would occur and contact the nearshore area. The most likely number of ≥ 1,000-bbl spills within the offshore Arctic is ten.

The likelihood of oil reaching the nearshore area during conditions that would promote sinking and mixing into the sediments is remote. The probability that one or more offshore oil spills would occur and contact important fish habitats, such as lagoons and estuaries, would not change significantly from the base case to the cumulative case (effects are most likely to be low). Moderate effects are possible for some anadromous fishes (salmon, rainbow smelt, and arctic char) and capelin if spawning-year individuals, aggregated multiaged assemblages, or a year-class of young were affected by a spill in nearshore waters. A large spill from the projected onshore pipeline is likely to have a very high effect on fishes by affecting overwintering and rearing habitat, sensitive lifestages, and/or concentrations of fishes in freshwater. Therefore, cumulative oil-spill effects on the fishes from proposed and existing Federal OCS leases range from low to very high.

Existing and proposed State leasing would have a greater likelihood of causing effects on fish in nearshore waters than would Federal offshore activities because of the proximity of State leases to nearshore areas, where the highest densities of fish are located. Oil spills from offshore State leases would occur in nearshore waters and, therefore, would have a greater likelihood of being incorporated in nearshore sediments in an unweathered state. Further, the chance of a spill occurring and contacting a major estuary or lagoon is greater. Therefore, the likelihood of moderate effects on fish from oil spills occurring on State leases is greater than for the base case if a spill occurred.

Drilling discharges from State and Federal offshore leases would not add significantly to the potential effects on fish. Formation-water discharges generally are prohibited in waters less than 10 m deep (which covers a large portion of the State waters), drilling discharges are prohibited under ice except under certain circumstances, and oil-based drilling discharges are prohibited. Therefore, drilling discharges associated with cumulative activities would have very low effects on the fishes of the Sale 126 area.

Seismic-disturbance effects on fish from these cumulative activities would remain very low for the base case because of the prevalent use of airguns or their close equivalents for this activity and their relatively harmless effect on fish.

Dredging in State waters would increase the number of sites where effects on fish could occur. Dredging that occurred in these nearshore waters would have a higher probability of entraining fish because of the higher densities of fish and larvae; however, the mobile nature of most adult fish species in this region would preclude all but relatively small numbers from being entrained. An exception, the fourhorn sculpin, would be more susceptible due to its low mobility and demersal behavior; however, this species is numerous and broadly distributed, so dredging activities on fishes of the Sale 126 area would be very low.

Possible coal mining from Cape Lisburne to Wainwright could affect the nearshore waters by directly increased turbidity in these waters or by an increased sediment load in nearby streams. Anadromous fishes may encounter the increased turbidity in the freshwater streams, which could affect the egg and larval stages. Onshore mining would have a low effect on the fishes of the Sale 126 area.

Drilling discharges in the cumulative case would increase somewhat but are regulated more in the shallow-water area, so a large amount is not expected in the nearshore area. Therefore, the effect of discharges on fishes of the Sale 126 area would remain very low. Construction activities would increase in the cumulative case; however, the effect on the fishes of the Sale 126 area would remain low, since any disturbance or displacement by construction would be temporary. Seismic disturbance may increase, but the prevalent use of airguns would result in a very low effect on fishes.

Marine and anadromous fish species of the Sale 126 area might be subjected to an additional two oil spills of $\geq$ 1,000 bbl from the base case of the proposal as part of the cumulative case. The base case of the proposal would also add drilling discharges, offshore construction, and seismic-survey trackline miles to the cumulative case. These increments, however, are comparatively small in number and in area affected, and can extend over a period of time. Therefore, the effect of the base case of the proposal would not change the cumulative-case low effect on fishes in marine waters or the very high effect on freshwater fishes.

CONCLUSION: The effect of the cumulative case on fishes is expected to be LOW in marine habitats and VERY HIGH in freshwater habitats.

e. Effects on Sea Otter and Harbor Seal: The additional effects of other ongoing and planned projects on the the sea otter and harbor seal are discussed in this section. Although these two species do not occur in the arctic region, they are considered here because the proposed transport of oil from this sale area via the TAP and tanker through Prince William Sound and southeast Alaska to southern ports would expose populations in the Gulf of Alaska region to some of the potentially adverse effects of petroleum development. Regional sea otter and harbor seal populations also could be affected by oil spills originating from development on current and future Bering Sea leases, future Gulf of Alaska leases, or State of Alaska leases in Cook Inlet. Spills of tanker origin also could occur as a result of development in these areas; effects could be especially adverse if spills occurred in the vicinity of Unimak Pass or in the northern Gulf of Alaska. This analysis assumes that all of the projects listed in Table IV-A-2 reach developmental stages, although the probability of any or all of them doing so generally is unknown. The State of Alaska lease sales listed have been deferred from the current State 5-year lease schedule but may be reinstated. The principal adverse effects of these projects on marine mammal populations would result primarily from oil spills, disturbance, and habitat alteration from construction or other activities. Subsistence harvests and commercial fishing operations also may have significant effects.

Current and future arctic region oil production transported through the TAP could place at risk significant portions of sea otter and harbor seal populations occupying Prince William Sound and the Gulf of Alaska by exposing them to spills from tankers transporting the oil to southern ports. Sea otters are resident from the northern Gulf of Alaska westward and in scattered localities in the northeastern gulf and southeast Alaska. Harbor seals are resident throughout the Gulf region as well as in coastal areas south to Baja California. The harbor seal population apparently has experienced significant declines in some areas in recent decades (Hoover, 1988). Among the few areas where documentation exists, the decline at Tugidak Island (Kodiak area) apparently has been precipitous; however, repeated census data necessary for monitoring the regional population are extremely limited.

Sea otters are highly susceptible to oiling, and there also could be local effects on the survival of young harbor seals if a spill occurred during the pupping season, as did the 1989 Exxon Valdez tanker oil spill in Prince William Sound (11 million gal or 260,000 bbl of oil). Surveys following the Exxon Valdez spill have provided some evidence of the effects that may result from a major release in this area. Indications from reconnaissance flights are that the Prince William Sound sea otter population, and possibly the population occupying the Kenai Peninsula and the Kodiak/Katmai area, were reduced substantially. The Prince William Sound sea otter population may have been reduced by 20 percent or more (estimated losses were 1,000 or more otters out of an estimated population of 5,000 [Irons, Nysewander, and Trapp, 1988]). The oil spill also adversely affected the survival of harbor seal pups at pupping areas in Prince William Sound that were contaminated by oil. It is likely that local assemblages or populations of sea otters in heavily contaminated coastal areas of Prince William Sound will take more than one to two generations (a high effect) to recover from the spill.

If one or more large tanker spills (>100,000 bbl) occurred in Prince William Sound over the life of arctic oil development, it is expected that a localized high (1-2 generations), or short-term regional (moderate) effect on the sea otter populations, and perhaps a short-term (within 1 generation: moderate) effect on the harbor seal population would occur as a result of transportation of arctic oil through the TAP and by tanker through Prince William Sound, especially if the oil reached the Kodiak Island, Alaska Peninsula, or Unimak Pass areas. Spills in the Unimak Pass area could contact a substantial proportion of their populations in this area. In combination with a severe winter, a spill in this area could have serious adverse consequences. This proposed sale is expected to contributerelatively little to the overall cumulative effect on these species.

CONCLUSION: While local populations of sea otter and harbor seal could experience HIGH effects, the overall effect of the cumulative case on these two species is expected to be MODERATE.

f. Effects on the Economy of the North Slope Borough:

(1) Effects on NSB Revenues and Expenditures: Cumulative-case projects could provide additional revenues to the NSB in the form of property taxes and could provide additional employment opportunities for residents. Projects that increase NSB property-tax revenues probably would allow increased NSB hiring of residents. Projects that expand employment opportunities in the region without significantly increasing NSB property-tax revenues may generate interest in employment from residents. The expected revenue and employment effects of the cumulative-case projects are considered by category--existing developments, exploration and potential development, and future lease sales. Most of the existing developments were considered as part of the existing-conditions case. The remainder of the existing developments that were not considered are expected to have a moderate effect on NSB revenues and employment.

The overall revenue and employment effects of these projects could be beneficial, but the magnitude and timing of these effects are extremely difficult to estimate. Major uncertainties exist about future world-energy prices; arctic-development technology; scale, timing, and location of developments; and hiring practices. If and when these factors result in a downturn of development activity, households (especially in the smaller communities) may have trouble maintaining the standards of living attained during boom periods.

(2) Effects of Subsistence-Harvest Disruptions: Cumulative-case oil and gas projects in the Chukchi Sea region could affect subsistence resources and, in turn, subsistence harvests as a result of oil spills, noise and traffic disturbance, or disturbance from construction activities associated with pipelines and shorebase facilities.

(3) Effects of Oil Spills: Under the base case, oil spills are expected to cause significant subsistence-harvest disruptions that result in high effects on the NSB economy. It is not expected that the level of effect for the cumulative case would be any higher.

(4) Effects of Industrial Activities: Industrial activities such as noise and traffic disturbance and construction activities associated with the base case are expected to have high effects on the bowhead whale for Wainwright. Moderate or low levels of effects would result from the base case for other subsistence resources in the communities of concern. All projects associated with the cumulative case in the Chukchi Sea and mid-Beaufort Sea regions would most likely exacerbate the situation. Since the bowhead whale harvest occurs within a short timeframe, disruptions during this time could affect the entire season's harvest. In addition, the belukha whale harvest for Barrow and Wainwright is expected to be affected to a greater degree for the cumulative case (see Sec. IV.H.11), resulting in a high effect. Construction activities associated with cumulative-case projects in the Chukchi Sea (except for the Red Dog Mine) and Beaufort Sea regions are expected to have high effects on the subsistence harvest of caribou for the communities of Barrow, Wainwright, Atqasuk, and Nuiqsut.

Summary: The extensive interconnections between the communities and the high dependency on subsistence resources make it likely that cumulative-case projects would have a high effect on the economy of the NSB. The conclusion of effects on the economy for the base and cumulative cases is high in both cases. However, the cumulative-case projects would contribute significantly to the effect; but the effect would still be within the range of high according to the definitions used.

CONCLUSION: Cumulative effects, including those resulting from the proposal, on the economy of the NSB are expected to be HIGH.

g. Effects on Subsistence-Harvest Patterns: Cumulative effects include effects of the proposal and the following projects: NSB CIP, OCS Sale 109, previous Federal OCS lease sales, future OCS Beaufort Sea lease sales, and future State oil and gas lease sales. Some of the effects levels resulting from this analysis are predicated on the proposed action; however, most of the effects are based on previous and future Federal OCS lease sales. (For a complete list of these ongoing and planned projects, their scenarios and timetables, and the resource estimates involved, see Table IV-A-2 and Appendix E.) The probability of any or all of the ongoing and planned offshore and onshore projects reaching the development stage is unknown; however, the following discussion assumes that all of these projects would reach the development and production stages.

The effects of these projects on subsistence may occur because of oil spills, noise and traffic disturbance, or disturbance from construction activities associated with onshore and offshore pipelines and the shorebase facility. Noise and traffic disturbance might result from seismic activities, the building or installation and operation of drilling facilities, and supply efforts.

(1) Effects of Oil Spills: According to Table IV-A-1, approximately ten oil spills are estimated to occur in arctic waters with a >99-percent chance that a spill of ≥ 1,000 bbl would occur. Oil spills associated with the Sale 126 area would tend to move westward away from the coast. Spills occurring under the cumulative case from Beaufort Sea leases or Canadian tankering would move westward, north of the sale area, and would not contact the Sale 126 subsistence-harvest areas. Overall cumulative effects on subsistence-harvest patterns as a result of oil spills are expected to be moderate.

(2) Effects of Noise and Traffic Disturbance: Geophysical (seismic) exploration would increase somewhat under the cumulative case, but it is not expected to greatly affect the size of regional biological populations of species used for subsistence purposes. Noise and traffic disturbance from offshore facilities also may affect marine-subsistence activities. In the cumulative case, the increased amount of oil-related traffic makes it likely that subsistence-harvest activities could be occasionally disrupted by boat and air traffic. Since most marine-hunting activities occur within a wide area of open water, such interruptions typically may cause boat crews to hunt longer or take extra trips but may not reduce the overall harvests of marine mammals or seabirds. In addition, because of their short and ice-condition-dependent seasons, bowhead whale harvests are more likely to be affected by noise and traffic disturbance than are other forms of marine mammal hunting (other than belukha whaling), as discussed for the base case. Since the bowhead whale harvest in all communities except Barrow tends to be quite small (1-2 whales/yr), noise disturbance from drilling units, icebreakers, and other vessels could cause this small harvest to become locally unavailable for the entire season, resulting in a moderate effect. Such activities already may have occasionally affected subsistence hunting. For example, Kaktovik whalers contend that their 1985 fall whaling season was adversely affected by vessels related to oil development operating in open-water areas. Effects on bowhead whaling due to noise and traffic disturbance are most likely to be moderate in Wainwright and Point Hope.

Effects from noise and disturbance on the belukha whale harvest could be increased under the cumulative case. Increased air traffic and exploratory activities east of Point Barrow and near Peard Bay could cause belukha whales to become locally unavailable for a period of time, resulting in moderate effects on the belukha harvest. At Wainwright and Barrow, cumulative-case effects on the subsistence harvests of belukha whales are expected to be high; thus, this would increase effects from noise and traffic disturbance from moderate under the base case to high under the cumulative case. Other subsistence resources are expected to experience low or very low effects as a result of increases in noise and traffic disturbance under the cumulative case. Overall cumulative effects on subsistence-harvest patterns in the Sale 126 area as a result of noise and traffic disturbance are expected to be high.

(3) Effects of Construction Activities: Cumulative-case effects due to construction activities on Wainwright's bowhead whale harvest would remain high, the same as for the base case, because of the Sale 126 offshore-pipeline landfall and shorebase facility at Point Belcher. Effects on Wainwright's belukha whale harvest would remain low, the same as for the base case.

Short-term effects from the construction of Sale 126 onshore support facilities and a pipeline corridor could cause short-term disruptions to caribou and seabird hunting, resulting in moderate effects on caribou and seabird harvests. The construction of an onshore pipeline from Point Belcher to the TAP may cause moderate effects on Wainwright's caribou harvest.

Onshore pipelines and support roads may affect caribou harvests over the long term. Cumulative oil and gas activities of proposed Sale 126 and other offshore and onshore projects would subject caribou herds on their summer ranges and calving ranges throughout the North Slope to a variety of oil development projects. Cumulative disturbance of caribou from pipelines/roads and associated road traffic is likely to cause low, or short-term biological disturbances on caribou. At present, cumulative oil development in the Prudhoe Bay/Kuparuk industrial complex has caused minor displacement of caribou from a small portion of the calving range, with no apparent effect on herd abundance or overall distribution. The cumulative displacement of cow/calf groups from additional parts of the calving range--because of the development of additional oil fields in the Prudhoe Bay/Kuparuk area and from ANWR, and because of Canadian oil development--could represent a moderate biological displacement of caribou from available calving habitat and could have a moderate effect on the overall distribution of caribou. These biological effects could cause caribou to become locally unavailable to subsistence hunters for a period of time each year, resulting in high effects on the subsistence harvest of caribou for Barrow, Wainwright, Atqasuk, and Nuiqsut.

The cumulative effects of oil spills on Barrow's walrus harvest would remain moderate, as for the base case. The cumulative effects of noise and traffic disturbance on Barrow's bowhead and belukha whale harvests are expected to be high. The effects of construction activities and noise and traffic disturbance are expected to cause moderate effects on Barrow's caribou harvest. Effects of an oil spill on Barrow's seal and fish harvests would remain the same as for the base case--low. The overall cumulative effect on Barrow's subsistence-harvest patterns is expected to be high.

Cumulative effects on Wainwright's subsistence harvest of bowhead whales are likely to be high due to the pipeline landfall and shorebase at Point Belcher and noise associated with construction activities in Peard Bay. These activities in the Peard Bay area are also likely to cause moderate effects on Wainwright's belukha whale, walrus, and caribou harvests, while effects on fishes and birds are expected to be very low. Cumulative effects from oil spills and noise and traffic disturbance on Wainwright's seal harvests are expected to remain low, as for the base case. The overall cumulative effect on Wainwright's subsistence-harvest patterns is expected to be high.

Cumulative effects from oil spills and noise and traffic disturbance associated with Federal lease sales on Point Lay's belukha whale harvest are expected to be moderate. Effects from oil spills on Point Lay's walrus and bird harvests would remain moderate, as for the base case. Oil spills and noise and traffic disturbance would cause low effects on Point Lay's caribou and seal harvests. Cumulative effects on Point Lay's fish harvests would be very low. However, effects on Point Lay's subsistence harvests are expected to be high if State lease sales in the Chukchi Sea are reinstated on the State's 5-year lease-sale schedule. Thus, the overall cumulative effect on Point Lay's subsistence-harvest patterns is expected to increase to high.

Effects would not increase in the cumulative case for Point Hope's subsistence-harvest patterns because of the absence of activity in the area other than from Sale 126 and possible State lease sales. Cumulative effects of oil spills on Point Hope's subsistence-harvest patterns are expected to be very low. Effects on Point Hope's bowhead whale harvest are expected to be moderate. Effects on Point Hope's belukha and bird harvests would remain low, as for the base case. Effects on other subsistence harvests in the area are expected to be very low. Effects on Point Hope's subsistence harvests are expected to be low for State lease sales in the Chukchi Sea. The overall cumulative effect on Point Hope's subsistence-harvest patterns is expected to be moderate.

Effects on Atqasuk's walrus harvest (done in conjunction with Barrow) would be the same as for the base case--moderate. Other effects on Atqasuk's and Nuiqsut's subsistence harvests would remain the same as for the base case, with the exception that moderate effects on the caribou harvest may occur due to road and pipeline construction and the presence of associated vehicle traffic. A further exception to the base case would be the high effects on Nuiqsut's and Atqasuk's subsistence-fish-harvest under the cumulative case. High effects are expected on Atqasuk's and Nuiqsut's subsistence harvests from State and Federal leases in the Beaufort Sea and in the NPR-A, and from possible development of the ANWR. The overall cumulative effects on Atqasuk's and Nuiqsut's subsistence-harvest patterns are expected to be high. Overall, the contribution of the proposal to the cumulative case is expected to be significant for Wainwright, Atqasuk, Point Lay, and Point Hope; substantial but of lesser proportions than Wainwright for Barrow; and modest for Nuiqsut.

CONCLUSION: The effects of the cumulative case on subsistence-harvest patterns are expected to be HIGH for Barrow, Wainwright, Point Lay, Atqasuk, and Nuiqsut and MODERATE for Point Hope.

h. Effects on Sociocultural Systems: Cumulative effects on sociocultural systems are assessed as the aggregate result of effects associated with this lease sale in combination with other activities or projects identified in Appendix E. Specifically assessed are the following projects: NSB CIP, OCS Sale 109, previous Federal OCS lease sales, future OCS Beaufort Sea lease sales, and future State oil and gas lease sales. Some of the effects levels resulting from this analysis are predicated on the proposed action; however, most of the effects are based on previous and future Federal OCS lease sales. Barrow is identified as a major air-support base for other projects and is the regional center for the North Slope. Beaufort Sea Sale 97 and Chukchi Sea Sale 109 FEIS scenarios identify Point Belcher as the location of an enclave near Wainwright and as the landfall for an onshore pipeline to the TAP.

Projects and activities in the cumulative case include projected offshore development from Chukchi Sea Sale 109, Beaufort Sea Sale 97, and the Diapir Field Lease Offering (Sale 87); onshore oil development in Prudhoe Bay and other fields; and the Red Dog Mine project. In the cumulative case, high effects of displacement of sociocultural systems are concluded in the Diapir Field Lease Offering (Sale 87) FEIS, the Beaufort Sea Sale 97 FEIS, and the Chukchi Sea Sale 109 FEIS (USDOI, MMS, 1984a, 1987a, 1987b) for communities in those lease-sale areas (Barrow, Wainwright, and Nuiqsut are the only communities affected by activities in those sale areas that also would be affected by Sale 126).

(1) Effects on Social Organization: In the cumulative case, effects on social organization would be the result of effects of industrial activities, changes in population and employment, and effects on subsistence-harvest patterns. These effects would be similar to those described for the proposal; however, the level of effects would be increased due to the intensity of activity in the cumulative case. Additional air traffic and growth in the number of non-Natives in the North Slope would increase the interaction between Natives and non-Natives and could cause additional stress between these groups. Increases in population growth and employment would be long-term in the cumulative case and would cause disruptions to (1) the kinship networks that organize the Inupiat communities' subsistence-production and -consumption levels, (2) extended families, and (3) informally derived systems of respect and authority (primarily respect of elders and other leaders in the community). High cumulative effects on subsistence-harvest patterns (which also would be long-term in the cumulative case) would affect Inupiat social organization through disruptions to their kinship ties, sharing networks, task groups, crew structures, and other social bonds. Effects on sharing networks and subsistence-task groups could cause a breakdown in family ties and the communities' well-being as well as tensions and anxieties leading to high levels of social discord. In the cumulative case, these disruptions to the social organization would be long-term and would cause displacement of the existing social organization.

(2) Effects on Cultural Values: Effects on cultural values in the cumulative case would be the result of effects of industrial activities, changes in population and employment, and effects on subsistence-harvest patterns. These effects would be similar to those described for the proposal; however, the level of effects would be higher due to the intensity of activity in the cumulative case. High effects on social organization in the cumulative case would lead to a decreased emphasis on the importance of the family, cooperation, sharing, and subsistence as a livelihood, and an increased emphasis on individualism, wage labor, and entreprenuerialism. Increased interaction with oil industry workers in the cumulative case

would result in increased stress and strain on traditional Inupiat institutions. In the cumulative case, high long-term effects are expected to affect subsistence-harvest patterns. Chronic, long-term disruptions of subsistence-harvest patterns would affect subsistence-task groups, have a tendency to displace sharing networks, and consequently cause a decrease in the importance of subsistence as a cultural value.

(3) Effects on Other Issues: In the cumulative case, increases in social problems (i.e., rising rates of alcoholism and drug abuse, domestic violence, wife and child abuse, rape, homicide, and suicide) would be issues of concern. The NSB is already experiencing problems in the social health and well-being of its communities; however, additional development, including offshore oil development, on the North Slope would lead to further disruptions of their social health and well-being. These long-term effects would cause a displacement of existing sociocultural institutions.

Cumulative effects of sociocultural systems would be high in Barrow and Wainwright because high effects are expected from Sale 97 (Barrow and Wainwright and the Diapir Field Lease Offering (Barrow only), in addition to the moderate (Wainwright) and low (Barrow) effects described in both the Sale 109 FEIS and for this proposal. Low effects are expected in Point Lay, Point Hope, and Atqasuk under the base case of the proposal. These effects would increase slightly for Point Hope in the cumulative case due to effects from the Red Dog Mine project; however, the effect would remain low. Point Lay and Atqasuk would not be directly affected by other development on the North Slope and would not experience more than low effects as a result of effects from the proposal. Overall, the contribution of the proposal to the cumulative case is expected to be significant for Wainwright; substantial but of lesser proportions than Wainwright for Point Hope, Point Lay, and Atqasuk; and neglegible for Nuiqsut.

CONCLUSION: The effect of the cumulative case on sociocultural systems is expected to be HIGH.

i. Effects on Archaeological Resources: The cumulative effects of other private, State, and Federal projects, together with the effects of the proposal, would result in a likely chance of interaction with archaeological resources. These cumulative industrial activities are discussed in detail in Appendix E, and those activities that have direct and indirect effects on archaeological resources are summarized in the following paragraphs.

(1) Effects of State of Alaska Oil and Gas Leasing: The State of Alaska's 5-year leasing schedule has included--and may include over the life of the Sale 126 proposal--lease areas where potential exploration and development could affect the archaeological sites shown in Figures III-C-18 and III-C-19. These areas are at Point Belcher, south of Point Lay, and inland (Graphic No. 3). These proposed activities (Table IV-A-2), discussed in Appendix E, would have to be consistent with legislative mandates presently in effect that ensure protection of archaeological resources (i.e., the Coastal Zone Management Act and the Alaska Historic Preservation Act).

Any construction activities on wetlands or navigable waters will require Federal permits in accordance with Section 10 of the Rivers and Harbors Act of 1899 or Section 404 of the Federal Water Pollution Control Act, as amended by the Clean Water Act of 1977. Archaeological-clearance surveys must be completed prior to commencement of such activities, thereby ensuring adequate protection through the U.S. Army COE permitting process.

Arctic Slope Regional Corporation Oil and Gas Leasing: The full extent and nature of activities proposed under this project are not completely known; however, several land-selection areas along the river where many sites are located would be affected by mineral activity if it occurred. It is assumed that any possible petroleum exploration and/or development would generate potential onshore effects on archaeological resources similar to those discussed under NPR-A (USDOI, MMS, 1984a). It is important to note that these activities would be conducted on privately owned land. No oil discoveries have been made to date (Table IV-A-2). The North Slope Borough's Land Management Regulations (Title 19) set policy and provide protection for archaeological resources. Due to low-level exploratory activity, the effects of the leasing activities on archaeological resources would be low.

(2) Effects of Future Federal Oil and Gas Leasing: Potential effects on unknown offshore sites could result with respect to future proposed OCS lease sales (see Appendix E). With respect to onshore sites where non-Federal land could be involved, the Coastal Zone Management Act and the Alaska Historic Preservation Act would ensure adequate protection of archaeological resources. Activity in the Beaufort Sea is expected to result in low cumulative effects. The contribution of the Sale 126 proposal to the cumulative case involves about one and one-half times that of the base case. The contribution of the proposal to the cumulative case is moderate.

(3) Effects of Canadian Oil and Gas Activities: The U.S. area adjacent to possible Canadian tanker routes (see Appendix E) contains archaeological sites. Adverse effects are possible if a tanker oil spill occurred and cleanup activities necessitated people and equipment crossing lands containing archaeological sites to get to contaminated areas. Effects on the archaeological resources of the Chukchi Sea and shore are expected to be low.

Overall, the proposal is expected to contribute greatly to the cumulative case.

CONCLUSION: The effect of the cumulative case on archaeological resources is expected to be MODERATE.

j. Effects of Land Use plans and Coastal Management Programs:

(1) Effects of Land Use Plans: The NSB has approved a master plan for the Endicott project and development permits for activities in the NSB contingent upon conditions to mitigate potential adverse effects and foster beneficial effects. If future developments lead to greater levels of adverse effects on onshore resources, more stringent conditions may be imposed to so the project can conform with more stringent requirements that are applied as access and resources are stressed to a greater extent. For example, if the potential effects of a development led to a decline in subsistence resources below the level needed by residents or precluded user access to the subsistence resources, the more stringent policies of NSBMC 19.70.050.A and B would apply. Ultimately, the NSB may prohibit development on lands subject to its jurisdiction.

Effects resulting from the Red Dog Mine, Canadian oil development, or development on Federal lands could lead to the imposition of stringent conditions for development to conform with the more stringent policies noted previously. This could occur because migrating resources are subject to effects of developments outside the jurisdiction of the NSB as well as within the Borough, and negative effects could reach higher levels in spite of the land management policies. Multiple road networks could magnify effects on caribou and conflict with NSB regulations for transportation and pipeline construction, and multiple causeways could magnify the effects on coastal resources and processes. These policies are cited below along with the relevant NSBCMP policy.

(2) Effects of Coastal Zone Management: Activities included in the cumulative analysis may magnify effects or generate types of effects different from those of the proposal. These differences are the focus of this analysis.

(a) Energy Facilities (6 AAC 80.070) and Transportation and Utilities (6 AAC 80.080): Cumulative effects on resources and uses protected through coastal management policies are accentuated in the cumulative case; both the likelihood and magnitude of effects would be greater.

Along the Beaufort Sea coast, free passage of fish is of greater concern in the cumulative case because additional causeways may be constructed. ACMP standard 6 AAC 80.070(b)(12) requires that causeways "allow for the free passage and movement of fish and wildlife with due consideration for historic migration patterns." Studies now underway should help the NSB and Federal and State agencies make informed decisions on causeways. However, given past experience, conflicts with ACMP Standard 6 AAC 80.070(b)(12) and NSBCMP 2.4.4(i) (NSBMC 19.70.050.I.9) are likely.

The effects of pipelines and roads also are magnified in the cumulative case. The Red Dog Mine has a road between the De Long Mountains and the Chukchi Sea. Oil development would lead to an extensive network of pipelines and associated roads extending east from Pump Station No. 1 to the Canadian border, west from Pump Station No. 1 along the Beaufort Sea, west from Pump Station No. 2 to the Chukchi Sea, and south from Pump Station No. 1 to Valdez. If these networks bisected important calving areas, effects could be greater and could increase the potential for conflict with 6 AAC 80.070(b)(1), (2), and (13) of the statewide standards for energy facilities (described in Sec. IV.C.14 [b][3]) and NSBCMP 2.4.5.1(g) (NSBMC 19.70.050.J.7) district policy for pipeline construction (described in Sec. IV.C.14 [b][4]).

(b) Subsistence (6 AAC 80.120): High levels of effects on subsistence-harvest patterns evident in the base case are more likely to occur and to occur in more communities in the cumulative case. Higher levels of effects reflect the increased likelihood of oil spills, longer periods of disruptive activities, and conversion of more shore areas from subsistence use to support facilities that could affect both the availability of subsistence resources and access to them. These effects accentuate potential conflicts with the Statewide standard that guarantees opportunities for subsistence use of coastal areas and resources and the NSBCMP policies that were addressed in Section IV.C.14.b(6) and may cause subsequent developments to fall into a more restrictive policy category. Rather than considering subsistence access as reduced or restricted (NSBCMP 2.4.5.1[b] and NSBMC 19.70.050.J.2), it may instead be considered precluded and, therefore, subject to NSBCMP 2.4.3(d) (NSBMC 19.70.050.D). However, at no point in Sections IV.H.3 through IV.H.9 and IV.H.11 is it evident that resources would be depleted below the subsistence needs of local residents (NSBCMP 2.4.3[a] and NSBMC 19.70.050.A).

(c) Habitats (6 AAC 80.130): All habitats noted as at risk in the base case are more likely to be adversely affected in the cumulative case and, therefore, lead to conflict with the ACMP statewide standard and the NSBCMP habitat policies identified in Section IV.C.14.b(7). Potential effects resulting from noise and disturbance on birds, mammals, and caribou are more likely in the cumulative case. Therefore, it is likely that NSBCMP 2.4.4(a) (NSBMC 19.70.050.I.1)--which curtails vehicles, vessels, and aircraft activity when and where it may affect concentrations of sensitive populations--will be implemented with greater scrutiny in all habitats.

In the offshore habitat, increased effects relate to the increased number of oil spills and the construction of additional causeways. The NSBCMP policy 2.4.4(i) (NSBMC 19.70.050.I.9), identified previously under transportation, deals with causeway installation. It is likely that it also will be related to achieving the objectives of the offshore habitat policy.

Development of State leases included in the cumulative case would increase the likelihood that barrier islands and lagoons would be affected. Sales for the Chukchi Sea have been removed from the State's lease-sale schedule; however, along the Beaufort Sea coast, Smith Bay, Camden Bay, and Beaufort Lagoon have been leased and a lease sale is scheduled in the vicinity of Elson Lagoon and the Plover Islands.

Tundra wetlands would be subject to significantly greater infilling. Oil development is anticipated on upland leases, to support offshore development, in NPR-A, and in the coastal plain of ANWR. Approximately 200 km^2 or 1 percent of the wetlands in NPR-A could be filled if development occurred within NPR-A. Another 64 km^2 could be filled as a result of a pipeline corridor associated with this sale. In ANWR, about 5 percent of the wetlands could be filled if development occurred on the coastal plain (Sec. IV.H.1.k). Coal development is possible at Cape Beaufort and hardrock mining in the De Long Mountains. Adverse effects on tundra and wetland nesting, feeding, and staging areas, particularly in the Teshekpuk Lake waterfowl-concentration area, the ANWR oil-development area, and the Mackenzie River Delta, could significantly affect marine and coastal birds and conflict with the standard for wetland habitat.

Pipeline and road crossings and gravel extraction would increase in riverine areas that are used extensively by anadromous fishes. The potential for onshore oil spills would be greater. This effect would conflict with the riverine-habitat policy.

Upland habitat used by caribou would be subjected to greater development. Avoidance by caribou cows with calves of areas with high levels of road and air traffic could affect caribou distribution or abundance. This effect would conflict with the upland habitat policy.

(d) Air, Land, and Water Quality (6 AAC 80.140): Greater adverse effects for water quality relate to problems associated with the erosion of gravel islands and ten spills of $\geq$ 1000 bbl. Artificial islands left to erode could result in local but persistent turbidity plumes. These would create a conflict with the ACMP statewide standard and district policies for water quality only if the effects exceeded Federal or State water quality standards.

Production in the cumulative case would exceed the significance level for NO_x air quality standards. As a result, lessees would be required to reduce emissions to preclude conflict with NSBCMP 2.4.3(h) (NSBMC 19.70.050.H), which requires that development comply with Federal and State air quality standards, and NSBCMP 2.4.4(c) (NSBMC 19.70.050.I.3), which specifically identifies airborne emissions as needing to meet the standards.

(e) Historic, Prehistoric, and Archaeological Resources (6 AAC 80.150): Numerous sites along the coast of the NSB have been identified as culturally important (NSB, 1984, 1989). Because of the vast areal extent susceptible to development in the cumulative case, opportunities for culturally important areas to be violated are increased significantly.

Summary: Potential policy conflicts would be more frequent and pervasive for the cumulative case than for the proposal. Along the Beaufort Sea coast, there is greater potential than there is along the Chukchi Sea coast for oil spills to affect coastal areas and for causeways to be constructed. Along the Chukchi Sea coast, areas most sensitive to development may be included in future State lease sales if these sales are reinstated in the State's 5-year lease schedule. Inland, development on the coastal plain of the ANWR may be permitted by Congress and may occur near Teshekpuk Lake; both areas contain sensitive habitat. Effects in the NSB could be compounded by those in the Northwest Arctic Borough and Canada. Given the potential for significant conflicts from other developments, the effects of this lease sale would generate a relatively minor portion of the onshore effects and possibly one-third of the offshore effects.

Policies that are most likely to conflict with potential development include those for energy-facility siting, transportation and utilities, habitat, subsistence, air and water quality, and cultural resources. Conflicts would arise from the siting and construction of shorebases, pipelines, roads and causeways; support activities; and associated noise and disturbance. Effects of oil spills would create a conflict with subsistence, several habitat policies, and the water quality standard. Overall, the proposal is expected to make a relatively significant contribution to the cumulative case.

CONCLUSION: Potential conflicts with land use and land and coastal management regulations in the cumulative case are expected to be HIGH.

k. Effects on Wetlands: The additive effects on wetlands of past, ongoing, and planned projects as well as the proposal are discussed in this section. Although the probability of any or all planned and ongoing projects reaching the development stage is generally unknown, this analysis assumes that all of the projects reach the development stage (see Graphic No. 3 for locations of existing projects and oil and gas leases). Gravel fill, onshore oil spills, thermokarst, road dust, and industrial contaminates are the primary factors affecting wetlands that are discussed in this section.

(1) Effects of Past Human Activities: During the early years of oil exploration

on the NPR-A and on the central coastal plain of the Prudhoe Bay area, trails across the tundra were commonly made with bulldozers during both summer and winter. Bulldozing was also used for excavating gravel, constructing drill pads and aircraft runways, disposing of sewage, and removing snow. Caterpillar tracks were most frequently used to create trails, and bulldozers were also used to build roads in which tundra peat was used as fill material. These bulldozer excavations and trails resulted in significant scarring of the coastal plain tundra wetlands across parts of the NPR-A and the central coastal plain. The removal/destruction of vegetation in these areas has resulted in thermokarst and hydraulic erosion where underlining permafrost has melted. The wetlands disturbance along these tracks has doubled due to thermokarst, and complete vegetation recovery has not taken place in 30 years. The bulldozing of tundra wetlands for roads is prohibited today. Where vegetation recovery has occurred, different plant species such as grasses and sedges have replaced the original plant communities and the bulldozer caterpillar tracks are still visible after 30 years.

Summer use of off-road vehicles used for seismic exploration, mining, and recreational and subsistence activities (track vehicles, four-wheel-drive trucks, and three-wheeled vehicles) across the tundra wetlands have resulted in effects ranging from compression of vegetation to destruction and removal of the vegetation mat. A single-pass vehicle track can be visible on the tundra for many years. Heavily used trails have resulted in damage to the vegetation that has persisted for decades after the trail is no longer used. Where vegetation has been removed in the tracks, the effects are similar to the bulldozer scars, with thermokarst occurring with significant local effects on some plant communities and aesthetic effects remaining for decades or more. Winter tracks from seismic exploration across the tundra wetlands also cause vegetation damage that persists for many years, especially where snow cover was sparse.

<u>Summary</u>: Past human activities on the coastal plain wetlands, including early oil exploration, have had significant local effects on vegetation across parts of the NPR-A and the central coastal plain (Prudhoe Bay area), particularily the use of bulldozers for building roads and heavily used off-road vehicle trails where the destruction and removal of wetland vegetation has occurred. Thermokarst has been extensive locally adjacent to some of these affected areas where the permafrost has melted greatly. The tracks and excavations have resulted in significant changes in the local plant communities, with grasses and sedges replacing other vegetation types in heavily damaged areas. However, these scars on the tundra wetlands have had no significant effect on the tundra ecosystem in general. The primary effect has been aesthetic, with these scars remaining on the tundra expected to continue to be visible for many years.

(2) <u>Effects of Ongoing and Recent Oil and Gas Activities</u>: Oil development on the central coastal plain, including the Prudhoe Bay, Kuparuk River, Lisburne, Milne Point, and Endicott fields and other undeveloped and unsuccessful exploratory-drill sites, has resulted in the filling in of wetland habitat with gravel for drill pads (40+ for the Prudhoe field), various oil-field facilities, camps, and storage pads (46 large pads in the Prudhoe Unit). The total tundra-wetland area covered by pads was estimated at 1,693 hectares in 1983 (Walker et al., 1987). In addition to covering wetland habitats, gravel pads result in flooding of some adjacent habitats with the formation of water impoundments by blockage of natural drainage patterns; and, in some cases, thermokarst occurs where the tundra's thermal regime is altered by the gravel pads. These effects are similar to that caused by gravel-road construction. Drilling and other industrial activities on the pads have resulted in some contamination of adjacent wetlands with oil and other contaminates that have had local effects on wetland invertebrates. However, there are no indications that contaminates have had significant effects on the ecosystem. The formation of the impoundments and thermokarst has resulted in changes in local plant communities adjacent to the pads and has affected bird use of adjacent wetlands. The densities of some bird species increase near pads with impoundments that have less human activities to disturb the birds. The pads have reduced or changed the amount of wetlands in the central coastal plain area by perhaps 2 percent.

Oil development on the central coastal plain has resulted in the construction of several hundred kilometers of roads through gravel filling of wetlands. In 1983, there were about 350 km of roads in the area covering an estimated 2,176 hectares of tundra wetlands (Walker et al., 1986). These roads have resulted in alteration of adjacent habitats by water impoundment, thermokarst, and road-traffic dust (effects usually confined to within 100 m on either side of the roads). These effects are the same as described under the base case for the proposal in regard to the pipeline-road corridor (see Sec. IV.C.15). Local changes in plant communties and birds densities and use of adjacent wetland habitats have occurred. However, the overall abundance of the birds and productivity of the wetlands have not been greatly reduced. Some of these local effects, particularly aesthetic effects on the tundra wetlands due to local effects on vegetation and topography, are expected to persist for many years beyond the life of the oil fields.

Recent seismic activities on ANWR for possible oil and gas exploration drilling occurred during the winter between 1984 and 1985, in which a total of 2,133 trackline kilometers of seismic line were run. These activities resulted in the compression and partial removal of the tundra vegetative mat, particularly where snow cover was sparse along the seismic lines. Vegetative damage was greatest intially in the tussock and shrub-tundra wetlands, with recovery being slower than in other vegetation types (Christiansen, 1990). The damage to tundra-wetland vegetation was far less than the damage done by earlier seismic exploration on NPR-A and the central coastal plain. Within the seismic lines, vegetation recovery was often different from the original plant community, leaving a visual indication of the seismic line even where recovery is occurring. The depths at which the permafrost has thawed within the seismic lines has increased since initial disturbance of the vegetation. Although the local effect on the plant-vegetation mat and wetland topography is not expected to have any significant effect on the wetland ecosystem in general, the visual presence of the seismic lines and scars on the tundra wetland are expected to persist for many years.

Summary: Recent and ongoing oil development in the central coastal plain/Prudhoe Bay area has resulted in the filling in of perhaps 2 percent of the tundra wetlands with gravel for the construction of drill pads and other facility pads (1,693 ha in 1983). The construction of over 350 km of roads has resulted in the loss of additional wetlands. Thermokarst, water impoundments, and contamination of tundra wetlands adjacent to the gravel pads has affected plant communities and invertebrates locally near the gravel pads. Road-traffic dust, thermokarst, and water impoundments have also had effects on plant communities and bird distribution within 100 m of the roads. These local effects have had no apparent great effect on the tundra-wetland ecosystem of the coastal plain in general. However, the local effects on vegetation and the visual appearance of the roads and pads are expected to persist for many years beyond the life of the oil fields. Seismic-exploration activities on ANWR have resulted in local vegetation damage within the seismic lines due to the compression and partial removal of the tundra-wetland mat. This local effect is expected to persist for many years.

(3) Effects of Proposed and Future Oil and Gas Development: Potential OCS oil development from oil and gas exploration in the Beaufort and Chukchi Seas, State of Alaska offshore exploration, and NPR-A leases, and proposed ANWR oil and gas exploration and possible development would result in the filling in of more tundra wetlands on the North Slope coastal plain. The OCS oil development scenarios are assumed to include offshore pipelines connecting to TAP by onshore-pipeline-road corridors. Development of OCS leases in the Chukchi Sea is assumed to include the construction of a 640-km-long pipeline and access road across NPR-A to the TAP (see Sec. IV.C.15) that would include the filling in of about 64 km^2 of tundra wetlands. Development of NPR-A leases is expected to use the same oil-transportation system as above but would include the filling in of additional wetlands if leases south of Barrow, south and east of Teshekpuk Lake, and near Umiat are developed (Graphic No. 3). Perhaps an additional 200 km^2 of wetlands would be filled in from NPR-A development and adjacent wetlands would be affected by water impoundments, thermokarst, and contaminants from industrial operations. The effects on plant communities, invertebrates, and birds are expected to be local near development facilities. The coastal plain and tundra-wetland area on NPR-A is much larger than the coastal plain near Prudhoe Bay, and the loss of wetland habitat is likely to represent perhaps 1 percent of the total wetlands available on NPR-A.

Development of OCS leases in the Beaufort Sea west of Harrison Bay is assumed to include a pipeline landfall in the Pitt Point/Camp Lonely area (USDOI, MMS, 1990a), with an onshore-pipeline-road corridor crossing the NPR-A/Teshekpuk Lake area and connecting to the Kuparuk oil field pipeline. The construction of this pipeline road would involve filling in some wetlands that have high waterfowl use. Construction of the road and pipeline would result in the filling in of perhaps 4 to 5 km^2 of tundra wetlands and would affect vegetation and birds' use of adjacent wetlands due to thermokarst, water impoundments, and road-traffic dust. These effects are expected to be local and similar in magnitude to those described under the base case of the proposal (see Sec. IV.C.15).

The OCS development in the Beaufort Sea east of Cape Halkett is assumed to have landfalls for offshore pipelines at Oliktok Point and Point Thomson, with pipeline-road corridors connecting with existing Kuparuk and Endicott pipelines. An additional 20 km of pipeline roads would fill in and alter a few square kilometers of tundra wetlands and have local effects near the corridors.

Potential oil development on ANWR is likely to include a pipeline-road corridor connecting to the TAP. The type of tundra wetlands on ANWR is primarily moist tundra, while wet tundra is more predominant in the Prudhoe Bay area and on NPR-A. Because the habitat is less wet and a lot fewer lakes and ponds are present on ANWR, the construction of roads and gravel pads is not expected to result in many impoundments being formed adjacent to the roads and gravel pads. However, thermokarst and effects on wetlands topography may be a greater problem on the dryer wetlands of ANWR. The effects of ANWR oil development on tundra wetlands are expected to be similar to the effects on wetlands in the central coastal plain (Prudhoe Bay area) and on NPR-A. The filling in of wetlands with gravel, thermokarst, road-traffic dust, and some water impoundments is expected to occur. The percentage of total wetlands affected could be greater because the coastal plain on ANWR is much narrower north-south (only about 40 miles wide between the Brooks Range and the arctic coast) than the coastal plain on NPR-A and in the Prudhoe Bay area. Perhaps 5 percent of the total wetlands could be affected by oil development on ANWR. Although thermokarst may be greater on ANWR, this effect is not expected to reach beyond 100 m of the roads, gravel pads, and other facilities. The effects on tundra wetlands are expected to be local with changes in plant communities, wetland topography, and aesthetic effects on the environment persisting for many years after the life of the field.

The habitat use of wetlands by birds and other wildlife is expected to be reduced locally very near (perhaps within 100 m) the pipelines, roads, gravel pads, and other facilities. Oil development on ANWR is not expected to have great effects on the tundra-wetland ecosystem in general.

Summary: Potential OCS oil development is assumed to include the construction of onshore pipeline-road corridors to the TAP that are expected to have effects on tundra wetlands similar to those of present oil development in the Prudhoe Bay area, with primary effects being the filling in of wetlands with gravel along the pipeline-road corridors and the effects of thermokarst, water impoundments, and road-traffic dust on adjacent wetland-plant communities. If NPR-A oil development occurs, perhaps an additional 200 km^2 of wetlands could be affected (representing about 1% of the total wetlands on NPR-A). The OCS-related onshore-pipeline roads for Beaufort Sea development would add perhaps 5 to 10 km^2 of additional wetland loss on the central coastal plain.

Oil development on ANWR could affect perhaps 5 percent of the total wetlands on the refuge coastal plain. The effects on wetland-plant communities, birds, and other wildlife are expected to be local. However, the effects on vegetation and the aesthetic effects on the environment are expected to persist for many years after the life of the oil fields. Planned future oil development is not expected to have great effects on the tundra-wetland ecosystem in general.

CONCLUSION: Cumulative oil development is expected to have long-term, local effects on tundra wetlands near oil facilities (roads, pipelines, gravel pads, and other facilities), with up to 5 percent of the total wetlands of the North Slope severely damaged. Some of these effects and aesthetic effects on the environment are expected to persist for many years beyond the life of the oil fields on the North Slope. However, cumulative oil development is not expected to have a great effect on the tundra-wetland ecosystem in general.

2. Effects on Migratory Species: This section on migratory species is organized to cover the following species or species groups: Pacific salmon; marine and coastal birds (waterfowl, seabirds, shorebirds, and bald eagle); pinnipeds (walrus and spotted, ringed, and bearded seal); polar bear; caribou; endangered and threatened species (bowhead and gray whale, Steller sea lion, and Arctic peregrine falcon); and belukha whale.

a. Additional Projects Considered in the Migratory Species Cumulative Effects Assessment: Appendix E describes non-OCS projects and proposals and existing oil and gas infrastructures that are part of the existing environment or are reasonably foreseeable future actions. These additional projects are used in assessing effects on migratory species within the range of the respective species.

b. Analysis of Migratory Species:

(1) Effects on Pacific Salmon: Alaska Pacific salmon resources range through all of the planning areas off Alaska but are not as numerous in the Beaufort, Chukchi, Hope, and Navarin Basins. Because of repeating adverse environmental conditions and lack of long-term management, Alaskan salmon populations were historically over-exploited and sometimes reduced to dangerously low levels. Current management administration has largely removed the majority of problems; thus, the populations may now be at optimum management levels that are consistent with available habitat at sea and in freshwater spawning/rearing areas. Although Alaskan salmon populations are generally at high levels, there are areas where the numbers are below optimum levels. These areas are localized and short-term, and the reductions are usually for a single species; for example, the Chignik sockeye salmon run on the south Alaska Peninsula was reduced from former high levels in 1988, as was the Kodiak Island pink salmon run).

Commercial fishing for salmon, a major industry in Alaskan waters, has significant effects on salmon population levels. While salmon stocks were once overfished, improved fisheries management now limits over-exploitation; and these species are now managed to provide maximum sustained yield. The illegal and incidental catch of salmon by foreign fleets in the eastern Bering Sea may also have a significant effect on salmon numbers. However, there is no information available as to the current total catch, and effects are difficult to quantify.

Logging, placer mining, dredging and filling, and pollutant discharge in waters where salmon migrate, spawn, and grow prior to their seaward migration may also have some adverse effects on salmon populations. Increased siltation from erosion caused by careless logging, placer mining, or construction activities could result in a reduction in egg and fry survival and/or a reduction in available spawning habitat, leading to a decline in overall productivity for affected streams. In Alaska, these types of activities are localized and tend to affect only small segments of the statewide salmon habitat. Presently, there are no means to accurately quantify these effects, given the limited scope of these operations and their comparatively limited number. The overall cumulative effect of these activities on the statewide salmon populations is estimated to be very low. However, these activities could have severe effects in the limited area where the activity occurs.

Seismic-survey activities as a result of existing oil and gas exploration are expected to consist primarily of site-specific, high-resolution surveys or localized deep-penetration surveys. Other activities that could have some effect on salmon populations would be exploratory drilling on tracts leased in prior lease sales. Currently, there are no immediate plans for companies to drill on leases within the major distribution range of Pacific salmon populations. There are, however, a number of active leases on which oil companies could drill. If drilling does occur, salmon would be most greatly at risk from large accidental oil spills. However, of the more than 8,000 exploratory wells that have been drilled on the OCS, no large accidental oil spills have occurred. If a discovery is made, the risk to salmon would increase during development and production activities.

To affect salmon, an oil spill would need to contact the fish and/or their food supply. Salmon, both immature smolts and spawning adults, usually occur in marine waters at depths of 1 to 5 fathoms (6-30 ft), and their schools do not constitute closely concentrated bands but, rather, separate groups that are constantly changing density and configurations in response to various conditions. Many researchers have studied the direct effects of petroleum hydrocarbons on Pacific salmon and have reported lethal and sublethal responses (Rice et al., 1979; Malins and Hodgins, 1981; Moles, Rice, and Korn, 1979; Brocksen and Baily, 1973; Weber et al., 1981).

Salmon are migratory with limited time in a given area; hence, the probability of being contacted by an oil spill for an extended period of time is very low. Even a large oil spill, either offshore or coastal, would contact only a small portion of the pelagic salmon habitat. Salmon also seem to be able to detect some hydrocarbons in the water and to divert from these areas. However, if the spill occurs along the spawning-migration route or at the mouth of spawning streams, diversion from an oil spill could affect the spawning success of that population. Although salmon are concentrated in the upper portion of the water column, where they are likely to come in contact with a slick or the water-soluble fraction around and beneath it, hydrocarbon concentrations in open-water areas are generally well below 1 ppm. Researchers have reported that adult salmon experience mortality following exposure to concentrations in excess of 3 ppm. Consequently, mortalities would be limited in number, although any sublethal effects would be difficult to quantify. Therefore, because of the limited amount of habitat that may be affected, and the typical concentration of water-soluble hydrocarbons, it is estimated that overall effects from an accidental oil spill would be very low.

Oil and gas activities associated with the addition of current and future OCS sales that might have effects on salmon are: (1) oil spills, (2) drilling discharges, (3) pipeline installation, and (4) onshore construction associated with offshore exploration and development. These additional activities might cumulatively affect salmon on the high seas and on their spawning and rearing areas over a 40-year period. During the course of offshore exploration and development off Alaska, more than 600 exploration wells and 52 production platforms are projected to be established. Based upon historic spill rates, it is estimated that about 42 oil spills of $\geq$ 1,000 bbl might occur. The oil spills are assumed to be equally distributed over the entire 40-year period of these projects and over the entire Alaska OCS. Because of the long time period over which the spills may occur and the extensive ocean area involved, the probability of contacting a significant portion of salmon, their habitat, or food supply is very low. Even given multiple oil spills within the same year, only a small portion of the statewide salmon populations would be contacted. Effects of oil spills on salmon have been previously described and have been shown to be very low.

Drilling discharges also have components that would prove toxic to salmon, with the number of wells drilled releasing large weights and volumes of these materials into ocean waters and to the benthos. While sublethal to lethal effects of these materials have also been substantiated by studies, the benthic area affected by them is not within the depths at which salmon normally migrate; the area contacted by the discharges is comparatively small, usually measured in hundreds of square meters.

Pipeline installation requires some excavation/disturbance of the ocean bottom with resultant turbidity. This is a temporary effect that dissipates very rapidly, and the turbidity should not extend to the pelagic waters where salmon migrate and rear. Onshore construction of pipelines, petroleum holding/processing facilities, and support installations could affect salmon spawning/rearing streams; however, development planning can prevent these effects through siting away from salmon streams.

Overall, the proposed action is expected to contribute negligibly to the cumulative effects on these species.

CONCLUSION: The effect of the cumulative case on Pacific salmon is expected to be LOW.

(2) Effects on Marine and Coastal Birds: The additional effects of other ongoing and planned projects and other activities on marine and coastal birds are discussed in this section. All species discused in this section are considered to be migratory between a summer range, where breeding takes place, and a winter range. These areas may not be widely separated. Although the probability of any

or all of the projects listed in Table IV-A-2 reaching developmental stages generally is unknown, this analysis assumes that all projects discussed in this section reach developmental stages. The State of Alaska lease sales listed have been deferred from the current State 5-year lease schedule but may be reinstated. The principal adverse effects these projects could have on bird populations would result primarily from oil spills, disturbance, and habitat alteration or destruction from construction or other activities. Subsistence and sport harvests, as well as periodic severe weather conditions and predation, also may have significant effects. Detailed discussion of cumulative risk to populations of migratory species contained in Section IV.D.2 of the 5-Year OCS Oil and Gas Leasing Program Final Supplemental EIS (USDOI, MMS, 1990b) provides the basis for the following analysis.

(a) Effects of Oil Spills:

Waterfowl: In the cumulative case, ten oil spills ≥ 1,000 bbl are estimated for Federal OCS oil and gas arctic region planning areas (Beaufort, Chukchi, and Hope Basin) listed on the current 5-Year Oil and Gas Leasing Program with most of the oil-spill risk originating in the Chukchi Sea area (Table II-A-1). Waterfowl populations are most vulnerable when they occupy restricted coastal habitats during migration or molting periods. Although numbers actually nesting along the Chukchi coast are relatively low (e.g., a few thousand common eiders nest on Kasegaluk Lagoon barrier islands), extremely large numbers of migrants follow offshore leads north in spring and lagoons and nearshore waters south in fall. The most abundant species involved in these migrations include about 1 million king eider, tens of thousands of common eider, several hundred thousand oldsquaw, and tens of thousands of Pacific black brant.

During northward migration in spring, several of these species occupy of the same areas in southern waters but also may be concentrated in Bristol Bay off the Alaska Peninsula, along the ice front, in river mouths when they become ice-free, and in leads and other openings in the pack ice. In particular, the large lead system extending from Point Hope to Point Barrow, where the probability of spill occurrence and contact is about 12 percent, is an important corridor used by hundreds of thousands of spring migrants. Any open-water areas restricted by surrounding ice, where these species tend to concentrate, may represent high-risk situations if oil is released or spilled into them.

Pacific Black Brant: Although less than 20 percent of the brant population currently nests on the Yukon-Kuskokwim (Y-K) Delta, adverse effects on any substantial proportion of this population that has exhibited a generally downward trend from levels in the 1960's could be significant. Potential effects associated with oil and gas production would result primarily from oiling of low-elevation grass/sedge meadow and elevated intertidal- mudflat habitats at the outermost fringe of the delta preferred by brant both for nesting and brood rearing. By nesting in habitats in or close to the tidal zone, brant expose their nests to tidal flooding and thus to virtually any oil spill that contacts the coast and subsequently is transported inland by high tides or storm surge. Later in the summer, molting adults and young would be at risk in these same habitats as well as in coastal lagoons along the Beaufort Sea coast. Sources of an oil spill with the potential to affect brant would be drill rigs, production platforms or tankers associated with oil and gas leases; fuel spills from fishing or supply vessels or barges (e.g., as many as 50 in the annual Prudhoe Bay Sealift) also are a potential source of pollution.

Beginning in July, large numbers of brant occupy Beaufort Sea lagoons with their young, joining large numbers of oldsquaw and other seaducks. Also, a migration of as much as 20 percent (10,000-20,000) of the brant population to the Teshekpuk Lake-Cape Halkett area on Alaska's arctic slope takes place in late June and July. Here they molt and then join brant that have nested on the slope and their young in Beaufort Sea coastal lagoons. In August and September, these postmolting and postbreeding birds migrate westward along the Beaufort coast and southward along the Chukchi and Bering Sea coasts, stopping frequently in lagoons to rest and feed (e.g., approximately 40,000 brant were observed in northern Kasegaluk Lagoon in August 1989 [Johnson, 1989, oral comm.]), until they join the remainder of the brant population staging from September to November at Izembek Lagoon on the north side of the Alaska Peninsula (Truett, 1983).

The former segment of the population could be exposed to both oil spills and disturbance from activity associated with State and Federal leases along the Beaufort Sea coast, and with Federal leases along the Chukchi and Bering Sea coasts. Since nearly all Pacific black brant stage in Izembek Lagoon, an oil spill entering this area poses the greatest risk to the population on its northern range. Those populations occupying Beaufort lagoons could be subject to at least three oil spills over the period of commercial development, while seven spills are estimated in the Chukchi and over 20 in the Bering Sea (5-Year FSEIS [USDOI, MMS, 1990b]). The probability of spills occurring and contacting the nearshore habitats in these areas where waterfowl are concentrated during migration periods generally is <5 percent in the Chukchi and Bering Seas but 10 to 20 percent in the Beaufort Sea and in an important area of Norton Sound (USDOI, MMS, 1984c, 1985, 1987a, 1987b; Appendix C of this EIS). Potential sources of oil spills, their probability of occurrence and contact, and possible consequences in this area are discussed in the 5-Year FSEIS (USDOI, MMS, 1990b). In addition to the direct effects of oil exposure, brant, as a result of their restricted diet, are extremely vulnerable to reduced forage that may result from oiling of eelgrass, their primary food source.

Over 90 percent of the brant population winters along the coasts of Baja California and mainland Mexico, most flying there directly from Izembek Lagoon. The remainder (7.5%) winter along the west coast from California to British Columbia, although this number has declined. Several thousand may remain at Izembek, especially in mild winters. It is evident that if recent trends in the number of brant wintering in these areas is an indication, a declining proportion of the population is likely to be affected by oil and gas development activity, disturbance from various other human activities, habitat reduction, changes in water quality, and hunting in the northern portions of the winter range in the future. The potential effects of adverse factors that may affect the bulk of the population wintering in Mexico are unknown at present but are likely to include many of those discussed above as the development of coastal western Mexico proceeds. Tankers enroute to the East Coast are likely to be the major source of any oil pollution in the near term.

An oil spill originating from existing Federal leases could have moderate effects if contact with the Y-K Delta occurred under conditions that promoted its reaching nesting habitat in May and June, if an oil spill entered Beaufort Sea coastal areas prior to the point at which both postmolting and postbreeding adults and their young are present in substantial numbers, or if a relatively limited proportion of winter habitat were contacted by an oil or fuel spill.

A high level of effect could result if an oil spill contacted the Y-K Delta from late June through August, when many adults and young occupy low-lying tidal habitats that are vulnerable, or at important staging areas along the Beaufort Sea coast from mid- to late summer, or if a limited portion of Alaska Peninsula staging habitat were contacted. Very high effects could result from oil spill contact with a substantial proportion of the habitat occupied by staging geese on the Alaska Peninsula. However, except for a tanker spill in the vicinity of the delta or peninsula, or a platform/pipeline spill in the Beaufort or Chukchi Sea, the probability of oil contact with most of the coastline in these areas is low to negligible.

Federal oil and gas development and production could increase in the future; and while overall effects may not be elevated above moderate or high as discussed above, their certainty of occurrence may increase. The potential for a high level of effect is increased as a result of black brant concentrating in Izembek Lagoon on the Alaska Peninsula during their migration, because more geese may be exposed to any single oil spill.

It is unlikely that an oil spill from the North Aleutian Basin would contact the Alaska Peninsula; and there is a lesser possibility of one occurring during a critical migration period, entering a coastal lagoon, and contacting geese on the water. Although any geese are likely to suffer high mortality, it is highly unlikely that any single oil spill would simultaneously contact all of the black brant or their habitat along the Alaska Peninsula. Therefore, future OCS sales are not expected to substantially increase the existing moderate cumulative effect on black brant.

If provisions of the Y-K Delta Goose Management Plan are effective in maintaining the brant population above the prescribed management level, effects of most factors other than current and future Federal lease sales should remain at a low level. However, if habitat availability/quality on the winter range were to decline, or substantial increases in the level of disturbance at Izembek Lagoon or subsistence or sport harvests were to occur, long-term effects on the population could be consistently elevated. The proposed sale is expected to contribute relatively little to the overall cumulative effect on this species.

Conclusion: The effect of the cumulative case on the Pacific black brant is expected to be moderate.

Snow Goose: Lesser snow geese, population about 40,000, nest on Wrangel Island off Siberia and winter in California's Central Valley. Lesser snow geese could be vulnerable to oil spills during spring staging in Cook Inlet, when concentrated on open water near Wrangel Island prior to occupying the breeding ground, and during fall staging on St. Lawrence Island, the Seward Peninsula, and the Yukon Delta and in Ugashik Bay. On the breeding, staging, and especially the wintering grounds in California, declining availability/quality of suitable habitat and increasing disturbance from human activities are likely to elevate adverse effects on this species.

Federal oil and gas development and production could increase in the future, thereby elevating the oil-spill-risk to which this species would be exposed. Lesser snow geese could experience moderate effects from oil spills in Cook Inlet, the Gulf of Alaska, or Kodiak lease areas. The proposed sale is expected to contribute relatively little to the overall cumulative effect on this species.

Conclusion: The effect of the cumulative case on the snow goose is expected to be moderate.

Diving Ducks: Of the 18 species of diving ducks that breed in Alaska, oldsquaw and common and king eiders are the most abundant to occur in Beaufort, Chukchi, and Bering Sea coastal habitats. During migration and/or molting periods, perhaps 500,000 oldsquaw, several hundred thousand common eiders, and 1 million or more king eiders utilize these coastlines. Bering Sea coastal habitats also are occupied by perhaps one million scoters, Steller's eiders, scaup, and other diving ducks during these periods; and substantial numbers of several species are found seasonally as far south as the Pacific northwest and California.

Activities that could produce significant adverse effects in diving duck populations include oil and gas development on current Federal leases in the Bering, Chukchi, and Beaufort Seas; current and future State oil and gas leases in Beaufort and Bering Sea areas and Cook Inlet; onshore Federal oil and gas development (including ANWR); the TAP; Canadian Beaufort production; increasing levels of disturbance from operation of aircraft, boats, and vehicles, and other human activity in areas where ducks are engaged in activities that make them particularly sensitive; expansion of residential and recreational land use; subsistence harvest of birds and their eggs; and sport harvest.

Persistent ice and snowcover and/or flooding of nesting areas, severe weather during spring migration, predation, decreased food availability during critical foraging periods, and declining water quality also can result in adverse effects.

The oldsquaw is the most abundant breeding duck on the arctic coastal plain (Truett, 1983), possibly numbering 100,000 to 200,000; but substantial numbers of several other species, including Steller's and spectacled eiders, also nest here and, thus, also could be exposed to oil spills from current and future State and Federal onshore lease areas, as well as the TAP, particularly if oil spills were to spread along major watercourses. Disturbance associated with petroleum development on the coastal plain could displace nesting waterfowl from preferred habitat, although there is evidence that oldsquaw do not readily abandon areas subjected to short-term, intermittent disturbance (Johnson, 1982a; Johnson and Richardson, 1981).

Fox predation on common eiders nesting on barrier islands along Beaufort and Chukchi Sea coasts (includes a majority of those nesting on the Alaskan arctic slope) is a major cause of breeding failure in this species; disturbance causing them to abandon secure islands could have adverse effects on productivity. Any of the nesting species could be affected adversely by other factors noted above, such as persistence of unfavorable nesting conditions in early summer, elevated or concentrated predator populations, elevated levels of disturbance in the breeding area (from recreational or industrial activity), decreased water quality, and increased harvests.

Waterfowl populations are most vulnerable when they occupy limited coastal aquatic habitats during the molting or migration periods. During the postbreeding molt period, which extends from mid-July to mid-August, as many as 500,000 oldsquaw, together with large numbers of other tundra-nesting species, may occupy Beaufort Sea lagoons and bays. Beginning in early July, hundreds of thousands of molt-migrant king eiders and tens of thousands of common eiders (males and nonbreeding birds) move westward along the Beaufort Sea coast primarily from Canadian breeding grounds; however, apparently few stop for any length of time until reaching molting areas along Chukchi and Bering Sea coasts. In late July, broods of common eiders also move from the barrier islands to the lagoons. By mid-August, most oldsquaw males and nonbreeders have departed; and in September, females with their young begin the southward migration. Although many eastbound spring migrants follow the Beaufort coastline in May and June (Flock, 1973), they are commonly recorded well inland and offshore (Divoky, 1983). For example, most common and king eiders appear to follow leads in the pack ice far offshore (40 km recorded); likewise, oldsquaw follow various routes but those near the coast frequently stop in the open water at river mouths to feed (since water is frozen elsewhere), joining coastal migrant eiders. Unseasonably cool weather occasionally may result in high mortality in king eiders and other species. Barry (1968) estimated that 100,000 king eiders died of starvation in 1964 as a result of a late thaw in the Beaufort Sea area.

The fact that spring migrants are strongly attracted to the limited open water available suggests both that large numbers could succumb in any large oil-contaminated lead, and that they might be attracted to oil on the ice surface (its dark appearance suggesting open water [Johnson and Richardson, 1981]). It is evident that the potential oil-spill risk to these species, especially oldsquaw, is high during migration and molt periods. Oil spills could originate onshore and follow major rivers into the lagoons, or at nearshore/offshore platforms or pipelines. The large numbers of eiders and oldsquaw that nest on the Canadian coastal plain also could be at risk from oil spills in the Canadian Beaufort. Overall, however, oil-spill effects are not likely to exceed a moderate level because of the large regional populations of these species and their substantial reproductive potential.

Seasonal use of the Chukchi Sea coastal area is similar to that of the Beaufort in that most eiders (about 1 million king, tens of thousands common) and oldsquaw (several hundred thousand) pass through during their spring and fall migration, substantial numbers molt in coastal lagoons, and a relatively small proportion of their populations actually nest in the area. Spring migration occurs from about mid-May to mid-June over a broad front with coastal, offshore, and inland routes used by various species. To a great extent the timing of migration varies with the wind direction and corresponding availability of open water (Divoky, 1983). A prominent and recurring offshore lead system extends between Point Hope and Point Barrow that is followed by most migrating waterfowl, and others probably are followed north from the Bering Strait. Strong headwinds of refreezing/closing of leads can retard their progress and cause them to be concentrated in remaining open water. Once conditions improve, they may proceed long distances nonstop. For example, an estimated 500,000 king eiders may have flown over 480 km from the Cape Lisburne area to Point Barrow in a single day (Woodby and Divoky, 1982).

In the northern Chukchi Sea area, a few thousand common eiders, representing a majority of those that nest in this area, nest in colonies along barrier islands of Kasegaluk Lagoon. In early July, hundreds of thousands of molt-migrant king eiders (mostly males) return along the coast; by mid-August, females and juveniles begin to predominate (Lehnhausen and Quinlan, 1981). Flocks are present in the lagoon and Peard Bay and in the nearshore waters off Point Lay and in Ledyard Bay after midsummer; and large-scale movements begin in late July, continuing until early October. Some remain until mid-November as long as open water persists. South of Cape Lisburne, migrants proceed farther offshore (Springer et al., 1982). In late June, soon after spring migration has ceased, there is a substantial northward movement of molt-migrant oldsquaw from more southerly areas. Large numbers of these molting birds are present in lagoons and along barrier islands, especially in Kasegaluk Lagoon and Peard Bay, from mid-July until late August. Fall migration is underway by early September and large flocks of hundreds or thousands may stop in the nearshore zone to rest and feed (Timson, 1976). Few remain after mid-October.

Oil spills may originate from platforms or pipelines in the Chukchi Sea lease area. Areas judged most vulnerable include: the spring-lead system, where extremely large numbers of migrating eiders and oldsquaw are concentrated; nearshore waters and lagoons from Cape Lisburne to Point Barrow in summer, which includes common eider breeding colonies and concentrations of tens to hundreds of thousands of molting eiders and oldsquaw; and these areas in fall, when large numbers of migrant eiders and oldsquaw frequently stop to rest and feed (Roseneau and Herter, 1984). Likewise, in Kotzebue Sound open leads in spring and coastal areas in summer and fall are important habitats vulnerable to oil spills of tanker origin. Effects of oil spills experienced by these three species could range from a moderate (single-oil-spill-exposure) to a high (multiple-oil-spill-exposure) level, for although each has a large regional population with substantial reproductive potential, large proportions of their respective regional populations are concentrated seasonally in vulnerable coastal areas. Among natural adverse factors, the occurrence of unseasonably severe weather during spring migration probably has the greatest potential for causing high mortality.

Although most of these three species' regional populations winter farther south, an estimated 50,000 eiders and as many as 500,000 oldsquaw (Fay, 1961) typically remain in open water near St. Lawrence Island; smaller numbers winter in the vicinity of St. Matthew Island and Nunivak Island, as well as other openings in the seasonal pack ice. The probability of an oil spill occurring in a lease area and contacting these areas generally is low; however, contact by an oil spill of tanker origin could occur and, in the case of St. Lawrence Island, potentially result in high effects if the highest estimates of oldsquaw abundance prevailed, moderate if the number were closer to 100,000.

On the Y-K Delta, common nesting species include common and spectacled eiders, greater scaup, black scoter, oldsquaw, and Barrow's goldeneye. Primarily eiders, especially spectacled, nest at a sufficiently low elevation for occasional flooding (and potential oiling) during storm surges. Large concentrations of diving ducks are at risk only during spring migration and the midsummer molting and brood-rearing period. In spring, as open water becomes available near the delta, large numbers of common and king eiders and oldsquaw, together with smaller numbers of Steller's eider and other species are concentrated in this restricted habitat. Molting of male, subadult, and nonbreeding eiders and oldsquaw occurs in the delta nearshore zone (and elsewhere in coastal Alaska) in July and August. A recently documented molt-migration of all three species of scoter, apparently including birds from other breeding areas, concentrates tens of thousands in the nearshore zone of the Y-K Delta, as well as in other areas from Kotzebue Sound to Cook Inlet, in July and August. During these periods when diving ducks are concentrated, contact of the area by an oil spill, unlikely unless originating from a tanker, could result in moderate effects.

Along the Alaska Peninsula several embayments, particularly Nelson and Izembek Lagoons, are of primary importance to migrating populations of diving ducks; but some provide wintering habitat as well. In spring, king eiders move from their wintering areas (Bristol Bay, the Aleutian Islands, and adjacent southern Bering Sea, east to Kodiak Island) to congregate in large rafts (10,000 to 50,000; one estimated at 300,000) in bays and lagoons of the peninsula (Gill, Handel, and Petersen, 1978). Similar movements are undertaken by common eiders from wintering areas in the Gulf of Alaska, Aleutian Islands, and southern Bering Sea. Steller's eiders occur in large flocks during spring- and fall-migration periods in the lagoons of Bristol Bay and the Alaska Peninsula (Troy and Johnson, 1987). Up to 100,000, mainly males, molt in Nelson Lagoon from early August to late September. Females molt primarily in Izembek Lagoon. Following the molt, Steller's eiders move to wintering areas in the eastern Aleutians, Alaska Peninsula, and east to Kodiak Island and Lower Cook Inlet. Spring migration involves a gradual return to the peninsula, where they remain through early May. Migration apparently proceeds to Nelson Lagoon, Cape Peirce, Dall Point, St. Lawrence Island, and Siberia, with small numbers following the Alaskan coast to the arctic slope. Risk to this population on its Siberian nesting areas is unknown.

Black scoters breed on coastal tundra, while surf and white-winged scoters nest in the interior of Alaska. Following their molt-migration to coastal areas, large numbers of migrant black scoters (720,000 reported by Gill, 1981), as well as greater scaup, are found in Nelson Lagoon on the Alaska Peninsula. Most scoters winter in more southern areas along the Pacific coast to California, but several hundred thousand winter in the eastern Aleutians and southern Alaska Peninsula, and east to Kodiak Island, Lower Cook Inlet, and Prince William Sound, where tens of thousands of white-winged and surf scoters have been reported (Arneson, 1980). Populations of any of these species wintering in the Gulf of Alaska area or along the west coast could be at risk from oil spills originating from tankers serving the TAP terminus in Valdez. Estimated numbers in the Bering Sea and the respective percent of the North American population are: black, 489,000 (50%); surf, 116,000 (25%); white-winged, 401,000 (33%) (King and Dau, 1981). The 1987 subsistence harvest of black scoters was 5,987 (Copp, 1987). Spring migration through Bristol Bay occurs in late April. Of the many species wintering in the Kodiak Island area, oldsquaw (65,000), white-winged (35,000), and black scoters (26,000) and harlequin duck (9,600) are the most numerous (Forsell and Gould, 1981). Across the Gulf of Alaska, in the Yakutat Bay area, white-winged and surf scoters are the most numerous species (Patten, 1981). Wintering populations of these two species occur all along the Pacific coast, and they are the most abundant waterfowl species off California. In most of the areas noted above, an oil spill is likely to have low to moderate effects; however, if an oil spill were to enter Nelson Lagoon or Izembek Lagoon during migration, high effects could result.

The highly migratory nature of most diving ducks suggests that, during their annual cycle, they will move through several OCS planning areas and nest and overwinter in others, thereby potentially exposing their populations to multiple oil spills and other adverse factors associated with oil and gas development. Exposure of diving ducks to multiple oil spills under the current schedule is possible since leases are held in several planning areas; however, except for potential development in the Beaufort Sea, the present rate of development does not suggest that this is likely. Presumably, multiple oil spills are more likely with additional OCS sales because of the inclusion of all Alaska planning areas as well as those adjacent to Washington, Oregon, and California. A multiple-spill scenario occurring within the equivalent of two generations would elevate projected effects or result in their occurrence with greater certainty.

Oldsquaw are most vulnerable when concentrated during the postbreeding molt and migration in Beaufort Sea lagoons from July to September and in Chukchi Sea lagoons from July to October, in the Chukchi Sea spring-lead system in May and June, and in the St. Lawrence Island polynya in winter. Oldsquaw occupying these areas could experience high effects from oil spills, while those occupying offshore leads and river mouths in the Beaufort Sea and leads and other open water in the Bering Sea in spring, coastal areas of the Y-K Delta and Alaska Peninsula in spring and fall, and wintering areas where this species concentrates (e.g., Aleutians and Gulf of Alaska) could be subject to moderate effects. Low effects are more likely from oil spills and disturbance on the arctic coastal plain nesting area, and in the southern wintering range, southeast Alaska to California, where distribution is more sparse. Approximately 44 oil spills are estimated, with additional OCS sales within the range where oldsquaw are seasonally abundant (Beaufort Sea to Gulf of Alaska).

King and common eiders are most vulnerable when concentrated during post-breeding molt and migration in Chukchi Sea lagoons from July until October, in the Chukchi Sea spring-lead system in May and June, and in lagoons along the Alaska Peninsula as well as openings in the retreating pack ice during spring migration in May and June. Eiders occupying these areas could experience high effects from oil spills, while those occupying offshore leads and river mouths in the Beaufort Sea and leads in the Bering Sea pack ice in spring, coastal areas of the Y-K Delta in spring and fall, Beaufort Sea lagoons from July to September, and wintering areas where these species concentrate (e.g., eastern Aleutians, southeastern Bering Sea, St. Lawrence Island polynya) could experience moderate effects. Approximately thirty-one oil spills are estimated, with additional OCS sales within the range where these species are seasonally abundant (Beaufort Sea to southern Bering Sea).

During spring- and fall- migration periods (April-May, August-September), Steller's eiders could experience high effects if an oil spill entered Nelson or Izembek Lagoon on the Alaska Peninsula. With additional OCS sales, 31 oil spills could occur in areas traversed by this species during spring migration (Alaska Peninsula to Arctic Coastal Plain).

Black, surf, and white-winged scoters are most vulnerable when concentrated during postbreeding molt-migration in the nearshore zone of the Y-K Delta in July and August, and in Nelson Lagoon on the Alaska Peninsula in the period following molt. Scoters occupying these areas could experience high effects from oil spills, while wintering concentrations from the eastern Aleutians to Prince William Sound are more likely to experience moderate effects from an oil spill. Approximately thirty-three oil spills are estimated, with additional OCS sales within the range where these species are seasonally abundant (northern Bering Sea to Gulf of Alaska).

Effects of most factors on diving duck populations, other than oil spills from existing and future Federal leases, should remain at a low level. An oil spill originating from a presently leased OCS area could result in moderate to high effects by contacting substantial proportions of populations of one or more species in this diverse group that are seasonally vulnerable in Beaufort Sea lagoons, Chukchi Sea lagoons, the spring-lead system, the St. Lawrence Island polynya, the Y-K Delta, and lagoons on the northern side of the Alaska Peninsula. Elsewhere, potential effects are likely to be low, although a very large oil spill in the Gulf of Alaska originating from a tanker transporting oil from the TAP terminus probably has the potential for producing moderate to high effects in this area. Federal oil and gas development and production could increase in the future; and while overall effects may not be elevated above moderate or high, as discussed above, their certainty of occurrence is likely to increase. Current and future OCS sales increase oil-spill risk in the Gulf of Alaska beyond that presently existing as a result of tankers transporting oil from the TAP terminus. Multiple oil spills could elevate potential effects if they occurred within a period of one or two generations.

Given the oil-spill estimates previously discussed, it is reasonable to assume that a major oil spill will occur and may enter a coastal area, lead, or lagoon where diving ducks are concentrated, contacting a portion of the local diving duck population. Although any oiled diving ducks are likely to suffer high mortality, it is highly unlikely that multiple oil spills would simultaneously contact a significant proportion of the diving duck habitat along the Alaska and Pacific coastal regions; and there is a lesser possibility of multiple spills occurring during a critical migration period, entering a coastal area, and contacting ducks on the water.

Overall, since most seaduck species have large regional populations and substantial reproductive potential, even relatively large losses (thousands or possibly tens of thousands of individuals among several species) that might be sustained if a large concentration were contacted by an oil spill are likely to result in moderate effects, with the populations returning to original levels within a generation. The proposed sale is expected to contribute relatively little to the overall cumulative effect on these species.

Conclusion: The effect of the cumulative case on diving ducks is expected to be moderate.

Loons: The tendency of loons to aggregate in substantial numbers in nearshore waters (between 2-5 km of shore) makes them particularly vulnerable to nearshore oil spills. In all major oil spills loons have made up a significant percentage of birds killed. Currently, the greatest risk of oil-spill effect on migrating or wintering marine waterfowl is in the Southern California Planning Area of the Pacific Region and the Gulf of Alaska in the Alaska Region. As loons spend the breeding season on and near freshwater lakes in Alaska and Canada, they are largely unaffected by existing OCS activities in the Alaska Region. However, loons that nest on the Arctic Coastal Plain frequent nearshore marine habitats to feed and, therefore, can be affected by nearshore spills or nearshore OCS activities.

Most loons breeding in Alaska and Canada either winter in the Gulf of Alaska or stage there prior to migrating farther south. From existing oil and gas activities, birds in the Gulf of Alaska are exposed to the possibility of an oil spill. Also, birds that migrate farther south could encounter another oil spill in the Pacific Region. However, an oil spill would have to contact a large number of birds in both areas in the same year to have an effect level greater than the existing low effect from other sources.

Spills occurring in both areas within 2 to 3 years (1 generation) would increase effects to a higher level. In summary, the effect factor that would most affect loons in the Alaska and Pacific Regions is contact with an oil spill. However, even though they have, in some instances, experienced significant losses from nearshore oil spills, their populations appear to be stable. It is estimated that loons would experience low effects from existing projects or proposals but would maintain viable populations. For example, in surveys conducted by the California Department of Fish and Game (CDFG) on incidental take of marine birds in gill nets, only 24 loons and grebes were taken during the period between 1983 and 1986 (Collins, Vojkovich, and Reed, 1984, 1985; Collins et al., 1986; Vojkovich, Reed, and Hieb, 1987; State of California, CDFG, 1987a).

The increment of effects contributed by normal operations resulting from future OCS sales is not expected to increase effect levels significantly from past, ongoing, and projected non-OCS activities and past and ongoing OCS activities. Potential effects from normal activities, combined with existing marine-vessel traffic, industrial discharges, and commercial fishing on waterfowl probably would increase; but the duration of negative effects is not expected to result in a change in the distribution and/or abundance in most loon species for more than 3 years.

With the addition of the oil and gas activities associated with current and future OCS sales, there is an increase in risk that an oil spill could occur and contact migrating or wintering birds in the Pacific Region and the Gulf of Alaska. Birds in the Gulf of Alaska (e.g., yellow-billed loons) are exposed to a higher risk of an oil spill under current and future OCS sales. Also, birds that migrate farther south could encounter another oil spill in the Pacific Region. This is the most likely place birds would be affected. Given the oil-spill estimates previously discussed, it is reasonable to assume that a major oil spill would occur in the southern California coastal area and contact some of the loon species. These oiled loons are likely to suffer a high mortality rate. It is highly unlikely that multiple oil spills would simultaneously contact all of the loon habitat along the Gulf of Alaska, northwestern U.S., and California coastal regions; and there is a lesser possibility of multiple spills occurring during a critical migration period, entering a coastal area, and contacting loons on the water. An oil spill would have to contact a large number of birds in both areas in the same year to have an effect greater than moderate. Additional oil spills occurring in both areas within 2 to 3 years (1 generation) could increase effects to a higher level.

Most species are expected to maintain viable populations throughout the 30-year period. However, the potential for one or more major oil spills contacting birds along the Alaska and/or Pacific coast during migration could result in locally high effects. Current and future OCS sales are not expected to substantially increase the existing moderate cumulative effect on loons. The proposed sale is expected to contribute relatively little to the overall cumulative effect on these species.

<u>Conclusion</u>: The effect of the cumulative case on loons is expected to be moderate.

<u>Summary (Waterfowl)</u>: Areas where large numbers of waterfowl could be seasonally vulnerable to the additional effects of other ongoing and future projects include the spring-lead system in the Chukchi and Beafort Seas; selected lagoons, bays, and river deltas of the Beaufort, Chukchi, and southeastern Bering Seas; Bering Sea polynyas; eastern Aleutian Islands east to Kodiak Island and Prince William Sound; coastal Baja California; and the Y-K Delta. Principal species involved would be Pacific black brant, oldsquaw, common and king eiders, and yellow-billed loon. Although the vulnerability of these species' populations to oil spills (and disturbance in the case of brant) could be high as a result of their being seasonally concentrated in restricted waters and potentially subject to multiple spills along the routes of annual movement, the risk of spill occurrence and contact in most areas where they may be concentrated is low. Potential effects of factors other than oil spills, and disturbance of brant, are likely to be low; and activities associated with current and future lease sales are not expected to increase the cumulative effect on waterfowl above the

moderate level. The proposed sale is expected to contribute relatively little to the overall cumulative effect on these species.

Conclusion: The effect of the cumulative case on waterfowl is expected to be moderate.

Seabirds: The principal seabird colonies in the sale-area vicinity are at Capes Lisburne, Lewis, and Thompson, with several hundred thousand birds present in the open-water season. These populations are most vulnerable to oil spills at the beginning of the breeding season, when large numbers of birds are rafting in open-water areas prior to occupation of the colonies as the pack ice breaks up and recedes. Contact of these large concentrations by an oil spill could result in the death of thousands or tens of thousands of murres, the most abundant species, although the probability of oil-spill occurrence and contact at Cape Lisburne is <0.5 percent. Reproductive potential in the murres varies but generally is likely to promote recovery from such mortality within one or two generations, a moderate to possibly high level of effect. Later in the open-water season, foraging concentrations occur at varying distances from the colonies; and only very large spills are likely to result in moderate effects. Overwintering birds generally disperse widely south of the Bering Sea pack ice, in the North Pacific, and in polynyas of Bering Sea islands, with the result that effects of oil spills during this season are not likely to exceed a low level. Relatively few individuals from these colonies are likely to overwinter in portions of the Pacific Region, where they would be exposed to oil and gas development activities.

The activity that recently has had the most negative effect on the seabird populations in the Alaska Region is gill-net fishing. In the northern North Pacific Ocean and Bering Sea, it has been estimated that some 250,000 to 500,000 seabirds are killed annually by the Asian gill-net fisheries for salmon (King, Brown, and Sanger, 1979; Ainley et al., 1981). The majority of the birds taken are murres, shearwaters, and puffins. As King, Brown, and Sanger (1979) noted, although the total standing seabird stock in Alaskan waters may be as high as 100 million birds, the few selectively caught species may be experiencing significant local effects.

Major offshore oil spills pose a significant threat to seabirds. Of the eight well-documented oil spills in the Alaska and Pacific Regions that have killed large numbers of seabirds, seven involved tankers from non-OCS sources. In 1989, the tanker Exxon Valdez ran aground in Prince William Sound (PWS), spilling nearly 11 million gallons of North Slope crude oil. It is estimated this very large spill may have killed about 100,000 to 300,000 seabirds (Piatt et al., 1990). Most of the mortality occurred among diving birds (e.g., murres, other alcids including murrelets, and diving ducks), with a low mortality among surface-feeding birds (e.g., kittiwakes, storm-petrels, and gulls). About 88 percent of the seabird mortality occurred outside PWS. Common murres concentrated at the Barren Islands for the breeding season were the local population most seriously affected by the spill. Of the dead birds recovered and identified, murres accounted for about 74 percent, with other species of alcids contributing another 5 percent before 1 August (Piatt et al., 1990). More than 1 million murres breed in the Gulf of Alaska, which means that even a higher-level murre mortality would not represent a threat to the species on a regional level. However, the excessive mortality of marbled murrelets and pigeon guillemots in the PWS area may represent a regionally significant proportion of their population in this area. Some large oil spills can cause excessive seabird mortality, resulting in locally high effects on some seabird species and regionally high effects on species with small populations.

Seabirds currently are experiencing adverse effects from drowning in gill nets, degradation and loss of breeding habitat, disturbance of breeding colonies, periodic unfavorable climatic conditions, alteration and reduction of prey-species populations, introduced predators on breeding colonies, and chronic oil pollution. Cumulatively, these effects can be significant.

Offshore construction and other OCS-related operations (gravel and/or ice islands, mobile bottom-supported drilling platforms, drillships, drilling mud and cuttings, and installation of pipelines) would result in dredging and the deposition of mud, rock fragments, and gravel on the seafloor. The deposition of fill material and dredging activities would cause water turbidity and smothering of benthic organisms and result in a moderate effect on the availability of food organisms in the vicinity of these activities. These offshore operations are expected to have a low effect on the availability of food organisms for seabirds. Marine debris (plastics, styrofoam pellets, and discarded gill nets) from shipping, fishing, and onshore sources cause an undetermined loss of seabirds and a low-level degradation of their marine environment.

Onshore construction and coastal development (marine terminals, processing facilities, pipelines, and commercial, municipal, and residential facilities, etc.) are not likely to be located in the vicinity of seabird breeding and/or nesting colonies, because seabird colonies are usually located on islands, in isolated areas, or protected wildlife areas. However, marine debris, waste effluents, and air emissions from coastal facilities could directly and indirectly contaminate and/or degrade seabird-breeding and -foraging areas and prey species.

Noise and disturbance from air and vessel traffic and human presence associated with non-OCS sources and OCS-related activities in the vicinity of seabird-breeding colonies and molting and foraging areas disrupts the normal behavior of seabirds and may result in nest desertion, predation of eggs or young, reduction in feeding, displacement to less desirable habitat, and mortality. Existing levels of disturbance are expected to have a very low level of effect on seabirds.

An oil spill can cause substantial short-or long-term reduction in local populations of some seabirds. The seabirds most likely to suffer direct mortality from oil spills are auklets, murres, and other species of alcids. Alcids, especially murres, form large concentrations on the water both at their breeding colonies and wintering areas; and they have suffered heavy mortality from oil spills. Murres are particularly susceptible to oiling because they dive and pursue their prey underwater; they also dive underwater when disturbed. The reproductive strategy of murres and other alcids (a low reproductive rate over a relatively long lifespan) makes the species slow to recover from additional man-induced mortalities (e.g., drowning in gill nets, oil spills). A higher level of effect on seabirds can occur if mortality is concentrated within only one or two species, especially species with small local populations such as some auklets and murrelets, which may require more than one generation for the local population to recover. In general, the size of an oil spill may be less important than the actual location of the oil spill. Significant mortality can occur during migration and breeding periods because seabirds are concentrated near their breeding colonies.

With the addition of activities associated with current and future OCS sales, there is a potential increase in risk that oil spills could occur and contact migratory seabirds. The planning areas with the highest estimated mean number of oil spills associated with current and future OCS programs are the Chukchi Sea (7), the Navarin Basin (13), and the St. George Basin (4) Planning Areas (USDOI, MMS, In Press). While many seabirds do not undertake extensive migrations of shorebirds and waterfowl, some migrate through or overwinter in or near other OCS planning areas and, therefore, could be subject to increased oil-spill risk from oil and gas development.

Ten potential OCS oil spills are estimated to occur in the Beaufort (3) and Chukchi (7) Seas over the 30-year time period (USDOI, MMS, In Press). Major seabird breeding colonies are located south of Cape Lisburne in the Chukchi Sea Region. If oil spills contacted seabird breeding colonies and/or foraging areas in this region, a moderate effect on local populations of murres, other alcids, and kittiwakes could occur. If a large oil spill occurred in the Bering Strait during the fall, when thousands of molting least and crested auklets and murres were present on the water, mortality would be substantial and locally high effects could occur to these species, although regional effects are not likely to exceed a moderate level in view of the considerable reproductive capacity of these species with such large populations.

Because most seabird species are widely distributed, it is unlikely that a seabird species would be jeopardized over a large portion of its migratory range from one or more oil spills. Recruitment of birds from unaffected parts of a regional population is likely to replace many of the lost individuals within a generation. The potential effect of an increased number of spills associated with current and future OCS sales would be to elevate the level of effect by increasing the proportion of a population contacted by oil. If multiple oil spills contacted a seabird breeding colony, molting area, and/or foraging area and resulted in the loss of several thousand birds from the same colony before the population was able to recover from a previous loss, significant effects on the regional seabird populations could occur depending on which species suffered the greatest mortality. Alcid species (e.g., murres, murrelets, and auklets) could suffer long-term population declines through the loss of breeding birds and require several generations to recover. However, it is unlikely that two or more large oil spills, either non-OCS or OCS-related, would contact the same seabird population within a 3-to-5-year time period. Where major seabird populations are coincident with a high cumulative risk of non-OCS and OCS-related oil spill contact (e.g., the Chukchi Sea, and Gulf of Alaska), moderate to high effects could be experienced by local alcid populations.

Overall, it is expected that most seabird species would maintain viable populations and experience moderate effects without current and future OCS sales. The additional current and future OCS sales is not expected to increase the existing moderate cumulative effect on very abundant species of seabirds. However, local populations of some species of alcids could experience high cumulative effects; and their populations may require more than one generation to recover.

Summary (Seabirds): Areas where large numbers of seabirds could be seasonally vulnerable to the additional effects of other ongoing and future projects include the spring-lead system in the Chukchi Sea; the Chukchi Sea ice front in fall; Bering Sea polynyas; the vicinity of Capes Lisburne, Lewis, and Thompson; and colony areas in the Gulf of Alaska and southeast Alaska (e.g., Barren Islands, Middleton Island, St. Lazaria Island, Forrester Island). Principal species involved would be murres, kittiwakes and, potentially, Ross' gull. Although the vulnerability of these species' populations to oil spills could be high as a result of their being seasonally concentrated and potentially subject to multiple spills, the risk of spill occurrence and contact in most areas where they may be concentrated is low. Potential effects of factors other than oil spills, including fishing-net mortality, are likely to be low; and activities associated with current and future lease sales are not expected to increase the cumulative effect on seabirds above the moderate level. The proposed sale is expected to contribute relatively little to the overall cumulative effect on these species.

Conclusion: The effect of the cumulative case on seabirds is expected to be moderate.

Shorebirds: Shorebirds probably are at less risk from oil spills than other species because, although they concentrate in some lagoon and estuarine areas--especially during migration, they do not generally occupy habitats that have a high probability of spill contact. Overwintering birds are dispersed widely from the Aleutians and West Coast to Central and South America and the Pacific islands. Shorebird species in neither the northern nor southern portions of their ranges are likely to be contacted by oil spills to an extent great enough to result in effects exceeding low.

Like seabirds, shorebirds show dramatic short- and long-term fluctuations in numbers (Prater, 1979; Page, Stenzel, and Wolfe, 1979). Therefore, estimates of population size, even when taken over long periods, can be misleading as to the true status of the species. Except for two species that are candidates for listing as threatened or endangered, all shorebirds are assumed to have stable populations. Currently, adverse effects on most shorebirds come primarily from the loss of winter habitat, and that used during migration, due to coastal development.

Shorebirds concentrate in large numbers on staging areas during their migration. While on the staging area, birds feed intensively to store up fat that is used to fuel their subsequent nonstop flight to the next staging area, which in some cases can be thousands of miles away (Odum, Connell, and Stoddard, 1961; Senner, 1979). For this reason, these staging areas are critical for shorebirds; and their loss could result in reduced population numbers through starvation on wintering grounds and/or reduced productivity on breeding grounds (Goss-Custard, 1977, 1979; Senner, 1979). Loss of coastal wetland habitat to commercial and residential development is especially acute in California. Speth (1979) reported that the state of California has lost some 261,000 acres (almost 70%) of its coastal wetlands since the early 1900's to a variety of coastal development projects. With the human-population-growth rate expected to remain constant or increase, net loss of habitat for migrating shorebirds is expected over the life of the project. However, shorebirds should maintain viable populations and effects should be relatively low.

A major oil spill that comes in contact with a coastal wetland or estuary has the potential to affect thousands of shorebirds. However, since most shorebirds tend to feed above the waterline, they generally would not come in direct contact with oil spilled, although their food source could be greatly affected. Therefore, shorebirds are less vulnerable to oil spills relative to most seabirds. Nevertheless, in those instances whered shorebird habitat has been contacted by oil, shorebird kills have been significant (Harrison, 1967; Page and Carter, 1986).

Shorebirds are most vulnerable to the effects of spilled oil on their staging and wintering areas. Birds wintering in southern California are exposed to the greatest risk of an oil spill from existing sources. Since shorebird habitat is located throughout California along the coast and since birds are present throughout much of the winter and fall (either wintering or staging), it is reasonable to assume that at least one oil spill would occur and contact shorebird habitat when birds are present. Another oil spill would have to occur and contact birds on the same wintering grounds within 3 to 5 years or on one of the staging areas in the same year to have an effect greater than low. However, assuming uniform distribution of the oil spills over the next 30 years, it is unlikely that another oil spill would occur and contact the same wintering ground or staging area.

In summary, the major existing effect-producing agent affecting shorebirds is the destruction of coastal habitat. While shorebirds are vulnerable to the effects of spilled oil, they have experienced few effects from most oil spills (Bourne, 1968). From existing projects and proposals, it is expected that shorebirds would maintain viable populations and experience low effects.

The increment of effects contributed by oil and gas activities associated with current and future OCS sales on shorebirds is not expected to increase existing levels substantially, because there are no lethal effects associated with drilling discharges, increased noise levels, or disturbance from vessel traffic that could result in effects requiring greater than 1 year's recovery time. Potential effects from normal activities, combined with existing marine-vessel traffic and industrial discharges, on coastal birds would probably increase but remain sublethal.

A major consequence of current and future OCS sales on shorebirds is the increased risk of an oil spill occurring and contacting habitat in the Alaska and Pacific Regions. The planning areas with the highest estimated mean number of oil spills are the Navarin Basin, Gulf of Alaska, Chukchi Sea, and Southern California Planning Areas. If a large oil spill contacted Beaufort or Chukchi Sea lagoon or the Y-K Delta, substantial numbers of postbreeding shorebirds could be affected. These areas are extremely productive shorebird-breeding areas. Shorebirds also could be exposed to a large oil spill in the Gulf of Alaska as they stage in the Cook Inlet or Prince William Sound areas (especially on the Copper River Delta). Shorebirds that migrate as far south as the Southern California Planning Area, or Mexico or Central America, could be exposed to additional risk.

Based on the importance of the areas in their life cycle, the potential exists for an oil spill to occur and contact any of the following sensitive shorebird areas within 1 to 3 years when shorebirds are present: (1) Beaufort and Chukchi Sea lagoon, (2) the Y-K Delta, (3) the Copper River Delta, and (4) coastal wetlands in southern California (e.g., Morro Bay, Mugu Lagoon, or Goleta Slough). Locally high effects could occur from a single large oil spill that contacted shorebird habitat in any of the planning areas in the Alaska and Pacific Regions. However, current and future OCS sales are not expected to increase the overall existing low cumulative effect on shorebirds.

Summary (Shorebirds): Areas where large numbers of shorebirds could be seasonally vulnerable to the additional effects of other ongoing and future projects include Beaufort and Chukchi Sea lagoons, the Y-K Delta, the Copper River Delta, and coastal wetlands in southern California. Principal species involved would be dunlin, western sandpiper, and red phalarope. Although the vulnerability of these species' populations to oil spills could be high as a result of their being seasonally concentrated and potentially subject to multiple spills along the routes of annual movement, the risk of spill occurrence and contact in most areas where they may be concentrated is low. Potential effects of factors other than oil spills are likely to be low, and activities associated with current and future lease sales are not expected to increase the cumulative effect on shorebirds above the low level. The proposed sale is expected to contribute relatively little to the overall cumulative effect on these species.

Conclusion: The effect of the cumulative case on shorebirds is expected to be low.

Bald Eagle: An estimated 30,000 bald eagles (20,000 adult and near-adult; 10,000 immatures) occupy coastal areas in Alaska (Schempf, 1987, 1989, oral comm.). Greatest concentrations of adult/near-adult birds are found in southeast Alaska (12,000+); northern Gulf of Alaska, especially Prince William Sound (2,600+); and the Kodiak Island-Alaska Peninsula area (2,500+). Approximately 30 percent may nest successfully in a given year (Hodges, 1982), but the proportion of adults not breeding is highly variable (e.g., ranging from 16% to 86% in southeast Alaska in the 1970's), as is annual productivity (e.g., 0.19 to 0.93 fledglings per nest in the Chilkat Valley, 1980-83), both within and between various areas in the state (Hansen, 1987; Hansen and Hodges, 1985; Hansen et al., 1986). Recent surveys suggest that the bald eagle population in Alaska is relatively stable, with increasing numbers of adults balanced by a decrease in productivity. Although many adults remain in the vicinity of their nesting areas throughout the year, substantial numbers migrate hundreds of miles to areas of food concentration and/or milder winter conditions (ADF&G, 1986). The bald eagle currently is unlisted in Alaska as a threatened or endangered species.

Cumulative factors with the potential for significant adverse effects on survivorship and/or productivity in the bald eagle population include disturbance prior to or during nesting, habitat degradation, illegal shooting, oil and gas development on Federal and State leases, fuel spills, commercial fishing operations and other fishing harvests, and severe weather during nesting. The most severe of these effects agents are shooting and habitat loss.

Disturbance may result from the presence of people, vehicles, boats, or aircraft in the vicinity of a nest site. Disturbance prior to nesting may prevent a nest site from being occupied, while that occurring after nesting has been initiated may cause it to be abandoned. Nesting habitat degradation may result from timber harvests, land development, and destruction of nest trees or windthrow. Foraging-habitat degradation may result from certain timber-harvesting practices or oil spills. Excessive fish harvests, particularly of salmon, or degradation of fish habitat may cause a decline in food availability.

Currently there are no active offshore oil and gas leases in the vicinity of most bald eagle nest sites or wintering areas in Alaska. However, North Slope oil transported through the TAP places at risk most of the Alaskan eagle population (i.e., Gulf of Alaska region) by exposing them to oil spills from tankers serving the pipeline. Oil spills from tankers are likely to result in more severe effects than those from a platform or pipeline due to the proximity of tanker routes to nearshore areas and bald eagle habitat. The effect of most factors has not been quantified over a sufficiently large proportion of the range of bald eagles in Alaska to accurately assess the overall population-level effect. However, the level of general boating and other recreational activity; commercial, subsistence and sport fishing; commercial, residential, and recreational-land development; and timber harvesting in the Gulf of Alaska region is substantial. These factors, other than oil spills of tanker origin, that disturb bald eagles or degrade bald eagle habitat could cause decreased survival and/or productivity; and at least a low level of effect from these factors can be expected.

Preliminary reports following the Exxon Valdez oil spill in Prince William Sound have provided some evidence of the effects that may result from a major oil release in this area. Potential effects on bald eagles include hypothermia and/or impaired flight capability from direct contact with oil while foraging, impaired physiological function or death from oil ingested while feeding on oiled prey (adults or young), death of eggs or young from oil transferred from adults, abandonment of nest sites disturbed by oil-spill-cleanup activities, and reduction in available food. By late summer 1989, 146 dead bald eagles (including chicks) had been retrieved from the vicinity of oiled beaches (presumably a portion of these were birds dying of other causes and oiled secondarily). This probably represents only a fraction of actual mortality, since a relatively small proportion of the shoreline affected by this spill was examined in sufficient detail to reveal carcasses (ADF&G, 1989). Preliminary results of postspill nest surveys suggest that failure/abandonment of nests adjacent to heavily oiled beaches may have exceeded 80 percent (all causes: oiled adults, eggs and young; disturbance from cleanup activities; natural mortality), while failure in a nearby unoiled area was less than 30 percent (Schempf, 1989, oral comm.). Considerable existing anecdotal evidence suggests that cleanup activities, in particular, were extremely disturbing to nesting eagles. At present, it is not possible to determine if effects of this and other recent oil spills on the eagle population would elevate the overall effect of all factors above the low level attributed to nonoil factors.

It is estimated that in the next 35 to 40 years, seven tanker spills (i.e., assumed to be relatively high-volume oil spills) could occur in association with the operation of the TAP in the Gulf of Alaska, where most of the Alaskan bald eagle population is concentrated (USDOI, MMS, 1989b). These oil spills thus represent a substantial risk to the eagle population, since the tanker route passes through Prince William Sound and adjacent to southeast Alaska, where a majority of Alaskan bald eagles reside. Based on fragmentary information available from the recent Exxon Valdez oil spill, risk to the eagle population represented by this level of contamination and potential cleanup activity is speculative but may be substantial. For example, if the dead eagles recovered during Exxon Valdez surveys represent only 10 percent of the total eagle mortality resulting from this incident, then the total (1,460 in this example) could represent 1 year's mortality for the Alaskan population. Bald eagles have a low reproductive potential because of the species' late attainment of sexual maturity and small clutch size; and they may not find the opportunity to breed every year after reaching maturity. Thus, each of the seven tanker spills noted above could also result in mortality equal to the annual mortality for the Alaskan population. Given that the distribution of these oil spills over time cannot be estimated, it is assumed for purposes of analysis that oil spills will occur uniformly over a 35- to 40-year period. As a result of these oil spills, the bald eagle population would probably require at least 3 to 5 years for recovery, for a moderate effect. If large spills occurred at a greater frequency (within 1-4 years of the first oil spill), the depressed population as a result of the first oil spill would not have fully recovered prior to the second oil spill, thereby resulting in an increase in the level of effect.

The apparent stability of the bald eagle population in Alaska suggests that these nonoil factors are not now causing major effects, although their overall effect may be obscured somewhat by the marked annual variability in proportion of adults breeding and reproductive success, both probably linked to availability of food. Implications of the effect of the Exxon Valdez oil spill on the stability of the population are being assessed.

With the addition of current and future OCS sales, nesting bald eagles could be disturbed by the noise of helicopters passing low overhead between support bases and exploration units or production platforms. This disturbance could possibly result in abandonment of nest sites, nestling mortality, and reduced reproductive rates. Habitat destruction due to the construction of support facilities could result in less suitable nesting/foraging habitat, which also could result in a lower reproductive rate. The combined effects from a variety of effects agents, other than tanker spills, may result in the death of a low number of individuals, the short or long-term abandonment of some nest sites, and the likelihood of a reduced reproductive rate. It is expected that the overall combined cumulative effect from all these sources would be low.

With the addition of current and future OCS sales it is estimated that thirteen oil spills from all sources could occur in the Gulf of Alaska subregion. It is further estimated that approximately half of these spills would originate from tankers serving the TAP--representing a substantial risk to the eagle population, as discussed above. Two of the remaining spills also are tanker spills in an area of eagle concentration (Shumagin Planning Area). Thus, each of nine spills could cause mortality equal to the annual mortality for the Alaskan population. It is assumed for the purpose of this analysis that these spills would occur uniformly over a 40-year period. The remaining three potential spills of platform or pipeline origin are likely to release much smaller quantities of oil than the assumed tanker spills. Thus, it is reasonable to assume that, for any given location, spills from pipelines or platforms would contact fewer eagles than spills from tankers. This is due to the close proximity of the tanker routes to bald eagle habitat. Further, one of the platform/pipeline spill is expected to occur in the western Gulf of Alaska, where fewer than 10 percent of the population resides. Given these factors, it is not expected that the number of eagles affected by the three assumed platform/pipeline spills would be substantively greater than the number affected by the ten assumed tanker spills. Thus, it is expected that there would be little overall difference between effects resulting from the thirteen total spills assumed for the cumulative case and those resulting from the ten assumed tanker spills. As a result of these oil spills, the bald eagle population would probably require at least 3 to 5 years for recovery, a moderate effect.

The estimates of activities and potential oil spills associated with current and future OCS sales suggest that development and production in the Gulf of Alaska subregion could increase in the future, while the overall effects may not be elevated above the current moderate level as discussed above, their certainty of occurrence may increase.

Summary (Bald Eagle): Areas where large numbers of bald eagles could be seasonally vulnerable to the additional effects of other ongoing and future projects include southeast Alaska, the northern Gulf of Alaska (especially Prince William Sound), and the Kodiak Island Alaska Peninsula area. Although the vulnerability of eagle populations to oil spills and disturbance could be high as a result of their being seasonally concentrated in some areas and potentially subject to multiple spills and periods of disturbance along the routes of their annual movement, the risk of oil-spill occurrence and contact in most areas where they may be concentrated is low. Potential effects of factors other than oil spills and related disturbance are likely to be low, and activities associated with current and future lease sales are not expected to increase the cumulative effects on bald eagles above the moderate level. The proposed sale is expected to contribute relatively little to the overall cumulative effect on this species.

Conclusion: The effect of the cumulative case on the bald eagle is expected to be moderate.

(b) Effects of Noise and Disturbance: Primary sources of cumulative noise and disturbance to marine and coastal birds are air and vessel traffic associated with industrial activities and air and ground-vehicle traffic from onshore activities along the coasts of the Chukchi, Bering, and Beaufort Seas. Offshore air traffic would consist primarily of helicopter traffic to and from platforms associated with the proposal. This traffic would have brief, inconsequential (very low) effects on birds while on their offshore feeding grounds but could have short-term adverse disturbance effects (low) on colonial-nesting seabirds, staging waterfowl, and shorebird flocks if the helicopters passed near coastal lagoons or seabird colonies during the summer season.

Brant could experience elevated levels of disturbance from aircraft operation as a result of the proximity of Izembek to the Cold Bay airport, favored as an air-support facility for the North Aleutian lease-sale area. Although brant obviously are greatly disturbed by aircraft overflights of the lagoon, as well as other types of human activity, no definite correlation between disturbance and their ability to store adequate energy reserves for continued migration or reproduction has been proven (USDOI, MMS, 1985b; Ward and Stehn, 1989). Disturbance does reduce brant-foraging efficiency (Derksen, Weller, and Eldridge, 1979). Brant utilize many of the same lagoons on their northward migration in April and May, particularly Izembek Lagoon; thus, potential adverse effects are likely to be similar to those discussed above. On the delta breeding ground, where now less than 20 percent of the brant population nests, total harvest in 1987 (1,030) represented about 1 percent of the winter population estimate. It is evident from recent studies that brant are the most easily and severely disturbed species of the four considered (Ward et al., 1988). Predation also appears to be a more severe problem for brant than the other species. In large concentrations, the brant's colonial-nesting habit is advantageous by decreasing the likelihood of individual predation; in the smaller colonies that now exist on the delta, this effect is reduced and may result in greater predator efficiency. Almost complete nesting failure due to predation was documented at one colony studied in 1985.

Cumulative vessel traffic of perhaps over 100 vessels per year would include barges and drillships associated with the proposal; tugs and barges associated with Prudhoe Bay Sealift traffic through the Sale 126 area; bulk-ore carriers, tankers, and supply ships that could be present in association with the Red Dog Mine project adjacent to the sale area; and several hundred vessel trips per year associated with Bering and Beaufort Sea leases. Most of this vessel traffic would remain offshore and would not disturb concentrations of nesting and feeding birds; however, some flocks of feeding birds in offshore waters would be briefly disturbed by the traffic.

Onshore air and ground-vehicle traffic (all-terrain vehicles, snowmobiles, "snow cats," gravel trucks) would be associated with the NPR-A, State oil and gas lease sales, the Sale 126-pipeline corridor, the Red Dog Mine project, and North Slope Borough projects. During the summer, cumulative onshore activities are likely to have low and generally local effects on shorebird and most waterfowl populations, with small segments of various species' populations being temporarily displaced by disturbance or adversely affected by the possible loss of some eggs or offspring. Effects may be moderate or greater on sensitive waterfowl species, such as Pacific brant and snow geese, if extensive oil development occurs in important habitat areas such as the Teshekpuk Lake waterfowl-concentration area on the NPR-A, with resulting frequent disturbance and possible displacement of these populations for a long period (several generations).

(c) Effects of Construction Activities: Cumulative offshore-construction activities would include platform installation and trenching and burial of offshore pipelines associated with Beaufort, Chukchi, and Bering Sea leases and construction of a short causeway for a ship terminal for the Red Dog Mine project. These activities would have local effects on benthic organisms through removal or burial of benthic sediments but would have low effects on the overall availability of food sources to marine and coastal birds, since only a small percentage of available foraging habitat would be affected.

Cumulative onshore-construction activities would include potential NPR-A oil development, the Red Dog Mine project, the pipeline and support facilities associated with the proposal and with Federal OCS leases in the Bering and Beaufort Seas, and State oil and gas lease sales. Several hundred kilometers of pipelines and roads would be built if several discoveries of oil occurred on the NPR-A (Shepard, Bennett, and Gilliam, 1982). About 1,036 to 2,331 km^2 of nesting and feeding habitat could be exposed to oil development, with perhaps 130 km^2 of habitat altered or destroyed in the construction of gravel pads, roads, pipelines, and other facilities (USDOI, BLM, NPR-A, 1983). This habitat loss would represent a small percentage of the total tundra habitat available on the NPR-A, representing a low effect. The possible habitat loss and displacement of geese from important habitat areas, such as the Teshekpuk Lake area or the Fish Creek Delta, could represent moderate to high effects on Pacific brant. However, if no oil development occurs in these important habitat areas, effects on regional populations of birds on the NPR-A are likely to be low. As with other onshore oil development, the actual amount of bird habitat lost to facility construction for the Sale 126-pipeline corridor would be a small percentage of the tundra habitat available in the area and would represent very low habitat loss. However, the cumulative loss of habitat from possible oil development on the NPR-A and from Sale 126 could represent moderate cumulative effects on birds.

Tundra-habitat loss or alteration associated with the Red Dog Mine project is estimated to include about 541 hectares (1,336 acres) of vegetation in Red Dog Valley and 197 hectares (487 acres) for the road corridor (USEPA and USDOI, 1984). This local-habitat loss would displace small numbers of nesting birds but would have very low effects on habitat availability to bird populations. The small amount of habitat loss associated with the Red Dog Mine project probably would not be significantly additive to the habitat loss associated with the proposal and NPR-A oil development.

(d) Effects of Tanker Transportation: Current and future arctic region oil production transported through the TAP could place at risk significant portions of some marine and coastal bird populations occupying Prince William Sound and the Gulf of Alaska by exposing them to spills from tankers transporting the oil to southern ports. Seabirds and waterfowl are present year-round in the Gulf of Alaska region, but are especially abundant during spring- (April-June) and fall- (September-November) migration periods and in the vicinity of seabird colonies in summer. Shorebirds numbering in the millions use the Copper River Delta area as an intermediate stopover site during their spring migration to northern breeding areas. Bald eagles are resident throughout the gulf region, but are especially abundant in southeast Alaska.

Preliminary reports following the 1989 Exxon Valdez oil spill in Prince William Sound have provided some evidence of the effects that may result from a major release in this area. According to published reports, the 1989 spill (11 million gal or 260,000 bbl of oil) probably killed from 100,000 to 300,000 birds (an estimate extrapolated from the recovery of approximately 35,000 individuals [Piatt et al., 1990]), including nesting seabirds, overwintering and migrant waterfowl, shorebirds, and bald eagle populations. Four months after the spill, oil still persisted in coastal habitats; and it remains in a viscous state that has the potential to foul and kill additional coastal birds. Preliminary analysis also suggests that disturbance associated with oil-spill-cleanup activities, in particular, may have resulted in a high rate of bald eagle-nest abandonment and failure (Schempf, 1989, oral comm.). The level of effect of the spill on various marine and coastal bird populations, and consequently the estimated recovery period, has not been determined at this time. Effects are difficult or impossible to assess at this time because of the limited information now available on pre-oil-spill-population levels of affected species. The best estimate of effect is that some local populations or portions of regional populations may experience effects ranging from long-term (several generations) local to short-term regional (moderate to high). In particular, high to possibly very high effects on portions of regional populations of murrelets as well as yellow-billed loon, pelagic cormorant, harlequin duck, and bald eagle are possible. At least one large murre colony (Barren Islands) probably was devastated and thus is likely to have sustained very high local effects (Piatt et al., 1990). If another large (≥ 100,000-bbl) tanker spill occurred in Prince William Sound, similar long-term (several generations) moderate to high effects on local bird populations could occur, depending on the season, size of the oil spill, and bird species affected.

Summary: Although the vulnerability of marine and coastal bird populations discussed in this section to oil spills could be high as a result of their being seasonally concentrated in restricted waters or other areas and potentially subject to multiple spills along the routes of annual movement, the risk of spill occurrence and contact in most areas where they may be concentrated is low. Potential additional effects of factors other than oil spills and related disturbance are likely to be low for most species; and activities associated with current and future lease sales are not expected to increase the population-recovery period following any adverse incident beyond one generation, or thereby to elevate the cumulative effect on marine and coastal birds above the moderate level. The proposed sale is expected to contribute relatively little to the overall cumulative effect on these species.

CONCLUSION: While local populations of common species or regional populations of rarer species could experience HIGH effects, the overall effect of the cumulative case on marine and coastal birds is expected to be LOW for shorebirds and MODERATE for waterfowl, seabirds, and the bald eagle.

(3) Effects on Pinnipeds and Polar Bear: The additional effects of other ongoing and planned projects on migratory pinnipeds (walrus; ringed, bearded and spotted seals) and the polar bear are discussed in this section. The northern fur seal also is discussed because it could be exposed to adverse effects of arctic oil production transported via the TAP and tankered through Prince William Sound and the Gulf of Alaska to southern ports. This analysis assumes that all of the projects listed in Table IV-A-2 reach developmental stages, although the probability of any or all of them doing so generally is unknown. The State of Alaska lease sales listed have been deferred from the current State 5-year lease schedule but may be reinstated. The principal adverse effects of these projects on marine mammal populations would result primarily from oil spills, disturbance, and habitat alteration from construction or other activities. Subsistence harvests also may have significant effects. Detailed discussion of cumulative risk to populations of migratory species contained in Section IV.D.1 of the 5-Year OCS Oil and Gas Leasing Program FSEIS (USDOI, MMS, 1990b) provides the basis for the following analysis.

(a) Effects of Oil Spills: In the cumulative case, ten oil spills of ≥ 1,000 bbl are estimated for all Federal OCS oil and gas activities in the arctic region (Beaufort, Chukchi, and Hope Basin Planning Areas), with most of the oil-spill risk originating in the Chukchi Sea area (Table II-A-1). Oil-spill risk from Beaufort Sea oil leases apparently would add relatively little risk to marine mammal populations occupying the western Beaufort/northern Chukchi Sea area. Those portions of migratory-species populations (all species noted above) that move south to overwinter in the Bering Sea could be exposed to as many as twenty additional spills in Norton Sound and the Navarin, St. George, and North Aleutian Basin Planning Areas over the life of fields in these areas (USDOI, MMS, 1990b). The potential for thirty oil spills suggests that multiple spills could contact various segments of these populations in the same year or sequentially (USDOI, MMS, 1990b).

Most of the oil spills that could originate from Beaufort Sea leases would move westward, contacting marine mammal habitats in the Beaufort and Chukchi Seas. As a result, substantial numbers of summering walrus females with calves and/or their food resources could be contacted along the pack-ice edge in the northern Chukchi and western Beaufort Seas, and seal habitat also is at risk of contact throughout this area. Arctic seal populations are likely to experience only low to moderate mortality from oil-spill contact or habitat/prey contamination associated with seven oil spills in the Chukchi Sea during cumulative oil exploration, development, production, and transportation, and from cumulative oil spills in the Bering Sea (20) and Beaufort Sea (3). This is primarily because only very young seal pups and, potentially, young walrus calves are likely to die from oil-spill contact, although oil spills may contribute to the death of some highly stressed adults. Repeated contact of areas with females and pups (or calves) could result in substantial local mortality; but at typical densities, the number of seals and walrus killed from oil-spill contact or habitat contamination over the life of oil-related activities is likely to be no more than a few hundred, requiring a generation or less for recovery at current population levels. Walrus cow/calf herds are at risk of contact in the remainder of the Chukchi Sea when ice is present from about May to July and October to December. Walrus remaining in the Bering Sea in summer (mostly males) primarily occupy areas that are not likely to be contacted by an oil spill. Likewise, those portions of pinniped populations that overwinter in the Bering Sea (relatively small proportion of bearded and ringed seals; majority of walrus and spotted seal) are at risk from spills (20) in that area primarily during the spring-ice-breakup period when any ice-entrained oil spill could be released prior to their migration into the Chukchi Sea or to less vulnerable coastal habitats; but they also would be present at low densities and adults apparently are relatively insensitive to oiling. A winter oil spill contacting one of the primary walrus-breeding areas potentially could disrupt this activity; but most of the oil released during this season is expected to be encapsulated in the ice and thus not as likely to have serious adverse effects. During the remainder of the year, these populations would not be particularly vulnerable to oil spills in the Bering Sea since they move north of the Bering Strait or to coastal areas; thus, oil spills associated with the cumulative case are likely to have low effects on seal populations but potentially moderate effects on walrus.

Polar bears are highly sensitive to oil spill fouling of the pelage and to ingestion of oil from grooming contaminated fur and probably from eating oiled seals. However, because of the generally dispersed distribution and low density of bears in the Chukchi Sea, a relatively small proportion of the population is likely to encounter oil spills, although the potential exists for multiple spills that could contact various local segments of the population in the same year or sequentially and thus could result in a higher level of effect (see Sec. IV.C.6 for base-case discussion). In an extreme situation, a concentration of perhaps 30 or 40 polar bears attracted to a large food source could be contaminated by an oil spill in a lead system and could eventually die. Similar concentrations could occur during the fall in new ice, at the advancing edge of the pack ice--where seals may concentrate--or in certain coastal areas where food is plentiful. If a high proportion of these were females, effects could be elevated significantly. Taylor et al. (1987) estimated that the population can sustain a 1.6-percent loss of females, or perhaps 32 individuals, in a population of 2,000. However, with seven oil spills estimated to occur in the Chukchi, the loss of perhaps 30 or 40 polar bears is not likely to occur often over the life of oil-related activities in this area. The total loss of perhaps 100 bears over the 30-year life of the proposal or over the life of other oil activities is likely to represent a low to moderate effect on the polar bear population. With the annual loss of perhaps this many or more bears from subsistence harvest, the overall cumulative effect could be elevated to a moderate level.

(b) Effects of Noise and Disturbance: The primary sources of cumulative noise and disturbance of pinnipeds and polar bears are air and vessel traffic from offshore industrial activities. Air and ground traffic along the coasts of the Chukchi, Bering, and Beaufort Seas associated with onshore construction activities is likely to be inconsequential. Most of the offshore air traffic would be helicopter flights to exploration units and production platforms in the Sale 126 area and to platforms that could be associated with other Federal OCS oil and gas leases in the Bering and Beaufort Seas. Because of frequent low visibility due to fog, some of these aircraft flights may not be able to avoid disturbing walrus and seals. Although this type of disturbance would be very brief, the effect on individual walrus calves and seal pups could be severe. Some walrus calves could be seriously injured or killed by trampling from frightened adults, while some seal pups may be abandoned by disturbed females. Because the walrus-nursery herds and pairs or small groups of seals are distributed widely along the pack-ice front, the helicopter flights are likely to temporarily disturb a small portion of the walrus and seal populations. Thus, offshore air traffic is likely to have a low effect on seals and walrus.

Disturbance of polar bears by air traffic also is likely to be very brief, resulting in no injury or abandonment of young and probably a very low effect on this species. Operation of vehicles and vessels, construction and operation of platforms and onshore facilities including Red Dog Mine, and subsistence hunting all could displace polar bears from within several kilometers of where these activities are localized. However, since bear density is low throughout most of their range, and the amount of displacement and change in habitat use is likely to be relatively small in comparison to the natural variability in seasonal habitat use, overall disturbance effects are expected to be low. Given the low density of denning bears in the Chukchi Sea region, except on Wrangel Island, disturbance associated with OCS activities is not expected to disrupt denning significantly. Currently, only Natives are allowed to take polar bears, essentially without restriction, in Alaska. The reported take from 1980-1985 averaged 135 bears per year; this may represent approximately 21 percent of total mortality (Amstrup and DeMaster, 1988) and is many times the annual mortality likely to be caused by OCS activities.

Vessels supporting drilling activities in the Bering and Chukchi Seas would be present primarily in the open-water season. Such traffic may coincide with seals and walrus using the same routes and may temporarily interfere with local movements (probably a few days at most) or displace some hauled out individuals within about 1 km. However, there is no evidence that vessel traffic would cause greater-than-low effects on their movements or distribution. During most of the operating season, seals, walrus, and polar bears would be congregated along the drifting pack-ice front, in the northern Chukchi north of where vessel traffic would be concentrated.

Air- and ground-vehicle traffic along the coast of the sale area would include helicopter and other air traffic, gravel trucks at Point Belcher, and all-terrain-vehicle and snowmobile traffic associated with the local communities, State of Alaska oil-lease activities, and the North Slope Borough. This traffic would create brief sources of noise and disturbance of spotted and ringed seals that haul out along the coast of the sale area, and occasional disturbance sources to polar bears when they frequent the coastline. Most disturbance associated with aircraft and ground vehicles onshore would be brief and of little consequence to spotted and ringed seals and polar bears; but increases in the frequency of disturbing activity could reduce the use of coastal habitats by these species over time and have a temporary adverse effect on the use of some spotted seal haulout sites, and could reduce polar bear denning along the coast. Oil-spill-cleanup activities, like other human activities, would displace seals and polar bears temporarily for the duration of the activity.

Overall, factors producing noise and disturbance, principally aircraft and vessels serving offshore areas and vehicles in use along coastal areas, are likely to disturb only local groups of pinnipeds or polar bears. Mortality is not likely to result from disturbance, except potentially in the case of walrus calves and seal pups, and thus is expected to have insignificant effects on these species. Any losses resulting from cumulative noise and disturbance are expected to be replaced in less than one generation and thus to represent a low level of effect.

(c) Effects of Construction Activities: Offshore-construction activities would include the installation of production platforms and trenching and laying of an offshore trunk pipeline in the Sale 126 area, construction of platforms and pipelines associated with future Chukchi and current and future Bering and Beaufort Sea leases, and a causeway and dock associated with the Red Dog Mine south of the Sale 126 area. These projects would bury some benthic invertebrate organisms and remove a small proportion of their habitat from occupation for the duration of the project; but overall this would result in only a minor reduction in local populations and a minimal effect on the availability of food resources for pinnipeds. Neither the benthic-feeding walrus and bearded seal, nor the ringed and spotted seals that rely on mobile prey, are expected to experience greater-than-very-low effects.

Onshore construction would include possible NPR-A oil development, possible development in the Red Dog Mine, and the pipeline corridor and support facilities associated with Sale 126. Onshore construction of the pipeline landfall at Point Belcher may include burial of the pipeline on the beachhead. During construction, the deposition of gravel and heavy-equipment noise could temporarily displace a few ringed and spotted seals and perhaps polar bears within about 1 km of Point Belcher. Onshore construction near Kivalina of a ship terminal associated with the Red Dog Mine and construction of onshore facilities associated with State oil development would have similar temporary-displacement effects on spotted and ringed seals and polar bears. Cumulative-onshore-construction effects on pinnipeds and polar bear are likely to be low.

Summary: Areas where substantial numbers of pinnipeds and polar bears could be seasonally vulnerable to the additional effects of other ongoing and future projects include the spring-lead system in the Chukchi and Beaufort Seas, Wrangel Island, and summer seal-haulout sites along the Chukchi coast. Principal species likely to experience adverse effects are walrus, spotted seal, and polar bear. Although the vulnerability of these species' populations to oil spills and related disturbance could be high as a result of their being seasonally concentrated in restricted waters or other areas and potentially subject to multiple oil spills and exposure to disturbance-producing factors along the routes of annual movement, the risk of spill occurrence and contact in most areas where they may be concentrated is relatively low and disturbance generally nonlethal. Potential effects of factors other than oil spills and related disturbance are not likely to exceed a moderate level, with populations that experience adverse effects recovering within a generation; and activities associated with current and future lease sales are not expected to elevate the cumulative effect on pinnipeds and polar bear above this level.

(d) Effects of Tanker Transportation: Current and future arctic region oil production transported through the TAP could place at risk significant portions of the northern fur seal population occupying the Gulf of Alaska by exposing them to spills from tankers transporting the oil to southern ports or a Cook Inlet destination.

Northern Fur Seal: The world population of northern fur seals is estimated at 1.2 million (Fowler, 1985a). About 827,000 comprise the Pribilof Islands population, while about 4,000 are associated with San Miguel Island off Santa Barbara, California. A small breeding group also has become established on one of the Aleutian Islands. The Pribilof population has been declining since the 1950's, interrupted by one period of increase; between 1975 and 1981 the rate of decline was estimated at 4 to 8 percent per year (Fowler, 1985b). Since 1981, the trend has not been statistically significant (York and Kozloff, 1987); however, the northern fur seal has been designated as depleted under the Marine Mammal Protection Act. There has been no commercial harvest of fur seals on the Pribilof Islands since 1984, although a small subsistence harvest has taken place (Zimmerman and Melovidov, 1987).

Although some fur seals are found throughout their range at all times of the year, the majority are found in the North Pacific during winter and spring (December to May) and in the Bering Sea during summer and fall (May-November). Fur seals rarely come ashore except at the rookeries. During summer, they are concentrated over the continental shelf in the vicinity of the Pribilof Islands and southeastward to the eastern Aleutian Islands. During fall migration, fur seals move through Aleutian passes and either follow the edge of the shelf around the Gulf of Alaska or proceed directly to the North Pacific and south to offshore wintering areas from British Columbia to California. Spring migration retraces much of this path, but many females and young males follow a more direct route from the Pacific northwest across the gulf to Kodiak

Island and the eastern Aleutians (Bigg, 1982; Fiscus, 1978).

Activities that could produce adverse effects include oil and gas development in the Bering Sea, Gulf of Alaska, and California, including oil-spill-cleanup activity; commercial fishing operations; and subsistence harvests. Certain climatic effects (e.g., El Nino), altered prey distribution or abundance, or predation also may exert periodic influence. Agreement is lacking on the factors causing the population decline. The decreased carrying capacity of the environment due to overfishing has been suggested, but this is not supported by stable reproductive rates, increased pup survival and weight, and increased fur seal body size. In fact, increased food availability is indicated. The current small subsistence harvest is not likely to significantly influence the size of the population, but the effects of past commercial harvests, if any, could continue for some time. A decline in the number of fur seals appears to be the result of factors causing increased mortality of juvenile classes at sea. Entanglement in debris, especially lost fishing nets or fragments, may be a significant cause of mortality, but other factors also may contribute. Organic pollutants, accumulated on the winter range, that adversely affect reproduction in other pinnipeds (DeLong, Gilmartin, and Simpson, 1973; Reijnders, 1986) are not known to have a significant effect on fur seal reproduction. Fur seal-food availability in Pribilof foraging areas did not appear altered by the 1983 El Nino episode, as may have been the case on San Miguel Island where female foraging trips increased in length during this period.

Since much of the fur seal's insulation derives from the pelage rather than from a thick fat layer, they rapidly incur fatal hypothermia if the fur layer is fouled by oil. Oil also may be transferred to pups by females returning from feeding trips. Effects of oiling, including surface contact; inhalation and ingestion; and noise associated with development are discussed in USDOI, MMS (1985a) and by Geraci and St. Aubin (1988).

The fur seal's migratory habits could expose the population to oil and gas development in several planning areas included in current and future OCS sales (Navarin, Norton, St. George Basin, and North Aleutian Basins; Shumagin; Kodiak; Cook Inlet; Gulf of Alaska; Washington/Oregon; and California). The cumulative number of oil spills estimated for this substantial area from all sources is fifty-two (USDOI, MMS, 1990b), including tankers carrying Beaufort and Chukchi Sea oil from the TAP to southern ports along much of the fur seal migration route. This suggests that multiple oil spills could contact various segments of the population, in the same year or sequentially, over the life of current or future OCS sales.

Significant effects of oil and gas development on the fur seal population are most likely to occur when seals are concentrated in the eastern Aleutian/Pribilof Island axis in late spring, summer, and fall, or in Unimak Pass during peak spring migration. Near several rookeries where summer densities are 250+ seals per square kilometer, up to 77,000 seals could be contacted by a 10,000-bbl oil spill, estimated to form a discontinuous slick covering 310 km^2 (Ford, 1985). Mortality of this magnitude could result in a high level of effect. Multiple oil spills contacting rookery areas during the pupping season, or vicinity of Unimak Pass at peak migration, within the equivalent of a generation (i.e., 4-6 years) could elevate the potential effect to high or very high levels. A large-volume oil spill, essentially surrounding the Pribilof Islands, thereby forcing a large proportion of the population into contact, also could result in very high effects. Where fur seal densities are much lower than in the vicinity of the Pribilof Islands in summer and fall, development of leased areas as a result of current and future OCS sales may not elevate overall effects significantly above the levels projected for existing lease areas. In pelagic areas farther offshore, along the shelfbreak and nearer to the Aleutian Islands, effects are more likely to be moderate. Likewise, where densities are relatively low, along most of the migration route, in wintering areas, and in the vicinity of the Pribilof-Unimak Pass corridor early in the breeding season, effects of an oil spill are likely to be low. Recent evidence (Ragen and Dayton, 1990) suggests that young fur seals depart the Bering Sea through Aleutian passes other than Unimak Pass and thus are less likely to experience an oil spill during migration than previously assumed.

An oil spill contacting the Pribilof Islands/Unimak Pass intensive use area is most likely to originate from existing leases in the St. George or North Aleutian Basins, or from tankers serving Navarin or Norton Basins as a result of previous lease sales. The probability that oil spilled in the St. George Basin (USDOI, MMS, 1985a) would contact the islands within 30 days in summer can be as high as 71 percent, and greater than 99 percent for entering the area within an 80-km radius surrounding them. Fur seals foraging to the north of the islands could be contacted by an oil spill in the Navarin Basin. Fur seals are present year-round in the Gulf of Alaska but are especially abundant during spring- (April-June) and fall- (October-December) migration periods. Those migrating in the Gulf of Alaska and farther south could be contacted by oil spills from tankers transporting oil from current and future arctic region production between the TAP terminal in Valdez and southern ports. If oil slicks from a spill in this area were swept farther offshore than those from the Exxon Valdez, migrant and/or overwintering fur seal populations could experience substantial mortality. Fur seals wintering off California could be exposed to oil spills originating from existing production in the Southern California Planning Area.

Helicopter traffic between St. Paul Island and the St. George or Navarin Basins is likely to result in low effects among males establishing territories in spring. Disturbance of rookeries when pups are present could have more serious effects but still are likely to be low. Vessel traffic is not likely to have significant effects. Oil-spill-cleanup activities on or near rookeries during the breeding season could displace some adult seals from these areas and result in some mortality of pups trampled by stampeding adults. Effects from air and vessel traffic and oil-spill cleanup are not expected to be sufficiently adverse to increase the aggregate effect to a level greater than that for oil spills, but their occurrence could cause the cumulative effect to occur with greater certainty.

Where fur seals are relatively concentrated, in the vicinity of the Pribilof Islands in summer and fall and during peak passage through Unimak Pass, a high level of effect could result from an oil spill. Moderate effects are more likely where densities are substantially lower, farther from the islands, along the migration route south of Unimak Pass, and in wintering areas off California. Since multiple oil spills are more probable with the addition of current or future OCS sales, more than one oil spill could contact fur seals in the vicinity of the Pribilof Islands during the summer and fall peak-concentration periods and during peak passage through Unimak Pass. Therefore, the effects to the fur seal could be elevated to high or very high levels. Although disturbance effects are not expected to increase the aggregate effect above that for oil spills alone, they could cause the cumulative effect to occur with greater certainty. The proposed sale is expected to contribute relatively little to the overall cumulative effect on this species.

Conclusion: The effect of the cumulative case on the northern fur seal is expected to be high.

Summary: Areas where large numbers of northern fur seals could be seasonally vulnerable to the additional effects of other ongoing and future projects include the migration corridor in the eastern Gulf of Alaska, outer banks of the Kodiak archipelago, Unimak Pass, and the Pribilof Islands and vicinity. Although the vulnerability of this species' population to oil spills and related disturbance could be high as a result of it eing seasonally concentrated in migration corridors and the vicinity of the Pribilof rookeries, and potentially subject to multiple spills along the routes of annual movement , the risk of spill occurrence and contact in most areas where they may be concentrated is low. Potential effects of factors other than oil spills and related disturbance are not likely to exceed moderate, and activities associated with current and future lease sales are not expected to elevate the cumulative effect on the northern fur seal above the high level. The proposed sale is expected to contribute relatively little to the overall cumulative effect on these species.

CONCLUSION: While the effect of the cumulative case on ice seals is expected to be LOW, the effects on the walrus and polar bear are expected to be MODERATE; and the regional fur seal population could experience a HIGH effect.

(4) Effects on Caribou: The additive effects on caribou of other ongoing and planned projects as well as the proposal are discussed in this section. Although the probability of any or all planned and ongoing projects reaching developmental stages is generally unknown, this analysis assumes that all of the projects discussed reach developmental stages. Vehicle traffic and construction associated with these projects could disturb caribou and alter or destroy some calving and summer range.

(a) Effects of Disturbance: The primary sources of disturbance of caribou are ground-vehicle traffic (perhaps several hundred vehicles/day), aircraft traffic, and associated human presence (several hundred to several thousand people). Disturbance--particularly from helicopter traffic associated with cumulative-case oil exploration--is likely to consist of brief incidents that result in low effects on caribou (principally cow/calf groups), with animals being displaced briefly from feeding and resting areas when aircraft pass nearby. The greatest concern related to ground-vehicle disturbance of caribou is that associated with roads adjacent to pipelines. Caribou are hesitant to cross under an elevated pipeline adjacent to a road, especially when vehicle traffic is present on the road. The success of crossing the pipeline corridor in the presence of traffic probably depends on strength of motivational stimulus. During the mosquito and oestrid-fly seasons, caribou are highly motivated to seek relief from insect harassment; and the frequency of pipeline crossings in the Prudhoe Bay/Kuparuk area increases (Curatolo, 1984). Increases in the percentage of disturbance reactions tend to reduce crossing frequency.

Caribou are known to cross pipeline corridors and numerous highways in Alaska and Canada with no apparent effects on herd distribution, abundance, or integrity. Disturbance from road traffic temporarily delays the successful crossing of pipeline corridors and roads by individual caribou, but this generally is a short-term effect that has no apparent effect on herd abundance or distribution. The only exception to this may occur when disturbance levels are very high and development facilities, drilling platforms, pump stations, pipelines and roads on the calving grounds are spaced close together (within about 100-200 m), causing some displacement of cows and calves from within about 4 km of these facilities--a small portion of their calving range.

At present, cumulative-case oil development in the Prudhoe Bay/Kuparuk area has caused minor displacement of caribou from a small portion of the calving range, with no apparent effect on herd abundance or overall distribution. The cumulative displacement of cow/calf groups from additional parts of the calving range associated with development of additional oil fields in the Prudhoe Bay/Kuparuk area, the NPR-A, and the Arctic National Wildlife Refuge (ANWR), and as a result of Canadian oil development could represent a long-term displacement (over the life of the oil fields) of caribou from a portion of the available calving habitat and thus a moderate effect on their distribution and abundance.

(b) Effects of Habitat Alteration: Cumulative-case oil development in the Prudhoe Bay/Kuparuk area encompasses over 800 km^2, and hundreds of kilometers of gravel roads cross a major portion of the calving range of the Central Arctic herd (see Graphic No. 3). A small percentage of the tundra grazing habitat has been destroyed where roads, gravel pads, gravel quarries, pipelines, pump stations, and other facilities are located. The cumulative loss of range from construction during future oil development (such as in the NPR-A and ANWR) and the Red Dog Mine project also would represent a small percentage of the available grazing habitat of the Western Arctic and Porcupine caribou herds, respectively, and would represent low habitat loss.

(c) Effects of Oil Spills: Potential oil spills from offshore- as well as onshore-oil activities associated with Federal, State, and Canadian leases probably would have low or very low effects on the caribou herds, in general, since few caribou are likely to be contaminated or ingest contaminated vegetation and die as a result of oil spills (see Sec. IV.C.9).

(d) Overall Cumulative Effects: Combined current and proposed onshore oil and gas activities in the Prudhoe Bay, NPR-A, ANWR, and Canadian Mackenzie River Delta areas could have some long-term, moderate disturbance/displacement effects on caribou herds if the animals avoided significant parts of the core calving areas of either the Western Arctic, Central Arctic, Teshekpuk, or Porcupine herds for the life of the projects, and a resulting reduction in caribou distribution or abundance occurred. Depending upon the timing, extent, and specific location of oil development and the duration (a few hours to several years) and intensity (few vehicles and aircraft/day to several hundred/day) of the disturbance, effects on caribou could range from low to moderate.

Transportation facilities associated with Federal and State offshore-oil activities alone would have low cumulative disturbance and habitat-alteration effects on caribou because onshore development associated with offshore leases generally would be limited to small shorebases and would not affect caribou over a large geographic area.

Cumulative reduction in local habitat use within about 4 km of construction (such as gravel mining, hundreds of kilometers of roads and pipelines, and a few square kilometers of drill pads) and the avoidance by caribou cows with calves of habitat areas with high levels of road and air traffic could have a moderate effect on the distribution of one or more of the North Slope caribou herds.

Because it has not been demonstrated that the present level of onshore-oil development in the Prudhoe Bay area has affected the abundance or overall distribution of any North Slope caribou herd, potentially high effects that would occur if caribou were displaced from or avoided calving habitats and summer ranges (causing a long-term reduction in herd productivity and leading to a population decline) are not expected. The proposed sale is expected to contribute relatively little to the overall cumulative effect on this species.

CONCLUSION: The effect of the cumulative case on caribou is expected to be MODERATE.

(5) Effects on Endangered and Threatened Species: Cumulative effects could result from individually minor, but collectively significant, actions that take place over a period of time or from individually significant actions that occur within a short period of time. As defined in the Council on Environmental Quality (CEQ) regulations, a cumulative effect is "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions." Consequently, this section addresses the cumulative effect of actions that are likely to affect endangered and threatened species, which includes activities associated with OCS oil and gas activities, commercial fishing activities, onshore activities, and subsistence hunting for bowhead whales.

This analysis assumes that whales do not respond (in the adverse sense) to noise of any kind until it is perceived as either a threat or an annoyance, although the noise may be heard at great distances. It is further assumed that the distance from the source of noise where a response occurs represents the outer limit of the response zone. The response zone is defined as the range of distances where a behavioral response (attributable to the industrial noise) can be expected from about one-half of the whales in the vicinity of a given source of industrial noise (based on Miles 1984, 1986, 1987). Hence, for the purposes of this discussion, encounters with industrial noise occur when one-half of the whales near a source of industrial noise are responding, or would be expected to respond, to the noise.

(a) Effects on Bowhead Whale: Activities likely to affect the bowhead whale population in the cumulative case include those associated with OCS oil and gas activities and subsistence hunting by Alaskan Natives. Agents associated with OCS oil and gas activities that may affect bowhead whales include industrial noise and crude oil from past, present, and future lease sales. Information regarding the effect of these agents on whales is incorporated by reference from Sections IV.B.7.a(1) and IV.C.7.a(3). Since studies concerning industrial noise and crude oil have shown that these agents are likely to have only local, short-term effects on some bowheads, even a high rate of encounter (such as could occur in the spring-lead system) is expected to result in minimal effects on the bowhead population. Further, the effect of industrial noise on individual bowhead whales in or near the spring-lead system (except in areas where they are being hunted) is likely to be similar to that anywhere else. Hence, the remaining discussion pertaining to OCS oil and gas activities focuses on the likely rate of bowhead whales encountering industrial noise and crude oil associated with the cumulative case and the resulting effect.

Regarding encounters with OCS industrial noise from former lease sales, to date there has never been a production operation on the arctic OCS (i.e., beyond the 3-mile limit), and only zero to two exploratory operations per year (only 1 in the Chukchi Sea). On their summering grounds in the Canadian Beaufort Sea, bowhead whales may also encounter noise from Canadian offshore oil and gas exploration and production. While the level of OCS industrial-noise-generating activity in the U.S. and Canada has been relatively low to date, it is considerably greater than that in any one sale area and is expected to remain that way into the future.

Regarding encounters with oil, about ten oil spills of ≥ 1,000 bbl are estimated for the development and production phase (none are estimated for the exploration phase) in the cumulative case. This includes the spills estimated for Sale 126, former Federal OCS lease sales, and Canadian production. On the basis of habitat use, bowhead whales could encounter an oil spill associated with Sale 126; former OCS Sales 97 and 109; Canadian production; and State leases. The probabilities of one or more spills of ≥ 1,000 bbl occurring within the production lives of Sales 92, 97, 109, and 126, and Canadian production operations are 67, 82, 99, 87, and 89 percent, respectively. Due to the high probability of one or more spills occurring in these areas, it is likely that at least one spill would occur in each planning area over its production life. If two spills occurred in separate planning areas used by bowhead whales during the same year, the probability of crude oil contacting bowhead whale habitat would be substantially increased over that of one spill in one sale area.

Hence, the probability of bowhead whales encountering industrial noise and crude oil would be substantially higher in the cumulative case than for the base case alone. The contribution of the proposal to the cumulative case involves about twice the level of exploration and development and production activity estimated for the base case. Hence, the incremental contribution of the proposal to the cumulative case, in terms of probable bowhead whale encounters with industrial noise and crude oil, is estimated to be about twice that of the base case (similar to the high case). The actual rate of bowhead whales encountering industrial noise in the cumulative case would vary depending on the number of whales in the population, the number of OCS exploration and development/production operations per year, annual ice conditions, and unknown factors associated with path selection within the greater migratory corridors. The actual rate of bowhead whales encountering crude oil in the cumulative case would depend on the number of spills; the size, duration, and timing of the spills; the density of the whale population in the area of the spills; and the whales' inclination to avoid contact with oil.

If there were a large oil spill associated with the cumulative case, it is likely that a number of bowhead whales in localized areas would encounter crude oil (assuming whales were in the area at that time of the year). It is also probable that a number of bowhead whales would encounter industrial noise associated with the cumulative case. However, contact with crude oil is expected to be brief, since bowhead whales spend most of their time underwater; they are believed to be capable of avoiding an oil slick; and bowhead whales on the Alaskan OCS are typically in a migratory mode. Contact with industrial noise is expected to be brief, since bowhead whales appear to avoid close encounters (1-4 km) with industrial operations. Neither the spring nor fall migrations are likely to be blocked or even delayed by industrial noise or crude oil associated with OCS industrial and commercial activities. In fact, these agents are likely to have no effect on most bowhead whales and only local, short-term effects on some bowhead whales (see Secs. IV.B.7.a(1) and IV.C.7.a(3)). Consequently, OCS industrial noise and crude oil associated with the cumulative case are expected to have a very low effect on the bowhead whale population, although some whales could be affected.

The only significant, man-induced effect agent on the endangered bowhead whale population is that due to the annual harvesting of bowhead whales by Alaskan Natives. Each year spring-migrating bowhead whales are hunted in the northern Bering and Chukchi Seas, and again on their fall migration in the Beaufort Sea. A quota of 44 strikes or 41 bowheads landed was authorized by the International Whaling Commission (IWC) in 1989. Alaskan Natives are allowed this level of harvest under the supposition that it still provides for a slow growth of the endangered bowhead whale population. The hunt for bowhead whales typically involves pursuit of whales in heavy skiffs powered by outboard motors and paddles, shoulder guns that fire internally exploding devices, and whale floats that assist in tiring and locating the stricken whales. Animals that are not found after a strike often die later or escape with substantial injuries. Animals that are pursued but not stricken, and animals that are in the vicinity of a strike, are likely to experience a significant amount of disturbance--particularly when cow-calf pairs are nearby. Brown (1982) indicates that whales that are being hunted typically flee such activities (and the noise associated with hunting vessels), and that hunted whales apparently do not habituate to being hunted or to other forms of overt harassment. Consequently, whenever Native hunting vessels are in the vicinity, whales are likely to strongly avoid them and the noise associated with them. Bowhead whales that are incidentally approached by Natives hunting belukha whales, seals, and walrus are likely to avoid these vessels for the same reasons. Hence, in areas where bowheads are traditionally hunted by Alaskan Natives, bowheads are likely to be more sensitive to noise, particularly to noise that could be associated with approaching hunters.

The hunting for bowheads by Alaskan Natives is likely to continue into the future in U.S. waters (Canadian Natives are not allowed to hunt for the endangered bowhead whale). Despite the fact that up to 44 bowheads may be killed or injured per year and many more are likely to experience a significant level of disturbance due to subsistence hunting, the bowhead whale population appears to be growing (based on IWC population estimates). No change in the historic distribution of bowheads or their migratory corridor appears to have taken place as a result of annual subsistence operations. Based on the definitions used in this EIS, subsistence operations are likely to have a moderate effect on the bowhead whale population.

Thus, OCS industrial noise and crude oil associated with the cumulative case are expected to have a very low effect on the bowhead whale population; and subsistence hunting is expected to have a moderate effect on the bowhead whale population. The proposed sale is expected to contribute little to the overall cumulative effect on this species.

<u>Conclusion</u>: The effect of the cumulative case on the endangered bowhead whale population is expected to be moderate.

(b) <u>Effects on Gray Whale</u>: Activities likely to affect the gray whale population in the cumulative case include those associated with OCS oil and gas activities and commercial fishing operations. Agents associated with OCS oil and gas activities that may affect gray whales include industrial noise and crude oil from past, present, and future lease sales. Information regarding the effect of these agents on whales is incorporated by reference from Sections IV.B.7.a(1) and IV.C.7.a(3). Since studies concerning industrial noise and crude oil have shown that these agents are likely to have only minor, short-term effects on some gray whales and no effect on most gray whales, even a high rate of encounter (an unlikely event) is expected to result in only insignificant effects on individual gray whales and the gray whale population. Hence, the remaining discussion pertaining to oil and gas activities focuses on the likely rate of gray whales encountering industrial noise and crude oil associated with the cumulative case and the resulting effect.

Regarding probable encounters with industrial and commercial noise from former lease sales, to date there has never been a production operation on the arctic OCS (i.e., beyond the 3-mile limit), and only zero to 2 exploratory operations per year (only 1 in the Chukchi Sea). In areas south of Alaska, gray whales have been subjected to increasingly high levels of industrial, commercial, military, and recreational vessel and aircraft noise for many years. This trend is likely to continue into the future. However, these many encounters have apparently not adversely affected the gray whale population, since it now exceeds pre-exploitation levels and is growing at about 2.5 percent per year.

Regarding encounters with oil, about ten oil spills of ≥ 1,000 bbl are estimated for the development and production phase (none are estimated for the exploration phase) in the cumulative case. This includes the spills estimated for Sale 126, former Federal OCS lease sales, and Canadian production. On the basis of habitat use, gray whales could encounter an oil spill associated with Sale 126; former OCS Sales 92 and 109; and former California sales. The probabilities of one or more spills of ≥ 1,000 bbl occurring within the production lives of Sales 92, 97, 109, and 126 are 67, 82, 99, and 87 percent, respectively. Due to the high probability of one or more spills occurring in these areas (and in the southern range of the gray whale), it is likely that at least one spill would occur in each planning area over its production life. If two spills occurred in separate planning areas used by gray whales during the same year, the probability of crude oil contacting gray whale habitat would be substantially increased over that of one spill in one sale area.

Hence, the probability of gray whales encountering industrial noise and crude oil would be substantially higher for the cumulative case than for the base case alone. The contribution of the proposal to the cumulative case involves about twice the level of exploration and development and production activity estimated for the base case. Hence, the incremental contribution of the proposal to the cumulative case, in terms of probable gray whale encounters with industrial noise and crude oil, is estimated to be about twice that of the base case (similar to the high case). The actual rate of gray whales encountering industrial noise in the cumulative case would vary depending on the number of whales in the population, the number of OCS exploration and development and production operations per year, annual ice conditions, and unknown factors associated with path selection within the greater migratory corridors. The actual rate of gray whales encountering crude oil in the cumulative case would depend on the number of spills; the size, duration, and timing of the spills; the density of the gray whale population in the area of the spills; and the whales' inclination to avoid contact with oil.

If there were a large oil spill associated with the cumulative case, it is likely that a number of gray whales in localized areas would encounter crude oil (assuming whales were in the area at that time of the year). It is also probable that a number of gray whales would encounter industrial noise associated with the cumulative case. However, contact with crude oil is expected to be brief, since gray whales spend most of their time underwater and are believed able to avoid an oil slick. Contact with industrial noise is expected to be brief, since gray whales appear to avoid close encounters (1-4 km) with industrial operations. Neither the spring nor fall migration is likely to be blocked or even delayed by industrial noise or crude oil associated with OCS industrial and commercial activities. In fact, these agents are likely to have no effect on most gray whales and only minor, short-term effects on some gray whales (see Secs. IV.B.7.a(1) and IV.C.7.a(3)). Any effect of industrial noise or crude oil on gray whales is expected to be insignificant compared to the effect of natural variations in habitat use, migratory-path selection, and whale behavior. Consequently, OCS industrial noise and crude oil associated with the cumulative case are expected to have a very low effect on the gray whale population.

Regarding encounters with gill nets due to commercial fishing operations, an unknown number of gray whales drown each year after becoming entangled in gill nets from commercial fishing operations. Gill netting was the known cause of death for 1 of 8 gray whales stranded in California in 1983 and for 4 of 21 stranded in 1984 (Seagers et al., 1986). Mortality caused by gill netting is expected to continue. However, this amount of mortality is not expected to significantly affect the gray whale population, which continues to increase at about 2.5 percent per year. Nevertheless, based on the definition used in this EIS, gill netting is expected to result in a moderate effect on the gray whale population.

Gray whales are seldom hunted by Alaskan Native hunters and, hence, would be subjected to subsistence-vessel encounters only when hunters are pursuing other species. Thus, Alaskan Native subsistence hunting associated with the cumulative case is expected to have a very low effect on the gray whale population.

Thus, OCS oil and gas operations associated with the cumulative case are expected to have a very low effect on the gray whale population; commercial fishing operations are expected to have a moderate effect on the gray whale population; and subsistence operations are expected to have a very low effect on the gray whale population. The proposed sale is expected to contribute little to the overall effect on this species.

Conclusion: The effect of the cumulative case on the gray whale is expected to be moderate.

(c) Effects on Steller (Northern) Sea Lion: The range of the Steller sea lion extends throughout the Bering Sea in the ice-free season to the Aleutian Islands, Gulf of Alaska, and south in small numbers to southern California. Although large-scale migrations are not typical of the species, long-distance movements of individuals and groups are common. Postbreeding dispersals have been documented throughout the Gulf of Alaska and south to British Columbia; from California to the Pacific northwest, Canada and southeast

Alaska; and north to the ice front in winter, to St. Lawrence Island in summer. The Alaska population from the central Aleutians to the Kenai Peninsula has declined precipitously in recent decades (Loughlin, 1989). The population of this area, currently estimated to be about 25,000, declined 63 percent between 1985 and 1989 and 82 percent since 1960, when it numbered about 140,000; the eastern Aleutians segment alone has declined 93 percent. Numbers in the northern Gulf of Alaska and the Kuril Islands, U.S.S.R., also are declining. Elsewhere, numbers apparently are stable. No commercial harvest has occurred since 1972. This species was designated as threatened in April 1990.

Activities that could produce cumulative adverse effects on sea lions include OCS exploration and development in the Bering Sea and Gulf of Alaska and commercial fishing operations. Altered prey distribution/abundance, and diseases, particularly those resulting in reproductive failure or juvenile/adult mortality, may be important factors in declining sea lion populations. Changes in the abundance of the prey size (pollock) thought to be preferred by sea lions have occurred (the large fish targeted in the pollock fishery), but too little information on sea lion-foraging patterns is available to confirm or reject a relationship between the changes and sea lion declines. Evidence of two disease organisms that could be responsible for reproductive failure and mortality has been found in Alaskan sea lions (Merrick, Loughlin, and Calkins, 1987).

Other cumulative factors, which by themselves are unlikely to explain the declines in some areas, but which may contribute to them, include changes in oceanographic conditions, subsistence harvest, predation, killing of individuals for bait and predator control, entanglement in net fragments and other debris, incidental taking in fisheries, harassment, chemical pollutants, and the residual effect of commercial harvest. How important most potential factors currently are is speculative. It is evident, however, that some factor(s) is devastating many areas of former sea lion abundance (very high effect).

Since the insulation of adult sea lions derives from a thick fat layer, they are relatively insensitive to hypothermia due to oil contact; however, oil may be transferred to the potentially more sensitive pups by females returning from feeding trips. Significant effects of oil and gas development on the sea lion population are most likely to occur when they are concentrated at rookeries in late spring, summer, and early fall. Major rookeries occur throughout the Aleutian Islands, on Walrus Island in the Pribilofs, on Amak Island north of the Alaska Peninsula, and in the western and northern Gulf of Alaska. Oil-spill effects are likely to be most severe in the eastern Aleutians, where the population is declining sharply. A spill contacting this area is most likely to originate in the St. George Basin lease-sale area or from tankers using Unimak Pass. Sea lions in the Gulf of Alaska are vulnerable to spills originating from tankers serving the TAP terminus in Prince William Sound or from future leases in this area. In the subregions including the Pribilofs and the eastern Aleutians, or western Gulf of Alaska and south Alaska Peninsula, a spill of a <10,000-bbl size probably would have moderate effects, while a large-volume spill surrounding rookery areas or multiple spills possible under cumulative assumptions are more likely to result in high effects. Elsewhere, although movements of sea lions occur between lease-sale areas or between lease-sale areas and other high-risk localities (potentially subjecting them to multiple spills or other adverse factors), the probable insensitivity of most age-classes to oil and the relatively small proportion of the population likely to be involved suggest that effects in these other areas would not exceed a moderate level. Disturbance of sea lion rookeries is not likely to increase significantly as a result of cumulative oil and gas development (low effect).

In summary, the Steller sea lion population is at an alarmingly low level in some Alaska areas and apparently is continuing to decline in these areas as a result of high to very high effects from non-OCS factors. The additional effects of oil spills could strongly influence their survival. In other portions of their range where they are concentrated, primarily in the vicinity of major rookeries in summer, a high level of effect could result from an oil spill, especially in areas of declining population. Low to moderate effects are more likely where densities are substantially lower, such as in the vicinity of minor rookeries, haulouts, and wintering concentrations throughout their range from Alaska to California. Multiple oil spills, more probable as a result of the addition of current and future OCS sales, could increase effects, particularly in areas where the population is declining.

The base case of the proposal is expected to contribute some effects, but the overall cumulative effects are expected to be very high because of the existing very high effect of unknown non-OCS factors and potential projects within the range of the Steller sea lion.

Conclusion: The effect of the cumulative case on the Steller sea lion is expected to be very high.

(d) Effects on Arctic Peregrine Falcon: There are a limited number of OCS and onshore activities that could affect arctic peregrine falcons. Agents associated with oil and gas activities that could affect peregrine falcons include industrial noise and crude oil from past, present, and future lease sales; and related onshore activities. While there are a limited number of oil and gas activities ongoing or proposed, any noisy activity or large-scale habitat alteration near nesting sites would be likely to adversely affect peregrine falcons (particularly from approximately late April to mid-August during nesting). Two existing projects that may affect arctic peregrine falcons would be offshore mining in Alaskan waters near Nome and the OCS Mining Program Norton Sound Lease Sale. Effects that could occur as a result of these two projects would be related to the mining and processing of the ore. As a result of these activities, mercury concentrations in the water column may be increased, possibly resulting in reduced reproductive success in birds. Several pairs of arctic peregrine falcons nest on coastline cliffs inshore of the sale area and feed on resident seabirds. The effect of mercury on peregrines could adversely affect the six nesting pairs near the proposed Norton Sound Lease Sale area.

Oil spills and noise as a result of previous oil and gas lease sales could also affect arctic peregrine falcons. Peregrines feed principally on birds, preferring to take their prey in flight. Consequently, it is unlikely that spilled oil would contact the falcons directly; but some could be oiled while feeding on partially oiled birds. Also, peregrines could be affected by a reduction in prey availability if a large number of birds in the area were contacted by spilled oil. The development and production scenario for the Chukchi Sea Planning Area anticipates construction of an onshore pipeline from Point Belcher to the TAP. At this time only a hypothetical corridor has been identified; however, it appears that the pipeline may pass in close proximity to some arctic peregrine falcon-nesting sites.

Based on 1988 surveys, the arctic peregrine population in Alaska is estimated to be about 80 pairs and 120 young. The combined effect from a variety of effect agents could result in the death of a small number of peregrine falcons, the short- or long-term abandonment of some nest sites, and the likelihood of a reduced reproductive rate. Bioaccumulation of trace metals, such as mercury resuspended by offshore mining programs, may result in mortality of a few peregrines or in reduced reproduction in those coastal nesting pairs near the mining area. Continued use of persistent pesticides and habitat disturbance or destruction along migration routes and in wintering areas would likely have sublethal effects that may result in reducing reproductive rates and slowing the recovery of the species. However, the more likely effect of OCS activities in the cumulative case would be limited to onshore-noise disturbance (associated with helicopter flights and the proposed pipeline) of nesting birds, which comprise a relatively small portion of the arctic peregrine falcon population. Consequently, only a small portion of the arctic peregrine falcon population is likely to be affected by OCS activities in the cumulative case. Overall, the contribution of the proposal to the cumulative case is expected to be insignificant.

Conclusion: The effect of the cumulative case on the arctic peregrine falcon is expected to be low.

CONCLUSION: The effect of the cumulative case on endangered and threatened species is expected to be MODERATE for the bowhead and gray whale populations, VERY HIGH for the Steller sea lion, and LOW for the arctic peregrine falcon.

(6) Effects on Belukha Whale: Activities that are likely to affect the belukha whale in the cumulative case include those associated with OCS oil and gas activities, commercial and subsistence fishing, mining operations, and subsistence hunting for belukha whales by Alaskan Natives. The effect of OCS oil and gas activities on belukha whales and other cetaceans is incorporated by reference from

Sections IV.B.7 and IV.B.8, IV.C.7 and IV.C.8, and IV.D.7 and IV.D.8 (a very low effect in each case). Hence, the remaining discussion pertaining to OCS oil and gas activities focuses on the expected rate of belukha whales encountering industrial noise and crude oil in the cumulative case and the resulting effect.

Belukha whales are likely to be affected by OCS oil and gas exploratory operations on previously leased tracts and by the proposal's contribution to the cumulative case (which is about twice that of the base case). On their summering grounds in the Canadian Beaufort Sea, belukhas may be subject to some noise disturbance from activities associated with offshore oil and gas exploration and development. However, due to the local, short-term effect of industrial noise on cetaceans and the relatively low level of exploration and production expected in the U.S. and Canada, industrial noise associated with former leases is not likely to have a significant effect on the belukha whale population. Due to the higher probability of crude oil contacting belukha whale habitat in the cumulative case, it is likely that a number of whales could be in areas where they may encounter crude oil. A prolonged spill in the spring-lead system at the start of the spring migration would increase the likelihood of whales encountering crude oil; and it is conceivable that some old, young, weakened, or stressed individuals could die. However, neither the spring nor fall migration is likely to be blocked or even delayed by crude oil associated with an oil spill. Consequently, the additional industrial noise and increased probability of an oil spill associated with previously leased tracts and the contribution of the proposal are not expected to have a significant effect on the belukha whale population.

Belukha whales are also likely to be affected by commercial and subsistence-fishing activities due to net entanglement, competition for prey, and disturbance due to vessel noise. Bristol Bay appears to be the primary area where net entanglement poses a problem. Mortality due to entanglement has apparently increased since the 1950's and is thought to have resulted from the shift from cotton to nylon nets, an increase in the number of set nets, and an increase in the amount of time gear is in the water (Frost, Lowry, and Nelson, 1983). The potential for noise disturbance by fishing vessels may vary from area to area. Outboard motors, especially when operated at high speed, have the greatest potential for interfering with belukha communication and echolocation. In an experiment, belukhas in Nushagak Bay responded more to outboard motors than to inboard-powered vessels or to playbacks of oil-drilling sounds; and outboard motor noise seemed to cause aversion at a considerable distance (Stewart et al., 1983). Residents from western and northwestern Alaska coastal communities attribute the reduced numbers of belukha whales in coastal areas to the increase in boat traffic, particularly boats powered by outboard motors. Commercial and subsistence-fishing activities due to net entanglement are expected to have a low effect on belukha whales.

Operation of the Red Dog Mine and the accompanying port may also affect some belukha whales. Transport of ore concentrates from the dock to lighters and from the lighters to ore carriers creates the risk of spillage and accompanying water quality degradation, as does the transfer of petroleum products, reagents, and other toxic materials. Belukhas migrate through the area in leads during the spring and along the coast in June through August and intermittently in autumn. Noise and activity associated with the operation of the port transfer facility would occur year-round and may cause occasional changes in swimming direction. Mining activities are expected to have a very low effect on belukha whales.

Effects due to subsistence hunting by Alaskan Natives represents the primary adverse effect of significance on belukha whales. The hunt typically involves the pursuit of belukha whales with heavy skiffs powered by outboard motors, high-powered rifles, harpoons, and retrieving hooks, and the technique of herding whales into areas where they can be harvested more efficiently. It is estimated that there are 15,800 to 18,450 belukha whales in the Alaskan and western Canadian population (Hazard, 1988). The average subsistence harvest of belukha whales in Alaska, Canada, and Siberia is about 500 to 600 whales (Stoker, 1983). About 150 to 200 belukha whales are harvested annually in Alaska; however, the current trend is toward a decline in the harvest as compared with the early and mid-1900's (Hazard, 1988). In all areas except Norton Sound, harvest mortality appears to be less than the estimated gross annual recruitment rate. Animals that are pursued but not killed, and animals in the vicinity of herding operations, are likely to experience a significant amount of disturbance. Consequently, whenever Native hunting vessels are nearby, belukha whales are likely to strongly avoid them and the noise associated with them. Due to lethal effects on 150 to 200 animals per year, and a corresponding change in population abundance that is expected to recover within one generation, Alaskan subsistence hunting is expected to have a moderate effect on the belukha whale population.

Thus, effects on the belukha whale population associated with the cumulative case are expected to be very low for OCS oil and gas activities, low for commercial and subsistence fishing operations, very low for mining operations, and moderate for subsistence hunting by Alaskan Natives. Overall, the proposal is expected to contribute little to the overall effects on this species in the cumulative case.

CONCLUSION: The effect of the cumulative case on the belukha whale is expected to be MODERATE.

I. Effects of Natural Gas Development and Production

Natural gas may be discovered in the Sale 126 area during exploration drilling. Although gas resources are not considered economic to exploit at this time or in the foreseeable future (see Appendices A and B), they may be developed and produced at some undeterminable future time. Under such circumstances, natural gas production probably would not occur until after oil production has begun. Thus, leases containing nonassociated natural gas that may be recoverable in the future probably will be retained by the leaseholder. (Associated and dissolved gases that are recovered along with the crude oil are expected to be reinjected or used as fuel, depending on the amount recovered.) Hence, the effects of potential gas development and production on the environment of the Sale 126 and adjacent areas that are in addition to the effects associated with oil development and production are described in this section.

Additional facilities and infrastructure would be needed if and when the nonassociated natural gas is developed and produced. The gas could be produced through wells drilled from gas-production platforms.

A large-diameter pipeline would be installed to transport the produced gas from the production platforms to an onshore gas-processing facility; the gas pipeline would be separated from any existing oil pipelines to the extent necessary to minimize risks that occur during installation and operation. No offshore booster-pump stations would be required between the platforms and the gas facility. Both the offshore and onshore sections of the gas pipeline would be buried.

A new facility would be needed to process gas produced from offshore reservoirs. Onshore, the gas pipeline would parallel the oil pipeline assumed in the base case to take advantage of the hypothetical road system. Because gas from offshore production would be taken into account in the final design of the Alaska Natural Gas Transportation System or the Trans-Alaska Gas System, the pipeline to market would be appropriately sized to accommodate the offshore production of gas. The gas would be refrigerated before it is pumped into the pipeline; at the refrigerated temperatures, there would be no significant threat to the permafrost.

Effects of natural gas development and production on the biological resources, social systems, and physical regimes of the Sale 126 and adjacent areas might be caused by gas blowouts; installing offshore pipelines and gas-production systems; drilling gas-production wells; installing onshore pipelines and a gas-processing facility; marine, surface, and air-traffic noise and disturbance; construction activities; and growth in the local economy, population, and employment.

Accidental emissions of natural gas could be the result of a gas-well blowout or a pipeline rupture. In the unlikely event that it occurred, a gas-well blowout probably would not persist for more than 1 day and would release perhaps 20 metric tons of gaseous hydrocarbons; 60 percent of all blowouts since 1974 have lasted 1 day or less. From such a blowout, a hazardous plume of gas could extend downwind for about a kilometer but would quickly dissipate once the blowout ceased. The amount of VOC released by such a blowout would be less than that evaporated from an oil spill of ≥ 1,000 bbl.

The rupture of a gas pipeline would result in a short-term release of gas. A sudden decrease in gas pressure would automatically initiate procedures to close those valves that would isolate the ruptured section of the pipeline and thus prevent further escape of gas.

1. Effects on Air Quality: The primary air pollutant would be VOC, of which more than 90 percent can be controlled by existing technology. The emissions from gas-production platforms and storage-and-treatment facilities would be analogous to those discussed in Section IV.J.6 of the Norton Sound Sale 100 FEIS (USDOI, MMS, 1985). The emissions from any gas blowouts (principally VOC) would be quickly evaporated or burned and dissipated by winds with minimal effect on air quality (USDOI, MMS, 1985).

Development drilling and platform and pipeline installation associated with natural gas resources would result in additional emissions of CO, SO_2, NO_x, and VOC. These emissions would be from the same kinds of sources as in oil development and production activities. On an energy-equivalent basis, production and offshore processing of natural gas emits fivefold fewer air pollutants than does oil production and processing.

The level of effects on air quality resulting from natural gas development and production is expected to be LOW.

2. Effects on Water Quality: Natural gas development and production would cause degradation of water quality as a result of platform and pipeline siting, and the discharge of drilling muds and cuttings.

Sediment resuspension and bottom disturbance are likely to occur as the result of platform siting, and pipeline construction. The amount of disturbance-associated gas-platform siting and drilling would be negligible and restricted to the area immediately around the activity. Sediment levels would likely be reduced to background levels within several hundred meters downcurrent. Ressuspension and seafloor disturbance associated with offshore-pipeline construction would occur along the entire pipeline route. The effects of trenching would be local and would occur only during periods of construction (see Sec. IV.C.2.b.).

Gas-production-well drilling would cause additional drilling muds and cuttings to be discharged; however, drilling muds would be recycled between oil and gas wells on the same platform. The effects of discharges would persist only during actual discharge within the 100-meter radius mixing zone around each discharge. Concentrations of trace metals would not exceed the acute marine water quality criteria at the edge of the mixing zone (see Sec. IV.B.2.a.). Production of an associated gas cap above an oil zone would result in no additional discharge of formation waters beyond that anticipated for oil development.

The level of effects resulting from natural gas development and production are expected to be LOW on local water quality and VERY LOW on regional water quality.

3. Effects on Lower-Trophic-Level Organisms and Fishes: If a natural gas blowout occurred--with possible explosion and fire--marine plants, invertebrates, and fishes in the immediate vicinity probably would be killed. Natural gas and condensates that did not burn in the blowout would be hazardous to any organisms exposed to high concentrations. A plume of natural gas vapors and condensates would be dispersed very rapidly from the blowout site but is not expected to be hazardous for more than 1 km downwind or for more than 1 day. It is not likely that the plume would affect any marine plants, invertebrates, and fishes except individuals present in the immediate vicinity of the blowout. In order to affect these organisms, the blowout would have to occur below or on the surface of the water.

Trenching activities associated with laying a gas pipeline would have localized effects on marine organisms. For mobile animals like fishes, virtually no adverse effects are expected; however, longer-term but extremely localized effects over a small area are possible for benthic organisms. In some instances, the alteration of the benthos by pipeline laying may enhance habitat for some lower-trophic-level organisms and fishes.

The level of effects on lower-trophic-level organisms and fishes resulting from natural gas development and production is expected to be VERY LOW.

4. Effects on Marine and Coastal Birds: The principal effects of natural gas development and production on marine and coastal birds would result from disturbance and habitat alteration associated with construction and operation of an onshore gas pipeline and processing facility and offshore gas production platforms. These effects would be similar to those disturbance and habitat-alteration effects associated with oil development and production (see Sec. IV.C.5). If there were a natural gas blowout with explosion and fire, birds in the immediate vicinity could be killed. Blowouts of natural gas condensates that did not burn would be dispersed very rapidly at the blowout site; thus, it is not likely that fumes would affect birds or their food sources, except those very near the source of the blowout.

The level of effects on marine and coastal birds resulting from natural gas development and production is expected to be LOW.

5. Effects on Pinnipeds, Polar Bear, and Belukha Whale: The principal effects of natural gas development and production on pinnipeds, polar bear, and the belukha whale would result from air traffic between the production platforms and shorebase and from construction of platforms, offshore pipelines, and an onshore gas processing facility. The air traffic associated with gas production would be an additive source of noise and disturbance of marine mammals. However, the effect of this noise and disturbance is likely to be very brief and result in only a temporary displacement of some individuals along the flight paths.

The effect of installing gas-production platforms and laying gas pipelines would be similar to the effect of installing oil production platforms and laying oil pipelines. These activities would temporarily (1 to 3 seasons) alter the availability of some food organisms of marine mammals near the production platforms and along the pipeline routes. Although this effect could be additive to the habitat alterations associated with oil development (see Secs. IV.C.6 and IV.C.8), the changes in availability of some food organisms of marine mammals are expected to be short-term and local.

If a natural gas blowout occurred, with possible explosion and fire, marine mammals in the immediate vicinity of the blowout could be killed. Natural gas and gas condensates that did not burn in the blowout would be hazardous to any organisms exposed to high concentrations. However, natural gas vapors and condensates would be dispersed very rapidly from the blowout site; it is not likely that these pollutants would affect any marine mammals except individuals present in the immediate vicinity of the blowout. For any marine mammals to be exposed to high concentrations of gas vapors or condensates, the blowout would have to occur below or on the surface of the water.

The level of effects on pinnipeds, polar bear, and the belukha whale resulting from natural gas development and production is expected to be LOW.

6. Effects on Endangered and Threatened Species: If natural gas development and production occur, effects would be similar to those described for oil exploration and production (ranging from a minor, short-term effect to no effect, see Secs. IV.B through IV.M). In addition, trenching for the gas pipeline would disturb a small amount of habitat that may support benthic invertebrates, a primary food source for gray whales and a secondary food source for bowhead whales. However, the amount of seafloor disturbed would be insignificant in comparison to the habitat available. Endangered whales may avoid approaching within a few kilometers of the vessels involved in trenching or pipelaying operations. The fall bowhead migration might be affected to a minimal degree by these activities.

If a natural gas blowout occurred--with possible explosion and fire--it is conceivable that a small number of endangered whales in the immediate vicinity could be killed. However, since whales are typically widely dispersed in or adjacent to the Sale 126 area, it is likely that they would seldom be near a platform. Further, when whales are in the vicinity of a platform, it is likely that they would be there only briefly, since whales in or near the Sale 126 area are typically in a migratory mode. Natural gas and condensates that did not burn in the blowout would be dispersed very rapidly, and it is not likely that they would affect endangered whales.

For endangered whales to be exposed to high concentrations of gas vapors or condensates, the blowout would have to occur below or at the surface of the water, not from the top of the production platform. It is possible that a gas blowout under ice cover could result in the formation of gas pockets under the ice, and that some whales may later inhale a portion of this gas. The probability of this would decrease over a period of weeks or months as the gas percolated through brine channels in the ice and was released into the atmosphere (Milne, 1977). The greatest vapor concentrations would likely occur if a blowout occurred during the winter months, but bowheads are unlikely to be present at this time. During the spring, when bowheads would be present, the rate of gas dissipation through the ice would be most rapid and would tend to reduce the time period when such exposure might occur (Geraci and St. Aubin, 1986). Also, gas pockets could be more prevalent under landfast ice rather than under moving ice, through which bowheads would be expected to migrate.

The effect of natural gas development and production on arctic peregrine falcons is expected to be limited to potential disturbance of a few migrating arctic peregrine falcons for a single season during construction of the gas pipeline. These effects are likely be very low, since it is expected that gas pipelines would be buried and would parallel oil pipelines to take advantage of existing roads.

The level of effects on endangered and threatened species resulting from natural gas development and production is estimated to be VERY LOW.

7. Effects on Caribou: The principal effects of natural gas development and production on caribou would result from motor-vehicle traffic and construction activities associated with installing the onshore pipeline system and processing facility. The onshore gas pipeline would run parallel to the oil pipeline and would be serviced by the same road. The gas pipeline probably would be buried and thus would not be likely to restrict caribou movements. Road-traffic disturbance of caribou along the gas-pipeline route would be most intense during the construction period, when motor-vehicle traffic is highest, but would subside after construction is complete. Caribou are likely to successfully cross the pipeline corridor within a short period of time (perhaps within a few hours or no more than a few days) during breaks in the traffic with little or no restriction in general movement and no effect on overall distribution and abundance. Construction of the gas pipeline would alter only a small fraction of the caribou range. Any accidental hydrocarbon release or explosion from the pipeline or processing facility is likely to affect only an insignificant proportion of the Western Arctic caribou herd for a very short period (1 day or less) and thus would not exceed a low level of effect.

The level of effects on caribou resulting from natural gas development and production is expected to be LOW.

8. Effects on the Economy of the North Slope Borough: Both the onshore pipeline and the gas processing facility would generate additional property-tax revenue for the NSB. However, the additional revenues would not be sufficient to reverse the long-term downtrend in revenues resulting from declining production from the Prudhoe Bay area. The long-term downtrends in population and employment would not be reversed.

The estimated level of effect on NSB revenues and employment resulting from natural gas development and production is not expected to exceed the estimated level of effect resulting from oil development and production (moderate). The effects on subsistence harvests, and in turn the NSB economy, are expected to be the same as in the base case (very high).

The level of effects on the economy of the NSB resulting from natural gas development and production is expected to be VERY HIGH.

9. Effects on Subsistence-Harvest Patterns: Effects on subsistence-harvest patterns from natural gas development and production could occur from natural gas blowouts, noise and traffic disturbance, and construction activities. These effects of natural gas development and production on the biological resources harvested for subsistence use are discussed in the above Sections IV.L.3 through IV.L.7. If a natural gas blowout occurred, the subsistence harvest of any species in the vicinity could be affected. Additionally, if a natural gas blowout occurred--with possible explosion and fire--subsistence resources in the immediate vicinity probably would be killed. Natural gas and condensates that did not burn in the blowout would be hazardous to any organisms exposed to high concentrations. However, natural gas vapors and condensates would be dispersed very rapidly from the blowout site (1 km downwind for about 1 day) and would affect only those species in the immediate vicinity of the accident. While such an effect would be short-term and localized and would not be likely to measurably affect the regional population of any species,

it could cause disruption to subsistence harvests in the area of the blowout. However, this disruption would be short-term and would not cause any species to become locally unavailable for more than one season.

The effects of installing and constructing gas-production platforms, laying gas pipelines, and activities associated with constructing onshore pipelines to connect the offshore-production platforms with the onshore-processing facility would be similar to the effects of installing and constructing oil-production platforms and pipelines. As with construction activities associated with oil development and gas production, effects are likely to be short-term, occurring only during the period of construction (which could disrupt subsistence harvests for the entire season in the vicinity where those activities were occurring).

Air and boat traffic--as well as road traffic along the pipeline route--associated with natural gas development and production would be additional sources of disturbance to subsistence harvests. However, the estimated level of noise and traffic disturbance is not expected to be greater for natural gas development and production than the level estimated for oil development and production.

The level of effects on subsistence-harvest patterns resulting from natural gas development and production is expected to be MODERATE.

10. Effects on Sociocultural Systems: Effects on sociocultural systems would be due to changes in employment and population and effects on subsistence-harvest patterns. In the event of natural gas development and production in the Chukchi Sea for Sale 126, there would be a slight increase in employment and population in the region adjacent to the Sale 126 area. However, these increases in employment and population are expected to be limited to an insignificant number and would not have any measurable effect on the sociocultural systems above that estimated to result from oil development and production. Effect levels of gas development and production on subsistence-harvest patterns in and adjacent to the Sale 126 area are not expected to exceed those already occurring from oil development and production; thus, there would not be an increased level of effect on sociocultural systems because of disruptions in subsistence harvests.

The level of effects on sociocultural systems resulting from natural gas development and production is expected to be MODERATE.

11. Effects on Archaeological Resources: Offshore archaeological resources could be affected by activities associated with potential gas-production-platform installation and pipeline installation. Such activities would require surveying of the area if there were a medium or high probability of finding archaeological resources. The area west and southwest of Point Belcher would be the most likely known offshore area where shipwrecks could be disturbed. Such disturbance would be modest. For further details on the probability of prehistoric and shipwreck resources see Appendix G.

Onshore archaeological resources would be affected by activities associated with gas-processing-facility and gas-pipeline installations; disturbance of onshore archaeological resources could occur at the time of construction activity. Disturbance also might occur as a result of onshore activity associated with accidents such as a blowout or explosion. Cleanup after such accidents could result in disturbance by graders or bulldozers being transported overground to the accident site. Such disturbance is likely to be moderate because of possible mitigation and surveys prior to the onshore activities being initiated.

The level of effects on archaeological resources resulting from natural gas development and production is expected to be MODERATE.

12. Effects of Land Use Plans and Coastal Management Programs: Natural gas development and production is assumed to occur on leases in the same area and follow the same transportation routes as oil production resulting from Sale 126. No further change in land use from subsistence uses to industrial uses is anticipated. With this scenario, the project would be consistent with the major siting elements of the

Alaska Coastal Management Program (ACMP) and with the district policies of the NSBCMP and Land Management Regulations (LMR's) that require transportation facilities be consolidated. The greatest disruptions would occur during the construction of the gas pipeline; effects from this disruption would be comparable to those of the base case. Moderate effects on subsistence could conflict with the statewide standards and district policies of the ACMP and the NSB LMR's. The pipeline route includes river, wetland, and shoreline habitats; conflict with the statewide standard and district policies protecting these habitats is likely.

The potential for conflict with land use plans and coastal management programs as a result of natural gas development and production is expected to be MODERATE.

13. Effects on Wetlands: The effects of natural gas development on wetlands would occur with construction of the onshore-pipeline-road corridor, the same as described for the base case. Severely changed wetlands would result from gravel fill, thermokarst, and road dust associated with this transportation corridor. The effects on wetlands are expected to be local within 100 m of the pipeline road, with <1 percent of the coastal wetland of the North Slope affected.

J. Very Large Oil-Spill Event:

The following analyzes the potential effects from a 160,000-bbl pipeline oil spill in the Chukchi Sea Planning Area. The 160,000-bbl spill is similar to the largest of 20 OCS pipeline or platform spills of at least 1,000 bbl that has occurred since 1964. The probability of one or more spills of at least 1,000 bbl in the Chukchi Sea is zero in the low case, 87 percent in the base case, and 99 percent in the high case. In the arctic cumulative case (Hope Basin to Canadian Beaufort Sea), there is a greater-than 99-percent chance of a spill of at least 1,000 bbl, with a most likely number of ten spills of at least 1,000 bbl.

Located in approximately 20 m of water, hypothetical spill site J-9 is closest to Point Belcher on the offshore trunk pipeline (Fig. IV-A-2). Based on the conditional probabilities, hypothetical spill site J-9 provides a high risk to environmental resources.

Pipeline-Spill Scenario: During a March storm, an unusually deep keel of an old multiyear-ice ridge crosses the 210,000-bbl-per-day trunk pipeline, damages a weld between two lengths, and causes a leak of 2,000 bbl per day. Because the sail heights of older multiyear ridges are eroded by surface melting and ablation, passage of the multiyear ridge through the area does not raise any suspicions; and the leak--equivalent to less than 0.9 percent of the pipeline flow per day--is not detected until June 15th of the following summer, a week after breakup. The pipeline operator locates the leak, fills the pipeline with a diesel pill, shuts the line down, and makes temporary repairs pending replacement of the ice-damaged pipeline. A total of 160,000 bbl of Prudhoe Bay-like crude is lost over the 80 days of leakage.

Spill Behavior: During the winter, the spill spreads as a ribbon, approximately 100 m wide and 0.6 mm thick. Separate oil droplets or small pools will not coalesce or flow into hollows underneath the ice when the oil is 0.6 mm thick (see Appendix L). In 5 to 10 days the oil will freeze into the ice, essentially unweathered. Over the 80 days, the ribbon increases in length at an average rate of 5 km/day, reaching a total length of 400 km. The ribbon, however, will not remain intact in the moving ice pack. The ice pack constantly deforms, and dispersion of individual ice floes in the winter is at least as great as for dispersion of surface oil in open water.

Both multiyear- and first-year-ice floes can cover hypothetical spill site J-9. In late spring and summer, the unweathered oil melts out of the ice at different rates depending on whether the oil is encapsulated in multiyear or first-year ice and on when the oil was frozen into the ice. In first-year ice, most of the oil spilled at any one time will percolate up to the ice surface over about a 10-day period (see Buist, Pistruzak, and Dickins, 1981). The oil spilled in March will surface on the ice in late-May; oil spilled in April will surface in early June. About mid-June, the oil pools will drain into the water among the floes of the opening ice pack. Thus, in first-year ice, oil will be pooled on the ice surface for up to 10 days before being discharged from the ice surface to the water surface. The oil spilled earlier will surface on the ice at a much greater distance from the spill site. Oil spilled under multiyear ice will melt out more slowly over the entire (partially) open-water season, with about 10 percent of the oil not surfacing until the second summer.

The spill scenario assumes that the pools on the first-year-ice surface will concentrate the oil, but only to about 6 mm thick, allowing evaporation of 13 percent of the pooled oil--the portion of the oil comprised of the lighter, more toxic components of the crude (Table IV-J-1). An additional 7 percent of the oil evaporates once oil is released into the melt. Oil released from multiyear ice will be unweathered.

After 30 days into the open-water season, 51,000 bbl or 32 percent of the spill volume will be left on the sea surface as individual tarballs rather than as a discrete slick (Table IV-J-1). The tarballs will disperse discontinuously over 6,200 km^2 (Table IV-J-2). Through 1,000 days, about 15 percent of the tarballs will sink (Butler, Morris, and Sleeter, 1976, as cited by Jordan and Payne, 1980), with 16 percent of original slick volume persisting in the remaining tarballs. Because of drift of the oil over distances of thousands of square kilometers during the slow process of sinking, individual, sunken tarballs will be widely dispersed in the sediments. The "average" levels of local or regional contamination in sediments will be insignificant. Oil

Table IV-J-1
Mass Balance of Oil Through Time for a Hypothetical 160,000-bbl Spill of Prudhoe Bay-Like Crude in the Chukchi Sea Planning Area[1/]

Day[2/]	Slick	Evaporated	Dispersed	Sedimented	Onshore
0	139,000	20,000[3/]	0	1,000	0
3	107,000	24,000	16,000	1,000	2,000
10	65,000	30,000	44,000	1,200	20,000
30	51,000	31,000	52,000	1,300	25,000

Source: USDOI, MMS, Alaska OCS Region; based on ocean-ice oil-weathering model of Kirstein, Payne, and Redding (1987), assuming 80 spillets of 2,000 bbl each.

1/ Assuming oil pools on ice to 2 mm at 32°F for 0 to 10 days, depending on when it was spilled, and melts out into 50-percent broken ice at 32°F, with 11-knot winds.
2/ Days after meltout of winter-spilled oil (93% of total spillage) or summer spillage (7% of total spillage).
3/ Evaporation on day 0 attributable to evaporation during oil pooling on ice surface prior to oil release to the water (= meltout).

Table IV-J-2
Areas of Discontinuous and Thick Slicks from a Hypothetical Spill of 160,000 bbl in the Chukchi Sea Planning Area

	Discontinuous-Slick Area (km^2)	Thick-Slick Area (km^2)
Initial Spill Area		40
Area During Oil Pooling on Ice Surface		4
Days After Spill Reaches Water Surface:[1/]		
3	4,200	18
10	4,700	30
30	6,175	44

Source: USDOI, MMS, Alaska OCS Region, 1990.

1/ Calculated from Ford (1985), and Kirstein, Payne, and Redding (1987), assuming 80 spillets of 2,000 bbl each.

mixed into the shoreline and then dispersed offshore will locally elevate hydrocarbon levels in nearshore sediments.

How much oil reaches specific shorelines or other environmental resources is best estimated from the conditional probabilities for a spill from hypothetical spill site J-9. Tables C-7 through C-12 in Appendix C provide the summer and winter conditional probabilities of contact for a spill originating at hypothetical spill site J-9. Table IV-J-3 provides a summary of the conditional probabilities that a spill will contact individual land segments or environmental resources within 3, 10, and 30 days of the early summer spillage or summer meltout of the spillage during the winter. Both winter and summer conditional probabilities are summarized since three-fourths of the spill occurs under winter conditions and one-fourth of the spill occurs under summer conditions. Trajectories and probabilities from both seasons are used in the analysis, with winter probabilities weighted more heavily than summer. A very important consideration is the spill size: both very large and of a very long duration. Spills of 2,000 bbl per day occurred for 80 days. In such cases, the interpretation of conditional probabilities must change because the spill is not instantaneous (see Sec. IV.A.1). The conditional probabilities in Table IV-J-3 represent the percentage of the spill contacting an individual land segment or environmental resource rather than the likelihood of contact.

Eight percent of the spill, less evaporation and dispersion, may contact shoreline. Based on the conditional probabilities, land segments 27 and 28 on Wrangel Island will be contacted after 30 days. Approximately 10,000 bbl could contact 120 km of shoreline, with 3 gallons of oil available for every meter of shoreline.

The concentration of oil in the upper 10 m of the water column is shown in Table IV-J-4.

Both summer and winter conditional probabilities show that greater than 99.5 percent of the oil spill may contact the Peard Bay Area and the Wainwright Subsistence Area. During the summer, the conditional probabilities show that greater than 99.5 percent of the oil may contact Migration Corridor A. In winter, Sea Segments 2 through 8 may be contacted by the spill in varying

1. Effects on Air Quality: A very large oil spill is an unplanned accident not generally accommodated by air quality standards. Consequently, the effects of such an oil spill on air quality are similar to those described for effects not related to standards for smaller accidental oil spills under the base case (Sec. IV.C.1), although for a larger total volume of oil. Under the scenario for an arctic low-probability pipeline spill, the primary effects on air quality would be evaporation of gaseous hydrocarbons from the slick. It is not expected that a crude oil would easily burn in sizable fires after being spilled gradually in sea ice, transported within the ice over a large area, and gradually released from the ice in small parcels. Mass-balance weathering calculations (Payne et al., 1984a,b, 1987) indicate that of 160,000 bbl spilled (approximately 21,760 metric tons), evaporation would account for 4,168 metric tons within 30 days after each of the parcels of oil was released from the sea ice during the arctic summer. Evaporation thereafter would be negligible. The amount of hydrocarbons released to the atmosphere corresponds to approximately 417 metric tons of VOC. Under the scenario, the VOC would be carried generally westward by the prevailing winds. Although the VOC may be carried toward land, the locations of the evaporating VOC would be thinly and widely scattered over the Chukchi Sea and would be released slowly throughout the summer. Consequently, the VOC would disperse quickly. No measurable effects from air quality are predictable on even a short-term or local basis under the scenario.

CONCLUSION: The effect of a very large spill on air quality is expected to be VERY LOW.

2. Effects on Water Quality: Very large spills generally result in peak, dissolved-hydrocarbon concentrations that are only locally and marginally at toxic levels. Concentrations of hydrocarbons, in the water column, following the Argo Merchant spill varied greatly with concentrations ranging up to 0.34 ppm. A concentration of 0.25 ppm was detected under the spill despite the presence of 20 percent by volume of the more soluble cutting stock (NRC, 1985). Volatile liquid hydrocarbons in the Ixtoc spill decreased from 0.4 ppm near the blowout to 0.06 ppm at a 10-km distance and to 0.004 ppm at a 19-km distance from the

Table IV-J-3
Summary of the Percentage of the Hypothetical Spill Estimated to Contact Individual Land Segments and Environmental Resources from Hypothetical Spill Site J-9 during Summer (one quarter) and Winter (three quarters)

Land Segment/ Environmental Resouce	Summer			Winter		
	Day 3	Day 10	Day 30	Day 3	Day 10	Entire
Sea Segment 1	n[1/]	n	n	n	n	n
Sea Segment 2	n	n	n	n	n	4
Sea Segment 3	n	n	n	n	n	2
Sea Segment 4	n	n	n	n	n	13
Sea Segment 5	n	n	n	n	n	27
Sea Segment 6	n	n	n	n	2	13
Sea Segment 7	n	n	n	n	n	2
Sea Segment 8	n	n	n	n	4	4
Sea Segment 9	n	n	n	n	n	n
Sea Segment 10	n	n	n	n	n	n
Seabird Concent. I	n	n	n	n	n	n
Seabird Concent. II	n	n	n	n	n	n
Bering Strait Area	n	n	n	n	n	n
Migrat. Corridor A	**[2/]	**	**	13	18	18
Migrat. Corridor B	n	n	23	n	4	7
Migrat. Corridor C	n	n	n	n	n	n
Whale Area A	n	n	n	n	n	n
Whale Area B	n	n	n	n	n	n
Whale Area C	n	n	n	n	n	n
Peard Bay Area	**	**	**	**	**	**
Barrow Subsis. Area	n	n	n	n	n	n
Wrght. Subsis. Area	**	**	**	**	**	**
P. Lay Subsis. Area	n	n	3	n	n	n
P. Hope Subsis. Area	n	n	n	n	n	n
Any Subsis. Area	**	**	**	**	**	**
Land Segment 27	n	n	n	n	n	4
Land Segment 28	n	n	n	n	n	2

Source: USDOI, MMS, Branch of Environmental Modeling (Appendix C, Tables C-1 through C-12), 1990.

[1/] n = < 0.5 percent.
[2/] ** = > 99.5 percent.

Table IV-J-4
Water-Column Concentrations of Dispersed Oil
Resulting from a Spill of 160,000 bbl
in the Chukchi Sea Planning Area

	Concentration in Water Column Beneath Discontinuous Slick at End of:		
	Day 3	Day 10	Day 30
Average ppm Concentration If All Dispersed Oil Is in Top 10 Meters[1/]	0.15	0.13	0.09

Source: USDOI, MMS, Alaska OCS Region, 1990.

1/ Calculations based on Ford (1985), and Kirstein, Payne, and Redding (1987) models, assuming 80 spillets of 2,000 bbl each.

blowout (NRC, 1985). Following the Amoco Cadiz spill, hydrocarbon concentrations in the water column varied widely with concentrations ranging from 0.003 to 0.02 ppm offshore and 0.002 to 0.2 ppm nearshore (NRC, 1985).

Hydrocarbon concentration in the water column following the 160,000-barrel spill would be expected to decline rapidly following the spill. The average concentration after 3 days in the top 10 m of the water column below the discontinuous slick would be 0.15 ppm. The discontinuous slick would cover 4,200 km^2 after 3 days. The average concentration in the top 10 m below the discontinuous slick would be expected to decline to 0.13 ppm after 10 days and to 0.09 ppm after 30 days following the spill. The area of the discontinuous slick would reach 4,700 km^2 after 10 days and 6,175 km^2 after 30 days.

After the slick disappeared (after 60 days), the spilled oil would persist as tarballs and tar particles suspended in the water column. Slow photo-oxidation and biological degradation would continue to slowly decrease the residual amount of oil. Through 1,000 days, about 15 percent of the tarballs would sink, with an additional 20-percent slick mass persisting in the tarballs (Butler, Morris, and Sleeter, 1976, as cited by Jordan and Payne, 1980). Because of the drift of the oil over distances of hundreds of kilometers during the slow process of sinking, individual, sunken tarballs would be widely dispersed in the sediments.

Sustained degradation of water quality to levels above State and Federal criteria because of hydrocarbon contamination is unlikely. Hydrocarbon concentrations from a spill of 160,000 barrels could exceed the chronic criterion of 0.015 ppm total hydrocarbons on about at least 6,175 km^2 of water for more than 30 days. Concentrations above the acute criterion are not anticipated. Effects of this oil spill on water quality are expected to be moderate locally and low regionally.

CONCLUSION: The effect of a very large oil spill on water quality is expected to be MODERATE locally and LOW regionally.

3. Effects on Lower-Trophic-Level Organisms: This group of marine plants and invertebrates ranges in size from the microscopic phytoplankton/zooplankton to the larger benthic clams and infaunal worms. Habitats range from surface waters down into the bottom sediments. If a very large oil spill of 160,000 bbl occurred over a period of 80 days during late winter and into early summer, the following effects on lower-trophic-level-organisms could occur.

Epontic (under-ice) organisms--primarily the ice algae (largely diatoms)--would be first contacted. It is possible that the ribbon of oil, about 100 m wide and with a somewhat discontinuous maximum length of 400 km, would contact and potentially affect epontic organisms over an area of about 40 km^2 (4,000 hectares). This area of winter distribution would constitute about 0.0421 ($4.2 \times 10\text{-}4^4$) percent of the Sale 126 area and a much smaller percentage of the total areal distribution of ice algae in the Chukchi Sea. Eighty days would pass before this total 40 km^2 would be contacted (sometime in June), at which time seasonal weather conditions may have both reduced the number of organisms present and also to large extent weathered much of the oil to levels of low toxicity. The normal distribution of ice algae tends to be patchy on both small and large scales (Sec. III B.1.b). Thus, only a minute part of the total population could be contacted. The effect of a very large oil spill on epontic life would then be very low.

Once meltout begins, in about mid-June, the dispersed oil would enter the water column at 3-, 10-, and 30-day concentrations of 0.15, 0.13, and 0.09 ppm, respectively (Table IV-J-4). These are probably well below toxic levels for most lower-trophic-level-organisms (Sec. IV.B.3.a). These low concentrations may, however, have sublethal effects, such as reduction in growth, activity, and reproduction.

A very large oil spill occurring at Hypothetical Spill Point J-9 has a conditional probability of >99.5 percent to contact the Peard Bay Area (a land segment) over 3-, 10-, and 30-day periods from the time of the spill event during both summer and winter seasons (Table IV-J-3). This could have a very localized effect on lower-trophic level organisms in Peard Bay, since evaporation and dispersion much reduces the volume of oil that reaches the shoreline (Table IV-J-l).

Three days after reaching the water surface during meltout, the discontinuous-slick area would encompass 4,200 km^2 (420,000 hectares) or 4.4 percent of the total 9.5 million hectares in the Sale 126 Area. Ten days from the time after the spill reaches the water surface, the discontinuous slick could contact 470,000 hectares (4.9%) and, at the 30-day point--when any remaining oil is much-reduced in toxicity, about 617,500 hectares (6.5%) would be discontinuously contacted. These small areas represent a very small fraction of the Sale 126 area and much smaller fractions of the total area inhabited by the lower-trophic-level organisms of the Chukchi Sea.

Only about 1,300 bbl--or about 0.08 percent of the total 160,000 bbl--would enter the sediments. This sedimented oil would largely be in the form of tarballs and would be widely distributed.

Localized effects on lower-trophic-level organisms would be moderate; i.e., the populations in this group would recover to their former status within one generation. This is predicated on the removal of oil from the area. While the localized effect would be moderate, the effect on regional populations would be very low, since these organisms are widely distributed beyond the boundaries of the very large oil spill and only minute numbers within the area of the oil spill might be contacted.

CONCLUSION: The overall effect of a very large oil spill on lower-trophic-level organisms is expected to be VERY LOW.

4. Effects on Fishes: Arctic fish tend to inhabit inshore, relatively shallow waters, as evinced by studies funded in part by the MMS (Craig, 1984). These areas, however, are most heavily used during the open-water season, with distribution of arctic fish more restricted during the period when there is ice cover over most of the Chukchi Sea Planning Area. During this period of ice cover, however, most of any spilled oil would be entrained in the ice.

A very large oil spill of 160,000 bbl over a period of 80 days would eventually discontinuously contact an area of about 4,000 hectares during the winter season; however, during spring/summer meltout, the area of the discontinuous slick would encompass more than 420,000 hectares after 3 days, 470,000 hectares after 10 days, and 617,500 hectares after 30 days. This discontinuous slick would then contact 4 percent of the Sale 126 area in 3 days, 5 percent after 10 days, and 6.5 percent after 30 days. This percent of contact would be much less for the additional fisheries habitat of the Chukchi Sea outside the Sale 126 Area. The toxicity of oil to fish has been tested extensively with indication that lethal levels range from 1 to 3 ppm for pelagic fish and 4 to 5 ppm for benthic fish (Rice et al., 1979). During meltout, when the fish would be most susceptible to exposure to oil, the water-column concentrations at 3-, 10-, and 30-day periods would not exceed 0.15 ppm--well below the toxic levels for fish found by Rice et al. (1979). The greatest hazard to fish would be in the area of Peard Bay and off the community of Wainwright, where fish are present and conditional probabilities show a >99.5-percent risk of an oil spill contacting these areas during both summer and winter. The concentrations of oil, however, would be below the lethal levels for fish. Farther offshore, the relatively limited distribution of an oil spill and the relatively low rate of loss per day would restrict the overall effect on fish. Only small fractional parts of the habitat for fish and only small fractional numbers of the total species populations would be affected. Oil that reached the benthos in the form of tarballs would be distributed over many thousands of square kilometers during the slow process of sinking to the bottom. With this wide dispersal, the effect on benthic life, including benthic fish, would be insignificant.

CONCLUSION: The effect of a very large oil spill on fishes is expected to be VERY LOW.

5. Effects on Marine and Coastal Birds: The effect of a large oil spill (160,000 bbl) off Point Belcher is likely to be most severe on migrant waterfowl and seabirds that spend substantial amounts of time on the sea surface in the vicinity of the sale area during spring migration and breakup of the pack ice.

By June, large numbers of seabirds and waterfowl have moved from the Bering Sea into the southeastern Chukchi Sea and smaller numbers are moving northward in the flaw-zone lead that has opened along the northwestern coast of Alaska. These latter individuals could contact oil released from the surface of first-year ice into the water at this time. The amount of oil present and the probability of contact depend upon where the ice in which it was trapped initially, in March and April, has moved. Beginning in mid-June, oil pooled on first-year ice as well as that released from multiyear ice would drain into the water surrounding floes of the opening pack ice. Probably at least 2 million migrant waterfowl (especially eiders, oldsquaw, and brant) pass through the eastern Chukchi in spring and early summer; and some seabirds also are present at this time in the northeastern Chukchi Sea spill area. As they move among ice floes and foraging areas, many tens of thousands of these birds could be exposed to oil that 30 days after release from the ice, occupies a discontinuous area of 6,175 km^2 (Table IV-J-2). In addition, any adverse effects on benthic-food-organism populations from tarballs sinking to the bottom (expected to be widely dispersed in sediments) could intensify existing environmental stress on these populations, which, together with other aspects of habitat degradation, could result in altered distribution and locally decreased abundance.

The concentration of these migrants in open-water areas of the Wainwright Subsistence/North Kasegaluk Lagoon Area, Peard Bay Area, and Migration Corridors A and B, through which a large proportion of the spilled oil is likely to pass (Table IV-J-3), suggests that substantial numbers of birds may be contacted. Oil remaining on the surface later in the summer and early fall could contact southward-moving concentrations of staging and migrant waterfowl and seabirds. Based on the limited pelagic-bird-density information available for this region (Fadely et al., 1989), mortality associated with this spill could be substantial, ranging from about 60,000 to more than 600,000, representing perhaps as much as 30 percent of these populations. Such mortality could elevate the level of effects above the low level expected under a more typical spill scenario.

CONCLUSION: The effect of a very large oil spill event on marine and coastal birds is expected to be MODERATE.

6 Effects on Pinnipeds and Polar Bear: A large oil spill (160,000 bbl) off Point Belcher is likely to result in more effects on the polar bear, because of its sensitivity to oil, than on walrus and ice seals, which are much less sensitive.

By late May or June, large numbers of walrus have moved from the Bering Sea into the southeastern Chukchi Sea and smaller numbers are moving northward in the flaw zone that is opening along the northwestern coast of Alaska. These latter individuals could contact oil pooled on the surface of first-year ice or released into the water at this time. The amount of oil present and the probability of contact in specific areas depend upon the extent of movement of the ice in which it was initially trapped in March and April. Beginning in mid-June, oil pooled on first-year ice as well as that released from multiyear ice drains into the water surrounding floes of the opening pack ice. Walrus are present in substantial numbers at this time in the northeastern Chukchi Sea spill area; and, as they move between haulout and foraging areas, many of these animals could be exposed to a thick oil slick that 30 days after release from the ice occupies 44 km^2 spread over a discontinuous area of 6,175 km^2.

Although there is no evidence that walrus would be killed by direct contact with oil, irritation of sensitive tissues or inhalation of hydrocarbon vapors might reduce survivorship of adults and calves, especially if they already are experiencing increased environmental stress from elevated population numbers and/or possible food depletion. Any adverse effects on benthic-food organism populations from tarballs sinking to the bottom (expected to be widely dispersed in sediments) could intensify existing environmental stress on the population, which, together with other aspects of habitat degradation, could result in altered distribution and locally decreased abundance. Thus, although it is not likely that walrus mortality associated with this spill would be significant, the combination of mortality, sublethal effects, and degradation of their habitat could produce effects considerably greater than those likely to result under a more typical spill scenario but still within the low range of effect.

Like walrus, adult ice seals contacted by oil are expected to experience primarily sublethal effects under this spill scenario, since the oil is likely to be encapsulated in ice during much of the late spring season when females in particular would be most vulnerable with their young. Ringed and bearded seal pups born late in the pupping period could be vulnerable to oil pooled or splashed on the ice or transferred from foraging adults prior to the onset of breakup in late May/early June. Even though the pack ice frequently is in motion, oil released from the pipeline break initially spreads over only 44 km^2 in winter and early spring (Table IV-J-2), with most expected to be trapped in the ice. This suggests that relatively few seals, which generally are dispersed and rarely occur as large concentrations, are likely to be contacted during this period. However, ringed seals pupping in the preferred shorefast-ice zone may be present at higher densities and thus greater numbers of both adults and pups could be contacted, especially since a larger proportion of the spilled oil is likely to pass through nearshore areas than farther offshore (Table IV-J-3). Potentially larger numbers may be contacted during breakup and the summer open-water season, when the discontinuous-oil-slick area is much larger; however, in summer most seals have withdrawn with the receding pack ice from the area where most of the oil is likely to persist.

An exception to this general situation is provided by the spotted seal which is most abundant and breeds primarily in the Bering Sea. During the summer season, substantial numbers move into the Chukchi Sea to occupy coastal haulout areas, in particular Peard Bay, the Wainwright and Icy Cape areas, and Kasegaluk Lagoon. The concentration of these seals in areas near the hypothetical spill site, which a large proportion of the spilled oil traverses, suggests that substantial numbers may be contacted; however, like other seals, effects are likely to be primarily sublethal, with relatively little mortality except in individuals already stressed. Any oil-related adverse effects on food-organism populations could intensify existing environmental stress on the population, which, together with other aspects of habitat degradation, could result in altered distribution and locally decreased abundance. Thus, although it is not likely that ice-seal mortality associated with this spill would be substantial, mortality resulting from oil contact in areas where the most sensitive segment of their populations occurs, or where concentrations occur, could produce effects considerably greater than those likely to result under a more typical spill scenario but still within the low range of effect.

Polar bears are extremely sensitive to both external contact and ingestion of oil. Concentrations may occur wherever seals, especially subadults, are abundant, and also where carrion (e.g., beached whale carcasses) is available, for example at Point Franklin and Icy Cape, adjacent to the sale area. Although a substantial proportion of the spilled oil is likely to pass near these areas (Table IV-J-3), relatively little is likely to come ashore. Thus, relatively few bears are expected to actually become oiled or to consume oiled food; therefore, a rather small proportion of the population is expected to be affected.

CONCLUSION: The effect of a very large oil spill on pinnipeds and polar bear is expected to be LOW.

7. Effects on Endangered and Threatened Species:

a. Bowhead and Gray Whales: The effect of crude oil on bowhead and gray whales was addressed in the base-case analysis and is incorporated by reference. The following analysis focuses on the likely rate of bowhead and gray whales encountering crude oil during a very large, hypothetical oil spill from a pipeline in 20 m of water at hypothetical Spill Site J9 (Fig. IV-A-2). The hypothetical spill occurs during a March storm and releases 2,000 bbl a day. Within 5 to 10 days after release from the pipeline, the essentially unweathered oil freezes into ice and is not detected until June 15. A total of 160,000 bbl of crude oil is lost over the 80-day period. Oil still containing toxic compounds melts out of the ice in late spring and summer. Summer and winter conditional probabilities are almost 100 percent for contacting the Peard Bay and Wainwright Subsistence Areas. If a spill occurred, summer conditional probabilities for oil contacting Migration Corridor A within 10 days are also nearly 100 percent. If a spill occurred in winter, Sea Segments 2 through 8 have conditional probabilities that range from 2 to 27 percent over the entire winter.

Assuming that the oil spreads into a spring-lead system used by bowheads, many whales would be likely to encounter crude oil on the surface before it freezes into the ice, since the spring bowhead migration passes through this area in April through June. Harmful concentrations of toxic vapors are likely to be carried away from any leads by the wind, and most volatile compounds would be lost within 24 to 48 hours of weathering at the surface. Since calving appears to occur from March to July--about the time of the northward migration, a number of young calves would be present and may be more susceptible to adverse effects from oil spills. However, encounters with oil would be brief unless the whales stopped to feed in the area. It is unlikely that prolonged encounters would occur unless individual whales were compelled to remain within an area into which fresh or relatively fresh oil were spilled. The chances of this occurring are very low, and the chances of such an event occurring to a large number of individuals would be even lower.

In late spring and summer, when the oil melts out of the ice, it is probable that many gray whales would encounter oil as the oil approaches inshore areas. Gray whales (like bowheads) spend about 90 percent of their time underwater and hence would contact oil on the surface only briefly, although such contact could occur periodically throughout the summer. In the fall, when bowheads are migrating westward through the Chukchi Sea, some may encounter residual weathered oil. However, the fall bowhead migration is very broad and encounter probabilities would be significantly lower than in the spring.

Clearly, the probability of bowhead and gray whales encountering oil associated with a very large oil spill would be substantially higher than that for the base case (although base-case spills would occur over a longer period). However, on the basis of the studies discussed in Section IV.C.7.a(3), any encounter with crude oil (weathered or not) is likely to have little effect on most whales. Studies have repeatedly shown that crude oil, and even gasoline, have had from only a minor, short-term effect on cetaceans. Nevertheless, it is conceivable that a very large oil spill could result in mortality in a small number of animals (primarily young or sick animals). If this occurred, the effect of the spill on bowhead and gray whale populations would be moderate, by definition. However, on the basis of studies findings, crude oil associated with a very large oil spill is likely to result in only a minor, short-term effect on cetaceans. Consequently, the very large oil spill would be likely to have little effect on bowhead and gray whale populations.

Conclusion: The effect of a very large oil spill on the bowhead and gray whale populations is expected to be very low.

a. Arctic Peregrine Falcon: A very large oil spill is expected to have a similar effect on arctic peregrine falcons as that discussed for the high case. However, a very large oil spill involves a substantial increase in the probability of shoreline contact by large amounts of crude oil, which substantially increases the likelihood that some arctic peregrine falcons would encounter oil when feeding on oiled prey. Reduced nesting success, bioaccumulation, and reductions in prey abundance are probable and would contribute to direct and indirect mortality. Consequently, a very large oil spill would be likely to have an insignificant effect on the arctic peregrine falcon population.

Conclusion: The effect of a very large oil spill on the arctic peregrine falcon population is expected to be high.

CONCLUSION: The effect of a very large oil spill on endangered and threatened species is expected to be VERY LOW for the bowhead and gray whale populations and HIGH for the arctic peregrine falcon population.

8. Effects on Belukha Whale: The effect of crude oil on belukha whales was addressed in the base-case analysis and is incorporated by reference. Belukha whales would be in the area of a very large oil spill at about the same time of the year as bowhead and gray whales (spring and fall). However, the oil-encounter rate is expected to be several times that discussed for bowhead and gray whales, since belukhas are estimated to be about twice as numerous and would be in the vicinity for a greater period of time. On the basis of studies information, the effect of crude oil on belukhas is likely to be similar to that for other whales. The effect of a very large oil spill on belukhas could be moderate if mortality of young or sickly animals occurred; however, on the basis of studies information, cetacean mortality is unlikely. Consequently, a very

large oil spill would be likely to have an insignificant effect on the belukha whale population.

CONCLUSION: The effect of a very large oil spill on the belukha whale population is expected to be VERY LOW.

9. Effects on Caribou: The effect of a very large oil spill on caribou is not likely to be substantial. Caribou sometimes frequent barrier islands and shallow coastal waters during periods of heavy insect harassment and may possibly become oiled or ingest contaminated vegetation, although they do not normally forage along the shoreline. Caribou that become oiled are not likely to suffer any lethal effects as a result of hair contamination since it would be shed during the fall before they grow their winter coat. Toxicity studies of crude-oil ingestion in cattle (Rowe, Dollahite, and Camp, 1973) suggest that anorexia (significant weight loss) and aspiration pneumonia leading to death are possible adverse effects of oil ingestion in caribou. However, caribou frequent coastal areas to avoid insects rather than to graze and thus are not likely to be feeding on coastal or tidal plants that may become contaminated.

During both winter and summer seasons, there is little chance of oil from a spill coming ashore on coastal spits, barrier islands, or other coastline habitats (including Ledyard Bay and Icy Cape) used by caribou for insect relief or overwintering. If circumstances during an oil spill in the open-water season resulted in the oil coming ashore, caribou that frequent coastal habitats--such as in the Icy Cape or Ledyard Bay areas--could possibly be directly exposed along the beaches and in shallow waters during periods of insect-pest-escape activities. However, only a small number of animals are likely to be exposed to the oil and die as a result--an effect that is likely to be insignificant for the Western Arctic caribou herd.

Likewise, as a result of the relatively small numbers of caribou using the beaches, it is unlikely that oil-spill-cleanup activities would cause significant adverse effects on this herd, although individual groups of caribou present are likely to be disturbed by the activity.

CONCLUSION: The effect of a very large oil spill on caribou is expected to be VERY LOW.

10. Effects on the Economy of the North Slope Borough: The potential effects of a very large oil spill on the economy of the NSB could be substantial and could result in long-term adverse effects. Because the economy of the NSB is highly dependent on subsistence resources, many of the adverse effects would be the result of losses in these resources. In addition, the local government would be taxed due to an increased demand for social services (see Sec. IV.J.12) and increased pressure on infrastructure due to the influx of spill-cleanup workers.

As discussed in Section IV.J.11, the effects of a very large oil spill would cause very high effects on subsistence-harvest patterns. By one estimate, 76 percent of the NSB households obtain greater than 50 percent of their meat and fish from subsistence resources (Stephen R. Braund and Assoc. and University of Alaska, ISER, 1989a,b). A loss in any part of this resource would represent a decline in household income. An event that caused very high effects on subsistence-harvest patterns would translate into a substantial decline in household income. Because there are limited job opportunities in the NSB, substitution of market activities for nonmarket activities would be limited. The exception to this would be jobs in cleanup activities. Some residents may find work cleaning up the spilled oil, as was true in the case of the Prince William Sound tanker-oil spill. These jobs, however, would be relatively short-term (one or two seasons), while the effects on the various subsistence species are expected to be long-term (4-5 yr).

In addition, the cost of harvesting subsistence resources could be greatly increased in two ways. First, subsistence users may have to venture farther to obtain the harvest because of population decreases in traditional hunting and gathering areas. Second, equipment used in the harvest of resources may become fouled by the spilled oil. Both of these factors would directly reduce household income.
Indirect costs of an oil spill could result from an increase in demand for social services. As discussed in Section IV.J.12, the loss of access to subsistence practices could manifest itself in social pathologies that

could result in an increased demand for social services. The cost of these services would most likely be borne by the NSB, which would have to redirect funds from other budget items. Increased costs to local government also would result from an influx of oil-spill workers, Federal and State bureaucrats, and the media, which would put strains on infrastructure such as housing, airports, and roads. These increased costs for the NSB would result in increased employment in related activities; however, this also would mean that other types of Borough-funded employment would have to be cut. This would most likely result in job losses to local residents because they might not be qualified to fill some of the spill-induced jobs, especially specialized jobs in social-service provision.

CONCLUSION: The effect of a very large oil spill on the economy of the NSB is expected to be VERY HIGH.

11. Effects on Subsistence-Harvest Patterns: A very large oil spill would increase effects levels significantly above those expected for the high case. During the spring--when the bowheads begin their northward journey to the Canadian Beaufort sea--they pass closest to land and are hunted by the Inupiat. Utilizing nearshore leads, the bowheads pass within a few miles of shore at several points along the northwestern Alaska coastline. Oil trapped within these leads could stress the bowhead (particularly the weaker and younger pod members) and cause behaviors that would increase mortality.

Apart from the immediate physical effects of a spill on bowheads, the fear that bowhead flesh could be tainted would, by itself, discourage potential hunters and curtail the subsistence harvest. Because of the lingering effects of the oil spill, fears of the effect on the bowhead could persist and disrupt the harvest even after residual oil was reduced to a weathered state. Under this scenario, the potential for multiyear disruption of the bowhead harvest is probable. The effect of a very large oil spill on the bowhead harvests of Wainwright, Barrow, and Atqasuk would be very high. In Nuiqsut, whaling could be suspended during the spring due to the condition of the bowheads and the perception of tainted meat; effects on Nuiqsut's bowhead harvest would be high. Point Hope's bowhead harvest would not initially be affected, since its hunt is the earliest of the affected communities--the oil slick would not have reached Point Hope's bowhead-harvest area by the start of the whaling season. Wainwright's harvest could be affected the following year due to the suspension of harvest quotas if the bowhead population suffered elevated mortality levels. Point Lay does not hunt the bowhead.

Other marine mammals harvested as subsistence resources--belukha whale, seals, walrus, and polar bear--would suffer high to very high effects as a result of a very large oil spill. Harvest efforts would be disrupted by cleanup efforts, oiled animals, and fears of tainted meat. Because of the short open-water season and the persistence of a considerable amount of the spilled oil into the second summer, the potential for multiyear disruption of the marine mammal subsistence harvest would be great. Waterfowl harvests may also suffer long-term disruption; the Point Lay, Point Belcher, and Peard Bay areas are prime subsistence-hunting areas for migratory birds. All of these areas would be highly susceptible to and affected by a major oil spill. Due to the low-energy (wave) environment of the northwestern Alaska coastline, oil contaminates could persist in the nearshore environment for more than one season and could affect harvest levels over a multiyear period. In regard to subsistence fisheries, the multiyear persistence of suspended hydrocarbons may cause the elimination or curtailment of marine fish harvests in more than one season.

In summary, the effects of an oil spill of the magnitude and duration postulated in this scenario would be very high for Wainwright, Point Lay, Barrow, Atqasuk, and Nuiqsut. Because of Point Hope's distance from the spill, the initial effects of the spill would be minimal. However, over time the dispersal of hydrocarbons would be such that oil would enter the Point Hope Subsistence Area, possibly by the following open-water season, and would cause some curtailment of the harvest. Geographically, the northern region of Point Hope's Subsistence Area--Cape Lewis to Cape Lisburne--may be most affected. The Cape Lewis-to-Cape Lisburne area is hunted primarily for seal, walrus, and waterfowl. Although harvests within the aforementioned areas could be limited, seal-, walrus-, and waterfowl-harvest areas are found in other portions of Point Hope's subsistence-harvest zone. Thus, it is expected that these resources would be as available as others--both in the first and second open-water seasons--after a very large oil spill.

CONCLUSION: The effects of a very large oil-spill event would be VERY HIGH for Point Lay, Wainwright, Barrow, and Atqasuk, and MODERATE for Point Hope and Nuiqsut.

12. Effects on Sociocultural Systems: In the analysis contained in Section IV.M.11, the conclusion was reached that in the event of an oil spill of the magnitude forecast by this scenario, subsistence harvests would suffer very high effects. The harvest of some species would be curtailed or eliminated over a multiyear period. In addition, key offshore and onshore (shoreline) subsistence areas would be highly traveled by cleanup crews and ships. Cleanup-related traffic, coupled with the existing oil field traffic and the spilled oil, would create an environment less then conducive to pursuit of traditional resource harvesting. Such a spill would have immediate and probable long-term effects on the affected communities. As was witnessed during the Prince William Sound oil-spill event, the initial reaction by the affected communities might well be one of shock followed by a sense of loss (a feeling for the need to mourn).

Accompanying this sense of loss would be anger. Hostility would be directed at--among others--oil companies, community and North Slope Borough officials (for allowing the leasing to occur), and other authority figures. Also, much of the good will that the Federal Government and oil industry sought to create with the Inupiat would be a casualty of a major spill. Future leasing programs in the Chukchi Sea would face a severe test from a united and somewhat hostile populace. Finally, the nuclear and extended family itself would absorb and be affected by much of the hostility. In such circumstances, structural change would occur within the most severely affected communities. This change would manifest itself in the political, cultural, and family life of the community. Respected leaders would suffer a loss of influence; traditional subsistence practices might be put on hold or seen by some as not relevant in the "new reality;" and the family unit would become less cohesive due to a variety of stresses (i.e., increased drug and alcohol use, domestic violence, and other pathologies).

The effects levels felt by the six communities near this sale area would not be uniform. Because of the proximity of Point Lay and Wainwright to an oil spill and their orientation toward traditional sociocultural values, the effects of this scenario on Point Lay and Wainwright would be very high. Due to Barrow's more diverse population, greater economic base, more extensive subsistence-harvest zone, and distance from the spill, the effects of a spill would not be as great. However, due to the potential effects of a spill on the bowhead whale harvest and the effects of the sale--as felt through kinship (extended-family) effects of the spill on Barrow--would be high. Due to the effect of the spill on the bowhead whale, effects of a large oil spill on Nuiqsut might also be high. The inland community of Atqasuk receives much of its marine mammal subsistence resources through kinship ties with Barrow. As an inland community, Atqasuk would not be directly affected by the spill and would escape much of the associated trauma. Atqasuk gathers the majority of its subsistence harvest from terrestrial resources. The community harvest would also benefit by its use of Barrow's extensive marine mammal-harvest areas. Effects of the spill on Atqasuk would be moderate. Point Hope lies far enough south of the spill that it would not be initially affected by the spill, and the recovery of its harvest areas would likely be rapid. The effects of the spill on Point Hope would be moderate.

CONCLUSION: The effects of a very large oil-spill event would be VERY HIGH on Point Lay and Wainwright; HIGH on Barrow and Nuiqsut; and MODERATE on Atqasuk and Point Hope.

13. Effects on Archaeological Resources: A very large oil-spill event could affect offshore and onshore archaeological sites because of the physical cleanup activities that could disturb resources and because of potential hydrocarbon contamination of organic site materials . About 32 percent of the spill would become tarballs and 15 percent of them would sink. Although "average" levels of local or regional contamination in the sediments would be insignificant, subsurface archaeological sites could be highly contaminated by individual tarballs which would affect the Carbon14 dating potential of the sites. Because of the drift of the oil spill over distances of thousands of square kilometers during the slow process of sinking, individual sunken tarballs would be widely dispersed in the sediments. Oil mixed into the shoreline

and then dispersed offshore would locally elevate hydrocarbon levels and could affect scientific dating of archaeological sites.

Cleanup activity, such as spraying a beach with water or bulldozing sediments on an oiled beach, could damage archaeological resources. Land Segments 22 and 23 would be especially vulnerable because of the known shipwrecks and historic sites in that area of the beach. An estimated 30 to 40 cleanup workers and their equipment would be used in each beach cleanup. Some looting of archaeological resources would be likely to occur during the cleanup of a very large oil spill in the Sale 126 area, as evidenced during the cleanup of the Prince William Sound oil spill ("Anchorage Daily News," August 15, 1989).

A spill of this size is unlikely to move outside of the sale area to the Cape Krusenstern National Monument beach area (Land Segments 9, 10, and 11) based on the OSRA conditional probabilities. The conditional probability that an oil spill during the summer or winter would reach these segments and thus reach Krusenstern from Spill Points J2, J28, and J29 is <0.5 percent (see Appendix C: Tables C-6 and C-12). At Cape Krusenstern, beach ridges that are thousands of years old and contain the remains of past fishing camps, settlements, and cemeteries would be affected.

There is a high likelihood that oil would damage the archaeological resources located in the Bering Land Bridge National Preserve on the Seward Peninsula (Land Segments 1-5) if contacted by a large oil-spill. However, the contact probability for these land segments is <0.5 percent (see Appendix C: Tables C-6 and C-12). Significant prehistoric and historic habitation and village sites would be affected should such an event occur.

CONCLUSION: The effect of a very large oil spill on archaeological resources is expected to be MODERATE.

14. Effects of Land Use Plans and Coastal Management Programs: In the event of a very large oil spill, biological resources would have higher levels of effects--shorelands, especially saltmarshes and river deltas, would be more heavily oiled; and cultural and archaeological resources, if present, would be damaged. A spill of the magnitude estimated in this case accentuates rather than expands the potential policy conflicts. Policies related to oil spills do not differentiate between low and high probabilities for oil spills. The very high level of effects identified for subsistence in the event of a very large oil spill provides a good indication that pipeline design will be scrutinized closely when development associated with this sale is proposed. Moreover, following a spill of this magnitude, subsequent activities are likely to be subjected to greater scrutiny and there is a greater likelihood that conflicts would arise.

CONCLUSION: In the event of a very large oil-spill event, the potential for conflict with NSB Land Management Regulations and the ACMP is expected to be HIGH.

15. Effects on Wetlands: A very large spill offshore of Point Belcher has a very low ($\leq$ 4%) chance of contacting the shoreline or coastal wetlands on Wrangel Island (see Table IV-J-3); and this contact is expected to occur during the winter season, when shorefast ice would prevent direct contamination of the coastal wetlands. No coastal wetlands along the Alaskan coast adjacent to the sale area are expected to be contaminated by the spill (see Table IV-J-3). If coastal wetlands were contaminated by the spill, damaging effects on vegetation and sensitive invertebrate communities in the wetland could persist for many years and represent a long-term, local effect on the wetland (effects would be similar to those of an onshore spill [see Sec. IV.C.15, base case]).

CONCLUSION: Coastal wetlands are not expected to be contaminated by the assumed very large oil spill; if some contact did occur, the damage is expected to be local but could persist for many years.

K. Unavoidable Adverse Effects

1. Effects on Air Quality: An increase in emissions of air pollutants would occur as a result of the proposed lease sale. In the base, high, and cumulative cases and the Point Lay Deferral Alternative, the emissions of NO_x would be controlled through application of BACT. In addition, BACT would be applied to emission sources that exceed the de minimis levels. Under all cases of the proposal, air quality standards limitations onshore would not be approached. A VERY LOW to LOW effect on air quality is expected.

2. Effects on Water Quality: The only unavoidable adverse effect on water quality anticipated from the proposal would be the input of large quantities of hydrocarbons into the water column through accidental spillage. Spillage would be expected to have a MODERATE local effect and a LOW regional effect on water quality. If toxic, drilling muds and formation waters could be reinjected into wells rather than discharged into the environment.

3. Effects on Lower-Trophic-Level Organisms: Accidental oil spills are considered to be unavoidable adverse effects. Their effects on marine plants and invertebrates in the Chukchi Sea are described in Section IV.C.3. The possible effects include the death of organisms in localized areas, with consequent changes in species composition; alterations in primary and secondary production; reduced reproduction and/or recruitment; and a variety of additional sublethal effects. Long-term changes could result if sediments became contaminated and if emigration, reproduction, and/or recruitment were reduced in affected areas. In general, unavoidable effects are expected to be VERY LOW on marine plants and invertebrates; however, MODERATE effects would be possible for the kelp-bed communities if they were largely contaminated by oil.

4. Effects on Fishes: Accidental oil spills are viewed as unavoidable adverse effects. Their overall effect on fish resources of the Sale 126 area, as described in Section IV.C.4, is likely to be VERY LOW, with a potential for VERY HIGH effects if a large oil spill from an onshore pipeline contacted the Colville River and affected overwintering and rearing habitat, sensitive lifestages, and/or concentrations of fishes in freshwater.

5. Effects on Marine and Coastal Birds: Under the base case, two oil spills are considered unavoidable, while most disturbance of nesting seabirds and most nesting waterfowl and shorebirds is considered avoidable through voluntary compliance with the recommendations on air and ship traffic in the proposed Information to Lessees on Bird and Marine Mammal Protection (Sec. II.F).

The oil-spill-trajectory analysis indicates that coastal habitats such as Kasegaluk Lagoon and Ledyard Bay are at very low risk of contact from oil spills that may be associated with the base case. However, if a spill contacted the coast, oil-spill-cleanup efforts could provide some protection of Kasegaluk Lagoon by possibly diverting an oil spill away from the lagoon entrances and saltmarshes.

If a spill occurred within the drifting pack ice of the Chukchi Sea, it would be very difficult to contain and clean up with present oil-spill-cleanup technology. Such an oil spill is likely to affect seabirds in the area of the spill. An unavoidable spill is expected to result in LOW effects on some bird populations.

6. Effects on Pinnipeds and Polar Bear: Under the base case, two oil spills are considered unavoidable, while most disturbance of these marine mammals is considered avoidable through voluntary compliance with the recommendations on air and ship traffic in the proposed Information to Lessees on Bird and Marine Mammal Protection (Sec. II.F). However, some disturbance of marine mammals near construction sites would be unavoidable, including a few polar bears denning near Point Belcher--which could result in den abandonment.

The oil-spill-trajectory analysis indicates that the lead-system habitat from Point Barrow to Point Hope is at risk from oil spills that could be associated with the base case. Under some circumstances, oil-spill-cleanup efforts could provide modest reduction in spill contact to marine mammals in this area.

If a spill occurred within the drifting pack ice of the Chukchi Sea, it would be very difficult to contain and clean up with present oil-spill-cleanup technology. Such an oil spill might unavoidably kill small numbers of highly stressed or young seals, young walrus, or polar bears in the area of the spill (Sec. IV.C.6).

Overall, oil spills, disturbance and habitat alteration are expected to have LOW unavoidable effects on seals, walrus, and polar bear.

7. Effects on Endangered and Threatened Species: In the event of exploration and production, it is probable that a number of endangered bowhead and gray whales would hear underwater noise associated with exploration and production (vessels, aircraft, drilling, dredging) during the relatively brief period of time it would take them to migrate past these activities. It also is probable that a small number of these whales would enter industrial response zones (generally 1-4 km from the source of noise), and that some would exhibit local, short-term responses to such noises. If a large oil spill were to occur during the period that endangered whales were in the Sale 126 area, it is likely that a small number of whales would be contacted by crude oil for brief periods of time. Whales contacted by crude oil are likely to experience minor short-term to no effect from such contact. A large oil spill would be likely to adversely affect bowhead and gray whale prey resources, but only in small areas within the greater feeding habitat. The arctic peregrine falcon population is likely to experience a small amount of disturbance due to onshore pipeline construction and associated activities. Overall unavoidable effects on endangered and threatened species are expected to be VERY LOW.

8. Effects on Belukha Whale: Unavoidable effects associated with Sale 126 are expected to be essentially the same for belukha whales as discussed for bowhead and gray whales.

9. Effects on Caribou: Some disturbance of caribou by vehicles and possibly aircraft, particularly along the pipeline-support road, and habitat alteration from the construction of a pipeline, support road, helicopter pads, and shorebase facility probably are unavoidable. Unavoidable disturbance of caribou along the pipeline would be temporary and would not affect migration or overall distribution and abundance. Habitat loss in the pipeline-road corridor would be 1 percent or less of the summer range. Unavoidable adverse effects associated with the base case are expected to be LOW.

10. Effects on the Economy of the North Slope Borough: Increased population, minor gains in revenues, and potential oil spills could cause disruptions to subsistence harvests and in turn village economies in both the short and long terms, having very high effects. Some of the effects of population change and oil spills could be mitigated, reducing these effects to HIGH.

11. Effects on Subsistence-Harvest Patterns: Oil-spill incidents that are unavoidable could lead to the localized, direct loss of small numbers of belukha whale, seals, walrus, polar bear, fishes, birds, and caribou; however, none of these losses, except for the bowhead harvest, would lead to the elimination of any subsistence harvest. Some of the risks to bowheads from oil spills can be mitigated. Only oil-spill effects on bowhead and belukha whales and walrus would lead to a reduction of total annual harvests. MODERATE effects on bowhead whale harvests due to noise and traffic disturbance, primarily from icebreakers, are expected to be avoidable, if mitigated, thus decreasing noise and traffic disturbance to LOW effects.

12. Effects on Sociocultural Systems: Government and Community-supported social programs with adequate funding could mitigate many of the sociocultural effects of Sale 126. Particularly those which could be causal agents in increased incidents of drug and alcohol abuse and domestic violence. Areas of unavoidable adverse effects involves potential the short-term loss of some subsistence resources and potential repercussions on the culturally significant sharing networks.

13. Effects on Archaeological Resources: Accidental, sale-related occurrences--such as pipeline breaks, tanker accidents, or blowouts--could increase offshore activities. Offshore effects of oil spills from the accidental occurrences would be caused by disturbance of the resources during repair of breaks in underwater pipelines while cleaning up oil spills. Onshore effects of oil spills would be caused by disturbance of archaeological resources while constructing, maintaining, or repairing pipelines and while digging and moving contaminated soil and building roads to bring in equipment from airports to shore.

14. Effects of Land Use Plans and Coastal Management Programs: Many of the potential biological and social effects of Sale 126 are related to oil spills and, therefore, are considered unavoidable. As a result, potential conflict with statewide standards for lagoon and river habitats would be unavoidable. Potential conflicts with NSB LMR's and CMP policies that protect access to subsistence resources from Point Belcher are considered avoidable, as are conflicts with the statewide water quality standard that could arise from the discharge of formation waters into the Chukchi Sea. Effects arising from lack of access and discharge of formation waters could be mitigated through development practices addressed during the permit processes. Unavoidable conflict between land use plans and coastal management programs and the activities associated with the base case are expected to be LOW.

15. Effects on Wetlands: Onshore-pipeline and road-construction effects on wetlands are expected to be unavoidable. The effects of gravel fill, thermokarst, road dust, and some small oil spills are unavoidable. However, these damaging effects are expected to be local (within 100 m of the pipeline-road corridor). Less than 1 percent of the coastal plain wetlands of the North Slope is likely to be unavoidably affected.

L. Relationship Between Local Short-Term Uses and Maintenance and Enhancement of Long-Term Productivity

In this section, the short-term effects and uses of various components of the environment of the Chukchi Sea Sale 126 area are related to long-term effects and the maintenance and enhancement of long-term productivity. The effects of the proposed action would vary in kind, intensity, and duration, beginning with preparation activities (seismic-data collection and exploration drilling) of oil development and ending when natural environmental balances might be restored.

In general, short-term refers to the useful lifetime of the proposal; but some even shorter-term uses and effects are considered. Long-term refers to the time beyond the lifetime of the proposed action. The overall life of the proposal under the base-case scenario is estimated to be 29 years, with 7 years of exploration and delineation activity and 22 years of oil development and production. Short-term refers to the total duration of oil exploration and production, whereas long-term refers to an indefinite period beyond the termination of oil production. The definitions for short-term and long-term, as used in this section, differ from those used in Sections IV.B through IV.G.

Many of the effects discussed in Section IV are considered to be short-term (being greatest during the exploration, development, and early production phases) and could be reduced by the mitigating measures discussed in Section II.F.

Major construction projects, such as the 640-km onshore-pipeline and support road, would cause definite changes in both the short and the long terms, with localized long-term effects on wetlands along the onshore pipeline corridor. Some species, such as nesting birds, may have difficulty repopulating altered habitats and could be permanently displaced from local areas. In the short-term, biological productivity would be reduced or lost on all onshore lands used in the proposed project; however, the productivity of some of these areas could be regained in the long term with habitat reclamation.

In offshore areas, construction projects could cause long-term changes by altering the local habitats of some marine-benthic organisms. Short-term oil pollution and the possibility of long-term accumulations of pollutants could cause adverse effects on some components of the marine ecosystem. Even though these events are unlikely, the potential must be recognized. A short-term, offshore regional decrease in water quality may be considered to be a tradeoff for obtaining hydrocarbon resources.

The biota would be threatened in the short term by potential oil pollution. Displacement could be significant through the combined effects of harassment by humans and the increased volume and frequency of noise from vessel traffic or overflying aircraft. Such disturbances could alter behavior patterns and drive fauna from some traditional feeding and breeding grounds or to other habitat areas within their ranges, thus reducing the local populations of species over a long period of time.

Habitat destruction could cause a local reduction in subsistence resources, which could threaten the regional economy and weaken the core values of sharing Native goods and subsistence as a way of life. The improved accessibility to primitive areas from increased construction and road building is a short-term and long-term result of the proposal. The wilderness values of the coast and along the pipeline route and associated access road would decrease with increased human activity in these areas. Land use changes would be dramatic at the shorebase site and along the pipeline route. Short-term changes include a shift in land use from subsistence-based activities to industrial activities throughout the life of the proposal. In addition, the area adjacent to the shorebase site and pipeline corridor would, in all likelihood, be subject to hunting regulations (hunting closures) similar to those imposed on the Prudhoe Bay complex and the Dalton Highway corridor. Zoning for the area would change from a Conservation District to a Resource Development District. This would be a short-term change if, after production ceases, use of the land reverts to previous uses. Long-term effects on land use could result if use of the infrastructure or facilities continues after the lifetime of this proposal. Potential users would be other resource developers, residents, or nonresidents who have become accustomed to the convenience of traveling the associated roads.

Increased population, minor gains in revenues, and the consequences of oil spills all contain the potential for disrupting Native communities in the short term. Added incentive to shift from a subsistence-based economy to a cash-based economy, a reduction in subsistence resources, a decrease in subsistence activities,and other changes brought about by the proposed lease sale could be factors in long-term consequences for Native social and cultural systems.

Archaeological and historic finds discovered during development would enhance long-term knowledge. Overall, finds may help to locate other sites; but destruction of artifacts would represent long-term losses.

Consumption of offshore oil would be a long-term use of nonrenewable resources. Economic, political, and social benefits would accrue from the availability of oil. Most benefits would be short-term and would decrease the Nation's dependency on oil imports. If additional supplies were discovered and developed, the assumed production system would enhance extraction.

The production of oil from the Chukchi Sea Sale 126 area would provide short-term energy and perhaps time for the development of long-term alternative-energy sources or substitutes for petroleum. Regional planning may aid in controlling changing economics and populations and, thus, in moderating any adverse effects.

Alternatives to the proposed action--such as cancellation, delay, and the deferral alternative--would reduce to varying degrees both the long- and short-term environmental effects as well as the long- and short-term energy benefits. The overall, long-term effect of Sale 126 would be to reduce the productivity of the environment.

M. Irreversible and Irretrievable Commitment of Resources

1. Minerals Resources: The undiscovered, economically recoverable resources estimated to be leased in the base case amounts to 1,610 MMbbl barrels of oil. Should these resources be discovered, they would be irretrievably consumed.

2. Biological Resources: Industrial activities onshore and along the coast of the Chukchi Sea, such as air and ground-vehicle traffic, and land-based-development projects such as roads and airstrips--could permanently displace some birds (such as nesting waterfowl and shorebirds) and mammals (such as denning polar bears) from favorable habitats to unfavorable habitats. This displacement and habitat loss could result in reduced population levels and become irretrievable if alterations to the environment, such as roads and airstrips, were permanently maintained by man. However, the degree of displacement (within a few kilometers of airstrips and roads) and amount of irretrievable habitat loss are likely to represent an insignificant level of effect on these bird and mammal populations.

3. Endangered and Threatened Species: Endangered whales could possibly be subjected to long-term effects from oil spills, noise disturbances, or loss of habitat due to facility developments. It is expected that such effects would not lead to permanent irreversible losses of these species, although individuals may be lost.

4. Subsistence-Harvest Patterns: Hunters may have to travel farther and longer, and the hunt may be more costly and may result in some reductions in harvests. A subsistence harvest most likely would have to be unavailable for many years before the effect would be irreversible or irretrievable, although the absence of the harvest of some species could have irreversible effects on sociocultural systems. It is not likely that any subsistence harvests would become unavailable for more than a few years or that effects would become irreversible or irretrievable.

5. Sociocultural Systems: Many important aspects of Inupiat society and culture are centered around subsistence activities. Virtually every family on the North Slope participates in the hunting of the bowhead whale and the sharing of its meat. In the event that oil spills or offshore-noise-and-traffic disturbance disrupted the harvesting of bowhead whales, there would be a loss to Inupiat social and cultural values. Such a loss could be irreversible and irretrievable, resulting in social stress in the communities, breakdown of family ties, increased drug and alcohol abuse, and a breakdown in the communities' sense of well-being. Activities associated with the taking of seals, walrus, birds, and fishes are less important to the integration of the region as a whole, but are just as important to the social organization of each community as well as to the domestic economies of most households. As with the bowhead whale, the inability to harvest sufficient quantities of these resources would be a loss to the Inupiat diet, to Inupiat values of sharing and reciprocity, and to the fundamental aspects of Inupiat identity. The contribution of Sale 126 to the cumulative consequences of offshore and onshore energy development, in conjunction with other processes of social change, may in the long term lead to the irretrievable loss of the Inupiaq language and other cultural behaviors.

6. Archaeological Resources: Irretrievable material products of prehistoric culture, such as archaeological sites, may be lost through looting and indiscriminate or accidental activity on known and unknown sites. Loss of ground context in which artifacts are located is a very important factor in dating and relating an artifact to other artifacts. The orientation program and the archaeological-resource stipulations would protect against some of such losses.

7. Land Use Plans and Coastal Managment Programs: It is unlikely that the landscape could ever revert exactly to its predevelopment characteristics. However, use of the land could revert to previous subsistence uses in spite of the changes.

☆U.S. GOVERNMENT PRINTING OFFICE: 1991-791-199/21802

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