Contents

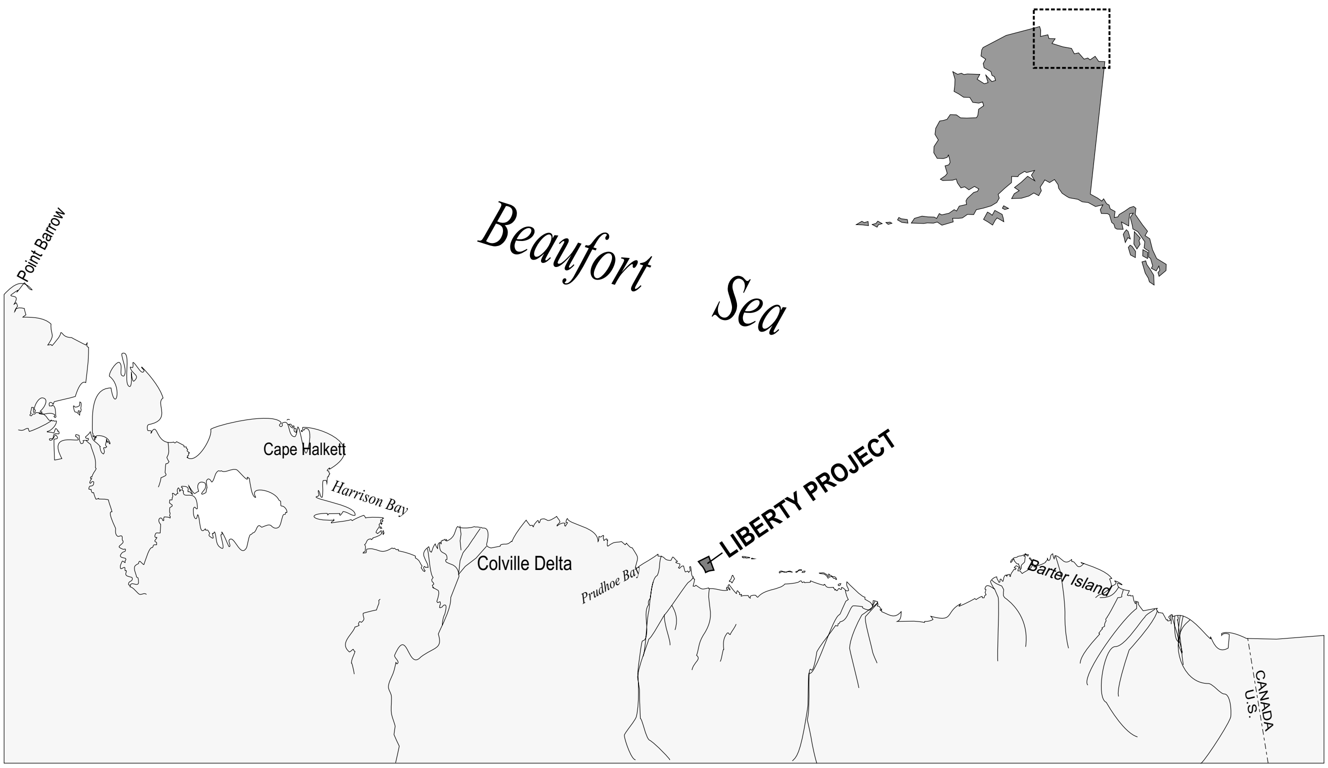
Alaska Outer Continental Shelf

OCS EIS/EA
MMS 2001-002

Liberty Development and Production Plan

Draft Environmental
Impact Statement

Executive Summary



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

Liberty Development and Production Plan, Draft Environmental Impact Statement,
OCS EIS/EA, MMS 2001-001, in 3 volumes:
Volume I, Executive Summary, Sections I through IX, Bibliography, Index
Volume II, Tables, Figures, and Maps for Volume I
Volume III, Appendices

The summary is also available as a separate document:
Executive Summary, **MMS 2001-002.**

The complete EIS is available on CD-ROM (**MMS 2001-001 CD**) and on the Internet (**http://www.mms.gov/alaska/cproject/liberty/**).

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 effects. 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 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.

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 believed 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 coastal states concerned. The United States expressly reserves its rights, and those of its nationals, in all areas in which the offshore-boundary dispute has not been resolved; and these illustrative lines are used without prejudice to such rights.

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Region 10

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

2001

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COVER SHEET

Beaufort Sea Oil and Gas Development/Liberty Development and Production Plan
Environmental Impact Statement
2001

Draft (X) **Final ( )**

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Lead Agency:

U.S. Department of the Interior,
Minerals Management Service

Cooperating Agencies:

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ABSTRACT

An Interagency EIS Team was created to assist MMS in preparing this EIS. The U.S. Army Corp of Engineers and the Environmental Protection Agency are cooperating agencies. Participating agencies include the U.S. Department of the Interior, Fish and Wildlife Service; U.S. Department of Commerce, National Marine Fisheries Service; State of Alaska, Pipeline Coordinator's Office; State of Alaska, Division of Governmental Coordination; and the North Slope Borough.

BP Exploration (Alaska) Inc. (BPXA) proposes to produce oil from the Liberty Prospect (OCS Lease Y-01650) located approximately 5 miles offshore and 1.5 miles west of the abandoned Tern Exploration Island in Foggy Island Bay in the Alaskan Beaufort Sea. BPXA's proposed action for the Liberty Prospect is to construct a self-contained offshore drilling operation (development) with processing (production) facilities located on a man-made artificial gravel island in 22 feet of water in Foggy Island Bay.

BPXA proposes to construct a 12-inch common-carrier oil pipeline buried in an undersea trench (approximately 6.1 miles long) from offshore Liberty Island to an onshore landfall and then connected by an elevated onshore pipeline to a tie in with the existing onshore Badami oil pipeline (approximately 1.5 miles long). This infrastructure will, in turn, transport sales quality oil (hydrocarbons) to the Trans-Alaska Pipeline System. Buried with this pipeline in the offshore portion of this project will be an external detection system capable of detecting the presence of leaking hydrocarbons, this is in addition to two internal monitoring systems the length of the project.

BPXA determined that the Liberty Prospect contains approximately 120 million barrels of recoverable crude oil. Production facilities on Liberty Island would be designed to produce up to 65,000 barrels of crude oil per day and 120 million standard cubic feet of natural gas per day. There would be producing wells, gas-injection wells, water-injection wells, and either one or two Class I industrial waste-disposal wells. The life of the proposed Liberty Prospect development is anticipated to be approximately 15-20 years.

This draft Environmental Impact Statement (EIS) covers the proposed Beaufort Sea Oil and Gas Development/Liberty Development and Production Plan. This document includes the purpose and background of the proposed action, alternatives, description of the affected environment, and the predicted environmental effects of the proposed action and the alternatives. The alternative analysis evaluates five sets of component alternatives (island location and pipeline route, pipeline design, upper slope protection system, gravel mine site, and pipeline burial depth) that focus on the different effects to modifying major project elements. The EIS also evaluate the range of alternatives that could be chosen by combining the different options from the component alternatives. In addition to the mitigation required by MMS in the lease and those built into the BPXA Proposal, two proposed mitigating measures and their potential effects are evaluated. The EIS also evaluates potential cumulative effects resulting from the BPXA Proposal and alternatives.

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EXECUTIVE SUMMARY

Executive Summary: Liberty Development and Production Plan, Environmental Impact Statement

In February 1998, BP Exploration (Alaska) Inc. (BPXA) submitted a Development and Production Plan (Plan) to the Minerals Management Service (MMS) for the proposed Liberty Project; a pipeline Right-of-Way application was submitted March 3, 1998. The Plan has since been revised. Revision 1 was issued in November 1998 and Revision 2 in July 2000. The Plan and application initiated a Federal review process for BPXA's proposed project. The Liberty Prospect is in Federal waters of the Beaufort Sea northeast of the Prudhoe Bay oil field. This project would develop and produce oil and gas from the Liberty Prospect to transport and sell oil to U.S. and world markets. The MMS's Regional Supervisor for Field Operations must consider BPXA's Plan and applications. If he approves the proposed Plan and applications, he would monitor the project to ensure that activities comply with MMS regulations. No development activity can occur on the lease until the Plan is approved.

This document includes the purpose and background of the proposed action, alternatives, description of the affected environment, and the proposed environmental effects of the proposed action and the alternatives. The alternative analysis in the EIS evaluates the effects of modifying five project components (island location and pipeline route, pipeline design, upper slope-protection system, gravel mine site, and pipeline burial depth). The EIS also evaluates three alternatives that could be chosen by combining project components and compares them to each other and to the BPXA Proposal.

In addition to the mitigation required by MMS in the lease and those built into the BPXA Proposal, the EIS evaluates effectiveness of two potential mitigating measures. The EIS also evaluates potential cumulative effects resulting from the BPXA Proposal and alternatives.

A. LIBERTY PROJECT, PLAN, AND SCHEDULES

1. Environmental Impact Statement Schedule

We (MMS) determined that approving BPXA's Plan would be "a major Federal action that may significantly affect the quality of the human environment pursuant to the National Environmental Policy Act"; therefore, we should prepare an environmental impact statement (EIS). Under this Act, the EIS will evaluate reasonable alternatives, including BPXA's Proposal and a No Action Alternative, as well as how each alternative may affect the environment. We will use information in the EIS in our Record of Decision to either approve the Plan and applications or decide on other actions. Currently, MMS intends to issue the final EIS in fall 2001. Under the Outer Continental Shelf Land Act, MMS needs to make a decision within 60 days of issuance of the final EIS; however, under the National Environmental Policy Act, no decisions can be made until 30 days after the issuance of the final EIS. Final agency decisions would be made in early 2002. Some of the alternatives, if chosen, may result in delays in the Liberty Project of 18-24 months to collect additional engineering data and allow time for specific design and testing work. This information would be necessary for technical approval of the project but is not expected to change the environmental effects. For purposes of analysis in the EIS, we have not adjusted the timelines for starting the different alternatives. Therefore, all the alternatives are on the same footing for the analysis of environmental effects.

We will respond to the public comments on the draft EIS in the final EIS. We have not committed to any specific course of action and will maintain an open mind throughout the development of the final EIS and decision processes. We will continue to consider and evaluate all reasonable options. The agency-preferred alternative(s) will be identified in the final EIS based on the analysis and full consideration of comments received. We especially encourage the public to comment on the sections describing the alternatives.

2. The Need and Purpose for the Liberty Project

Need: To satisfy the demand for domestic oil and decrease the dependence of the United States on foreign oil imports.

Purpose: To recover oil from the Liberty Prospect and transport it to market.

This project helps satisfy the mandate of the Outer Continental Shelf Lands Act to explore for and develop offshore mineral resources by developing the oil resources of OCS Lease Y-01650 issued by the MMS in Foggy Island Bay in the Alaskan Beaufort Sea.

3. Description of the Plan

Under the Outer Continental Shelf Lands Act, the MMS is required to analyze the environmental effects of BPXA's proposed action, as described in the Development and Production Plan (Sec. II.A of the EIS).

Note: We have included in the Executive Summary, several tables, and a map from the EIS. To lessen confusion, we are keeping the same table or map number used in the EIS. Citations are listed in the EIS bibliography.

BPXA proposes to develop the Liberty oil field from a manmade gravel island constructed on the Federal Outer Continental Shelf in Foggy Island Bay (see Map 1) The gravel island would be located in water about 22 feet deep and inside the barrier islands. The Liberty Project is about 5 miles off the coast nearly midway between Point Brower to the west and Tigvariak Island to the east. The proposed gravel island would be between the McClure Islands and the coast. The overall project includes the following:

- a manmade offshore gravel island;
- stand-alone processing facilities and associated infrastructure on the island;
- about 6.1 miles of offshore buried oil pipeline and about 1.5 miles of onshore elevated pipeline connecting the island facilities to the Badami Pipeline;
- an onshore gravel mine site at the Kadleroshilik River used during construction and then rehabilitated; and
- onshore and offshore ice roads.

4. Development Schedule

If the project were approved, construction of the ice roads presently are planned to begin in November or December of 2002, which would be Year 1 of the project as described in the EIS. The planned construction process would occur over 2 years. The gravel island would be constructed in 1 year (Year 2), and the offshore pipeline would be constructed the next year (Year 3). To the extent possible, construction would occur during the winter. If construction were delayed, all construction would occur in a single season (Year 3).

A drill rig would be transported to the island by a barge in the summer of Year 2 or moved over an ice road in the winter of Year 3. An infrastructure module would be sealifted to the island in July/August of Year 2. Process modules would be sealifted to the island in July/August of Year 3. Drilling would start in the first quarter of Year 3. Oil shipment (production) would start in the fourth quarter of Year 3. The economic life of the field is estimated at about 15 years.

B. COLLABORATION WITH OTHER AGENCIES

1. Interagency Team Meetings

The Liberty Interagency Team was created in the spring of 1998 to discuss a broad range of issues related to the development and content of the Liberty EIS. The Liberty Interagency Team consists of five Federal Agencies (MMS, Fish and Wildlife Service, U.S. Army Corps of Engineers, National Marine Fisheries Service, and the Environmental Protection Agency); two State of Alaska Agencies (State Pipeline Coordinator's Office and the Division of Governmental Coordination); and the North Slope Borough. The Interagency Team met periodically during the EIS preparation process. Scoping and EIS alternatives were major issues of discussion for the Liberty Interagency Team.

2. EIS Partnerships

For the purposes of preparation of this particular EIS, the Corps of Engineers and the Environmental Protection Agency are cooperating agencies. They, along with the MMS, will consider using this EIS as their National Environmental Policy Act documentation for review of the Liberty Project. Both the Corps of Engineers and the Environmental Protection Agency have attended frequent meetings with MMS and have reviewed draft EIS text. The Corps of Engineers Preliminary Section 404(b)(1*)*

Evaluation - Liberty Development Project and *Evaluation of Proposed Liberty Project Ocean Disposal Sites for Dredged Material at Foggy Island Bay* can be found in Appendices G and H of the EIS. The Environmental Protection Agency draft National Pollution Discharge Elimination System draft permit can be found in Appendix I-2 of the EIS. The Fish and Wildlife Service, National Marine Fisheries Service, North Slope Borough, the State Pipeline Coordinator's Office, and the State Division of Governmental Coordination have entered into a participating relationship with MMS and have attended meetings and exchanged information, as time permitted.

The MMS is writing Biological Assessments on the Liberty Project for both the Fish and Wildlife Service and the National Marine Fisheries Service. The Fish and Wildlife Service and National Marine Fisheries Service each will write individual Biological Opinions on species specific to their jurisdiction regarding the Liberty Project in accordance with Section 7 Endangered Species Act consultation procedures. The Fish and Wildlife Service and the Biological Resources Division of the U.S. Geological Survey each prepared an analysis that can be found in Appendix J of the EIS. The Fish and Wildlife Service prepared the report *Exposure of Birds to Potential Oil Spills at the Liberty Project* and the Biological Resources Division evaluated potential effects to polar bears in their report *Estimating Potential Effects of Hypothetical Oil-Spills from the Liberty Oil Production Island on Polar Bears*.

National Marine Fisheries Service is responsible for the authorization of the incidental taking of certain species of marine mammals under the Marine Mammal Protection Act and/or the Endangered Species Act. The EIS describes the type and extent of such takings.

C. ISSUES

1. Scoping

"Scoping" is an ongoing public process to determine the public concerns about BPXA's proposed plan and to identify issues to be analyzed in depth in the EIS. Scoping also is used to develop alternatives to BPXA's Plan and mitigating measures that could eliminate or reduce potential development impacts. Alternatives could include technological modifications to the Plan or different drilling locations or pipeline routes. The scoping process includes an evaluation of the issues, alternatives, and mitigating measures that will be addressed further in the EIS and those that will not.

As part of the scoping process, we have received comments in response to our Notice of Intent to Prepare an EIS in the *Federal Register* Notice of February 23, 1998, and from public meetings and the Liberty Interagency Team. We received seven comment letters in response to the Notice. Scoping meetings were held during March and April 1998 in Nuiqsut, Barrow, Anchorage, Kaktovik, and Fairbanks. Additional scoping comments were provided as part of the information update meetings in these communities in October and November 1999.

During scoping meetings, attendees expressed concerns about the effects of development on the physical and biological resources in and adjacent to the Liberty Prospect and on the Inupiat inhabitants of Alaska's North Slope. These concerns, characterized as issues, are associated with planned activities or accidental events that are or may be part of the construction and operation of oil and gas facilities.

The planned activities would alter the local environment. These disturbances, often in the form of noise, may last only a few minutes; whereas, physical changes to the environment, such as construction of the gravel island, may last 15-20 years or more. Short-term disturbances include the noise from aircraft overflights or marine transport of facilities and supplies. Disturbances also may last up to several months; these include noise and physical changes to the environment associated with mining and hauling gravel for island construction, changes to seafloor sediments, and suspension of sediments that result from trenching for the pipeline.

Accidental events include crude oil spills during production, during transport through the pipelines, or from diesel fuel used to power electrical generators if natural gas, produced from the Liberty reservoir, is not available. Such events have a very low probability of happening.

Primarily, the issues express concerns about the effects of disturbances and large offshore oil spills on the environment. These effects are analyzed in the EIS for the following essential resources and systems:

- endangered and threatened species (bowhead whales and spectacled and Steller's eiders)
- seals
- polar bears
- marine and coastal birds
- terrestrial mammals
- fishes and essential fish habitat
- lower trophic-level organisms
- vegetation-wetland habitats
- subsistence harvests
- sociocultural systems
- archaeological resources
- economy
- water quality
- air quality

Associated with disturbance and oil-spill issues are concerns that include:

- risk of damage to the island and production facilities from storm waves, currents, and ice forces
- risk of damage to the offshore pipeline from ice gouging, strudel scouring, and permafrost melting
- leak detection for the buried pipeline
- offshore pipeline design and the risk of failure and leaks
- height of onshore pipeline
- erosion in the area where the pipeline crosses the shoreline
- oil-spill-response and cleanup capability, especially in broken ice
- waste disposal
- discharges of production fluids
- air emissions
- abandonment
- population growth and balance between modern lifestyles and the lifestyle of the Inupiat people
- timing and size of the prospective workforce and how it would affect community economies
- use of gravel bags to prevent gravel erosion of the island
- disregard for local traditional knowledge in making decisions
- use of Tern Island as either a drilling site or a source of gravel
- locating the Liberty drilling and production facility either onshore or in waters no deeper than 6 feet
- global climate change
- alternative energy sources

The issues raised during scoping also are used to develop alternatives and mitigating measures for this EIS.

2. Traditional Knowledge

We include in the EIS analysis what local indigenous people on the North Slope say and have said about development on the outer continental shelf. We developed a protocol to extract, from past testimony and community meetings, traditional knowledge that relates to oil and gas activities in the Alaskan Beaufort Sea. Various sources of traditional knowledge (TK) were queried to provide this information. Sections III.C.3.h and i (Subsistence-Harvest Patterns and Sociocultural Systems) in the EIS illustrate how traditional knowledge was incorporated into the EIS and into the design, construction, and planned operations of the proposed project to minimize potential conflicts with subsistence users.

This information endeavors to capture the traditional Inupiat perspective about the potential effects of the Liberty Project and other oil and gas development activities on the North Slope. In some instances, the words of individual speakers are incorporated and cited. In other cases, when several people shared an observation or concern, it is paraphrased in a single statement and cited.

The TK-gathering efforts undertaken specifically for the Liberty Project include: (1) meeting minutes from the 1999 community meetings conducted under the auspices of Environmental Justice (see the following and Appendix E of the EIS); (2) use of an interim portion of the Inupiat TK collection study by the Barrow nonprofit Ukpeagvik Inupiat Corporation; (3) the Arctic Nearshore Impact Monitoring in Development Area study that includes a task for gathering subsistence whaling TK from Nuiqsut whalers; and (4) an in-depth assessment and use by MMS analysts of existing TK sources. These sources include TK citations for the Northstar final EIS; the TK database developed by Dames and Moore for the Northstar Project from MMS hearing transcripts; Native interviews from the North Slope Borough's *Mid-Beaufort Sea Traditional Resource Survey*; TK from the North Slope Borough document *Cross Island: Inupiat Cultural Continuum*; and TK gleaned from the North Slope Borough's *Subsistence Harvest Documentation Project Data for Nuiqsut, Alaska* (North Slope Borough, 1997a).

3. Environmental Justice, Indian Trust Resources, and Government-to-Government Coordination

Executive Order 12898, Environmental Justice, requires that Federal Agencies identify and address disproportionately high and adverse human health and environmental effects of its actions on minority and low income populations.

To meet the direction of this Order (*Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*) and the accompanying memorandum from President Clinton to the heads of all departments and agencies, MMS held Environmental Justice Meetings in Barrow, Nuiqsut, and Kaktovik. Environmental Justice, as a formal part of the Sociocultural Systems analysis, is discussed in Section III.C.3.i., Effects of Disturbance on Sociocultural Systems in the EIS. The MMS met with local tribal governments to discuss subsistence issues and the Liberty Project during scoping meetings in the community of Nuiqsut on March 18, 1998; in the community of Barrow on March 19, 1998; and in the community of Kaktovik on March 31, 1998. In these first meetings, MMS established a dialogue on environmental justice with these communities. Followup meetings to address environmental justice issues were held in Barrow on November 1, 1999; in Nuiqsut on November 2, 1999; and in Kaktovik on November 5, 1999.

The environmental justice concerns raised during scoping and from the Environmental Justice Meetings are covered in the EIS in the sections on Subsistence-Harvest Patterns, Sociocultural Systems, and marine mammals (see Sec.

III.C.3 in the EIS). The analyses in these sections incorporate TK of the Inupiat people of the North Slope communities of Barrow, Nuiqsut, and Kaktovik, along with Western scientific knowledge. Environmental Justice is discussed in more detail in Appendix B, Part E of the EIS.

The Department of the Interior and the MMS are responsible for ensuring that Indian Trust Resources of federally recognized Indian Tribes and their members that may be affected by these project activities are identified, cared for, and protected (Appendix B, Part D of the EIS). No significant impacts were identified during the EIS scoping process, including the Environmental Justice Meetings, that pertain to this topic. Native allotments in the project are discussed in Section III.C.3.i of the EIS.

Executive Order 13084 (*Consultation and Coordination with Indian Tribal Governments*) states that the U.S. Government will continue "to work with Indian tribes on a government-to-government basis to address issues concerning Indian tribal self-government, trust resources, and Indian tribal treaty and other rights." To meet that direction, MMS has met with the local tribal governments of Barrow, Nuiqsut, and Kaktovik; as well as the Inupiat Community of the Arctic Slope (the recognized regional tribal government), and an important nongovernmental Native organization, the Alaska Eskimo Whaling Commission. Notes from the 1999 meetings are included in Appendix E of the EIS. These tribal governments were contacted by letter and given the opportunity to participate in the development of this EIS. None of the letters sent received a response; nonetheless, in Liberty meetings held on the North Slope, we have met with these groups to keep them informed of this Proposal and will continue to do so. Local Inupiat government representatives are members of our Outer Continental Shelf Lease Sale Advisory Committee that meets to discuss and resolve issues that arise from recent lease sales.

4. Major Issues

Based on scoping concerns, MMS has determined that the major issues are:

- disturbances from planned project activities;
- oil spills from accidental events; and
- cumulative effects of past, present, and future development on the people and environment of Alaska's North Slope.

Generally, the above issues are analyzed more fully than other concerns that include:

- discharges (water discharges and air emissions)
- gravel mining
- small oil spills
- seawater intake
- economic effects
- abandonment of the project
- global climate change
- alternative energy sources

Air pollution also is an important issue for North Slope inhabitants. The effects of emissions from burning fossil fuels during Liberty drilling and production operations are analyzed in detail under the discussion of discharges under the heading of Other Issues.

These issues served as the basis for the development of alternatives and were used to configure the analysis in the alternatives as well as the analysis of the proposed Development and Production Plan. The major issues/perturbations mentioned below apply to each analyzed alternative, as well as the proposed Development and Production Plan.

a. Disturbances

The Liberty Project involves constructing a gravel island about 5 miles offshore, using gravel hauled by truck over ice roads to a prepared subsea pad, and construction of a pipeline from the island to an existing onshore pipeline. The island and pipelines would be constructed mainly in winter, and most potential disturbance from construction would occur in that season. Construction of the subsea pipeline trench and the onshore pipeline would permanently disturb habitats. The following are examples of disturbances:

- sediment and turbidity from the dumping of gravel during construction of the proposed island and from the pipeline trenching and backfilling activities;
- noise from construction and drilling activities; and
- noise from the transportation of people and materials to and from the gravel island.

Helicopters, supply boats, and some barges would provide transport over water. Long-term disturbances would include noise from various kinds of transportation and any other drilling that might occur over the operational life of the field.

Releases of particulate matter and attendant turbidity in the water may come from remnant fill from the pipeline trench, particulate leaching from the island, and final island preparation (reshaping). When refilling pipeline trenches, the excess fill not deposited back into the trench would be placed on the ice parallel to the pipeline and would filter into the Beaufort Sea as breakup progresses. Particulate matter would leach from the island after initial construction and before the placement of filter fabrics and cement blocks; some island reshaping may be necessary, but this would be a short-term action.

The project descriptions in Section II.A.1 and Table II.A-1 of the EIS more thoroughly discuss Liberty development and potential sources of noise and habitat disturbance.

b. Large Offshore Oil Spills

The potential effects of oil spills were a major concern raised during scoping. For purposes of analysis, we divide oil spills into two classes. We define large oil spills as greater than or equal to 500 barrels, and small spills as less than 500 barrels. See Sections IX.A and B in the EIS for an analysis of a very large oil spill.

(1) Spill Assumptions and Sizes

The assumptions about large oil spills are a mixture of project-specific information, modeling results, statistical analysis, and professional judgement. For purposes of analysis, we assume that one large spill occurs from the proposed or alternative Liberty gravel island locations or along the proposed or alternative offshore/onshore pipeline routes. After we analyze the effects of a large oil spill, we consider the chance of a large oil spill occurring. Even though the chance of one or more large spills occurring and entering offshore waters is low (on the order of 1%), we analyze the consequences of an oil spill because it is a significant concern to all stakeholders. The analysis of a large spill represents the range of effects that might occur from a range of offshore or onshore spill sizes at Liberty facilities. Table III.C-4 of the EIS shows the large spill sizes we assume for analysis. These hypothetical spills range from 715-2,956 barrels for crude and diesel oil. The spills are broken out as follows:

Crude Oil

- gravel island: 925 barrels
- offshore pipeline: 715, 1,580, and 2,956 barrels
- onshore pipeline: 720 and 1,142 barrels

Diesel

- storage tank: 1,283 barrels

A large spill from the Liberty facilities could happen at any time of the year. We assume that the island would not absorb any oil. Depending on the time of year, we assume that a spill reaches the following environments:

- gravel island and then the water or ice
- open water
- broken ice
- on top of or under solid ice
- shoreline
- tundra or snow

(2) Oil-Spill-Trajectory Analysis

We analyze spills from nine locations. We use the location of the Liberty, Southern, and Tern gravel islands as the sites where large oil spills would originate, if they were to occur from an island. (Liberty Island is the site proposed by BPXA. Southern and Tern Islands are alternative sites selected by MMS for the EIS analysis.) We also use the Liberty, Tern, and eastern pipeline sites, with each pipeline divided into two segments. The two pipeline segments represent spills that would occur nearshore and offshore. (Similarly, the Liberty pipeline route was proposed by BPXA and the Tern and eastern routes were selected for analysis as EIS alternatives.)

In general, there is a 0-2% difference in the chance of oil-spill contact with the majority of the environmental resource areas when we compare Liberty Island, Southern Island, and Tern Island to each other. Each of these islands is within 1.2-1.4 miles of each other, and no geographic barriers to spills exist between these island locations. There is a 3-12% difference in the chance of contact with resources directly adjacent to the area where we hypothesize a spill would start. For example, the largest difference (12%) is to the Boulder Patch, because Liberty Island is directly adjacent to it, and the Southern Island and Tern Island are slightly farther away. Changing the location of the island would cause an insignificant change in the chance of oil spill contact to the majority of the environmental resource areas.

In general, there is a 0-2% difference in the chance of contact to the majority of the land segments when we compare Liberty Island, Southern Island, and Tern Island to each other. The reader should note, however, that the closer the island is located to shore, the greater the probability of oil contacting the nearby coastline. The coastline between the Sagavanirktok and Kadleroshilik rivers has a 3-4% difference in the chance of contact from Southern Island or Tern Island when we compare them to Liberty Island. While these differences are measurable, they do not result in effects to the resources that are substantial.

(3) The Chance of a Large Spill Occurring

The analysis of historical oil-spill rates and failure rates and their application to the Liberty Project provides insights, but not definitive answers, about whether oil may be spilled from a site-specific project. Engineering risk abatement and careful professional judgment are key in confirming whether a project would be safe.

We conclude that the designs for the Liberty Project would produce minimal risk of a significant oil spill reaching the water. If an estimate of chance must be given for the offshore production island and the buried pipeline, our best professional judgment is that the chance of an oil spill greater than or equal to 500 barrels occurring from the Liberty Project and entering the offshore waters is on the order of 1%. We uses the volume of oil produced as the basis for projecting oil spills; therefore, the chance of an oil spill is essentially the same for all alternatives evaluated in this EIS.

We base our conclusion on the results gathered from several spill analyses done for Liberty. All showed a low likelihood of a spill, on the order of a 1-6% chance or less. More importantly, we also base our conclusion on the engineering design factors that BPXA has included in the project, especially for the buried pipeline. The combination of pollution-prevention measures, design, testing, quality assurance, and proactive monitoring lead us to conclude that the proposed and alternative pipelines would be safe.

We base the analysis of effects on the following assumptions:

- One large spill occurs.
- The spill size is one of the sizes shown in Table III-C.4 of the EIS.
- All the oil reaches the environment; the island absorbs no oil.
- The spill starts at the gravel island or along the pipeline.
- The spill could occur at any time of the year.
- A spill under ice does not move significantly until the ice breaks up.
- The spill area varies over time and is calculated from Ford (1985).
- The time and chance of contact from an oil spill are calculated from an oil-spill-trajectory model.
- Effects are analyzed for the location where the chance of contact is highest.

The analysis in Section III.C.2 first considers context and intensity effects of an oil spill to the resources and then considers whether the effects would be local or regional. The analysis next evaluates the adverse effects resulting from the oil-spill-cleanup efforts on the resource (noise, disturbance, etc.) and provides an assessment of the mitigation benefits that might occur. However, the effectiveness of oil-spill recovery and cleanup is uncertain and depends on weather conditions, wind and wave conditions, and other variables at the time of the spill. Oil-spill recovery can range from very little to almost all of the oil.

The BPXA Proposal includes the use of either the “Leak-Detection and Location System” (LEOS) for detecting any leaks from the pipeline or the use of an equivalent system. Siemens developed LEOS about 30 years ago. The LEOS system detects leaks by means of a low-density polyethylene tube, which is highly permeable to oil and gas molecules. The tube is pressure tight and contains air at atmospheric pressure when installed. In the event of an oil leak, some of the leaking oil diffuses into the tube due to the concentration gradient. The air in the tube is tested every day when a pump at the island pulls the air at a constant speed through the tube into a detector unit. The detector unit is equipped with semiconductor gas sensors that can detect very small amounts of hydrocarbons. An electrolytic cell onshore injects a specific amount of hydrogen gas into the tube just before each daily test. This gas is transported through the tube at each test and generates a “marking peak” that not only notes the test is complete but helps to verify that the equipment is functioning and properly calibrated. The LEOS system can detect a leak, when the total volume of the leak reaches 0.3 barrel, within 24 hours. Because the air moves through the tube at a specific rate, this system can accurately determine within meters the location of a pipeline leak. Should a leak be detected, an alarm sounds.

This system has been installed in underground pipelines and in aquatic environments, mostly in Europe. Recently, LEOS was successfully installed as part of the Northstar development. During testing in September 2000, it pinpointed hydrogen gas coming from the pipeline anodes (Franklin, 2000, pers. commun.). In Europe, the LEOS system has detected two hydrocarbon leaks in the soils saturated with water. The sizes of both leaks were below the detection threshold by conventional leak detection systems (INTEC, 1999a). While the LEOS system is operating to specifications for the Northstar Project, its long-term effectiveness in the arctic undersea has not been demonstrated.

The BPXA Proposal also includes what has been considered as the best available technology for leak detection—Pressure-Point Analysis and Mass-Balance Line-Pack Compensation—which can detect spills over 0.015% of the line flow. During peak production flow rates, a leak of more than about 98 barrels per day can be detected by these two systems.

If a leak is detected by any of these three systems, the pipeline would be shut down.

c. Cumulative Effects of Past, Present, and Future Development

Oil and gas activities considered in the analysis include past development and production, present development, reasonably foreseeable future development, and speculative development. Some activities beyond the 20-year life of the Liberty Project are considered too speculative to include at this time, while other similar activities are included in this analysis. Furthermore, we exclude future actions from the cumulative-effects analysis, if those actions are outside the geographic boundaries or timeframes established for the cumulative-effects analysis. We address uncertainty through monitoring, and note that monitoring is the last step in determining the cumulative effects that ultimately might result from an action.

To keep the cumulative-effects analysis useful, manageable, and concentrated on the effects that are meaningful, we weigh more heavily other activities that are more certain and geographically close to Liberty, and we analyze more intensively effects that are of greatest concern. This would include activities in the Beaufort Sea and on the North Slope. To be consistent with the MMS 5-Year OCS Oil and Gas Program, the Liberty cumulative analysis also evaluates effects from transporting oil through the Trans-Alaska Pipeline System and tankering from Valdez to ports on the U.S. west coast.

Activities other than those associated with oil and gas also are considered. These include the sport harvest of wildlife, commercial fishing, subsistence hunting, and loss of overwintering range for certain wildlife species. More details on the cumulative-effects analysis are presented at the end of the Executive Summary.

5. Other Issues

a. Discharges (Water Discharges and Air Emissions)

The majority of wastes generated during construction and developmental drilling would consist of drill cuttings and spent muds. Some waste also would be generated during operations from well-workover rigs. Drilling fluids would be disposed of through onsite injection into a permitted disposal well or would be transported offsite to permitted disposal locations. In addition, domestic wastewater, solid waste, and produced waters would be generated during the project and injected into the disposal well. Solid wastes, including scrap metal, would be hauled offsite for disposal at an approved facility.

In case the disposal well cannot be used, BPXA has applied for a National Pollution Discharge Elimination System permit authorizing marine discharges of treated sanitary and domestic wastewater from the seawater-treatment plant, the desalination-unit filter backwash, construction dewatering, and fire-control test water.

Chronic discharges of contaminants would occur during every breakup from fluids entrained in the ice roads. Entrained contaminants from vehicle exhaust, grease, antifreeze, oil, and other vehicle-related fluids would pass into the Beaufort Sea system at each breakup. These discharges are not expected to be major; however, they would exist over the life of the field.

Sources of potential air emissions would be oil or gas turbine electric generators; heavy construction equipment; tugboats and support vessels; and drill-rig-support equipment, including boilers and heaters. The use of best available control technology and compliance with the Environmental Protection Agency emission standards would be required. Water discharge and air emission considerations would apply to all alternatives.

b. Gravel Mining

BPXA would need about 990,000 cubic yards of gravel to construct the following elements of the Liberty Project:

- the drilling and production island and, if needed, potential relief well island(s);
- pads for pipeline landfall;
- backfill for parts of the pipeline trench; and
- a pad for the tie in with the Badami pipeline.

BPXA has proposed mining a new site in the winter, approximately 53 acres on a partially vegetated island in the Kadleroshilik River floodplain, located about 1.4 miles upstream from the Beaufort Sea. Mining activities are planned to occur in two phases and would occur on about 31.5 acres; about 24 acres of wetlands would be lost or disturbed by the mining activities (see Table III.D-6 of the EIS). A reserve area, covering about 22.5 acres (about 17 acres of wetland area), would be used if additional gravel were needed. Gravel required for alternative island locations and pipeline routes would range from 792,000 cubic yards to 877,300 cubic yards. The alternative island design (Use Steel Sheetpile) would require about 50,000 additional cubic yards of gravel.

c. Small Oil Spills from Liberty Facilities

We analyze the consequences of small spills of crude and refined oil (for the proposed Development and Production Plan and all alternatives) to address concerns about chronic effects from numerous small spills. For purposes of analysis, we assume the following spill sizes:

Offshore or onshore crude oil:
17 spills less than 1 barrel and
6 spills greater than or equal to 1 barrel and less than 25 barrels.
Onshore or offshore refined oil:
53 spills of 0.7 barrels (29 gallons).

We assume:

- Offshore crude spills can begin anywhere on the Liberty gravel island or along the offshore pipeline.
- Small spills on the Liberty gravel island are kept within containment or cleaned up and do not reach the water.
- Onshore crude spills can begin anywhere along the onshore pipeline.
- Onshore or offshore refined oil spills can occur along the ice road, from barges, from helicopters, from the gravel island, or from trucks along the road system.
- Most of these spills are contained or cleaned up.

Typical refined products that spill on the Alaskan North Slope are aviation fuel, diesel fuel, engine lube oil, fuel oil, gasoline, grease, hydraulic oil, transformer oil, and transmission oil. Diesel spills on the Alaskan North Slope are 61% of refined oil spills by frequency and 75% by volume.

d. Seawater Intake

BPXA plans to locate a vertical intake pipe for a seawater-treatment plant on the south side of Liberty Island. The pipe would have an opening 8 feet by 5.67 feet and would be located approximately 7.5 feet below the mean low-water level. Recirculation pipes located just inside the opening

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would help keep large fish, other animals, and debris out of the intake. Two vertically parallel screens (6 inches apart) would be located in the intake pipe above the intake opening. They would have a mesh size of 1 inch by 1/4 inch. Maximum water velocity would be 0.29 feet per second at the first screen and 0.33 feet per second at the second screen. These velocities typically would occur only for a few hours each week while testing the fire-control water system. At other times, the velocities would be considerably lower. Periodically, the screens would be removed, cleaned, and replaced. The seawater intake system would be part of all alternatives.

e. Economic Effects

Employment, wages, royalties, and income to Federal, State, and local governments were noted as issues during scoping.

Local hire likewise was identified as an issue. This section evaluates the economic impacts of the project for those issues. Economic effects' considerations apply to all alternatives.

f. Abandonment of the Project

In Section III.D.6 of the EIS, we evaluate the effects of general actions (removal of all gravel bags, all facilities on the island, etc.) that would occur at abandonment. However, exact abandonment procedures of the Liberty Project would be developed before the end of the project's life. A goal for restoration of any project is to restore the affected environment to its original condition. In our effort to achieve that goal, we do not want to cause unnecessary environmental effects. At the time of abandonment, we likely would have new technologies, and we expect to have additional environmental information concerning the area and its resources. We want to evaluate both the new technologies and the additional environmental data in the abandonment plan. Therefore, we do not evaluate all the specific items of abandonment at this time. Those specific items would be evaluated in an environmental assessment on the abandonment plan that would be required at the end of the project. All environmental regulations in place at that time would be enforced. The MMS, Corps of Engineers, and applicable State agencies would review BPXA's abandonment plan and decide what actions are appropriate at the end of the project. Abandonment considerations apply to all alternatives.

g. Global Climate Change and Alternative Energy Sources

Global climate change and alternative energy sources are addressed in the MMS 1997-2002 Outer Continental Shelf Oil and Gas Leasing Program (USDOI, MMS, Herndon, 1996a) and are incorporated here by reference. In addition, the Council on Environmental Quality, in its *Draft Guidance Regarding Consideration of Global Climate Change in Environmental Documents Prepared Pursuant to the National Environmental Policy Act*, October 8, 1997, recommends addressing this issue at the program level rather than at the project level.

6. Alternatives to the Proposed Plan

Through the planning and scoping process, five sets of components alternatives were developed from the issues and concerns noted in A.4 above.(See Table I-1) They were configured around major project components: Drilling and Production Island Location and Pipeline Route; Pipeline Design; Upper Island Slope-Protection System; Gravel Mine Site; and Pipeline Burial Depth. The component alternatives (which include the BPXA-proposed project component) are described and analyzed further in Section E.3.a of the Executive Summary.

Combination Alternatives are the second grouping of alternatives developed in the EIS. They build on the analysis of effects identified by each component alternative, and provide decisionmakers and readers with the range of possible effects that may result from selecting and combining different project component alternatives. The Interagency Team developed three combination alternatives that are compared to each other and to the BPXA Proposal (see Table I-1 and Section E.3.b of the Executive Summary).

7. Significance Thresholds

Our EIS impact analysis addresses the significance of the impacts on the resources and systems listed in Section D.1 of the Executive Summary. It considers such factors as the nature of the impact (for example, habitat disturbance or mortality); the spatial extent (local or regional effect); the temporal effect and recovery times (years, generations); and the effects of mitigation (for example, implementation of the oil-spill-response plan).

The Council on Environmental Quality National Environmental Policy Act regulations (40 CFR 1508.27) define the term "significantly" in terms of both context and intensity. "Context" considers the setting of the Proposed Action, what the affected resource may be, and whether the effect on this resource would be local or more regional in extent. "Intensity" considers the severity of the impact, taking into account such factors as whether the impact is beneficial or adverse; the uniqueness of the resource (for example, threatened or endangered species); the cumulative aspects of the impact; and whether Federal, State, or local laws may be violated. The analysis in this document uses terminology that is consistent with that definition. Impacts may be beneficial or adverse. Impacts are described in terms of frequency, duration, general scope and/or size and intensity. The analysis in this EIS also considers whether the mitigation that is proposed as part of the project can reduce or eliminate all or part of the potential adverse effects.

For the EIS, we have defined a "significance threshold" for each resource as the level of effect that equals or exceeds the adverse changes indicated in the following impact situations:

- **Threatened and Endangered Species** (bowhead whale, spectacled and Steller's eiders): An adverse impact that results in a decline in abundance and/or change in distribution requiring one or more generations for the indicated population to recover to its former status.
- **Other Biological Resources** (seals, polar bear, marine and coastal birds, terrestrial mammals, lower trophic-level organisms, fishes, and vegetation-wetland habitats): An adverse impact that results in a decline in abundance and/or change in distribution requiring three or more generations (one or more generations for polar bears) for the indicated population to recover to its former status.
- **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 1-2 years.
- **Sociocultural Systems:** Chronic disruption of sociocultural systems occurs for a period of 2-5 years, with a tendency toward the displacement of existing social patterns.
- **Archaeological Resources:** An interaction between an archaeological site and an effect-producing factor occurs and results in the loss of unique, archaeological information.
- **Economy:** Economic effects that will cause important and sweeping changes in the economic well-being of the residents or the area or region. Local employment is increased by 20% or more for at least 5 years.
- **Water Quality:** A regulated contaminant is discharged into the water column, and the resulting concentration outside a specified mixing zone is above the acute (toxic) State standard or Environmental Protection Agency criterion more than once in a 1-year period and averages more than the chronic State Standard or Environmental Protection Agency criterion for a month. Turbidity exceeds 7,500 parts per million suspended solid concentration outside the mixing zone specified for regulated discharges more than once in a 3-year period and averages more than chronic State standards or Environmental Protection Agency criteria for a month. The accidental discharge of crude or refined oil in which the total aqueous hydrocarbons in the water column exceeds 1,500 micrograms per liter (1.5 parts per million)—the assumed acute (toxic) criteria—for more than one day and 15 micrograms per liter (0.015 parts per million)—the assumed chronic criteria and the State of Alaska ambient-water-quality standard—for more than 5 days.
  Violating the effluent limits of the NPDES Permit (Appendix I-2) might cause an adverse effect and could result in an Environmental Protection Agency enforcement action. Violations would be caused by exceeding an effluent limit or creating an oil sheen. The accidental discharge of a small volume of crude or refined oil also might cause an adverse impact and could result in concentrations of hydrocarbons that are greater than the acute criteria in a local area (less than 1 square mile) for less than a day and concentration that are greater than the chronic criteria in a larger area (less than 100 square miles) for less than 5 days. However an action of violation or accidental discharge of a small volume crude or refined oil would not necessarily constitute a significant environmental impact as defined in 40 CFR 1508.27.
- **Air Quality:** Emissions cause substantial increases in concentrations over more than half of the Federal attainment area (regional effect), resulting in the consumption of at least 50%, but not all of the available Prevention of Significant Deterioration criteria for Nitrogen dioxide, sulfur dioxide, or TSP or National Ambient Air Quality Standards concentration for particulate matter less than 10 micrograms in diameter, carbon monoxide, or ozone readily identifiable adverse long-term effects on human health or vegetation. No significant decrease in onshore visibility, as determined by Environmental Protection Agency visibility-analysis guidelines.

D. EFFECTS SUMMARIES

These summaries are divided into two types of effects, if the Proposal or an alternative is approved:

- those from routine operations, such as noise and disturbance from island and pipeline construction; and
- those that might occur from accidental events, such as oil spills.

In both instances, most of the effects would be minor, localized, and short term. Some of the effects would be more serious, but the resources are expected to recover. Recovery of a few resources might occur very slowly; therefore, the effects would be classified as significant as defined by Council on Environmental Quality National Environmental Policy Act Regulations.

For this EIS, we identify as "significant" those impacts where the effects exceed the significance threshold defined above. All other impacts are, therefore, insignificant; that

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is, they fail to exceed the threshold. We found that including the statement of "insignificant" effects for each resource over and over again to be very distracting and unnecessarily redundant. We hope the limited use of the terms "significant" and "insignificant" help the reader to focus on those effects we found to exceed the "significant" threshold.

We do not expect significant impacts to result from any of the planned activities associated with Alternative I (Liberty Development and Production Plan) or any of the other alternatives. Some significant impacts—adverse effects to spectacled eiders, common eiders, long-tailed ducks, and local water quality—would occur in the unlikely event of a large oil spill. However, the very low probability of such an event occurring (a less than 1% chance of oil entering the environment), combined with the seasonal nature of the resources inhabiting the area (for example, eiders are present in the Liberty area 1-4 months of the year), make it highly unlikely that an oil spill would occur and contact the resources. A resource may be present in the area but may not necessarily be contacted by the oil. Furthermore, Alternative I and the other alternatives include mitigation such as extra-thick-walled pipelines, pipeline burial depths more than twice the maximum100-year ice-gouging event, and advanced leak-detection systems (LEOS). Together, they reduce the likelihood of an oil spill and can detect very small volumes of oil and limit the size of potential chronic leaks to about 100 barrels of oil.

1. Effects Summary from Construction and Routine Operations from the BPXA Proposal

These are effects from construction and operations of the Liberty Project.

a. Bowhead Whales

Noise sources that may affect endangered bowhead whales are drilling and other noise associated with production operations, vessel traffic, aircraft traffic, construction, and oil-spill cleanup. Underwater industrial noise, including drilling noise measured from artificial gravel islands, has not been audible in the water more than a few kilometers away. Because the main bowhead whale migration corridor is 10 kilometers or more seaward of the barrier islands, drilling and production noise from Liberty Island is not likely to reach many migrating whales. Noise also is unlikely to affect the few whales that may be in lagoon entrances or inside the barrier islands due to the rapid attenuation of industrial sounds in a shallow water environment. Subsistence whalers have stated that noise from some drilling activities displaces whales farther offshore away from their traditional hunting areas.

Marine-vessel traffic outside the barrier islands probably would include only seagoing barges transporting modules and other equipment and supplies from Southcentral Alaska to the Liberty location, most likely between mid-August and mid- to late September in Year 2 and Year 3. Barge traffic continuing into September could disturb some bowheads. Whales may avoid being within 4 kilometers of barges. Fleeing behavior usually stops within minutes after a vessel has passed but may last longer. Vessels and aircraft inside the barrier islands should not affect bowhead whales.

Because island and pipeline construction would occur during the winter and be well inside the barrier islands, it is not likely to affect bowhead whales. Reshaping of the island and placement of slope-protection material should be completed by mid-August, before bowhead whales start their migration. Whales should not be affected by these activities, even during the migration, because the island is well shoreward of the barrier islands, and whales infrequently go there. Bowhead whales are not likely to be affected by sediment or turbidity from placing fill for island construction, island reshaping before placing slope-protection material, or pipeline trenching or backfilling.

b. Spectacled Eiders

Helicopter flights to Liberty Island during pack-ice breakup may disturb some threatened spectacled eiders feeding in open water off the Sagavanirktok River Delta. If they relocate to other areas, competition for food available during this period following migration may result in lowered fitness. Summer flights to the island may displace some eiders from preferred marine foraging areas or juveniles from coastal habitats occupied after they fledge. These flights are not likely to directly cause bird mortality, but extra energy and time used in response to disturbance and to find alternate areas may result in decreased survival to breeding age. Alternate foraging habitat, similar in appearance and with similar prey organisms evident, apparently is readily available, although the amount of high-quality foraging habitat in the Beaufort Sea area remains unknown.

Frequent flights over nesting or broodrearing eiders may cause them to relocate in less favorable habitat; eiders that abandon a nest probably would not renest. Females temporarily displaced from a nest by occasional onshore pipeline inspection flights may expose eggs to predation. Either situation may result in fewer young produced. Most onshore activities in the Liberty area are likely to affect at most only a few individuals, and careful selection of aircraft routes could eliminate most disturbance of nesting eiders. Development of the Liberty Prospect is expected to result in only a small amount of habitat loss, involving displacement of few eiders to alternate sites. Displacement of eiders from the vicinity of disturbing activities would eliminate them from only a small proportion of available similar habitat.

This likely would be a minor effect, unless it results in decreased survival either by itself or in combination with other factors. Spectacled eider mortality from collisions with island structures is estimated to be two or less per year. Collisions with the onshore pipeline are considered unlikely.

The small losses and displacements likely to result from the above activities may cause population effects that would be difficult to separate from natural variation in population numbers. However, any decline in productivity or survival resulting from the Liberty Project would be additive to natural mortality and interfere with the recovery from declines of the Arctic Slope spectacled eider population. Such disturbances of spectacled eiders probably would be considered a take under the Endangered Species Act. Steller's eiders are not expected to be found in the Liberty Project area.

c. Seals and Polar Bears

Construction activity would displace some ringed seals within perhaps 1 kilometer of the island and along the pipeline route in Foggy Island Bay. Seals and polar bears would be exposed to noise and disturbance from pipeline dredging and burial activities in Foggy Island Bay. This disturbance of seals and polar bears would be local, within about 1 mile along the pipeline route, and would persist for one season.

Food smells coming from the camp on the island may attract a few bears to the production-island. This attraction could require deliberate hazing of these polar bears, but this effect would not be substantial to bear abundance or distribution.

Low-flying helicopters or boats would cause some ringed and bearded seals to dive into the water, and a few females might be temporarily separated from their pups. This displacement is expected to be brief (a few minutes to less than 1 hour). Low-flying helicopters moving to and from the Liberty Project area could briefly disturb a few polar bears. These disturbances would not affect overall seal or bear abundance and distribution in Foggy Island Bay.

Vehicle traffic on the ice roads from the Endicott causeway directly to the Liberty production island and along the coast to Foggy Island Bay/Kadleroshilik River could disturb and displace a few denning polar bears and a small number of denning ringed seals. The number of bears and seals potentially displaced is expected to be low and would not affect the populations of ringed seals and polar bears.

d. Marine and Coastal Birds

Helicopter flights to Liberty Island during the pack-ice breakup may disturb some loons and king or common eiders feeding in open water off the Sagavanirktok River Delta. If they relocate to other areas, competition for food available during this period following migration may result in lowered fitness. During the summer, flights to the island may displace some long-tailed ducks, eiders, glaucous gulls, and other species from preferred marine foraging areas and snow goose and brant family groups from coastal broodrearing areas. These flights are not likely to directly cause bird mortality, but extra energy and time used in response to disturbance and to find alternate areas may result in decreased fitness and, potentially, survival to breeding age in some individuals. Alternate foraging habitat, superficially similar in appearance and with similar prey organisms evident, apparently is readily available, although the amount of high-quality foraging habitat in the Beaufort Sea area remains unknown. Collision of birds with Liberty Island or structures under conditions of poor visibility could result in substantial adverse effects, if they involve species whose Arctic Coastal Plain populations are or may be declining.

Frequent flights over nesting or broodrearing waterfowl and shorebirds on the mainland may cause birds to relocate in less favorable habitat. Birds that abandon a nest might not renest or might be delayed to a less favorable period. Adults temporarily displaced from nests by occasional onshore pipeline inspection flights may expose eggs or nestlings to predation. Any of these situations may result in fewer young produced.

Most onshore activities in the Liberty area are likely to disturb relatively few birds. Construction and vehicle traffic in winter may displace a few ptarmigan from near the activity. Spill-cleanup activities may displace some nesting, broodrearing, juvenile, or staging waterfowl and shorebirds from preferred habitats, resulting in lower survival. Development of the Liberty Prospect is expected to result in a small amount of habitat loss involving displacement of a few birds to alternate sites. This is likely to be a minor effect, unless it results in decreased survival either by itself or in combination with other factors. Mortality from collisions with onshore structures is expected to be negligible.

The small losses and displacements likely to result from the above activities are expected to cause minor changes in numbers that may be difficult to separate from natural variation in population numbers for any species . Such changes are not expected to require lengthy recovery periods. However, any mortality resulting from development of the Liberty Prospect would be additive to natural mortality, requiring some time for recovery from such losses, and may interfere with the recovery of Arctic Coastal Plain populations should declines in these species (for example, long-tailed ducks and common eiders) take place.

e. Terrestrial Mammals

Helicopter and ice-road traffic, encounters with people, and mining and construction operations could disturb individual or small groups of these mammals for a few minutes to a few days or no more than about 6 months within about 1 mile of these activities. These disturbances would not affect populations. This traffic could briefly disturb some caribou, muskoxen, and grizzly bears, when the aircraft pass overhead or nearby, but would not affect terrestrial mammal populations.

Traffic for constructing the ice roads, production island, pipeline, gravel pads and for hauling gravel and supplies could disturb some caribou and muskoxen along the ice roads during the 2 years of development and during other winters, when further work on the project is needed. This traffic would occur during December though early May, with more ice-road construction and traffic occurring during the 2 years of development. Some continued ice-road activity would occur during the 15 years of production to support project operations. These disturbances would have short-term effects on individual animals and would not affect populations.

Encounters between grizzly bears and oil workers or with facilities could lead to the removal of problem bears. However, the amount of onshore activity associated with Liberty (1.4 miles of onshore pipeline with no onshore camp facilities) is not likely to result in the loss of any bears. Arctic fox numbers could increase in the project area because of the possible availability of food and shelter on the production island. However, the amount of onshore activity associated with Liberty would not result in a substantial increase in fox abundance. BPXA's wildlife interaction plan and treatment of galley wastes should help to reduce the availability of food to foxes.

f. Lower Trophic-Level Organisms

These organisms include those in the Boulder Patch kelp habitat. The Boulder Patch is the largest known kelp community along the Alaskan arctic coast. A section of the Boulder Patch with more than 10% coverage of the seafloor is about a mile northwest of the BPXA proposed Liberty Island location (see Map 1 and Sec. VI.A.5.b of the EIS).

BPXA's proposed Development and Production Plan would disturb lower trophic-level organisms in three primary ways: (1) island construction would bury about 22 acres of typical benthic organisms; (2) pipeline trenching would disturb additional benthos, burying up to 14 acres with very low (1%) coverage of kelp, boulders, and suitable substrate; and (3) sediment plumes would reduce Boulder Patch kelp production by up to 6% during 1 year. The buried 14 acres would equal less than 0.1% of the Boulder Patch kelp habitat. The density of the kelp, boulders, and suitable substrate in the pipeline corridor is very low, averaging about 1% coverage, and the lost kelp biomass and production probably would be less than 0.01% of the Boulder Patch totals, but the effect (kelp substrate burial) would last forever.

Some of the suspended sediment from pipeline trenching and island construction would drift over other parts of the Boulder Patch, reducing light penetration and kelp production during 1 year. This reduction is estimated to be less than 6%, about one-third of which would be due to the proximity between the Boulder Patch to the Zone 1 disposal area for excess sediments. However, in relation to the large range of natural variability, these suspended sediment effects would be barely detectable.

The island's concrete slope from 6-feet deep to the seafloor could be colonized by kelp and other organisms that grow on hard substrates. This portion of the concrete slope could become a home for colonies of species similar to those of the Boulder Patch area. Upon abandonment, the concrete mats probably would become buried naturally or would be removed, cutting back on the new kelp habitat.

g. Fishes

Noise and discharges from dredging, gravel mining, island construction, island reshaping, and pipeline trenching associated with Liberty are expected to have no measurable effect on fish populations. While a few fish could be harmed or killed, most in the immediate area could avoid these activities and would be otherwise unaffected. Effects on most overwintering fish are expected to be short term and sublethal, with no measurable effect on overwintering fish populations. Placement of the concrete mat could create additional food resources for fishes and could have a beneficial effect on nearshore fish populations in the Beaufort Sea. Gravel mining would create potential new fish habitat at the mine site.

h. Essential Fish Habitat

The Magnuson Fishery Conservation and Management Act (16 U.S.C. 1801-1882) established and delineated an area from the State's seaward boundary out 200 nautical miles as a fisheries conservation zone for the United States and its possessions. The Act established national standards for fishery conservation and management, and created eight Regional Fishery Management Councils to apply those national standards in fishery management plans. Another provision of the Act requires that Fishery Management Councils identify and protect essential fish habitat for every species managed by a fishery management plan (50 CFR 600). The essential fish habitat is defined as the water and substrate necessary for fish spawning, breeding, feeding, and growth to maturity. The Act also requires Federal Agencies to consult on activities that may adversely affect essential fish habitats designated in the fishery management plans. An adverse effect is "…any impact which reduces the quality or quantity of EFH." Activities may have direct (for example, physical disruption) or indirect (for example, loss of prey species) effects on essential fish habitats and be site-specific or habitatwide. Loss of prey is considered an adverse effect on essential fish habitat, because one component of the essential fish habitat is that it be necessary for feeding. Adverse effects must be evaluated individually and cumulatively.

Habitat Areas of particular concern have been recognized for salmon in Alaska. These include all anadromous streams, lakes, and other freshwater areas used by salmon and nearshore marine and estuarine habitats such as eel grass beds, submerged aquatic vegetation, emergent vegetated wetlands, and certain intertidal zones. Although it is possible that all five species of salmon that live in Alaskan waters could be found in the Beaufort Sea, there are no commercial salmon fisheries there. Only pink salmon appear to be present in the Liberty area in sufficient numbers to permit small (0-1.5 kilograms per year per person) subsistence fisheries for residents of Nuiqsut and Kaktovik (State of Alaska, Dept. of Fish and Game, 1998). Although chum salmon are believed to be present in the Liberty area, in recent years, they appear to be little used for subsistence purposes by those villages.

The waters surrounding the development have been designated as essential fish habitat for Alaskan salmon. None of the lifestages of Pacific salmon have been documented to use or inhabit the areas expected to be disturbed directly by Liberty construction and operations. Regardless, essential fish habitat would be adversely affected by disturbances to potential prey, to prey habitat, to potential substrate, and to marine and fresh waters. All of these disturbances are expected to be fairly localized and short term.

i. Vegetation-Wetland Habitats

Disturbances mainly come from constructing gravel pads and ice roads and installing the onshore pipeline and tie in with the Badami pipeline. The development of the Kadleroshilik River Mine site would result in the loss of about 24 acres of wetland habitat. Gravel pads, the pipeline trench, and the 1.4-mile-long onshore pipeline would destroy only 0.8 acre of vegetation and affect a few acres of nearby vegetation and have only local effects on the tundra ecosystem. Ice roads would have local effects (compression of tundra under the ice roads) on vegetation, with recovery expected within a few years, and no vegetation would be killed. The construction and installation of the onshore pipeline and gravel pads on State land would be required to have a Section 404/10 permit and approval by the Corps of Engineers, as stated in the Liberty Development and Production Plan (BPXA, 2000a). The permit and approval process is expected to minimize adverse effects on wetlands.

j. Subsistence-Harvest Patterns

For the communities of Nuiqsut and Kaktovik, disturbances periodically could affect subsistence resources, but no resource or harvest area would become unavailable and no resource population would experience an overall decrease. Disturbance and noise could affect subsistence species that include bowhead whales, seals, polar bears, caribou, fish, and birds. Disturbances could displace subsistence species, alter or reduce subsistence-hunter access to these species and, therefore, alter or extend the normal subsistence hunt; but potential disruptions to subsistence resources should not displace traditional practices for harvesting, sharing, and processing those resources. Beluga whales rarely appear in the Liberty Project area. We do not expect belugas to be affected by noise or other project activities, neither do we expect changes in Kaktovik's subsistence harvest of beluga whales.

k. Sociocultural Systems

Effects on the sociocultural systems of communities near the Liberty Project area could occur as a result of disturbance from industrial activities; changes in population and employment; and effects on subsistence-harvest patterns. They could affect the social organization, cultural values, and social health of the communities. Together, effects may periodically disrupt, but not displace, ongoing social systems, community activities, and traditional practices for harvesting, sharing, and processing subsistence resources.

Alaska Inupiat Natives, a recognized minority population, are the predominant residents of the North Slope Borough, the area potentially most affected by Liberty development. Inupiat Natives may be disproportionately affected because of their reliance on subsistence foods, and Liberty development may affect subsistence resources and harvest practices. Disproportionately adverse effects on Alaskan Natives could result from Liberty development under the Proposal. Effects would focus on the Inupiat community of Nuiqsut, and possibly of Kaktovik, within the North Slope Borough. Effects to subsistence resources and subsistence harvests are expected to be mitigated substantially though not eliminated.

l. Archaeological Resources

The Prehistoric Resource Analysis concluded that there is potential for preserved prehistoric archaeological sites to exist within the project area. As a result of this analysis, we requested that BPXA must prepare an archaeological report based on geophysical data. The report concluded that "Suitable situations for the preservation of archaeological remains of terrestrial origin cannot be identified in the present data…."

Onshore surveys have recorded two Historic Period sites. Both contain ruins of historic sod houses; and one site also contains a grave. Offshore, there are two known shipwrecks near the project area—the *Reindeer* and the *Duchess of Bedford*. They have been identified through literature sources but have not yet been ground-truthed. While we do not expect a shipwreck to be present in the project area, the information on these wrecks is insufficient to pinpoint their location. The Cultural Resource Assessment received from BPXA concluded that: "…there is no evidence, archival or physical, to indicate the presence of a shipwreck within the project area."

Any bottom- or surface-disturbing activity, such as pipeline construction, island installation, vessel anchors, or oil-spill-cleanup activities could damage previously unidentified archaeological sites. Physical disturbance of sites could cause destruction of artifacts, disturbance or complete loss of site context, and resulting loss of data. Archaeological sites are a nonrenewable resource and could not be replaced.

m. Economics

We examined the effects of construction activities on the Alaskan economy and the subsistence aspects of the economy. We do not expect disturbances to affect the cash economies. Some of the general effects of developing the Liberty Prospect are noted below and discussed in more detail in Section III.D.5 of the EIS.

Employment and wages are a function of the types of activities shown in Table II.A-1 and described in Section II.A.1 of the EIS, the amount of time required to complete them, and where they occur.

Royalties to the State and Federal governments and a spill conservation tax are a function of the production of oil. Federal income tax (and State income tax, if instituted by the State) is a function of the wages paid to workers. The ad valorem tax to the North Slope Borough is a function of the value of onshore infrastructure. The North Slope Borough and Nuiqsut would have an opportunity to see a share of the State royalty share.

BPXA has committed to hiring local workers on the North Slope and within Alaska. However, the oil industry employs few village residents, even though they provide training programs and try to recruit. Many of the contractors BPXA hires for design, construction, drilling, and operations are Native corporations, subsidiaries of such corporations, or otherwise affiliated with such corporations through joint ventures or other relationships. This relationship should benefit the local economy.

The North Slope Borough has tried to improve employment of its Inupiat people in the oil industry at Prudhoe Bay. The Borough believes the oil industry has not done enough to train unskilled laborers or to allow them to go subsistence hunting, which is central to their traditional culture. The Borough also is concerned that the oil industry uses recruiting methods common to Western industry and would like to see the industry become more serious about hiring its residents.

Disruptions to the harvest of subsistence resources could affect the economic well-being of North Slope Borough residents mainly by the loss of some part of those resources.

n. Water Quality

The greatest effect on water quality from gravel island and pipeline construction would be additional turbidity caused by increases in suspended particles in the water column. Increases in turbidity generally are expected to be considerably less than the 7,500 parts per million suspended solids used in the analysis as an acute (toxic) criterion for water quality (Sec. III.C.3.l (2) of the EIS); exceptions may occur within the immediate vicinity of the construction activity. Turbidity increases from construction activities generally are temporary and expected to occur during the winter and end within a few days after construction stops. Material excavated from the pipeline trench but not used for backfill most likely would be left in an area where active erosion of sediment particles could occur during breakup and open water. This material would be similar in composition to seafloor sediments in the trenching and disposal areas, and its contribution to the future turbidity from waves and currents is expected to be about the same as the sediments existing at the seafloor surface prior to pipeline construction. Construction activities are not expected to introduce or add any chemical pollutants.

o. Air Quality

We believe that essentially no disturbances to wildlife, plants, or people would occur due to degradation of air quality caused by Liberty Project activities. The Liberty Proposal would cause a small, local increase in the concentrations of criteria pollutants. Concentrations would be within the Prevention of Significant Deterioration Class II limits and National Ambient Air Quality Standards. Therefore, the effects would be low. (See supporting materials and discussions in Secs. III.D.1.m and VI.C.3. of the EIS). The air-quality analysis is based on the specific emission controls and emission limitations that BPXA would apply to meet the appropriate Environmental Protection Agency regulations. This would include the requirement to use dry, low nitrogen oxide technology for the turbines to further reduce emissions. These controls become part of the proposed project and are written into the

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permit and, thus, are binding. The use of best available control technology and compliance with the Environmental Protection Agency emission standards is the primary factor in reducing emissions of criteria pollutants (such as nitrogen oxides and sulfur dioxide). BPXA also plans voluntary reduction of greenhouse gases (notably carbon dioxide); this also would result in a slight additional reduction in emissions of other pollutants. These voluntary measures, however, would not be part of the permit and, therefore, are not enforceable. BPXA's Development and Production Plan, especially Sections 12.3 and 6.2.1, have some additional information; their *Part 55 Permit Application for the BP Exploration (Alaska) Inc. Liberty Development Project*, includes a thorough discussion of control measures.

2. Effects Summary for a Large Oil Spill

In the following, we discuss effects that would be expected in the unlikely event of an oil spill.

a. Bowhead Whales

We do not know with certainty what effects an oil spill would have on bowhead whales, but some conclusions can be drawn from studies that have looked at the effects of oil spills on other cetaceans. If a spill occurred and contacted bowhead habitat during the fall whale migration, it is likely that some whales would be contacted by oil. Some of these whales likely would experience temporary, nonlethal effects, including one or more of the following symptoms:

- oiling of their skin, causing irritation
- inhaling hydrocarbon vapors
- ingesting oil-contaminated prey
- fouling of their baleen
- losing their food source
- moving temporarily from some feeding areas

Some whales could die as a result of contact with spilled oil. Geraci (1990) reviewed a number of studies on the physiologic and toxic effects of oil on whales and concluded there was no evidence that oil contamination had been responsible for the death of a cetacean. Nevertheless, the effects of oil exposure to the bowhead whale population are uncertain, speculative, and controversial. The effects would depend on how many whales contacted oil, the duration of contact, and the age/degree of weathering of the spilled oil. If oil got into leads or ice-free areas frequented by migrating bowheads, a substantial portion of the population could be exposed to spilled oil. Prolonged exposure to freshly spilled oil could kill some whales, but we expect that number to be very small with such a low chance of contact.

The potential for bowhead whales to be affected by spilled oil from the Liberty Project is relatively small, based on the estimated size of a spill and the relatively low chance of spilled oil reaching the main bowhead fall migration route outside the barrier islands (14% or less).

b. Spectacled Eiders

A large spill from Liberty Island or an associated marine pipeline would have the highest probability of contacting nearshore and offshore areas of Foggy Island Bay and the eastern Sagavanirktok River Delta, where spectacled eiders may be staging before migration. Oil could contact these eiders from early June to September although mortality from a spill that moves offshore would be difficult to estimate. A spill that enters open water off river deltas in spring could contact any migrant eiders present. Mortality resulting from the Liberty Project would be additive to natural mortality and interfere with recovery from any declines of the coastal plain population. Therefore, recovery of the spectacled eider population from even small losses is not likely to occur quickly. Any substantial spill-related losses are expected to have significant adverse effects on this population and would be considered a take under the Endangered Species Act. A Fish and Wildlife Service report *Exposure of Birds to Assumed Oil Spills at the Liberty Project* estimates exposure (mortality) of spectacled eiders to modeled oil spills originating in the Liberty Project area in summer. To calculate the potential numbers of birds oiled, an overlay of spectacled eider densities was used with MMS oil-spill-trajectory maps, using a Geographic Information System model developed by the Fish and Wildlife Service. See Appendix J of the EIS for the full report. The Fish and Wildlife Service estimates indicated just a few spectacled eiders would be oiled by a large spill (out of an estimated Arctic Coastal Plain population of about 9,500 individuals). Spill-cleanup activities may disturb nesting, broodrearing, or staging eiders or juveniles occupying coastal habitats, resulting in decreased survival.

The MMS estimates that small oil spills could cause a few deaths among nesting, broodrearing, or staging spectacled eiders. Reduction of prey populations from a spill could have a negative effect on the foraging success of spectacled eiders in the local area, especially in spring when there is limited open water. However, alternate foraging habitat, similar in appearance and with similar prey organisms evident apparently is available. However, the amount of high-quality foraging habitat in the Beaufort Sea area remains unknown. Potentially, one or two spectacled eiders and their productivity could be lost as a result of an onshore spill. Although there is no clear evidence of a significant recent decline in the coastal plain spectacled eider population, the overall effect of adverse factors associated with the Liberty Project seriously could impact the population, particularly that segment nesting in the eastern portion of the range, and effects from an oil spill would be significant. The threatened Steller's eider is not expected to occur in the Liberty Project area.

c. Seals and Polar Bears

Seals and polar bears most likely would contact a large spill in the Foggy Island Bay and Mikkelsen Bay areas. An estimated 60-150 ringed seals (out of a resident population of 40,000) and fewer than 50 bearded seals (based on their sparse distribution in the project area out of a population of several thousand) could be affected by the large spill. An estimated 5-30 polar bears could be lost if a spill contacted Cross Island when and where that many polar bears might be concentrated during a whale harvest. This represents a severe event. The more likely loss from Liberty development would be no more than one or two bears. The seal and polar bear populations are expected to recover individuals killed by the spill within 1 year, and there would be no effect on the population.

Amstrup, Durner, and McDonald (2000) estimated that a 5,912-barrel spill could contact from 0-25 polar bears in open-water conditions and from 0-61 polar bears in autumn mixed-ice conditions (out of an estimated resident Beaufort Sea population of 1,800 individuals). The 5,912-barrel-spill size used in the Fish and Wildlife Service model is twice the size of the large spill (2,956 barrels) estimated by MMS. The Fish and Wildlife Service used this larger size as a type of worst-case analysis. The oil-spill trajectories contacted small numbers of bears far more often than they contacted large numbers of bears. In October, 75% of the trajectories oiled 12 or fewer polar bears while in September, 75% of the trajectories oiled 7 or fewer polar bears (Amstrup, Durner, and McDonald; 2000). The median number of polar bears that could be affected by a 5,912-barrel spill in October was 4.2. These results are comparable to the estimate of 5-30 bears given. We conclude that a spill from Liberty is likely to affect 12 or fewer polar bears. The polar bear population is expected to recover this likely loss within 1 year.

Secondary effects on polar bears could come from oil contaminating food sources. A spill might affect the abundance of some prey species in local, coastal areas of Foggy Island Bay where epibenthic food such as amphipods (small shrimp) concentrate, but a spill should not greatly decrease abundant food, such as arctic cod. Local changes in the abundance of some food sources would not affect the seal populations or, in turn, affect the polar bear population in the Beaufort Sea.

d. Marine and Coastal Birds

A large spill would have the highest probability of contacting nearshore and offshore areas of Foggy Island Bay and the eastern Sagavanirktok River Delta, where waterfowl and other aquatic birds may be staging before migration. The long-tailed duck is one of the dominant sea ducks in the Arctic. Mortality from a spill contacting long-tailed ducks in lagoons or other protected nearshore areas of the Harrison Bay to Brownlow Point area surveyed by the Fish and Wildlife Service, where these ducks concentrate during the molt period, is estimated to exceed 1,400 individuals at the average bird densities used in a model developed by the Fish and Wildlife Service. This is equivalent to about 1% of the average coastal plain population. The 5,912-barrel-spill size used in the Fish and Wildlife Service model is twice the size of the large spill (2,956 barrels) estimated by MMS. The Fish and Wildlife Service used this larger size as a type of worst-case analysis. Total kill could range much higher (potentially up to 35% of this central Beaufort population), if oil were to contact areas of high bird density. The 1,400-bird-minimum estimate would result in a significant adverse effect on population numbers and productivity (out of an estimated Arctic Coastal Plain population of about 115,500 individuals), especially if many of those molting in this area come from declining subpopulations. Should long-tailed ducks be contacted by a spill outside the barrier islands, mortality is likely to be considerably lower than this number due to lower bird density.

Flocks of staging king and common eiders could contact oil in nearshore and/or offshore areas. These eider populations have declined 50% in the past 20 years, and substantial oil-spill mortality would aggravate this effect. These species, plus the long-tailed duck and red-throated loon, that have a limited capacity for population growth (loons and sea ducks, in general), are expected to recover slowly from oil-spill mortality. Those that are declining probably will not return to target population levels until the trend is reversed or becomes very small. In particular, because of historic or current declines in common eiders and long-tailed ducks, and the estimated mortalities from an assumed oil spill, a large offshore spill would result in significant impacts to these species.

For most bird species, the relatively small losses likely to result from a spill may be difficult to separate from the natural variation in population numbers, but their populations are not expected to require lengthy recovery periods.

A spill that enters open water off river deltas in spring could contact migrant loons and eiders. Some of the several hundred broodrearing, molting, or staging brant and snow geese could contact oil in coastal habitats. Also, several thousand shorebirds could encounter oil in shoreline habitats, and the rapid turnover of migrants during the migration period suggests that many more could be exposed. Effects are expected to be similar to those outlined above.

An onshore pipeline spill in summer probably would affect only a few nests, even considering all species. If the oil spread to streams or lakes, long-tailed ducks, brant, and greater white-fronted geese that gather on large lakes to molt could be adversely affected in larger numbers. Losses of oiled birds in this case could range up to a few hundred individuals, a minor effect for species whose populations are relatively abundant and stable or increasing. Reduction of prey populations from a spill may reduce foraging success of shorebirds and sea ducks that depend on this local energy source for molt or migration. However, alternate foraging habitat, similar in appearance and with similar prey organisms evident apparently is readily available during the open-water season following the breeding period, although the amount of high-quality foraging habitat in the Beaufort Sea area remains unknown.

e. Terrestrial Mammals

A large offshore spill is most likely to contact some coastal areas from the Sagavanirktok River Delta east to Mikkelsen Bay. Caribou may use some of these areas for relief from insects. The main potential effect on terrestrial mammals that contact spilled oil could be the loss of fewer than 100 caribou (out of an estimated resident population of the Central Arctic Herd of 18,000 individuals) and a few muskoxen, grizzly bears, and arctic foxes. These losses are expected to be replaced by normal reproduction within about 1 year.

A 1,500-barrel onshore pipeline spill could occur and oil less than 5 acres of vegetation along the pipeline landfall to the Badami tie in. Such a spill is not expected to directly affect caribou or other terrestrial mammals and would cause very minor ecological harm.

Secondary effects could come from disturbance associated with spill-cleanup activities and temporary local displacement of some caribou, muskoxen, grizzly bears, and foxes. These activities, however, would not affect the terrestrial mammals' movements or overall use of habitat.

f. Lower Trophic-Level Organisms

A large oil spill would have only short-term effects on plankton but have long-term effects on the fouled coastlines. Up to 15% of the sound's coastline would be affected by a large spill. While the ice-gouged coastline is inhabited by mobile, seasonal invertebrate species that would recover within a year, fractions of the oil would persist in the sediments for about 5 years in most areas, and could persist up to 10 years in areas where water circulation is reduced. Liberty crude is highly viscous and particularly resistant to natural dispersion, and very little would be dispersed down in the water column and affect benthic communities such as the Boulder Patch kelp habitat. However, diesel oil, which would be used on the island for startup and emergency fuel, could be dispersed down to the seafloor. If 1,500 barrels of diesel were spilled from a fuel-delivery barge at the island during the open-water season, the concentration would be toxic within an area of about 18 square kilometers (7 square miles), as noted in the water quality section of the EIS. Such toxicity probably would stunt the seasonal growth of kelp plants and reduce the population size of associated invertebrates for several years. Oil-spill response in general would have both minor beneficial and adverse effects on these organisms.

g. Fishes

The likely effects on arctic fishes from a large crude-oil spill, diesel-fuel spill or pipeline spill that entered offshore waters would depend primarily on the season and location of the spill, the lifestage of the fishes, and the duration of the oil contact. Due to their very low numbers in the spill area, no measurable effects are expected on fishes in winter. Effects would be more likely to occur from an offshore oil spill moving into nearshore waters during summer, where fishes concentrate to feed and migrate. The probability of an offshore oil spill contacting nearshore waters in summer ranges from less than 1-26%. If an offshore spill did occur and contact the nearshore area, some marine and migratory fish may be harmed or killed. However, it would not be expected to have a measurable effect on fish populations, and recovery would be expected within 5 years. In general, the effects of fuel spills on fish are expected to be less than the effects of crude-oil spills.

If a pipeline oil spill occurred onshore and contacted a small waterbody with restricted water exchange supporting fish, it would be expected to kill or harm most of the fish within the affected area. Recovery would be expected in 5-7 years. Because of the small amount of oil or diesel fuel likely to enter freshwater habitat, the low diversity and abundance of fish in most of the onshore area, and the unlikelihood of spills blocking fish migrations or occurring in overwintering areas or small waterbodies, an onshore spill of this kind is not expected to have a measurable effect on fish populations on the Arctic Coastal Plain.

h. Essential Fish Habitat

The most likely threat to salmon in essential fish habitat would occur if spilled oil came in contact with spawning areas or migratory pathways. However, salmon are not believed to spawn in the intertidal areas or the mouths of streams or rivers of the Beaufort Sea. Therefore, contact between spilled oil and spawning areas is very unlikely. If spilled oil concentrated along the coastline at the mouths of streams or rivers, the potential movements of a small number of salmon could be disrupted during migrations.

Zooplankton and fish form most of the diet for salmon in the Beaufort Sea. Zooplankton populations could be subjected to short-term, localized, negative effects from oil spilled as a result of Liberty development. Juvenile lifestages of salmon inhabit fresh or estuarine waters and generally feed on insects. Oil spilled in wetland habitat could kill vegetation and associated insect species and, thus, have an adverse effect on essential fish habitat lasting from less than 10 years to several decades. Because of the predominance of shorefast ice in the Liberty area, there is no resident marine flora in waters less than 6 feet deep. Therefore, no effects are expected on marine plants in those waters.

Salmon and their prey require relatively clean water in which to live and perform their basic life functions. Essential fish habitat would be adversely affected to the extent that water quality would be degraded. Water quality would be significantly degraded over a fairly large area for a period from days to months, if a large spill of crude or diesel oil occurred. The relative effect of an oil spill on water quality during times of open water would be relatively long lived and widespread, as compared to times of broken or complete ice cover. The effects of a diesel spill generally would be more acute and widespread than the effects of a crude oil spill under similar environmental conditions.

i. Vegetation-Wetland Habitats

Main potential effects of a large offshore spill on vegetation and wetlands include oil fouling, smothering, asphyxiation, and poisoning of plants and associated insects and other small animals. In this case, complete recovery of moderately oiled wetlands of the Sagavanirktok River east to Mikkelsen Bay would take perhaps 10 years or longer. A second main effect is the disturbance of wetlands from cleanup activities. Complete recovery of heavily oiled coastal wetlands from these disturbances and oil could take several decades.

A large onshore spill would oil no more than 5 acres of vegetation along the pipeline landfall to the Badami tie in and would cause some ecological harm. Oiled vegetation should recover within a few years but may take more than 10 years to fully recover.

j. Subsistence-Harvest Patterns

The chance of a large spill from the offshore production island and the buried pipeline occurring and entering offshore waters is estimated to be low. Based on the assumption that a spill has occurred, the chance of an oil spill during summer from either Liberty Island or the pipeline contacting the important traditional bowhead whale and seal harvest areas of Cross and McClure Islands over a 360-day period would be up to 16%. A spill also could affect other subsistence resources and harvest areas used by the communities of Nuiqsut and Kaktovik.

No harvest areas would become unavailable for use and all resources, except possibly bowhead whales, would remain available for use. Some resource populations could suffer losses and, as a result of tainting, bowhead whales could be rendered culturally unavailable for use. Tainting concerns in communities nearest a spill event could seriously curtail traditional practices for harvesting, sharing, and processing bowhead whales and threaten a pivotal underpinning of Inupiat culture. Whaling communities unaffected by potential spill effects are likely to share bowhead whale products with impacted villages. Harvesting, sharing, and processing of other subsistence resources should continue.

k. Sociocultural Systems

Effects on the sociocultural systems of the communities of Nuiqsut and Kaktovik could come from disturbance from small changes in population and employment and periodic interference with subsistence-harvest patterns from oil spills and oil-spill cleanup. Effects from these sources are not expected to displace ongoing sociocultural systems, but community activities and traditional practices for harvesting, sharing, and processing subsistence resources could be seriously curtailed in the short term if there are concerns over the tainting of bowhead whales from an oil spill.

Alaska Inupiat Natives, a recognized minority population, are the predominant residents of the North Slope Borough, the area potentially most affected by Liberty development. Inupiat Natives may be disproportionately affected because of their reliance on subsistence foods, and Liberty development may affect subsistence resources and harvest practices. Disproportionately adverse effects on Alaskan Natives could result from Liberty development under the Proposal. Effects would focus on the Inupiat community of Nuiqsut, and possibly of Kaktovik, within the North Slope Borough. Effects to subsistence resources and subsistence harvests are expected to be mitigated substantially though not eliminated.

l. Archaeological Resources

The geography, prehistory, and history of the Liberty Prospect is very different from that of Prince William Sound where the effects of the *Exxon Valdez* oil spill were concentrated; therefore, direct analogies cannot be drawn regarding the numbers and types of sites that may be affected should such a spill occur in the Liberty Prospect area. However, general finds and conclusions regarding the types and severity of impacts to archaeological sites present within the *Exxon Valdez* oil spill area are applicable to this proposed project. The most important understanding that came from the *Exxon Valdez* oil spill was that the greatest impacts to archaeological sites were not from effects from the oil itself, but from the cleanup activities (Bittner, 1993, Dekin, 1993). The effects from cleanup activities were due both to physical disturbance of sites from cleanup equipment and due to vandalism by cleanup workers. Regardless, researchers concluded that less than 3% of the archaeological resources within the spill area suffered any substantial effects (Mobley, et al., 1990, Wooley and Haggarty, 1993) and that a similar level of effect would be projected in the unlikely event that an oil spill occurred from the Liberty development.

m. Economics

Employment generated to clean up possible large oil spills of 715-2,956-barrels is estimated to be 30-125 cleanup workers for 6 months in the first year, declining to zero by the third year following the spill.

n. Water Quality

During open water, hydrocarbons dispersed in the water column from a large (greater than or equal to 500 barrels) crude oil spill could exceed the 0.015-parts per million chronic criterion for 10-30 days in an area that ranges from 30-45 square kilometers (11.6-17.4 square miles) to 51-186 square kilometers (19.7-71.8 square miles). Hydrocarbons in the water could exceed the 1.5-parts per million acute (toxic) criterion during the first day in the immediate vicinity of the spill. A large crude oil spill in broken sea ice or when the sea ice melts could exceed the chronic criterion for several days in an area of about 7.6 square kilometers (2.9 square miles). Hydrocarbons from a 1,283-barrel diesel oil spill during open water could exceed the acute (toxic) criterion for about 7 days in an area of about 18 square kilometers (7 square miles). During broken sea ice or melting ice conditions, a 1,283-barrel diesel spill could exceed the acute (toxic) criterion for about 1 day in an area of about 1 square kilometer (0.4 square mile) and the chronic criterion for more than 30 days in an area of about 103 square kilometers (39.8 square miles). The effects from a spill occurring under the ice would be similar to those described for broken-ice or melting conditions; the oil would be trapped and essentially remain unchanged until breakup occurred and the ice began to melt.

A large crude or refined oil spill (greater than or equal to 500 barrels) would have a significant effect on water quality by increasing the concentration of hydrocarbons in the water column to levels that greatly exceed background concentrations; however, the chance of a large spill occurring and oil entering the offshore waters is estimated to be about 1%. Also, regional (more than 1,000 square kilometers [386 square miles]), long-term (more than 1 year) degradation of water quality to levels above State and Federal criteria because of hydrocarbon contamination is very unlikely.

o. Air Quality

Oil spills from the offshore gravel island and the buried pipeline could cause a small, local increase in the concentrations of gaseous hydrocarbons (volatile organic compounds) due to evaporation from the spill. The concentrations of volatile organic compounds would be very low and normally be limited to only 1 or 2 square kilometers (0.4-0.8 square mile). During open-water conditions, spreading of the spilled oil and action by winds, waves, and currents would disperse the volatile organic compounds so that they would be at extremely low levels over a relatively larger area. During broken-ice or melting ice conditions, because of limited dispersion of the oil, there would be some increase in volatile organic compounds for several hours, possibly up to 1 day. The effects from a spill occurring under the ice would be similar to but less than those described for broken ice or melting conditions; the oil would be trapped and essentially remain unchanged until the ice began to melt and breakup occurred. Some of the volatile organic compounds, however, would be released from the oil and dispersed, even under the ice. In any of these situations, moderate or greater winds would further reduce the concentrations of volatile organic compounds in the air. Concentrations of criteria pollutants would remain well below Federal air-quality standards. The overall effects on air quality would be minimal.

E. ALTERNATIVES AND MITIGATION

1. Decision Options

The project as proposed by BPXA and described in their Development and Production Plan (BPXA, 2000a) is presented in the EIS and is being evaluated by the MMS and other permitting and regulatory agencies. Construction of the project would not take place unless these agencies approve the project or a modified project.

At the completion of this EIS process, the decisionmakers will have three options available:

- Accept the Project as proposed in the Liberty Development and Production Plan (Alternative I);
- Deny the Project (No Action - Alternative II); or
- Accept the project with modification by choosing one or more of component alternatives or one of the combination alternatives described below and/or any proposed mitigating measures.

Alternative I was briefly described in Section A and the effects of Alternative I were summarized previously in Section D.

2. Alternative II – No Action

A decisionmaker not wanting to approve the project would select the second decision option, Alternative II, the No Action Alternative. Under this alternative, the Liberty Development and Production Plan would not be approved. None of the potential 120 million barrels of oil would be produced, and none of the environmental effects that would result from the proposed development would occur. There would be no potential oil spills and no effects to the flora and fauna in the Foggy Island Bay. Economic benefits, royalties, and taxes to Federal and State governments would be forgone.

To replace the potential 120 million barrels of oil not developed from Liberty, a large portion of the oil would be imported from other countries. The associated environmental impacts from producing oil and transporting it to market still would occur. These imports have attendant environmental effects and other negative effects on the Nation's balance of trade.

The Most Important Substitutes for Lost Production: The energy that would have flowed into the United States' economy from this development would need to be provided from a substitute source. Possible sources include:

- Other domestic oil production
- Imported oil production
- Other alternative energy sources such as
  - Imported Methanol
  - Gasohol
  - Compressed Natural Gas
  - Electricity
- Conservation in the areas of transportation, heating, or reduced consumption of plastics
- Fuel-switching
- Reduction in the consumption of energy

Environmental Impacts from the Most Important Substitutes: If imports increased to satisfy oil demands, effects to the environment would be similar in kind to those of the Proposal but would occur in different locations. The species of animals and plants affected might be different and would depend on the location of the development. Some effects still could occur within the United States from accidental or intentional discharges of oil from tankers or pipelines. These events would:

- generate greenhouse gases and air pollutants from transportation and dockside activities;
- degrade air quality from emissions of nitrogen oxides and volatile organic compounds;
- degrade water quality; and
- destroy flora and fauna and water.

Imported oil imposes negative environmental impacts in producing countries and in countries along trade routes. By importing oil we are exporting environmental impacts to those countries from which the United States imports and to countries along or adjacent to the transportation routes as well.

Substituting energy-saving technology or consuming less energy would conserve energy and result in positive net gains to the environment. However, these efforts may require additional manufacturing. The amount of gain would depend on the extent of negative impacts from capital-equipment fabrication.

Onshore oil production has notable negative impacts on surface water, groundwater, and wildlife. It also can cause negative impacts on soils, air quality, and vegetation and cause or increase noise and odors. Offshore oil production may result in impacts similar to those of the Proposal, but they would occur in a different location.

Consumers probably could switch to natural gas to heat their homes and businesses or for industrial uses. While natural gas production would create environmental impacts, they would be at a lower level than those impacts normally associated with oil spills. Other alternative transportation fuels may constitute part of the fuel-substitution mix that depends on future technical and economic advances.

Natural resources in the Arctic Ocean, Beaufort Sea and, to a more limited extent, Foggy Island Bay still would be exposed to other ongoing oil and gas activities in the area, as described in Section I.F of the Executive Summary and Section V of the EIS.

3. Component and Combination Alternatives and Their Effects

For the balance of our alternatives analysis, we use both "component alternatives" and "combination alternatives." First, we define and discuss five sets of component alternatives. Each set varies a single project component identified during scoping as being important. Each component alternative is a "complete" alternative in that it includes all the same elements as the BPXA Proposal except for the one component at issue. For ease in making comparisons, each set of component alternatives also includes the BPXA proposed project component. See Tables IV.D-1 and IV.D-2 of the EIS.

The five sets of component alternatives areas follow:

- **Three island locations and pipeline routes** (Liberty Island/Liberty pipeline route, Tern Island/Tern Pipeline route, and Southern Island/eastern pipeline route)
- **Four pipeline designs** (single-wall pipe, steel pipe-in-steel pipe, steel pipe-in-plastic pipe, and flexible pipe)
- **Two types of upper slope protection for the production island** (gravel bags and steel plate)
- **Two gravel mine sites** (Kadleroshilik River and Duck Island)
- **Two pipeline burial depths** (design trench depth and a 15-foot trench depth)

The decisionmakers for this project can select one alternative from each of the above five sets of component alternatives. That means there are 96 possible combinations of components to choose from, including the components proposed by BPXA (3 x 4 x 2 x 2 x 2 = 96).

Some of the alternatives (Island Location and Pipeline Routes and/or Pipeline Design), if chosen, may result in delays in the Liberty Project of 18-24 months to collect additional engineering data and allow time for specific design and testing work. This information would be necessary for technical approval of the project but is not expected to change the environmental effects. For purposes of analysis in the EIS, we have not adjusted the timelines for starting the different alternatives. Therefore, all the alternatives are on the same footing for the analysis of environmental effects.

After the evaluation of the component alternatives, we define and discuss three “combination alternatives.” The Liberty Interagency Team formulated each of these combinations by selecting one alternative from each of the five sets of component alternatives. In Section IV.D of the EIS, these three combination alternatives are compared with each other and with the Proposal to assess their relative effects on the environment.

Because this approach of analyzing “component alternatives” and “combination alternatives” is a bit unusual, the following should help explain our rationale for using both in this EIS.

As a first step, we evaluated each alternative in each set of component alternatives and compared it to the other alternatives in the set. Because all the component alternatives are “complete” alternatives, the comparisons can be made on an even footing. The Liberty Interagency Team believes that using component alternatives is a good way to focus analysis on the issues and concerns related to a particular component. It also facilitates comparison among the choices in each set.

However, by using this approach, the component alternatives are all the same as the BPXA Proposal except for the one component that we vary within each set. Also, this approach does not provide for concurrent evaluation of two or more components. In essence, analyzing only component alternatives does not facilitate either evaluating a reasonable range of alternatives or selecting multiple alternative components as required under the National Environmental Policy Act.

We therefore took a second step to overcome these limitations. Using the component alternatives as building blocks, the Liberty Interagency Team developed three more alternatives that we refer to as “combination alternatives.” These were selected from the possible 96 combinations mentioned previously. Each combination alternative also is a “complete” alternative, and each varies substantially from the other combination alternatives.

The Combination Alternatives, with the BPXA Proposal shown for comparison, are:

Combination Alternative A
- Use Liberty Island and Liberty Pipeline Route
- Use Pipe-in-Pipe Pipeline Design
- Use Steel Sheetpile for Upper Slope Protection
- Use Duck Island Gravel Mine
- Use a 7-Foot Burial Depth

Combination Alternative B
- Use Southern Island and Eastern Pipeline Route
- Use Pipe-in-HDPE Pipeline
- Use Gravel Bags for Upper Island Slope Protection
- Use the Kadleroshilik River Mine Site
- Use the 6-Foot Burial Depth as designed by for the Steel Pipe-in-HDPE pipeline design

Combination Alternative C
- Use Tern Island and Tern Pipeline Route
- Use Steel Pipe-in-Pipe Pipeline Design
- Use Steel Sheetpile for Upper Slope Protection
- Use Duck Island Mine Site
- Use a 15-Foot Burial Depth

The BPXA Proposal (Liberty Development and Production Plan)
- Use Liberty Island and Liberty Pipeline Route
- Use Single-Wall Pipeline Design
- Use Gravel Bags for Upper Island Slope Protection
- Use the Kadleroshilik River Mine Site
- Use a 7-Foot Burial Depth

Note that one of these options, Combination C, has none of the component alternatives included in the BPXA Proposal, while Combination A and Combination B have some components in common with the BPXA Proposal and some that are different. Therefore, as a group, the combination alternatives range from the BPXA Proposal to a proposal as different from BPXA’s as possible. Evaluating a reasonable number of examples that cover the spectrum of 96 alternatives in this manner allows the decisionmaker to ultimately select any of those 96 possibilities. (See Questions 1a and 1b, *Forty Most Asked Questions Concerning the Council on Environmental Quality National Environmental Policy Act Regulations*, 46 *Federal Register* 18026, as amended.)

Some of the alternatives (Island Location and Pipeline Route or Pipeline Design), if chosen, may result in delays of 18-24 months, to collect additional data and for design and testing. For purposes of analysis in the EIS, we have not adjusted the timelines for starting the different alternatives. This keeps all the alternatives on the same footing for the analysis of environmental effects.

Many of the Liberty Project key elements are shown in Table II.A-1. Elements that are also part of the project and would apply to all alternatives, but which are not shown in the table, include the following:

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- Island and pipeline construction would occur over 2 years.
- Excess trenching material would be disposed of at approved ocean dumping sites.
- Natural gas would be used to fuel all activities on the island when production begins.
- Ice roads would be constructed annually in winter to provide access to the island.
- During broken-ice and open-water conditions, marine vessels would be used to transport personnel and materials to the island; helicopters would be used year-round as needed.
- Waste materials from the island would either be reinjected into the disposal well or disposed of at approved sites.
- Drilling waste material (muds, cuttings, and produced waters) would be reinjected into a disposal well.
- The field would be developed using waterflood and gas reinjection to maintain reservoir pressure.
- The Oil Discharge Prevention and Contingency Plan (BPXA, 2000b) would apply to all alternatives.

For the most part, the effects to the natural resources and species affected by a change in one component of the project (one alternative) differ from the effects to natural resources and species affected by a change in another component (another alternative). The overall effects of any combination of alternatives can be seen by simply combining or adding the effects identified for each natural resource.

The EIS devotes extensive text to the effects of the component alternatives, but only includes the highlights of the benefits, concerns, and effects of the combination alternatives. Our rationale for this is that the component alternatives are the building blocks for the combination alternatives. With a thorough understand of the building blocks, the reader or decisionmaker can easily review the combination alternatives formulated by the Liberty Interagency Team or use the blocks to construct and assess whatever combination is preferred.

a. Effects of Component Alternatives

For ease of reading up to this point, we have not attached roman numerals to the component alternatives, but will do so in the following. Also, the reader should note that for the purpose of alternative analysis, MMS assumes an oil spill would occur, and that the probability of an oil spill occurring (less than 1%) is the same for all alternatives.

(1) Effects of Alternative Drilling and Production Island Locations and Pipeline Routes

This set of component alternatives evaluates the different impacts of using three different island locations and their corresponding pipeline routes (see Map 1 of the EIS):

- Alternative I – Use the Liberty Island and Pipeline Route (Liberty Development and Production Plan)
- Alternative III.A – Use the Southern Island Location and Eastern Pipeline Route
- Alternative III.B – Use the Tern Island Location and Pipeline Route

(Note that this set and each of the other four sets of component alternatives include BPXA's Proposal for comparison.) Spill rates and the chance of occurrence of small, large, and very large oil spills are the same for the proposed Development and Production Plan, component alternatives, and combination alternatives.

The Eastern and Tern Pipeline Routes share the same shoreline crossing as well as the onshore pipeline route. If either Alternative III.A or III.B is selected, BPXA would be required to submit for our review additional geophysical survey data that sufficiently cover the proposed area of offshore disturbance. An archaeological report would be prepared to address whether the data show any evidence of areas having prehistoric or historic site potential. Based on this analysis, we would require that any areas of archaeological site potential either be investigated further to determine conclusively whether a site exists at the location or that the area of the potential site be avoided by all bottom-disturbing activities.

As indicated in Section E.3.a(1), the differences in island locations and pipeline routes for Alternatives I, III.A, and III.B do not provide measurable differences in effects to the following resources:

- Bowhead Whales
- Seals and Polar Bears
- Fishes
- Subsistence-Harvest Patterns
- Sociocultural Systems
- Archaeological Resources
- Air Quality

(a) Alternative I – Use Liberty Island Location and Pipeline Route (Liberty Development and Production Plan)

The Liberty Island and its pipeline route are shown in Map 1 of the EIS. This alternative is the Proposed Action - BPXA's Liberty Development and Production Plan. The features of this alternative are shown in Table II.A-1 of the EIS. Liberty Island is in about 22 feet of water and about 5 miles from shore. The Liberty pipeline route would go southwest to shore. The offshore pipeline is about 6.1 miles long. The distance for hauling the gravel is about 7 miles to the island from the Kadleroshilik River Mine Site. The proposed Liberty gravel island would be centered above the Liberty reservoir. This location would minimize the number of high-departure wells needed to develop the reservoir and maximize the total oil recovered. The present island location had no observed permafrost to a minimum of 50 feet below the island location. Liberty Island would be about 1mile southeast of the Boulder Patch. For purposes of analysis, we assume a trench with a 7-foot minimum burial depth.

Alternative I would have effects to the following resources:

Spectacled Eiders: Disturbance of nesting or broodrearing spectacled eiders may result in loss of eggs or young to predators; however, displacement of more than a few eiders (or females with broods) by onshore facilities or activities is considered unlikely. Significant adverse population effects are *not* expected to occur as a result of disturbance.

A large oil spill from Liberty Island or associated marine pipeline would have the highest probability of contacting nearshore and offshore areas of Foggy Island Bay and the eastern Sagavanirktok River Delta, where spectacled eiders may be staging before migration. Recovery of the spectacled eider population from even small losses is not likely to occur quickly. Any substantial spill-related losses are expected to have significant adverse effects on this population.

Marine and Coastal Birds: Helicopter flights to Liberty Island may disturb some loons and king or common eiders feeding in open water off the Sagavanirktok River Delta during breakup or displace long-tailed ducks and eiders from preferred marine foraging areas in summer, adversely affecting fitness in some individuals. Snow goose and brant family groups could be displaced from coastal broodrearing areas, but alternative sites generally are available. Spill-cleanup activities may displace some nesting, broodrearing, juvenile or staging waterfowl and shorebirds from preferred habitats, resulting in lowered fitness. The small losses and displacements likely to result from the above activities are expected to cause minor changes in numbers but are not expected to require lengthy recovery periods.

A large oil spill from Liberty Island or the associated marine pipeline would have the highest probability of contacting nearshore and offshore areas of Foggy Island Bay and the eastern Sagavanirktok River Delta, where waterfowl and other aquatic birds may be molting or staging before migration. Mortality from a spill contacting long-tailed ducks in lagoons or other protected nearshore areas, where they concentrate during the molt period is estimated to exceed 1,200 individuals (equivalent to about 1% of the average coastal plain population) at average bird densities. Species that have a limited capacity for population growth (loons and sea ducks, in general), are expected to recover slowly from oil-spill mortality. Those that are declining (eiders, long-tailed ducks, red-throated loons) probably would not return to a target population level until the trend is reversed or becomes very small. In particular, because of historic or current declines in common eiders and long-tailed ducks and the estimated mortalities from an assumed oil spill, a large offshore spill would result in significant impacts to these species. Losses of other species (for example, the northern pintail, geese, glaucous gull, most shorebirds, and songbirds) through oiling could range up to a few hundred individuals, a minor effect for species whose populations are relatively abundant and stable or increasing.

Terrestrial Mammals: Disturbances would have short-term effects on individual animals and would not affect populations.

Crude oil or diesel fuel is most likely to contact some coastal areas from the Sagavanirktok River Delta east to Mikkelsen Bay. Caribou may use some of these areas for relief from insects. The main potential effect on terrestrial mammals that contact spilled oil could be the loss of fewer than 100 caribou and a few muskoxen, grizzly bears, and arctic foxes. These losses are expected to be replaced by normal reproduction within about 1 year. Secondary effects could come from disturbance associated with spill-cleanup activities and temporary local displacement of some caribou, muskoxen, grizzly bears, and foxes. These activities, however, would not affect the terrestrial mammals' movements or overall use of habitat.

Lower Trophic-Level Organisms: Alternative I would disturb lower trophic-level organisms in three primary ways: (1) island construction would bury about 23 acres of typical benthic organisms; (2) pipeline trenching would disturb additional benthos, burying up to 14 acres with very low (1%) coverage of kelp, boulders, and suitable substrate; and (3) sediment plumes would reduce Boulder Patch kelp production by up to 6% during 1 year. The buried 14 acres would equal less than 0.1% of the Boulder Patch kelp habitat. The density of the kelp, boulders and suitable substrate in the pipeline corridor is very low, averaging about 1% coverage, and the lost kelp biomass and production probably would be less than .01% of the Boulder Patch totals, but the effect (kelp substrate burial) would last forever.

Some of the suspended sediment from pipeline trenching and island construction would drift over other parts of the Boulder Patch, reducing light penetration and kelp production during 1 year. This reduction is estimated to be less than 6%, about one-third of which would be due to the proximity between the Boulder Patch to the Zone 1 disposal area for excess sediments. However, in relation to the large range of natural variability, all of these suspended sediment effects would be barely detectable.

A portion of the concrete slope would be a temporary home for colonies of species similar to those of the Boulder Patch area. Upon abandonment, the concrete mats probably would be removed or would become buried naturally, eliminating the additional kelp habitat.

Lower trophic-level organisms would be affected by a large oil spill. It would have only short-term effects on plankton, including phytoplankton, zooplankton, and epontic species on the bottom of the ice cover, but longer term effects on the fouled coastlines. Very little of Liberty crude, which is highly viscous and particularly resistant to natural dispersion, would be dispersed down in the Stefansson

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Sound water column and affect deep benthic communities such as the Boulder Patch kelp habitat. However, diesel oil, which would be used on the island for startup and emergency fuel, could be dispersed down to the seafloor. If 1,500 barrels of diesel were spilled from a fuel-delivery barge at the island during the open-water season, the concentration would be toxic within an area of about 18 square kilometers (7 square miles), as noted in the water quality section (see Sec. III.A.2 (l) in the EIS). Such toxicity probably would stunt the seasonal growth of kelp plants and reduce the population size of associated invertebrates for several years. Oil-spill responses in general would have both beneficial effects of some and adverse effects on other lower trophic-level organisms.

Essential Fish Habitat: As a result of disturbances caused by Liberty Island construction and operation, fish and zooplankton might experience short-term, localized but unmeasurable effects.

Vegetation-Wetland Habitat: Disturbances mainly come from constructing gravel pads and ice roads and installing the onshore pipeline and tie-in with the Badami pipeline. Gravel pads, pipeline trench, and the 1.4-mile-long onshore pipeline would destroy only 0.8 acre of vegetation and affect a few acres of nearby vegetation and have only local effects on the tundra ecosystem. Ice roads would have local effects (compression of tundra under the ice roads) on vegetation, with recovery expected within a few years, and no vegetation would be killed.

The main potential effects of a large offshore spill on vegetation and wetlands include oil fouling, smothering, asphyxiation, and poisoning of plants and associated insects and other small animals. In this case, complete recovery of moderately oiled wetlands of the Sagavanirktok River east to Mikkelsen Bay would take perhaps 10 years or longer. A second main effect is the disturbance of wetlands from cleanup activities. A large onshore spill would oil no more than 5 acres of vegetation along the pipeline landfall to the Badami tie-in and would cause very minor ecological harm. Complete recovery of heavily oiled coastal wetlands from these disturbances and oil could take several decades.

Economy: The Liberty Project would generate approximately $100 million in wages and 870 full-time equivalent construction jobs for 1 year in Alaska during 14-18 months of construction; 1,248 indirect full-time equivalent jobs during the 14-18 months of construction; and $480 million capital expenditure.

Water Quality: The greatest effect on water quality from gravel island and pipeline construction would be additional turbidity caused by increases in suspended particles in the water column. Increases in turbidity generally are expected to be considerably less than the 7,500 parts per million suspended solids used in the analysis as an acute (toxic) criterion for water quality; exceptions may occur within the immediate vicinity of the construction activity. Turbidity increases from construction activities generally are temporary and expected to occur during the winter and end within a few days after construction stops. Material excavated from the pipeline trench but not used for backfill most likely would be left in an area where active erosion of sediment particles could occur during breakup and open water. This material would be similar in composition to seafloor sediments in the trenching and disposal areas and its contribution to the future turbidity from waves and currents is expected to be about the same as the sediments existing at the seafloor surface prior to pipeline construction. Construction activities are not expected to introduce or add any chemical pollutants.

(b) Alternative III.A – Use the Southern Island Location and Eastern Pipeline Route

The Southern Island location and Eastern Pipeline Route are shown in Map 1 of the EIS. The features of this alternative are shown in Table II.A-1 of the EIS. This alternative was developed in response to scoping comments requesting analysis of island locations in shallower water to eliminate or reduce effects to bowhead whales.

The features of Alternative III.A that affect the resources differently than Alternative I are island size, island and pipeline location closer to shore, island and pipeline location farther from the Boulder Patch, and offshore and onshore pipeline lengths. The Southern Island is in shallower water and requires about 20% less gravel than Liberty Island and is about 2 miles closer to shore than Liberty Island. The Southern Island and the offshore end of the eastern pipeline are about 2.5 miles from the Boulder Patch; whereas, Liberty Island and the offshore end of the Liberty pipeline are about 1 mile away. The offshore segment of the eastern pipeline is about 1.9 miles shorter than the Liberty pipeline, but the onshore part is 1.6 miles longer.

The effects of disturbances decrease the level of suspended sediments because of the smaller island size, shorter offshore pipeline length, and longer distance to the Boulder Patch. Noise levels increase because of the longer onshore pipeline. The likelihood of a large oil spill contacting the shore in Foggy Island Bay increases because of the shorter distance between the island and the shore. Compared to Alternative I, these differences would change impacts to the following resources in the ways described:

Spectacled Eiders: Compared to Alternative I, helicopter inspections of the onshore pipeline would slightly increase disturbances to nesting (from 0.75-1.5 nests) and broodrearing spectacled eiders.

The probability of a large oil spill contacting nesting or broodrearing spectacled eiders in the southern part of Foggy Island Bay after 30 days is 2-14% greater than for Alternative I. Any substantial spill-related losses are expected to have significant adverse effects on this population.

Marine and Coastal Birds: Disturbances to nesting and broodrearing birds from helicopter inspections of the onshore pipeline would increase compared to Alternative I.

The probability of a large oil spill contacting nesting or broodrearing birds in the southern part of Foggy Island Bay after 30 days is 2-14% greater than for Alternative I.

Terrestrial Mammals: Terrestrial mammals may frequent coastal habitats, and the probability of a large oil spill contacting these habitats after 30 days is 0-4% greater than for Alternative I.

Lower Trophic-Level Organisms: Trenching for the eastern pipeline would not destroy any kelp habitat; trenching for the Liberty pipeline would destroy about 14 acres. Suspended sediments from constructing the eastern pipeline would reduce kelp production in the Boulder Patch about 1% less than from Liberty pipeline construction.

The general effects of a crude-oil spill on lower trophic-level organisms would be similar to those for Alternative I; however, the longer distance between the alternative island site and the Boulder Patch kelp habitat would reduce slightly the risk of diesel fuel spill effects to the kelp community.

Essential Fish Habitat: The potential adverse effects of this alternative on essential fish habitat could be reduced slightly because the size of the island footprint and amount of offshore trenching would be reduced.

Vegetation-Wetland Habitats: The probability of a large oil spill contacting coastal vegetation and wetland habitats after 30 days is 0-4% greater than for Alternative I.

Economy: Alternative III.A would generate fewer jobs, less wages, and less revenue to the government than the Proposal. This alternative would result in a decrease of approximately $1.7 million in wages for 12 months, 9 direct jobs in Alaska for 12 months, 14 indirect jobs in Alaska for 12 months, and $10 million in net present value to the company. The net present value to the government is estimated to be $107million, or $7 million less than the Proposal.

Water Quality: Constructing a smaller island and shorter pipeline reduces the suspended sediments by about 14% and 32%, respectively, and decreases the time the suspended sediments would affect the water quality by 3 to 5 and 15 days, respectively, compared to Alternative I.

(c) Alternative III.B - Use the Tern Island Location and Tern Pipeline Route

The Tern Island and Tern Pipeline Route are shown in Map 1 of the EIS. The features of this alternative are shown in Table II.A-1 of the EIS. This alternative was developed in response to scoping comments regarding the use of the abandoned exploration island as a source of gravel or as a drilling/production island.

The features of Alternative III.B that affect the resources differently than Alternative I are the amount of gravel used to construct the island, the island and pipeline location closer to shore, the island and pipeline location farther from the Boulder Patch, and the offshore pipeline length. Tern Island is in deeper water than Liberty Island but requires about 25% less gravel because of gravel than has remained after the island was abandoned as an exploration drilling site. Tern Island is about 0.6 mile closer to shore than Liberty Island. Tern Island and the offshore end of the pipeline are about 4 miles from the Boulder Patch; whereas, Liberty Island and the offshore end of the Liberty pipeline are about 1 mile. The offshore segment of the Eastern Pipeline is about 0.6 mile shorter than the Liberty pipeline.

The effects of disturbance associated with suspended sediments decrease because of the smaller amount of gravel used to construct the island, the shorter offshore pipeline length, and longer distance to the Boulder Patch. The likelihood of a large oil spill contacting the shore in Foggy Island Bay decrease slightly because of the location of the island and pipeline in relation to the nearshore currents. Compared to Alternative I, these differences would change impacts to the following resources in the ways described:

Spectacled Eiders: The probability of a large oil spill contacting nesting or broodrearing spectacled eiders in the southern part of Foggy Island Bay after 30 days is 10-20% lower than for Alternative I. Any substantial spill-related losses are expected to have significant adverse effects on this population.

Marine and Coastal Birds: The probability of a large oil spill contacting nesting or broodrearing birds in the southern part of Foggy Island Bay after 30 days is 10-20% lower than for Alternative I.

Terrestrial Mammals: Terrestrial mammals may frequent coastal habitats, and the probability of a large oil spill contacting these habitats after 30 days is 0-4% greater than Alternative I.

Lower Trophic-Level Organisms: Trenching for the eastern pipeline would not destroy any kelp habitat; trenching for the Liberty pipeline would destroy about 14 acres but there would be minor, short-term effects to organisms in the silty/sandy sediments. Suspended sediments from constructing the eastern pipeline would reduce kelp production in the Boulder Patch by about 1% of that for Liberty pipeline construction.

The general effects of a crude-oil spill on lower trophic-level organisms would be similar to those for Alternative I; however, the longer distance between the alternative island site and the Boulder Patch kelp habitat would reduce slightly the risk of diesel fuel spill effects to the kelp community.

Essential Fish Habitat: The potential adverse effects of this alternative on essential fish habitat could be slightly reduced primarily because of expected smaller effects on fish and algae at the Boulder Patch. The longer distance between Tern Island and the Boulder Patch would reduce the risk of diesel fuel spills to the kelp and associate fish communities. The disturbance effects would be slightly lower for this alternative, because pipeline trenching would not eliminate kelp. Less material would be used to construct Tern Island than Liberty Island, and the total amount of particulate matter suspended would be less. The turbidity plume would be expected to have a shorter duration than the plume associated with Liberty.

Vegetation-Wetland Habitats: The probability of a large oil spill contacting coastal vegetation and wetland habitats after 30 days is 0-4% greater than for Alternative I.

Economy: Alternative III.B would generate fewer jobs, less wages, and less revenue to the government than Alternative I. This alternative would result in a decrease of approximately $1.7 million in wages for 12 months, 9 direct jobs in Alaska for 12 months, 14 indirect jobs in Alaska for 12 months, and $10 million in net present value to the company. The net present value to the government is estimated to be $107 million, or $7 million less than Alternative I.

Water Quality: Constructing an island with less gravel and a shorter pipeline reduces the suspended sediments by about 25% and 10%, respectively, decreases the time the suspended sediments affect the water quality by about 15 days for island construction and 5 days for pipeline construction, as compared to Alternative I.

(2) Effects of Alternative Pipeline Designs

This set of component alternatives evaluates the different impacts of using four different pipeline designs:

- Alternative I - Use Single Steel Wall Pipe System (Liberty Development and Production Plan)
- Alternatives IV.A - Use Pipe-in-Pipe System
- Alternative IV.B - Use Pipe-in-HDPE System
- Alternative IV.C - Use Flexible Pipe System

Alternatives IV.A, IV.B, and IV.C were identified during scoping by members of the Liberty Interagency Team. Some of the team members expressed concern about pipeline safety and wanted MMS to investigate further whether alternative pipeline designs could reduce the potential for oil spills to enter the marine environment. Each of the alternatives in this section evaluates the impacts of using different pipeline designs. Each of these design alternatives is based on a conceptual engineering report by INTEC (2000).

Evaluation of the pipeline designs in the EIS is based on the following reports:

An Engineering Assessment of Double Versus Single Wall Designs for Offshore Pipelines in an Arctic Environment (Center for Cold Oceans Resource Engineering [C-CORE], 2000). This study compared the advantages and disadvantages of pipe-in-pipe and single-wall pipe designs in general and was not based on a specific project.

Pipeline System Alternatives - Liberty Development Project Conceptual Engineering (INTEC, 1999a). The INTEC report contains conceptual engineering designs for the four pipeline designs that are described as the pipeline design alternatives: single-wall pipeline, a steel-in-steel pipe-in-pipe system, a steel pipe-in-HDPE (high-density polyethylene) system, and a flexible pipe system.

Independent Evaluation of Liberty Pipeline System Design Alternatives (Stress Engineering Services, Inc. [Stress], 2000). This study provides an independent review of the INTEC (1999a) report.

INTEC revised their *Pipeline System Alternatives - Liberty Development Project Conceptual Engineering Report* (INTEC, 1999a) after receiving comments from members of the Interagency EIS Team and reviewing the results of the report prepared by Stress. The main body of the revised report is identical to the original report, but INTEC's responses to comments and an addendum, in which all pipeline systems are designed with a 7-foot burial depth, were added to the report. The revised report is referred to in this EIS as INTEC (2000).

Independent Risk Evaluation for the Liberty Pipeline (Fleet Technology Limited [Fleet], 2000). This study was done to get an independent assessment to the risks of spills from the four conceptual pipeline designs in the INTEC (2000) report. The analysis was performed both for the original designs and the designs contained in Addendum A of the INTEC (2000) report, which all have a 7-foot burial depth.

The four studies above generally concurred with, or concluded that:

- All four pipeline designs proposed by INTEC could be constructed and operated safely;
- The probability of a spill is low for any of the four pipeline designs;
- The steel pipe-in-pipe design provides secondary containment for certain types of failures that, with other design factors held constant, lowers the probability of oil entering the environment; and,
- The pipe-in-pipe designs would be more complex to construct and repair than the single-walled designs.

For the purpose of this draft EIS, we have categorized all pipeline failures as either functional or containment failures. A functional failure is one where the pipeline is no longer capable of operating as designed, such as bending excessively, becoming oval instead of staying round or, in the case of a pipe-in-pipe system, developing a leak in one but not both pipes; however, the failure does not result in a leak to the environment. A containment failure is one that would allow oil to enter the environment; in the case of a pipe-in-pipe system, this would require a leak in both pipelines. Both functional and containment failures would require the pipeline to be returned to within design basis parameters or require the operator to prove to the proper regulatory agency(ies) that it is safe to continue operating the pipeline before it can be returned to service.

“Risk” is the product of the probability of a spill and the associated consequences. Pipelines have low probabilities of failure when compared to other types of oil transportation systems. This is attributed to their simplistic design and the fact that most are buried out of harm’s way. Any pipeline can be designed to satisfy a target safety level but has certain inherent advantages and disadvantages. Double-wall pipelines reduce the probability of a containment failure but increase the probability of functional failures. The reduction in the probability of containment failure potentially is larger than the increase in the probability of functional failure. The single-wall pipe has a lower probability of functional failure but a higher probability of a containment failure.

The MMS believes that, in general, it is more prudent to spend both time and money trying to reduce the likelihood of an oil spill than in trying to mitigate spill consequences. Because no amount of effort absolutely could guarantee that a pipeline leak would not occur, the MMS participates in and supports oil-spill-cleanup research and testing, and insures compliance with the Oil Pollution Act of 1990 readiness requirements. Pipeline failure rates and expected spill volumes are shown in Table II.C-5 of the EIS.

All of these designs are expected to be able to be constructed in a single construction season, but it is possible that a second construction season may be needed if there are problems with construction for any of the designs. The more complex the construction processes, the higher the potential for multiple-year construction. All offshore pipeline systems evaluated would be constructed during the Year 3 of the project, which is the second winter construction season. This pipeline would be constructed using construction equipment similar to what is used onshore, such as the process used for the Northstar Project. Construction and fabrication of the pipeline would occur from the surface of the ice. The LEOS leak-detection system would be installed with all pipelines. In addition to the LEOS system, pressure-point analysis and mass-balance line-pack compensation leak-detection systems would be installed with all pipeline alternatives. Excess trenching material would be disposed at approved ocean dumping sites.

Higher pipeline construction costs result in higher pipeline tariffs. Higher pipeline tariffs reduce royalty revenue to the Federal Government from the project and likewise reduce Section 8(g) payments to the State.

For purposes of analysis, MMS assumes and evaluates an offshore oil spill for all pipeline alternatives. This analysis does not include differences in pipeline failure rates as calculated by the four pipeline studies. While the decisionmaker may consider the differences in failure rates, they do not provide measurable differences of environmental impacts to the following resources:

- Bowhead Whales
- Eiders
- Seals and Polar Bears
- Marine and Coastal Birds
- Terrestrial Mammals
- Fishes
- Vegetation-Wetland Habitats
- Subsistence-Harvest Patterns
- Sociocultural Systems
- Archaeological Resources
- Air Quality.

(a) Alternative I – Use Single-Wall Pipe System (Liberty Development and Production Plan)

The major advantages of a single-wall pipeline are simpler construction, lower construction costs, lower life-cycle costs, and greater inspection reliability (C-CORE, 2000).

The single-wall pipeline system does not have many of the same construction, operations, and maintenance concerns as the other systems, because it is the most widely used type of pipeline and the inspection and monitoring tools were developed to work on these types of systems. However, by its very design, it does not provide any secondary containment capabilities and, therefore, has a higher risk of a containment failure than the steel pipe-in-pipe system.

For the offshore pipeline, BPXA proposes a single-wall steel pipeline system that would be constructed with a 12.75-inch outside diameter pipe with a 0.688-inch wall thickness. The system would be protected from corrosion by a dual-layer fusion-bonded epoxy coating and sacrificial anodes. The system would be buried with a minimum burial depth of 7 feet.

Alternative I would have effects to the following resources:

Lower Trophic-Level Organisms: Alternative I would disturb lower trophic-level organisms in three primary ways: (1) island construction would bury about 23 acres of typical benthic organisms; (2) pipeline trenching would disturb additional benthos, burying up to 14 acres with very low (1%) coverage of kelp, boulders, and suitable substrate; and (3) sediment plumes would reduce Boulder Patch kelp production by up to 6% during 1 year. The buried 14 acres would equal less than 0.1% of the Boulder Patch kelp habitat. The density of the kelp, boulders, and suitable substrate in the pipeline corridor is very low, averaging about 1% coverage, and the lost kelp biomass and production probably would be less than .01% of the Boulder Patch totals, but the effect (kelp substrate burial) would last forever.

Some of the suspended sediment from pipeline trenching and island construction would drift over other parts of the Boulder Patch, reducing light penetration and kelp production during 1 year. This reduction is estimated to be less than 6%, about one-third of which would be due to the proximity between the Boulder Patch to the Zone 1 disposal area for excess sediments. However, in relation to the large range of natural variability, all of these suspended sediment effects would be barely detectable.

A portion of the concrete slope would be a temporary home for colonies of species similar to those of the Boulder Patch area. Upon abandonment, the concrete mats would probably be removed or would become buried naturally, eliminating the additional kelp habitat.

Essential Fish Habitat: As a result of disturbances caused by Liberty Island construction and operation, fish and zooplankton might experience short-term, localized, but unmeasurable effects.

Economy: The Liberty Project would generate approximately $100 million in wages and 870 full-time equivalent construction jobs for 1 year in Alaska during 14-18 months of construction; 1,248 indirect full-time equivalent jobs during the 14-18 months of construction; and $480 million capital expenditure.

Water Quality: The greatest effect on water quality from gravel island and pipeline construction would be additional turbidity caused by increases in suspended particles in the water column. Increases in turbidity generally are expected to be considerably less than the 7,500 parts per million suspended solids used in the analysis as an acute (toxic) criterion for water quality; exceptions may occur within the immediate vicinity of the construction activity. Turbidity increases from construction activities generally are temporary and expected to occur during the winter and end within a few days after construction stops. Material excavated from the pipeline trench but not used for backfill most likely would be left in an area where active erosion of sediment particles could occur during breakup and open water. This material would be similar in composition to seafloor sediments in the trenching and disposal areas, and its contribution to the future turbidity from waves and currents is expected to be about the same as the sediments existing at the seafloor surface prior to pipeline construction. Construction activities are not expected to introduce or add any chemical pollutants.

(b) Alternative IV.A – Use Pipe-in-Pipe System

The primary benefit provided by this pipeline design is that it reduces the probability of a containment failure.

The C-CORE (2000) study indicated that pipe-in-pipe systems have several advantages over a single-wall pipeline. The primary benefit is the ability to contain leaks from the carrier pipe in the annulus. It is possible that some oil may spill during pipeline repair operations, but spill volumes would be small and spill-response equipment would be onsite; therefore, the effects this would have on the environment would be minor. Containing a leak in the annulus of the pipeline could provide some flexibility in scheduling the pipeline repair to minimize the impacts on the species that inhabit the area. For example, if a leak occurred during spring breakup, it might be possible to wait and repair the leak the following winter rather than in the summer when waterfowl and bowhead whales are in the area. Another benefit of pipe-in-pipe is that the annulus surrounding the carrier pipeline may provide an advantage for leak detection.

The conceptual pipe-in-pipe system would be constructed with a steel inner pipe with an outside diameter of 12.75 inches and a wall thickness of 0.500-inch. The inner pipe would be placed in a steel outer pipe with an outside diameter of 16.00 inches and a wall thickness of 0.844 inch. The inner pipe would be supported in the outer pipe with annular spacers, or centralizers. The outer pipe would be protected from external corrosion by a dual-layer fusion-bonded epoxy and sacrificial anodes. The inner pipe would be protected from corrosion by a dual-layer fusion-bonded epoxy. For the EIS analysis, we assume the double-wall pipeline design, as well as the other pipeline designs, can be built in a single winter construction season. However, due to the substantially increased weight of the double-wall system, as compared to the other designs, INTEC (2000) calculated that floating sea ice along the pipeline route would have to be 2 feet thicker for the pipe-in-pipe design than the other alternatives to ensure safe working conditions. This additional ice thickness would take approximately 10 additional days to achieve. Because this alternative requires additional time to prepare a safe worksite when compared to the others, it is more sensitive to weather delays and, therefore, would have a higher potential for requiring a second winter construction season. The added complexity of the construction process also increases the potential for construction-related problems and further would increase the potential for a second winter construction season. The system would be buried with a minimum burial depth of 5 feet.

Using a pipe-in-pipe design adds some complexity to construction, operations, maintenance, and monitoring plans. The added complexity is a result of the following concerns. The steel outer pipe can be cathodically protected in the same fashion as a single-wall pipeline and the status of the cathodic protection monitored at the island and shore crossing, but it cannot be smart pigged; therefore, its overall corrosion-monitoring capabilities are somewhat reduced when compared to a single-wall pipeline. The design does not incorporate a cathodic protection system for the inner pipe and instead relies on protective coatings to prevent corrosion of the inner pipe. The Stress (2000) report suggests that it may be feasible to install a cathodic protection system to the inner pipe that should work in the event that the annulus becomes contaminated with water. There are approximately twice as many welds, some of which cannot be tested by both nondestructive testing methods that would be used on the other welds. While either test alone should be sufficient to determine if a weld is acceptable, each test method works differently and is better at detecting certain types of weld imperfections.

The feature of Alternative IV.A that affects the resources differently than Alternative I is the pipeline burial depth. The pipe-in-pipe pipeline system is heavier than the single steel wall pipeline system in Alternative I and, thus, needs less of the overburden fill material to prevent upheaval buckling from thermal expansion when oil flows through the pipeline. The minimum burial depth for the pipe-in-pipe and single steel wall systems are 5 and 7 feet, respectively; the average minimum trench depths are 9 and 10.5 feet, respectively. The volume of material excavated and later used as backfill for the pipe-in-pipe and single steel wall trenches is 557,300 and 724,000 cubic yards, respectively.

The effects of disturbances from pipeline construction would decrease because of the shallower excavation depth and smaller seafloor surface area affected. Disturbances from suspended sediments would decrease because of the smaller volume, about 23% less, of sediment excavated and used as backfill.

This alternative, compared to Alternative I, would change the impacts to the following resources in the ways described:

Lower Trophic-Level Organisms: Shallower burial along the Alternative I pipeline route would permanently eliminate 15 fewer acres of very diffuse kelp, boulder, and suitable substrate than would the Alternative I burial depth. The amount of turbidity generated by shallower burial would be only two-thirds of that for Alternative I, probably causing less reduction in annual kelp production during the construction phase.

Essential Fish Habitat: Water quality is expected to be improved, because the total amount of suspended-particulate matter would be less than under Alternative I (Liberty Development and Production Plan).

Economy: Alternative IV.A would generate more jobs, greater wages, and greater capital expenditure than Alternative I. This alternative would result in an increase of $4 million in wages for 7 months; 45 direct jobs in pipeline construction in Alaska for 7 months; 68 indirect jobs in Alaska for 7 months; and $20 million in capital expenditures. The increased cost of this alternative is based primarily on additional labor, welding, and material costs.

Water Quality: The duration of turbidity from pipe-in-pipe pipeline construction is expected to be 11 days shorter than the Liberty pipeline (49 days). The overall effects of turbidity are expected to be about 23% less for the pipe-in-pipe pipeline construction compared to the Liberty pipeline construction.

(c) Alternative IV.B – Use Pipe-in-HDPE System

The primary benefits provided by this pipeline design are that it provides secondary containment against small leaks, and the outer pipe cannot corrode.

This alternative uses a steel carrier pipe, which is identical to Alternative I. That carrier pipe is placed inside a high-density polyethylene sleeve with a diameter of 16.25 inches and a wall thickness of 0.75 inches.

Using a pipe-in-HDPE design adds some complexity to the construction, operations, maintenance, and monitoring of the system. The complexity arises from concerns in the following areas. The HDPE system is more susceptible to damage during installation than the other alternatives due to weaker material properties of the HDPE as compared to steel. The design does not incorporate a cathodic protection system for the inner pipe and instead relies on protective coatings to prevent corrosion of the inner pipe. The Stress (2000) report suggests that it may be feasible to install a cathodic protection system to the inner pipe that should work in the event the annulus becomes contaminated with water. The condition of the HDPE outer pipe cannot be monitored as effectively as a single-wall pipeline. Because corrosion is not a concern for the outer HDPE pipe, the lack of outer pipe monitoring capabilities for the pipe-in-HDPE design are not as relevant a concern as they are with the steel pipe-in-pipe design. However, the outer pipe of the pipe-in-HDPE design is weaker than the outer pipe of the steel pipe-in-pipe design; therefore, the reduced outer pipe defect monitoring capabilities are more of a concern as they relate to physical damage to the outer pipe. As designed, the HDPE casing would not be able to contain the operating pressure of the pipeline. It would be possible to design an HDPE pipe to contain the full operating pressure of the pipeline, but the diameter and wall thickness of the pipe would be so large that pipeline buoyancy would become a major concern during design and installation. The ability to verify the joining of the HDPE and the ability to repair HDPE to original integrity is unknown.

The minimum burial depth for the pipe-in-HDPE is 6 feet; the average minimum trench depth is 10 feet. The volume of material excavated and later used as backfill for the pipe-in-HDPE is 673,920 cubic yards.

The effects of disturbance from pipeline construction would decrease because of the shallower excavation depth and the smaller seafloor surface area affected. Disturbance from suspended sediments would decrease because of the smaller volume, about 7% less, of sediment excavated and used as backfill.

This alternative, compared to Alternative I, would change the impacts to the following resources in the ways described:

Lower Trophic-Level Organisms: The pipe-in-HDPE would require less burial depth, causing fewer effects than Alternative I in two important ways: (1) shallower burial in the Alternative I pipeline route would permanently eliminate 2 fewer acres of very diffuse kelp, boulder, and suitable substrate than the Alternative I burial depth; and (2) the amount of turbidity generated by shallower burial would be only two-thirds of that for Alternative I, probably causing less reduction in annual kelp production during the construction phase.

Essential Fish Habitat: Water quality is expected to be improved slightly, because the total amount of suspended-particulate matter would be slightly less than under Alternative I.

Economy: Alternative IV.B would generate more jobs, greater wages, and greater capital expenditures than Alternative I. This alternative would result in an increase of $2.1 million in wages for 7 months; 19 direct jobs in pipeline construction in Alaska for 7 months; 29 indirect jobs in Alaska for 7 months; and $12.9 million in capital expenditures. The increased cost of this alternative is based primarily on additional installation costs, and they reflect the new costs developed by INTEC for single season construction of the pipeline. Note that all pipeline designs have a standard 10% contingency (see INTEC, 2000).

Water Quality: The duration of turbidity from pipe-in-pipe pipeline construction is expected to be 4 days shorter than the Liberty pipeline (49 days). The overall effects of turbidity are expected to be about 7% lower for the pipe-in-HDPE pipeline as compared to the Liberty pipeline construction.

(d) Alternative IV.C – Use Flexible Pipe System

The primary benefit of the flexible pipeline system is that it requires the least amount of trenching and, therefore, introduces the least amount of sediments into the water column. Also, because it is shipped on large spools, its installation process is very simple and can be completed more quickly then any of the other pipeline designs. The probability of a containment failure is, at best, no better than for a single-wall pipeline, and the system has the highest probability of a functional failure. Because the system is manufactured in long, continuous sections, it may be necessary to replace entire sections of the pipe, approximately 2,800 feet in length, depending on the location and nature of the damage. The flexible pipe system is constructed of multiple layers of metallic and nonmetallic materials—a design that makes pipeline monitoring more complex than the other systems.

For purposes of analysis in the EIS, we do not consider the annulus of the flexible pipe to have any containment capabilities, even though the flexible pipe has many different layers in its design.

This pipe system would be constructed with an internal diameter of 12 inches of flexible pipe with a wall thickness of 1.47 inches. The flexible pipe is a nonbonded pipe made of thermoplastic layers and steel strips. The plastic layers provide very limited containment, and they transfer the pressure loads to the steel strips. The pipe has eight layers: an inner interlocked steel carcass; a pressure thermoplastic sheath; two layers of armor wires; fabric tape; and a polyethylene external sheath. The minimum burial depth for the flexible pipe system is 5 feet; the average minimum trench depth is 8.5 feet. The volume of material excavated and later used as backfill is 498,960 cubic yards.

The effects of disturbances from pipeline construction would decrease because of the shallower excavation depth and less of the seafloor surface area is affected. Disturbances from suspended sediments would decrease because of the smaller volume, about 31% less, of sediment excavated and used as backfill as compared to the single wall pipeline.

This alternative, compared to Alternative I, would change the impacts to the following resources in the ways described:

Lower Trophic-Level Organisms: Shallower burial in the Alternative I pipeline route would permanently eliminate 2 fewer acres of very diffuse kelp, boulder, and suitable substrate than the Alternative I burial depth. The amount of turbidity generated by shallower burial would be only two-thirds of that for Alternative I, probably causing less reduction in annual kelp production during the construction phase.

Essential Fish Habitat: Water quality is expected to be improved, because the total amount of suspended-particulate matter would be less than under Alternative I.

Economy: Alternative IV.C would generate more jobs, greater wages, and greater capital expenditures than Alternative I. This alternative would result in increases of $0.9 million in wages for 7 months; 8 direct jobs in pipeline construction in Alaska for 7 months; 12 indirect jobs in Alaska for 7 months; and $5.1 million in capital expenditures. The increased cost of this alternative is based primarily on increased material cost.

Water Quality: The duration of turbidity from flexible pipe pipeline construction is expected to be 15 days shorter as compared to the Liberty pipeline (49 days). The overall effects of turbidity are expected to be about 31% lower for the flexible pipeline construction compared to Liberty pipeline construction.

(3) Effects of Alternative Upper Island Slope-Protection Systems

This component set of alternatives evaluates the effects for two options that provide upper slope protection to the gravel island.

- Alternative I - Use Gravel Bags, would use gravel bags similar to those used at the Endicott Island.
- Alternative V - Use Steel Sheetpile, would use steel sheetpile similar to the system installed at the Northstar Project.

The impacts to the following resources would be the same for both, because they are not impacted differently by the unique aspects of this alternative:

- Bowhead Whales
- Eiders
- Seals and Polar Bears
- Marine and Coastal Birds
- Terrestrial Mammals
- Lower Trophic-Level Organisms
- Fishes and Essential Fish Habitat
- Vegetation-Wetland Habitat
- Subsistence-Harvest Patterns
- Archaeological Resources
- Economy
- Water Quality
- Air Quality

(a) Alternative I - Use Gravel Bags (Liberty Development and Production Plan)

Gravel bags would be used in the upper portion of the island slope starting at 7-8 feet above sea level and continuing to the top of the berm, which is 23 feet above sea level and 8 feet above the working surface of the island. The bags would be placed in an overlapping pattern. A gravel bench covered with concrete mats extending more than 40 feet from the base of the gravel bags to the sea surface would dampen wave energy approaching the island and induce natural formation of ice rubble. The gravel bags would be used only in the upper portion of the island to keep them from contact with direct forces from ice or wave action which would lessen potential damage and dislocation, and protect the surface of the island from the unlikely event of further ice rideup.

BPXA's proposed use of gravel bags for this project is quite different from previous exploration island construction. The bags proposed for use in Liberty Island construction are made from a polyester material that does not float. BPXA would monitor ice events at or near the island and repair or replace any torn or ripped bags as part of their ongoing maintenance program. With proposed BPXA maintenance, it is highly unlikely that a gravel bag would be ripped or torn during an ice event and not repaired before a wave event could wash the bag into the ocean. In the unlikely event a bag or part of a bag is washed into the marine environment, the bag would not float but sink to the bottom. BPXA would remove all of the gravel bags used in the upper slope-protection system at project abandonment.

Alternative I would have effects to the sociocultural systems described below.

Sociocultural Systems: Using gravel bags would contribute to ongoing concerns of local subsistence hunters about gravel bags from past gravel exploration islands contaminating the environment and creating navigation hazards for whaling boats. This increased stress of local Inupiat could be considered a slight increase in effects to sociocultural systems and could be construed as not taking into account local knowledge and concern for the local offshore environment and its resources.

(b) Alternative V - Use Steel Sheetpile

This alternative was developed to eliminate the potential of gravel bags entering the environment and becoming a hazard to local navigation, especially to bowhead whaling vessels.

Under this alternative, steel sheetpile would protect the upper part of Liberty Island; no gravel-filled bags would be on the island. The sheetpile would be similar to that used for Seal Island in the Northstar Development Project. This alternative would eliminate the need for gravel bags as upper slope protection, which would eliminate the possibility of damaged bags entering the environment as a result of a storm or ice event. The sheetpile would be designed to carry the surface loads. It would protect the island above the concrete blocks used for lower slope protection and would weather to a natural rust color. The steel sheetpile would be removed when the island is abandoned.

The specific components of using steel sheetpile for upper island slope protection, as described, would change the impacts only to sociocultural systems as described in the following:

Sociocultural Systems: Using steel sheetpile in island construction would relieve ongoing concerns of local subsistence hunters about gravel bags from past gravel exploration island developments contaminating the environment and creating navigation hazards for whaling boats. Using steel sheetpile would serve to reduce overall stress in the local Inupiat population, particularly Nuiqsut, over the development of Liberty Island in the Beaufort Sea offshore environment. This reduction in stress of local Inupiat could be considered a slight reduction in effects to sociocultural systems and also could be construed as taking into account local knowledge and concern for the offshore environment and its resources.

(4) Effects of Alternative Gravel Mine Sites

This set of component alternatives evaluates two different gravel mine sites.

- Alternative I - Use the Kadleroshilik River Mine Site (Liberty Development and Production Plan), evaluates the effects of creating a new mine site at the Kadleroshilik River.
- Alternative VI - Use Duck Island Mine Site evaluates the existing Duck Island Mine Site (see Map 1 of the EIS), which was used as a gravel source for the Endicott Project and other projects. Key components of these alternatives are summarized in Table II.A-1 of the EIS.

The differences in mine site locations for Alternatives I and VI do not provide measurable differences to the following resources:

- Bowhead Whales
- Subsistence-Harvest Patterns
- Sociocultural Systems
- Archaeological Resources

(a) Alternative I – Use Kadleroshilik River Mine (Liberty Development and Production Plan)

The Kadleroshilik River mine site is approximately 1.4 miles south of Foggy Island Bay, with a ground surface elevation of 6-10 feet above mean sea level (BPXA, 2000a). The mine site is in a region of riverine barrens and alluvial floodplain. BPXA has estimated that the proposed site is about 40% dry dwarf shrub/lichen tundra, 10% dry barren/dwarf shrub and forb grass complex, and 50% river gravel. The development of this mine site would destroy about 24 acres of wetland habitat.

The development mine site is approximately 31 acres, with the primary excavation area developed in two cells. The first cell would be approximately 19 acres and developed in Year 2; it would support construction of the gravel island. The second cell is approximately 12 acres and would support pipeline construction activities in Year 3 (Noel and McKendrick, 2000).

Mining would not extend into the active river channel; a dike approximately 50 feet wide would be left in place between the mine site and the river channel while mining operations are under way. Gravel would be excavated by blasting, ripping, and removing material in two 20-foot lifts to a total depth of 40 plus feet below the ground surface. Some portion of the lower 20-foot lift may be left in place, if all gravel available from the site is not needed to meet island requirements.

After usable gravel has been removed from the mine, material unsuitable for construction (for example, unusable material stockpiled during mining) would be placed back into the mine excavation. This backfilled material would be used to create a shelf (at approximately mean water level) along one side of the mine to improve future habitat potential. The backfilled area would provide substrate and nutrients to support revegetation and improve future habitat potential of the constructed shelf along the mine wall.

Alternative I, would have effects to the following resources:

Spectacled Eiders: Obtaining gravel from the proposed Kadleroshilik River quarry site would avoid disturbing any habitat at the Duck Island gravel mine site on the Sagavanirktok River Delta that might be used by spectacled eiders. The potential for eider use of the Kadleroshilik quarry site likely is considerably greater than for the Duck Island quarry site because of its undisturbed character and vegetative cover. However, less than 1% of the gravel island site in the Kadleroshilik River would be characterized as good spectacled eider nesting habitat. The nesting density and average density of eiders at tundra sites in the general vicinity of the two sites were similar (0.3-0.5 nests/square kilometer and 0.4 birds/square kilometer, respectively) in 1994. The numbers of nesting eiders displaced from the Kadleroshilik area (Alternative I) is likely to be very low but greater than from the Duck Island site (Alternative VI) as a result of habitat disturbance. Significant adverse population effects are not expected to occur as a result of disturbance.

Seals and Polar Bears: Using the Kadleroshilik River mine site rather than the Duck Island gravel mine site may increase potential noise and disturbance of denning polar bears in the Kadleroshilik River area during winter. However, the number of bears potentially displaced would be low and would not affect polar bear populations.

Marine and Coastal Birds: Obtaining gravel from the proposed Kadleroshilik River quarry site instead of the Duck Island gravel mine site would avoid disturbing any habitat at the Duck Island site that might be used by any of several species that may nest, forage, or rest in the area the following summer. The potential for bird use of the Kadleroshilik quarry site likely is substantially greater than for the Duck Island quarry site because of its undisturbed character and vegetative cover. However, we would expect relatively lower densities of fewer nesting species than nearby tundra areas due to the lower proportion of habitat types generally preferred by species likely to nest there. Total nest density and total average density of individuals for 14 bird species in the general vicinity of the two sites were similar (43.3-46.3 nests/square kilometer and 111.2-136.2 birds/square kilometer) in 1994. The numbers of nesting birds displaced from the Kadleroshilik area (Alternative I) is likely to be low but considerably greater than from the Duck Island site as a result of habitat disturbance.

Terrestrial Mammals: Using the Kadleroshilik River mine could increase potential noise and disturbance to muskoxen from ice-road traffic and mining activities in the Kadleroshilik River area during winter. The highest levels would be during construction, but some activities would be expected during the 15-year life of the project. The disturbances would have short-term effects on individual animals and would not affect the population.

Lower Trophic-Level Organisms: Alternative I would disturb lower trophic-level organisms in three primary ways: (1) island construction would bury about 23 acres of typical benthic organisms; (2) pipeline trenching would disturb additional benthos, burying up to 14 acres with very low (1%) coverage of kelp, boulders, and suitable substrate; and (3) sediment plumes would reduce Boulder Patch kelp production by up to 6% during 1 year. The buried 14 acres would equal less than 0.1% of the Boulder Patch kelp habitat. The density of the kelp, boulders, and suitable substrate in the pipeline corridor is very low, averaging about 1% coverage, and the lost kelp biomass and production probably would be less than .01% of the Boulder Patch totals, but the effect (kelp substrate burial) would last forever.

Some of the suspended sediment from pipeline trenching and island construction would drift over other parts of the Boulder Patch, reducing light penetration and kelp production during 1 year. This reduction is estimated to be less than 6%, about one-third of which would be due to the proximity between the Boulder Patch to the Zone 1 disposal area for excess sediments. However, in relation to the large range of natural variability, all of these suspended sediment effects would be barely detectable.

From 6-feet deep to the seafloor, the island's concrete slope temporarily would benefit kelp and other organisms that need a hard substrate for settlement. This portion of the concrete slope would be a temporary home for colonies of species similar to those of the Boulder Patch area. Upon abandonment, the concrete mats probably would be removed or would become buried naturally, eliminating the additional kelp habitat.

Fishes : To our knowledge, the Kadleroshilik River does not support overwintering fish. However, if it did, the effects from mining at the Kadleroshilik mine site during the winter on most overwintering fish would be expected to be short term and sublethal, with no measurable effect on overwintering fish populations. After the mine site becomes accessible to fishes, it may benefit them by providing the first viable overwintering habitat in this region of the Kadleroshilik River. This assumes that the mine site depth is adequate (i.e., 20 feet or more), and that oxygen levels remain sufficient during winter to support the number of fishes under the ice. While the Kadleroshilik River mine site possibly could create overwintering habitat, the Duck Island mine site would eliminate any possibility of disturbing fish.

Essential Fish Habitat: The Kadleroshilik River mine site would create potential overwintering habitat on the Kadleroshilik River for fish that potentially would serve as prey for salmon.

Vegetation-Wetland Habitats: Gravel mining is likely to have a minimal effect on overall vegetation-wetland habitats in the project area. The development of this mine site would destroy about 24 acres of wetland habitat. The gravel mining operations on State land would be required to have Section 404/10 permit and approval by the Corps of Engineers, as stated in BPXA's Development Project Development and Production Plan (BPXA, 2000a). The permit and approval process is expected to minimize adverse effects on wetlands. We assume that all associated work would occur in winter, resulting in little or no dust on adjacent vegetation. Any moisture-regime changes as a result of snow drifting would be confined to fewer than 20 acres at the mine site. Conducting mining operations during winter would lessen impacts on vegetation and wetland habitats. Winter operations and the use of ice roads for transporting the gravel would avoid the need to build gravel roads that would increase effects on tundra vegetation along any onshore transportation routes. Rehabilitation of the mine site would include flooding of the mine pit by connecting it with a river channel. The pit also would be used as a source of water for the construction of ice roads during winter.

Economy: Alternative I would generate approximately $100 million in wages and 870 full-time equivalent construction jobs for 1 year in Alaska during 14-18 months of construction; 1,248 indirect full-time equivalent jobs during the 14-18 months of construction; and $480 million capital expenditure.

Water Quality: The general effects of disturbances are analyzed in Section III.C.3.l(2)(a) in the EIS. The greatest effect on water quality from gravel island and pipeline construction would be additional turbidity caused by increases in suspended particles in the water column. Increases in turbidity generally are expected to be considerably less than the 7,500 parts per million suspended solids used in the analysis as an acute (toxic) criterion for water quality (Sec. III.C.3.l (2) in this EIS); exceptions may occur within the immediate vicinity of the construction activity. Turbidity increases from construction activities generally are temporary and expected to occur during the winter and end within a few days after construction stops. Material excavated from the pipeline trench but not used for backfill most likely would be left in an area where active erosion of sediment particles could occur during breakup and open water. This material would be similar in composition to seafloor sediments in the trenching and disposal areas, and its contribution to the future turbidity from waves and currents is expected to be about the same as the sediments existing at the seafloor surface before pipeline construction. Construction activities are not expected to introduce or add any chemical pollutants.

Air Quality: The proposed Liberty Project would affect air quality in several ways, but the overall effects would be very low. The general effects of a large spill and the effects of oil-spill-cleanup activities are analyzed in Section III.C.2.m(2) of the EIS. An oil spill could cause an increase in hydrocarbon air pollutants, as discussed in Section III.C.2.m and summarized in Section III.A.1.a(13) of the EIS. The overall effects on air quality would be minimal.

The most noticeable effects on air quality are caused by emissions from equipment. This is discussed in detail in Section III.D.1.m of the EIS. That section concludes that the Liberty Proposal would cause a small, local increase in the concentrations of criteria pollutants. Concentrations would be within the Prevention of Significant Deterioration Class II limits and National Ambient Air Quality Standards. Therefore, the effects would be low.

(b) Alternative VI - Use the Duck Island Gravel Mine

This alternative was developed to provide less onshore noise disturbance and habitat alteration from gravel mining.

Under Alternative VI, the existing Duck Island gravel mine would be mined to provide gravel for the project. To get the required gravel for the project from the Duck Island mine site, BPXA would need to deepen a portion of the gravel pit by 20-40 feet (6-12 meters). This site does not require any overburden to be removed, and it would reduce the snow and ice removal cost by about half. Eventually, BPXA would need to rehabilitate the site, but the Liberty Project would share a portion of the total costs.

Under this alternative, BPXA also would need to remove water from the mine before extracting the gravel. At the current permitted rate, it would take more than 400 days to remove the estimated 600 million gallons of water from the mine site. This water could go to adjacent tundra or creeks under the current general National Pollutant Discharge Elimination System permit. However, BPXA's preferred construction method would be to obtain a modified permit to increase appreciably the discharge rate (5-6 million gallons per day) to avoid a delay in the construction schedule.

The Duck Island mine site is about 17.4 miles (28 kilometers, or about 2.7 times) farther from the Liberty Island construction sites than the proposed Kadleroshilik mine. For purposes of analysis, the EIS assumes the use of two different sizes of haul vehicles and the use of a temporary dumping site. The larger of the vehicles (B70's) would haul the gravel from the mine site to a temporary site near the base of the Endicott Causeway. The gravel would be reloaded at the temporary site into smaller trucks (Maxhauls), which would haul the gravel to the island location. This is similar to the process used in the construction the Northstar gravel island. An ice road 7.9-miles (12.7 kilometers) long from the base of Endicott to the gravel island would need to be constructed and maintained. From there, the distance to any of the three island locations (Liberty, Southern, and Tern) is approximately the same.

This alternative could delay the planned rehabilitation of the Duck Island mine site by a year or more.

The effects of disturbances from noise would decrease at a different mine site, and increase from different and longer haul routes. The effects of disturbances from habitat alternation would decrease at the mine site and increase along the haul route.

The specific components of the Alternative VI - Use Duck Island Mine Site as described above would change the impacts to the following resources in the ways described:

Spectacled Eiders: Obtaining gravel from the Duck Island gravel mine site on the Sagavanirktok River Delta instead of the proposed Kadleroshilik River quarry site would avoid disturbing any potential nesting habitat at the latter site; and, thus, any spectacled eiders that nest in that area would not be displaced from disturbed habitat the following summer. Because the potential for eider use of the Duck Island quarry site is likely much lower than the Kadleroshilik site, this may be viewed as a modest benefit. The nesting density and average density of eiders on tundra habitats in the general vicinity of the two sites were similar (0.3-0.5 nests/square kilometer and 0.4 birds/square kilometer) in 1994. The numbers of nesting eiders displaced from the Kadleroshilik area (Alternative I) is likely to be very low but greater than from the Duck Island site (Alternative VI) as a result of habitat disturbance. Significant adverse population effects are not expected to occur as a result of disturbance.

Seals and Polar Bears: Using the Duck Island Gravel Mine rather than the Kadleroshilik River mine site would avoid potential noise and disturbance of denning polar bears in the Kadleroshilik River area during winter. Using this gravel mine site probably would involve an increase in ice-road traffic to and from the Sagavanirktok River to Liberty Island, which could present a potential increase in disturbance of polar bears and seals in this area. The potential effect on polar bears from mining and other development activities could be reduced along the coast of the Kadleroshilik River.

Marine and Coastal Birds: Obtaining gravel from the Duck Island gravel mine site on the Sagavanirktok River Delta instead of the proposed Kadleroshilik River quarry site would avoid disturbing any potential nesting habitat at the latter site, and, thus, any of several species that may nest in that area would not be displaced from disturbed habitat the following summer. Because the potential for bird use of the Duck Island quarry site is likely much lower than the Kadleroshilik site, this may be viewed as a modest benefit. Total nest density and total average density of individuals for 14 bird species on tundra habitats in the general vicinity of the two sites were similar (43.3-46.3 nests/square kilometer and 111.2-136.2 birds/square kilometer) in 1994. The numbers of nesting birds displaced from the Kadleroshilik area (Alternative I) is likely to be low but considerably greater than from the Duck Island site as a result of habitat disturbance.

Terrestrial Mammals: Using the Duck Island Gravel Mine site rather than the Kadleroshilik River mine site would avoid potential noise and disturbance to muskoxen from ice-road traffic and mining activities in the Kadleroshilik River area during winter. Using the Duck Island gravel mine site would involve a general increase in ice-road traffic to and from this mine site to Liberty Island, which could disturb some overwintering caribou in the area.

Lower Trophic-Level Organisms: For this alternative, the effects of island construction and pipeline trenching would be the same as analyzed for Alternative I, except that gravel probably would be hauled over the Endicott access road and across an ice road to the Liberty island site. A direct ice road would pass over 5 miles of Boulder Patch kelp habitat and could reduce the light transmission and growth of kelp during the spring.

Fishes : While the Duck Island mine site would eliminate any possibility of disturbing fish, it also would eliminate the possibility of creating overwintering habitat on the Kadleroshilik River, as discussed for Alternative I.

Essential Fish Habitat: The potential net effect of this alternative on essential fish habitat is expected to be similar to Alternative I. However, using the Duck Island mine site as a source for gravel would eliminate any possibility of disturbance of fish or algae from increased turbidity and sedimentation downstream of the mine site. It also would eliminate the potential countervailing effect of creating overwintering habitat on the Kadleroshilik River for fish that potentially would serve as prey for salmon.

Vegetation-Wetland Habitats: Using Duck Island-Sagavanirktok River gravel mines rather than the Kadleroshilik River mine site would avoid disturbance of the sparsely vegetated gravel bar on the Kadleroshilik River. Consequently, the disturbance effect on vegetation and wetlands from mining activities would be avoided. Disturbance of vegetation and wetlands from the Liberty Project would still occur at the pipeline landfall site and along the onshore pipeline route. Effects would be local and have very little overall effect on the vegetation and wetlands habitats.

Economy: Alternative VI would generate more jobs, greater wages, and greater costs than Alternative I. This alternative would result in an increase of approximately $4.4 million in wages for 14 months, 20 direct jobs in Alaska for 14 months, 30 indirect jobs in Alaska for 14 months, approximately $15 million in costs for gravel island construction, and additional costs associated for gravel mining and hauling for pipeline construction. The increased costs are based on three factors: (1) dewatering the Duck Island site would cost about $2.4 million; (2) the distance from the Duck Island mine to the island is about 17.3 miles or about 2.7 times farther from the Kadleroshilik mine, causing increased costs of hauling; and (3) the Duck Island haul route would include preparation of a longer floating-ice segment than the route to the island in Alternative 1.

Water Quality: Increasing the mine dewatering rate from 1.5-5 million gallons per day most likely would have little if any measurable effect on the quality of the receiving waters.

Air Quality: The general effects from using this alternative gravel mine site on air quality are expected to be the same as those analyzed for Alternative I in Section IV.C.4.a(10) of the EIS.

If the Duck Island gravel mine is used as a source of gravel for Liberty Island, the gravel would need to be hauled about 17.4 miles (28 kilometers), or about 2.7 times farther to the Liberty Island construction site than from the proposed Kadleroshilik mine. The potential effects of increasing this gravel-hauling distance are analyzed in Section IV.C.4.(b)(10) of the EIS.

The effect on air quality at the Liberty Island site from using gravel from the Duck Island mine site should be the same as for Alternative I, using gravel from the Kadleroshilik River mine site.

The differences in air-quality effects from hauling the gravel from the Duck Island mine site (a greater distance than from BPXA’s proposed Kadleroshilik mine site) would be a slight increase in the fugitive dust from trucks traveling the greater distance and in the air emissions from truck engines operating for a longer period of time. These air emissions would remain at negligible levels and should have no substantial effect on regional air quality.

(5) Effects of Alternative Pipeline Burial Depths

For purposes of analysis for the EIS, burial depth is defined as the distance between the top of the installed pipeline and the original seafloor, and trench depth is defined as the depth of the trench in relation to the original seafloor. Burial depth always would be less than trench depth. In various locations in the EIS, and in some of the pipeline studies, the term “depth of cover” is used. This term has the same meaning as burial depth.

This set of component alternatives evaluates two different pipeline burial depths. Alternative I - Use a 7-Foot Burial Depth, evaluates excavating a trench with a trench depth of 8-12 feet (10.5 foot average trench depth) and burying the pipeline with a minimum burial depth of 7 feet. Alternative VII - Use a 15-Foot Pipeline Trench Depth, evaluates excavating a trench to a maximum 15-foot trench depth, which would result in a minimum 11-foot burial depth. Key components of these alternatives are summarized in Table II.A-1 of the EIS.

The following resources are not affected differently by the unique aspects of this alternative:

- Bowhead Whales
- Eiders
- Marine and Coastal Birds
- Terrestrial Mammals
- Vegetation-Wetlands Habitat
- Subsistence-Harvest Patterns
- Sociocultural Systems
- Archaeological Resources
- Air Quality

(a) Alternative I - Use a 7-Foot Burial Depth (Liberty Development and Production Plan)

For this alternative, the pipeline trench would be an average of 10.5 feet (3.2 meters) deep. The trench depth may vary between 8 and 12 feet (2.4 and 3.7 meters). The trench would be dug using conventional trenching equipment and constructed on the ice surface. The minimum burial depth, assuming a single-wall steel pipe, is 7 feet. The trench at

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the seafloor would be 61-132 feet wide (18.5-40 meters) for this alternative. This alternative would require excavating and backfilling approximately 724,000 cubic yards of soil (see Table II.A-2 of the EIS). Trenching is estimated to take about 58 days.

Alternative I would have effects to the following resources:

Seals and Polar Bears: Construction activity would displace some ringed seals within perhaps 1 kilometer of the production island and along the pipeline route in Foggy Island Bay. This disturbance of seals and polar bears would be local, within about 1 mile along the pipeline route, and would persist for one season.

Lower Trophic-Level Organisms: Alternative I would disturb lower trophic-level organisms in three primary ways: (1) island construction would bury about 23 acres of typical benthic organisms; (2) pipeline trenching would disturb additional benthos, burying up to 14 acres with very low (1%) coverage of kelp, boulders, and suitable substrate; and (3) sediment plumes would reduce Boulder Patch kelp production by up to 6% during 1 year. The buried 14 acres would equal less than 0.1% of the Boulder Patch kelp habitat. The density of the kelp, boulders, and suitable substrate in the pipeline corridor is very low, averaging about 1% coverage, and the lost kelp biomass and production probably would be less than .01% of the Boulder Patch totals, but the effect (kelp substrate burial) would last forever.

Some of the suspended sediment from pipeline trenching and island construction would drift over other parts of the Boulder Patch, reducing light penetration and kelp production during 1 year. This reduction is estimated to be less than 6%, about one-third of which would be due to the proximity between the Boulder Patch to the Zone 1 disposal area for excess sediments. However, in relation to the large range of natural variability, all of these suspended sediment effects would be barely detectable.

From 6-feet deep to the seafloor, the island's concrete slope temporarily would benefit kelp and other organisms that need a hard substrate for settlement. This portion of the concrete slope would be a temporary home for colonies of species similar to those of the Boulder Patch area. Upon abandonment, the concrete mats probably would be removed or would become buried naturally, eliminating the additional kelp habitat.

Fishes: Noise and discharges from dredging, gravel mining, island construction, island reshaping, and pipeline trenching associated with Liberty are expected to have no measurable effect on fish populations. While a few fish could be harmed or killed, most in the immediate area would avoid these activities and would be otherwise unaffected. Effects on most overwintering fish are expected to be short term and sublethal, with no measurable effect on overwintering fish populations. Placement of the concrete mat would create additional food resources for fishes and would have a beneficial effect on nearshore fish populations in the Beaufort Sea.

Essential Fish Habitat: As a result of disturbances caused by Liberty Island construction and operation, fish and zooplankton might experience short-term, localized but unmeasurable effects. This would include potential adverse effects from noise during construction and operations and from increased turbidity and sedimentation as a result of dredging, gravel mining, island construction, and pipeline trenching (see Secs. III.C.3.e and III.C.3.f of the EIS). Marine plants could be subjected to short-term, localized, negative effects due to mechanical removals of individuals and from sedimentation resulting from pipeline trenching and island construction. Pipeline construction is expected to bury up to 14 acres of kelp and solid substrate, and sediment plumes are expected to reduce kelp production by 6% during 1 year. The effect of disturbance on water quality is discussed in Section III.C.3.l in this EIS. Water quality primarily would be affected by increased turbidity that would result from gravel island and pipeline construction, Liberty Island abandonment, and gravel mine reclamation. Turbidity and salinity of seawater discharged from the Liberty Island production facility are expected to be slightly higher than water in surrounding Foggy Island Bay. All of these disturbances are expected to be fairly localized and short term.

Economy: Alternative I would generate approximately $100 million in wages and 870 full-time equivalent construction jobs for 1 year in Alaska during 14-18 months of construction; and 1,248 indirect full-time equivalent jobs during the 14-18 months of construction.

Water Quality: The greatest effect on water quality from gravel island and pipeline construction would be additional turbidity caused by increases in suspended particles in the water column. Increases in turbidity generally are expected to be considerably less than the 7,500 parts per million suspended solids used in the analysis as an acute (toxic) criterion for water quality; exceptions may occur within the immediate vicinity of the construction activity. Turbidity increases from construction activities generally are temporary and expected to occur during the winter and end within a few days after construction stops. Material excavated from the pipeline trench but not used for backfill most likely would be left in an area where active erosion of sediment particles could occur during breakup and open water. This material would be similar in composition to seafloor sediments in the trenching and disposal areas, and its contribution to the future turbidity from waves and currents is expected to be about the same as the sediments existing at the seafloor surface before pipeline construction. Construction activities are not expected to introduce or add any chemical pollutants.

(b) Alternative VII – Use a 15-Foot Pipeline Trench Depth

This alternative was developed to reduce potential ice scouring and ice gouging effects to the pipeline.

For this alternative, the pipeline trench depth would be 15-feet (4.6 meters) rather than the proposed 10.5 feet (3.2 meters). This alternative assumes the trench would be dug using the same equipment and constructed on the ice surface, the same as for the other alternatives. For purposes of analysis, we assume an 11-foot minimum burial depth, regardless of the pipeline route or pipeline design. The trench at the seafloor would be 120-200 feet (36.5-61 meters) wide. This greater width would be needed for the 6.1 miles (9.8 kilometers) of offshore pipeline. Table II.C-3 of the EIS provides information about the trench excavation and backfill quantities for this alternative in combination with the three pipeline routes evaluated in this EIS.

This alternative would require excavating approximately 1,438,560 cubic yards of soil, which almost doubles (98%) the amount of soil excavated under Alternative I. The total area disturbed is greater, about 81 acres, compared to 59 acres for Alternative I. The additional excavation work would add an additional 30 days of trenching time. Increasing the number of days needed for trenching also increases the number of days required for ice maintenance. This alternative would add to the likelihood of not completing the installation of the pipeline in a single winter construction season because of increased excavation and backfill handling.

The effects of disturbances from suspended sediments would increase because of the deeper pipeline excavation depth and increased trenching and backfilling times. Effects of disturbances from habitat alteration would increase because of the greater seafloor area disturbed and from noise increases associated with longer trenching and backfilling times.

The differences would change some of the impacts to the following resources in the ways described:

Seals and Polar Bears: Burying the offshore pipeline deeper would double the amount of benthic habitat altered by pipeline installation. This alternative would increase the amount of time that seals and polar bears would be exposed to noise and disturbance from pipeline dredging and burial activities in Foggy Island Bay. The disturbance of seals and polar bears would be local within about 1 mile along the pipeline route and would persist for one season.

Lower Trophic-Level Organisms: Deeper burial in the Alternative I pipeline route would permanently eliminate an additional 3 acres of very diffuse kelp, boulder, and suitable substrate. The amount of turbidity generated by deeper burial would be about two times greater than Alternative I, possibly causing additional reduction in annual kelp production during the construction phase.

Fishes : Alternative VII would be expected to have a slightly greater effect on fishes from temporary displacement than Alternative I, due to more trenching and disturbance.

Essential Fish Habitat: The potential adverse effects of this alternative on essential fish habitat could be slightly increased compared to Alternative I. The risk of oil spills to essential fish habitat would be unchanged. However, deeper burial in the proposed pipeline route would permanently eliminate an additional 3 acres of diffuse kelp and solid substrate. Moreover, the amount of suspended sediments from deeper burial would be about two times greater than Alternative I, possibly causing additional reduction in annual kelp production during the construction phase.

Economy: Alternative VII would generate more jobs and greater wages than Alternative I. Assuming labor costs for construction of the deeper pipeline would increase by as much as two times over those of Alternative I, this alternative would result in increases of $10.8 million in wages, 100 direct jobs in pipeline construction for 7 months in Alaska, and 150 indirect jobs in Alaska. This twofold factor is about in proportion to the volume of additional material to be handled in this alternative as compared to Alternative I. Higher pipeline construction costs result in higher pipeline tariffs. Higher pipeline tariffs reduce royalty revenue to the Federal Government from the project and likewise reduce Section 8(g) payments to the State.

Water Quality: The duration of turbidity from pipeline construction and trenching to a depth of 15 feet is expected to be longer than for the Liberty pipeline trenched to an average depth of 10.5 feet. The overall effects of turbidity are expected to be about 98% greater for the 15-foot trench compared to the 10-foot trench.

b. Comparison of Effects Among Combination Alternatives

As indicated in Section E.3 of the Executive Summary, the Liberty Interagency Team developed three combination alternatives to compare to the BPXA Proposal. A discussion of their relative features and merits follows. Table I-1 shows the relationship between the component alternatives and combination alternatives. Table IV.D-2 compares selected features between the combination alternatives.

Combination Alternative A and the BPXA Proposal (Liberty Island Location - 22-foot water depth) are located at the optimal location for the producing the Liberty Prospect. Combination Alternative B (Southern Island Location - 18 foot water depth) and Combination Alternative C (Tern Island Location - 23-foot water depth) are both 1.5 miles away from the optimal location. Combination Alternatives B and C would require more directional drilling, which increases costs, the time required to develop the field, and the amount of muds and cuttings.

Combination Alternative A (Liberty Island Location with Steel Sheetpile) requires the most gravel; about 20% more gravel than Combination Alternative B (Southern Island Location with Gravel Bags); 7% more gravel than the BPXA Proposal (Liberty Island with Gravel Bags); and, 26% more gravel than Combination Alternative C. Although Combination Alternative C has the largest footprint on the seafloor (26.8 acres), it incorporates existing gravel from the Tern Exploration Island. Combination Alternative B has the smallest footprint (21.9 acres). The BPXA Proposal and Combination Alternative A have footprints of 22.4 and 25.8 acres, respectively. Combination Alternative B and C use the least amount of gravel. The reduction in gravel is not likely to result in a lower level of effects to most resources.

Combination Alternative A and the BPXA Proposal (Liberty Island Location) are closest to the Boulder Patch area, about 1 mile away. Combination Alternative C (Tern Island) is about 1.5 miles away, and Combination Alternative B is the farthest at 2.5 miles away. Combination Alternative B reduces the impacts of construction (sediment effects) to water quality and the kelp biological community in the Boulder Patch.

Combination Alternative A and the BPXA Proposal use the Liberty Pipeline Route that is 6.1 miles long. It is longer than the routes for Combination Alternative B (Eastern Pipeline Route) and Combination Alternative C (Tern Pipeline Route), which are 4.2 and 5.5 miles long, respectively. However, the length of a pipeline in 8 feet or more of water is about the same for Combination Alternatives A and B and for the BPXA Proposal. Combination Alternative C (Tern Pipeline Route) has the greatest length in water depths over 8 feet. Combination Alternative A and the BPXA Proposal have the same 7-foot burial depth. One can argue that a longer offshore pipeline is less safe and would increase the potential for an oil spill, but MMS has found that the oil-spill rate per mile is very small and, for offshore pipelines between 6.1 and 4.2 miles in length, the calculated oil-spill rate essentially is the same. Furthermore, if ice gouging and length of pipe in water depths more than 8 feet beyond the bottomfast-ice zone are the concern, then Combination Alternative C (Tern Pipeline Route) has the greatest length of pipeline in 8 feet or more of water.

The longer offshore pipeline length for the Liberty Pipeline Route and the 7-foot burial depth would require 724,000 cubic yards of material to be excavated and backfilled. Combination Alternative B has a shorter offshore length and a shallower burial depth (6-foot), with a smaller volume of 466,190 cubic yards of material to be excavated and backfilled. Combination Alternative C requires the largest volume of material (1,298,100 cubic yards), which is related to the 15-foot burial depth. There would be some effects to the kelp community and water column during pipeline construction. The pipeline route (Liberty Pipeline Route) in Combination Alternative A and the BPXA Proposal goes through areas with less than 10% boulders and sediment. Effects to water quality would be less than those in Combination Alternative C, which has a deeper pipeline burial depth. Combination Alternative B has the least effects on water quality. The sediment effects to water quality are short term and local for all alternatives.

Combination Alternatives A, B, and C all offer potential secondary oil containment and have lower risks of containment failure than the single wall pipeline contained in the BPXA proposal. The Fleet (2000) report estimates the probability of a containment failure that releases 1,000 barrels or more of oil to the environment for Combination Alternatives A and C (Pipe-in-Pipe) at 0.00234 (0.234%) (Fleet, 2000). The BPXA Proposal and Combination B probability is estimated at 0.0138 (1.38%) (Fleet, 2000). The Combination Alternatives A, B, and C are more likely to suffer a functional failure than the single-wall pipeline design in the BPXA Proposal. The secondary containment afforded by the pipeline designs in Combination Alternatives A, B, and C could provide some flexibility in scheduling a pipeline repair to minimize the impacts on the species that inhabit the area.

The Pipe-in-HDPE Pipeline design in Combination Alternative B eliminates the problems of corrosion to the outer pipe. However, the HDPE pipeline is not capable of handling the operating pressure in the carrier pipeline; therefore, it is important to monitor the annular space and shut down the pipeline if a leak occurs.

Combination Alternative A and the BPXA Proposal use the Liberty Pipeline Route with an onshore pipeline length of 1.5 miles. Combination Alternatives B and C use the same pipeline route onshore (Eastern Pipeline Route), which is 3.1 miles long.

Combination Alternative C (Pipe-in-Pipe and 15-Foot Burial Depth) would be the most expensive pipeline to install. Combination Alternative A (Pipe-in-Pipe and 7-Foot Burial Depth) is next, followed by Combination Alternative B (Pipe-in-HPDE). The BPXA Proposal (Single-Wall Steel Pipe and 7-Foot Burial Depth) is the least expensive. Increased pipeline costs translate to increased pipeline tariffs, which decreases Federal and State revenue from the project.

In Appendix D-1 of the EIS, MMS estimates the cost of the BPXA Proposal at $384 million and a Net Present Value of $58 million. Combination Alternative A would increase costs by $51.5 million, an increase of 13%. Combination Alternative B would increase costs by $24.5 million, an increase of 6%. Combination Alternative C would increase costs by $59 million, an increase of 16%. In this last case, expected costs would exceed expected revenue. Higher pipeline construction costs would also result in higher pipeline tariffs. Higher pipeline tariffs reduce royalty revenue to the Federal Government from the project and likewise reduce Section 8(g) payments to the State.

Combination Alternative A and the BPXA Proposal (Liberty Island Location) would be farther offshore than any of the other island locations and closer to the bowhead whale migration route. It is more likely that noise from drilling and production operations from this island location would affect bowhead whales and the subsistence hunting of bowhead whales. However, our analysis indicates that all of the island locations, including Liberty Island, are located more than 9 kilometers from the bowhead migration route, farther than noise is likely to travel. Bowhead whales and subsistence whale hunting should not be adversely affected by noise from any of the island locations.

Combination Alternatives A and C use steel sheetpile for the upper slope-protection system, which eliminates the potential for gravel bags to enter the marine environment. Gravel bags that are part of Combination Alternative B and the BPXA Proposal would be placed as a berm beginning 7 feet above sea level at the inner edge of a horizontal 40-foot concrete-block buffer zone. Because gravel bags are not used at or below the water line, it is unlikely that gravel bag material would enter the marine environment. These gravel bags would not float in the water. The placement of the steel sheetpile would increase the amount of noise during the construction period. However, construction of the steel sheetpile should be completed prior to the fall bowhead whale migration.

Combination Alternative B and the BPXA Proposal would use the Kadleroshilik River Mine Site. The Kadleroshilik River mine site would destroy about 24 acres of wetland habitat, but there also would be the potential for a new fish-overwintering site in the Kadleroshilik River. The haul distance of the gravel from the mine site to the gravel island would be about 6 miles. Combination Alternatives A and C would use the Duck Island Mine Site. It eliminates all potential effects at the Kadleroshilik River mine site, both beneficial and adverse. There would be no surface disturbance at the Kadleroshilik River mine site, and the potential for a new fish-overwintering site in the Kadleroshilik River would be lost. The mine site would need to be dewatered. The haul distance of the gravel would be increased from 6 miles to about 20 miles. The amount of equipment needed to transport the gravel would be increased, which translates to increased costs.

4. Mitigation

a. BPXA's Mitigating Actions

In planning for construction and design, BPXA has attempted to minimize impacts and to incorporate mitigating measures into the Liberty Project design. They are listed in Table I-3 of the EIS.

b. Mitigation Required by the MMS

The project also includes stipulations that are part of the lease OCS-Y-01650. This mitigation reflects the efforts of the people of the North Slope and their tribal and local governments working with MMS and other Federal and State agencies. The full text for these stipulations is found in Appendix B, Part B of the EIS. BPXA is required to comply with these stipulations.

Stipulation No. 1, Protection of Biological Resources. The Liberty Prospect is located near the Stefansson Sound Boulder Patch, a special biological resource. The drilling and production island locations and pipeline routes have been selected to avoid impacts to the Boulder Patch.

Stipulation No. 2, Orientation Program. Site personnel would receive training on at least an annual basis, and full training records would be maintained for at least 5 years.

Stipulation No. 3, Transportation of Hydrocarbons. Pipelines are the preferred mode of transportation hydrocarbons.

Stipulation No. 4, Industry Site-Specific Bowhead Whale Monitoring Program. Not applicable, because this stipulation applies to exploratory operations.

Stipulation No. 5, Subsistence Whaling and Other Subsistence Activities. BPXA proposes measures that include ongoing community liaison, development of a Cooperation and Avoidance Agreement with the Alaska Eskimo Whaling Commission, planning major construction activities for the winter season, and limiting vessel transit to the island to routes inside the barrier islands. An ongoing consultation process would be used to identify any concerns not addressed by BPXA's proposed mitigation and potential measures to be considered.

c. Mitigation and Traditional Knowledge

The above mitigating measures incorporate traditional knowledge and the cooperative efforts between the MMS, the State, and the people of the North Slope and their tribal and local governments to develop effective mitigating measures for our leasing program. The concerns of North Slope residents to protect their subsistence and cultural heritage are incorporated in the Orientation Program and the Subsistence Whaling and other Subsistence Activities stipulations. The Transportation of Hydrocarbons stipulation reflects the concerns of the North Slope residents to require that the transportation of oil and gas be done in a safe manner. The subsistence and sociocultural sections of this EIS highlight and note the information, concerns, and traditional knowledge that North Slope residents have provided.

d. Potential Mitigation

Mitigation was developed through public planning and scoping. This mitigation reflects the efforts of people of the North Slope and their tribal and local governments working with MMS and other Federal and State agencies. Other mitigating measures may be identified during the public hearing process, and they will be considered in the final EIS. The MMS expects to develop other mitigation in response to issues and comments received from the draft EIS.

Seasonal Drilling Restriction: The purpose of this mitigation is to provide protection to resources by eliminating the potential for a blowout during periods of broken ice during the development phase of the project. This mitigating measure is similar to the measure required by the State of Alaska for the Northstar Project. BPXA is prohibited from drilling the first development well into targeted hydrocarbon formations during the defined broken ice periods for the site location; drilling subsequent development wells into previously untested hydrocarbon formations during defined broken ice periods; and subject to the imposition of additional restrictions on a case-by-case basis.

This mitigating measure would reduce the risk of a large blowout type oil spill during the development of the Liberty Prospect and reduce the already low risk of a large oil spill even further. It could increase the length of time (a few weeks) needed to develop the field.

Recovery and Reuse of Gravel: The purpose of this mitigation is to offset the reduction in wetlands that would result from onshore mining activities and gravel pad construction (e.g., shore crossing pad and pipeline tie-in pad). This mitigation would recover gravel from abandoned gravel facilities and rehabilitate those sites to useable wetland habitats in an amount equal to or greater than the area lost from gravel mining and pad construction. The permittee would be required to recover and reuse available gravel from abandoned pads, roads, and airstrips within the immediate project area and/or within the Prudhoe Bay oil field complex and to rehabilitate the site.

This mitigation would require the permittee to assess abandoned onshore gravel sites near the Liberty Prospect and/or within the Prudhoe Bay oil field and develop gravel recovery and rehabilitation plans for abandoned site(s). These plans would need to include: the location, amount, and type of gravel; the aerial extent of the gravel site (size); the current owner and any ownership issues; any potential gravel contamination concerns and a proposal to deal with those concerns; the proposed timing for obtaining applicable local, state, and federal permits; and a rehabilitation plan, including timetable. If potential gravel contamination or travel costs prohibit the use of the recovered gravel for this offshore project, the gravel could be stockpiled in non-wetland or currently filled areas and used in other ongoing or future projects by the permittee.

This mitigation is based on recently permitted on- and offshore oil and gas developments (e.g., Northwest Eileen and Northstar). The effectiveness of this mitigation is evaluated in Section III.D.2.n of the EIS.

F. CUMULATIVE ANALYSIS

For the cumulative analysis, MMS found that all of the alternatives were very similar to those of BPXA’s Proposal. That is, the differences in alternatives would result in very small differences in cumulative effects. These small differences are greatly overshadowed by the inherent uncertainty in making estimates of past, present, and reasonably foreseeable cumulative effects. Therefore, we present just one analysis for all the Alternatives.

1. Scope of Analysis

In light of our past experience, we base our cumulative-effects analysis for this EIS on a five-step process:

Step 1: We identify the potential effects of the Liberty Development and Production Plan that may occur on the natural resources and human environment

- in the Beaufort Sea,
- on the North Slope, and
- along the oil transportation route.

Step 2: We analyze other past, present, and reasonably foreseeable future oil-development activity on the North Slope/Beaufort Sea for effects on the natural resources and human environment that we found were potentially affected by the Liberty Development and Production Plan.

Step 3: We consider effects from other actions (sport harvest, commercial fishing, subsistence hunting, and loss of overwintering range, etc.) on these same natural resources and human environments.

Step 4: We attempt to quantify effects by estimating the extent of the effects (number of animals and habitat affected) and how long the effects would last (population-recovery time).

Step 5: To keep the cumulative-effects analysis useful, manageable, and concentrated on the effects that are meaningful, we weigh more heavily other activities that are more certain and geographically close to Liberty, and we analyze more intensively effects that are of greatest concern. We also focus our effort by using guiding principles from existing standards (see the following), criteria, and policies that control management of the natural resources of concern. Where existing standards, criteria, and policies are not available, our experts use their best judgment on where and how to focus the analysis.

Oil and gas activities occur on the Outer Continental Shelf in Alaska, the Gulf of Mexico, and California and are cited in the most recent 5-year Oil and Gas Program EIS (USDOI, MMS, Herndon, 1996a). To be consistent with the 5-Year Program EIS, the Liberty cumulative analysis also evaluates the effects for transporting oil through the Trans-Alaska Pipeline System and tankering from Valdez to ports on the U.S. west coast. Activities other than those associated with oil and gas also are considered. We also include by reference certain cumulative effects that are more national in scope, for example, global warming and alternative energy development.

Oil and gas activities considered in the analysis include past development and production, present development, reasonably foreseeable future development, and speculative development. Some activities beyond the 20-year life of the Liberty Project are considered too speculative to include at this time, while other such activities are included in this analysis. Furthermore, we exclude future actions from the cumulative effects analysis if those actions are outside the geographic boundaries or timeframes established for the cumulative-effects analysis. We address uncertainty through monitoring, and note that monitoring is the last step in determining the cumulative effects that may ultimately result from an action.

For this analysis, we used the Endangered Species Act of 1973 and the Liberty scoping process as appropriate vehicles to identify species that are potentially at risk from incremental cumulative effects from the Liberty Project. Effects on listed species identified for the Liberty Project by the National Marine Fisheries Service and the Fish and Wildlife Service under Section 7 of the Endangered Species Act are covered in this cumulative-effects analysis. The management of seals by the National Marine Fisheries Service and polar bears by the Fish and Wildlife Service under the Marine Mammal Protection Act of 1972 provides for monitoring these species' populations and managing/mitigating potential effects of development on these species. The State of Alaska, Department of Fish and Game monitors caribou, including the Central Arctic Herd. Water quality on the North Slope is regulated and/or monitored through various permitting and regulatory programs administered by the Environmental Protection Agency; the Alaska Departments of Natural Resources, Environmental Conservation, and Fish and Game; and the North Slope Borough. These programs have been established to protect against the significant degradation of water quality associated with specific human/development activities. In evaluating the cumulative effects to water quality, we consider the collective impacts associated with permitted/regulated activities as well as other nonregulated activities and/or naturally occurring events.

Air quality is regulated under the Clean Air Act. The major stationary sources of air pollutants are regulated under the Prevention of Significant Deterioration permitting process. For sources located on the outer continental shelf (such as the proposed Liberty Project), the Prevention of Significant Deterioration program is administered by the Environmental Protection Agency. For sources located in State waters and onshore, the Prevention of Significant Deterioration program is administered by the Alaska Department of Environmental Conservation. Minor sources of air pollutants are not subject to Prevention of Significant Deterioration permitting requirements. The analysis of cumulative effects to air quality in this EIS is based on five monitoring sites, three of which were deemed subject to maximum air-pollutant concentrations and two of which were deemed more representative of the air quality of the general Prudhoe Bay area.

Impacts to wetlands are regulated under Section 404 of the Clean Water Act and administered by the U.S. Army Corps of Engineers. In addition, the Administration has a No-Net-Loss goal for wetland functions and values. Under the Memorandum of Agreement between the Corps of Engineers and the Environmental Protection Agency, it is recognized that in areas such as the North Slope of Alaska (where there is a high proportion of wetlands), minimizing wetland losses would be the primary method of mitigation. However, compensatory mitigation could be required for unavoidable losses to high-use wetlands.

For the human environment (subsistence activities, sociocultural systems, and the economy), we focus our evaluation of cumulative effects associated with oil-development activities on the North Slope local environment, because this is where the most significant cumulative effects are expected to be concentrated. We have met with local tribal governments to discuss subsistence issues relating to the Liberty Project and have established a dialogue on environmental justice with these communities. Mitigation in place for the Liberty Project (measures developed for MMS's Beaufort Sea Lease Sale 144) evolved through negotiations with local, borough, and agency representatives, and Inupiat traditional knowledge had a large part in developing mitigation and the timing of project activities. Local Inupiat government representatives have been members of our Outer Continental Shelf Advisory Committee that have met to discuss and resolve issues that arise from the 5-Year Plan and recent lease sales. Conflict avoidance agreements between the oil industry and Inupiat whalers are an important mechanism for overcoming conflicts.

The cumulative effects on archaeological resources can be minimized through required surveys, consultations with the State Historical Preservation Officer to identify potential archaeological sites, and requirements to plan and schedule activities to avoid these locations. We analyze the potential for disturbance to archaeological resources on the North

Slope and in the Beaufort Sea as well as the potential effects from the cleanup of oil spills along the transportation route.

2. Cumulative Effects

a. Significant Effects Conclusion

The MMS does not expect any significant cumulative impacts to result from any of the planned activities associated with the Proposal (Alternative I, Liberty Development and Production Plan) or any of the alternatives. In the unlikely event of a large offshore oil spill, some significant cumulative impacts could occur, such as adverse effects to spectacled eiders, long-tailed ducks, common eiders, subsistence resources, and local water quality. However, the probability of such an event combined with the seasonal nature of the resources inhabiting the area make it highly unlikely that an oil spill would occur and contact these resources. Spectacled eiders, long-tailed ducks, and common eiders are only present on the North Slope for 3-5 months out of the year. A resource may be present in the area but may not necessarily be contacted by the oil. An oil spill could affect the availability of bowhead whales, or the resource might be considered tainted and unusable as a food source. The potential for adverse effects to some key resources (bowhead whales, subsistence, the Boulder Patch, polar bears, and caribou) are of primary concern and warrant continued close attention. Effective mitigation practices (winter construction, an advanced leak-detection system, thick-walled pipeline designs, etc) also should be considered in future projects.

b. General Conclusions

The MMS found the following general conclusions were applicable and informative:

- The incremental contribution of the Liberty Project to cumulative effects is likely to be quite small. Construction and operations related to the Liberty Project would be confined to a relatively small geographic area, and oil output would be a small percentage (approximately 1%) of the total estimated North Slope/Beaufort Sea production.
- The Liberty Project would contribute a small percentage of risk (about 6%) to resources in State and Federal waters in the Beaufort Sea from potential offshore oil spills. Any subsequent spills are not expected to contact the same resources or to occur before those resources recover from the first spill. We recognize the importance of readily available abiotic standards to determine environmental quality. Abiotic measurements for air and water quality, for example, often provide a good indication of the quality of biological and cultural resources. We also recognize that as we move from the abiotic and the biotic to the human environment, the variables increase, making it more difficult to determine cumulative effects on the quality of life. Similarly, as we move from the terrestrial environment to the offshore environment, the variables of environmental quality increase. Migratory species present additional variables that reflect habitat and species condition outside the primary study areas. Humans introduce even more variables with their mobility and behavioral diversity. Hence, as we progress from abiotic to biotic, or from freshwater to marine, or from terrestrial and marine to sociocultural effects, our analysis, by necessity, becomes more difficult and less conclusive.

c. Keeping Cumulative Effects in Perspective

Concern about the potential for cumulative effects should be weighed with the following information:

- Expected oil and gas activities are likely to have fewer impacts on the environment than those activities conducted in the early years of the region's development.
- Current industry practices and the environmental state of the North Slope/Beaufort Sea region frequently are observed and assessed, and much of this information is available to the public.
- A key element of the transportation system for development of North Slope/Beaufort Sea oil is the Trans-Alaska Pipeline System pipeline. The pipeline is 800 miles long, stretching from Pump Station 1 at Prudhoe Bay to the Valdez Marine Terminal with a corridor width of about 100 feet, it represents an area of about 16 square miles.
- Following the *Exxon Valdez* oil spill, substantive improvements have been made in tanker safety to reduce the potential for oil spills from tanker accidents.
- If a major oil spill occurred, there likely would be a great slowdown in new development during which additional safeguards certainly would be put in place and new concepts for pipeline placement and design would be researched.
- The actual sizes and locations of future oil and gas developments on the North Slope and in the Beaufort Sea are uncertain.

d. Cumulative Effects by Resource

Endangered Species (Bowhead Whales, Eiders, Other Species): Some bowhead whales temporarily may avoid noise-producing activities, and contact with spilled oil could cause temporary, nonlethal effects, and a few could die from prolonged exposure to freshly spilled oil. The Liberty Project's contribution to cumulative effects is expected to be limited to temporary avoidance behavior by a few bowhead whales in response to vessel traffic. Significant effects to spectacled eiders would occur if they are contacted by an oil spill. Disturbance may cause short-term energy loss if spectacled eiders are displaced from preferred habitat, and a large oil spill could result in significant losses in offshore and nearshore areas. Liberty would be additive to effects from all projects in this cumulative analysis, but only in the case of a large offshore oil spill would Liberty be expected to increase adverse cumulative effects to potentially significant population levels. Oil transportation from Liberty to ports along the U.S. west coast likely would contribute little to cumulative effects on species occurring along transportation routes.

Seals and Polar Bears: Ongoing activities that may affect polar bears and seals include disturbance, habitat alteration, and spilled oil. Overall effects (mainly from oil) should last no more than one generation (about 5-6 years) for ringed and bearded seals and about 7-10 years for polar bears. Liberty should only briefly and locally disturb or displace a few seals and polar bears. A few polar bears could be temporarily attracted to the production island with no substantial effects on the population's distribution and abundance.

Marine and Coastal Birds: Substantial numbers of birds potentially could be exposed to a large oil spill during migration periods as they pass through offshore staging areas, lagoons, or beaches in the petroleum development area. It is unknown what percentage actually use it as a stopover or staging area. Also, migrating birds may collide with production islands or structures under poor visibility conditions. Collision losses are expected to be relatively low, unless greater numbers of offshore production structures are constructed in the foreseeable future. Disturbance from support activities could cause displacement to less favorable foraging areas. Effects of Liberty would be additive to effects observed or anticipated for cumulative projects and, in the case of a large oil spill, could substantially increase adverse effects at the population level in several loon, waterfowl, shorebird, and seabird species. Mortality resulting from an oil spill would cause significant effects in long-tailed duck and common eider populations.

Terrestrial Mammals: About half the Central Arctic Caribou Herd uses coastal habitat adjacent to the Liberty area during summer. Oil development in the Prudhoe Bay area is likely to continue to displace some caribou during the calving season within about 4 kilometers of roads with vehicle traffic. Liberty is expected to contribute less than 1% of the local short-term disturbance of caribou. Liberty should only briefly and locally disturb or displace a few muskoxen and grizzly bears.

Lower Trophic-Level Organisms: Effects of additional drilling discharges, construction-related activities and oil spills are not expected to substantially affect organisms near Liberty island or elsewhere. Liberty is not expected to make a measurable contribution to the cumulative effects on these organisms.

Fishes and Essential Fish Habitat: Small numbers of fish in the immediate area of an offshore or onshore oil spill may be killed or harmed, but this would not have a measurable effect on fish populations. Marine and migratory fishes are widely distributed in the Beaufort Sea and are not likely to be affected by the Liberty Project. Oil is not expected to contact overwintering areas during winter. Hence, the Liberty Project is not expected to contribute measurably to the overall cumulative effect on fishes.

Vegetation-Wetland Habitats: Construction causes more than 99% of the effects, with spills having a very minor role. Rehabilitation of gravel pads can result in the growth of grasses-sedges within 2 years after abandonment of the pads. Natural growth of plant cover would be very slow. Liberty would contribute less than 1% of the cumulative disturbance effects on 9,000 acres now affected by oil development.

Subsistence-Harvest Patterns: Subsistence harvests in Nuiqsut and Kaktovik could be affected by Liberty development and other past, present, and future projects with one or more important subsistence resources becoming unavailable or undesirable for use for 1-2 years, a significant effect. Liberty is expected to have periodic effects on subsistence resources, with no harvest areas becoming unavailable for use and no resource population experiencing an overall decrease.

Sociocultural Systems: Liberty development and other past, present and future projects could disturb sociocultural systems for an entire season (1 year) but would not displace traditional practices for harvesting, sharing and processing resources. Liberty would contribute periodic disturbance effects on communities near the Liberty Project but would not displace any social systems, community activities or traditional practices.

Alaska Inupiat Natives, a recognized minority population, are the predominant residents of the North Slope Borough, the area potentially most affected by Liberty development. Inupiat Natives may be disproportionately affected because of their reliance on subsistence foods, and Liberty development may affect subsistence resources and harvest practices. Disproportionately adverse effects on Alaskan Natives could result from Liberty development under the Proposal. Effects would focus on the Inupiat community of Nuiqsut, and possibly of Kaktovik, within the North Slope Borough. Effects to subsistence resources and subsistence harvests are expected to be mitigated substantially though not eliminated.

Archaeological Resources: Existing laws and regulation protect archaeology resources and known sites are avoided when possible. Liberty's contribution to cumulative effects and the cumulative effects overall are expected to be minimal for archaeological resources because any surface-disturbing activities that could damage archaeological sites would be mitigated by current State and Federal procedures.

Economy: This cumulative analysis projects employment increases as follows: 2,400 direct oil industry jobs at peak, declining to 1,300; about 3,400 indirect jobs at peak, declining to 2,000; about 150 jobs for North Slope Borough residents at peak, declining to 50; about 5-125 jobs for 6 months for cleanup of an oil spill in the Beaufort Sea; and about 10,000 jobs and 25% price inflation for 6 months for cleanup of a tanker oil spill in the Gulf of Alaska. This cumulative analysis projects annual revenues as follows: $125 million Federal, $77 million State, and $28 million for the State and North Slope Borough. Liberty's contribution to the cumulative effects ranges from 1% to at peak level 36%.

Water Quality: Oil spills would degrade the marine environment and result in a greater than 1.5 parts per million acute criterion for about 3 or more days in an area of 15-20 square kilometers. A large crude or refined oil spill (greater than or equal to 500 barrels) would have a significant effect on water quality by increasing the concentration of hydrocarbons in the water column to levels that greatly exceed background concentrations; however, the chance of a large spill occurring is low. Also, regional (more than 1,000 square kilometers [386 square miles]), long-term (more than 1 year) degradation of water quality to levels above State and Federal criteria because of hydrocarbon contamination is very unlikely.

Resuspended sediments from construction activities are not expected to exceed acute water-quality criteria, and permitted discharges would be designed to ensure rapid mixing and dilution of the discharge. The effects from the Liberty Project from construction activities are expected to be short term, lasting as long as the individual activity, and have the greatest impact in the immediate vicinity of the activity.

Air Quality: Projects in the past and present have caused essentially no deterioration in air quality or contribute measurably to global climate change. Air emissions from the Liberty Project essentially would have no effects on air quality.

TABLES

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Table I-1 The Relationship between the Component Alternatives and Combination Alternatives

Component Alternative	Combination Alternative A	Combination Alternative B	Combination Alternative C	Liberty DPP
Alternative Drilling Island Location and Pipeline Route				
Alt. I – Use Liberty Island Location and Pipeline Route (Liberty DPP)	✔	–	–	✔
Alt. III.A – Use Southern Island Location and Eastern Pipeline Route	–	✔	–	–
Alt. III.B – Use Tern Island Location and Pipeline Route	–	–	✔	–
Alternative Pipeline Design				
Alt. I – Use Single Wall Steel Pipe System (Liberty DPP)	–	–	–	✔
Alt. IV.A – Use Pipe-in-Pipe System	✔	–	✔	–
Alt. IV.B – Use Pipe-in-HDPE System	–	✔	–	–
Alt. IV.C – Use Flexible Pipe System	–	–	–	–
Alternative Upper Island Slope Protection System				
Alt. I – Use Gravel Bags (Liberty DPP)	–	✔	–	✔
Alt. V – Use Steel Sheetpile	✔	–	✔	–
Alternative Gravel Mine Sites				
Alt. I – Use Kadleroshilik River Mine Site (Liberty DPP)	–	✔	–	✔
Alt. VI – Use Duck Island Gravel Mine Site	✔	–	–	–
Alternative Pipeline Burial Depths				
Alt. I – Use a 7-Foot Burial Depth (Liberty DPP)	✔	*	–	✔
Alt. VII – Use a 15-Foot Pipeline Trench Depth	–	*	✔	–

* The burial depth for the HDPE System is a 6-foot minimal depth as designed by INTEC (2000).

Note: Each of the above component and combination alternatives is a complete project. That is, each has all of the project elements needed to develop the liberty prospect and therefore can be compared to each other on an equal footing.

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Table I-3 Measures BPXA Incorporated into their Liberty Development and Production Plan (Alternative I–BPXA's Proposal) to Avoid or Minimize Potential Impacts to the Biological, Physical, and Sociocultural Resources Within the Study Area

Action	Benefit
Mitigation by Design	
Smaller facility size; reduced wellhead spacing to 9 feet, directional drilling.	Minimize impacts associated with size of the offshore island.
Designed facility for zero discharge of drilling wastes; no reserve pits.	Reduce island size and impacts to benthos; eliminate potential for contaminant release from reserve pits; avoid water quality impacts; avoid impacts to fish and essential fish habitat.
Locate island as close to shore as possible.	Reduce length of pipeline necessary to reach shore, thereby minimizing disturbance to the marine environment and essential fish habitat.
Use filter fabric to reduce leaching of fine particulates downstream onto sensitive marine habitat.	Minimize redistribution of fine sediments from the gravel island following construction.
Process design incorporated measures to minimize CO_2 emissions by using natural gas and electrical power for drilling (long term) .	Reduce emissions of "greenhouse" gases.
Mine gravel and construct island and pipeline during winter from ice roads.	Eliminate impacts to wildlife; reduce sediment input effects, eliminate dust effects, eliminate impacts to tundra wetlands from a permanent access road; minimize impacts to essential fish habitat subsistence; and facilitate abandonment and reclamation of mine site.
Dispose of solid wastes onshore.	Minimize waste storage on the island. Reduce fox and polar bear encounters.
Impose restrictions to spring helicopter overflights of Howe Island.	Avoid disturbance to breeding and nesting snow geese and brant.
Route helicopter traffic to minimize effects to wildlife. Route vessel traffic inside the barrier islands.	Minimize disturbance to seals, bowhead whales, polar bear dens, and subsistence whaling activities.
Consult with Alaska Eskimo Whaling Commission if bowhead whales are observed inside the Midway Islands barrier island group.	Minimize disturbance to migrating bowhead whales or subsistence whaling activities.
Prohibit hunting by project personnel, and restrict public access.	Protect wildlife and cultural resources.
Train personnel in interactions with wildlife. Establish an environmental awareness program.	Reduce potential for disturbance to wildlife and essential fish habitat Increase awareness of risks and means to reduce impacts on wildlife.
Train personnel to recognize and avoid cultural resources.	Ensure that cultural resources are preserved.
Develop Conflict and Avoidance Agreement with local subsistence users.	Avoid unreasonable conflicts to subsistence activities.
Use ice roads to access Liberty Project and resources.	Minimize impacts to the tundra.
Use sea ice to support island construction and pipeline placement. Install pipeline during winter, when water currents are low.	Avoid barge traffic in summer for gravel transport, reducing air emissions. Reduce sedimentation of disturbed materials from the pipeline trench on adjacent benthic environments and essential fish habitat. Reduce noise disturbance to marine mammals.
Minimize Island size.	Reduce footprint of island and impacts on benthic environment.
Coordinate with the Alaska Department of Fish and Game on studies of fish and brown bears within project area. Identify and avoid den locations.	Minimize interactions with bears; identify important fish resources in project area.
Coordinate with U.S. Fish and Wildlife Service on historic and recent locations of polar bear den sites.	Avoid actions that would disturb denning polar bears.
Archaeology Surveys.	Avoid disturbance of potential archaeology sites.

Source: BPXA (2000a)

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Table II.A-1 Key Project Component Summary for All Alternatives[1]

	I Proposal	III.A Southern Island	III.B Tern Island	IV.A Pipe-in- Pipe	IV.B Pipe-in-HDPE	IV.C Flexible Pipe	V Steel Sheetpile	VI Duck Island. Gravel Mine	VII Bury Deeper
GRAVEL ISLAND									
a. Location	Liberty Island	Southern Island	Tern Island	Liberty Island	Liberty Island	Liberty Island	Liberty Island	Liberty Island	Liberty Island
b. Upper Slope Protection	Gravel Bags	Gravel Bags	Gravel Bags	Gravel Bags	Gravel Bags	Gravel Bags	Steel Sheetpile	Gravel Bags	Gravel Bags
c. Lower Slope Protection	17,000Cement Mats	16,000 Cement Mats	18,000 Cement Mats	17,000Cement Mats	17,000Cement Mats	17,000Cement Mats	22,500 Cement Mats	17,000Cement Mats	17,000Cement Mats
d. Amount of Gravel	797,600 cu yd	684,800 cu yd	599,500 cu yd	797,600 cu yd	797,600 cu yd	797,600 cu yd	855,000 cu yd	797,600 cu yd	797,600 cu yd
e. Maximum Footprint	835' * 1170'	825' * 1155'	850' * 1190'	835' * 1170'	835' * 1170'	835' * 1170'	905' * 1240'	835' * 1170'	835' * 1170'
f. Maximum Footprint Area	22.4 acres	21.9 acres	23,3 acres	22.4 acres	22.4 acres	22.4 acres	25.8 acres	22.4 acres	22.4 acres
g. Working Surface	345' * 680'	345' * 680'	345' * 680'	345' * 680'	345' * 680'	345' * 680'	345' * 680'	345' * 680'	345' * 680'
h. Water Depth at Island	22 feet	18 feet	23 feet	22 feet	22 feet	22 feet	22 feet	22 feet	22 feet
PIPELINE									
a. Pipe Design	1 Steel pipe	1Steel pipe	1 Steel pipe	1 Steel pipe in a steel pipe	1 Steel pipe in an HDPE pipe.	1 Flexible pipe	1 Steel pipe	1 Steel pipe	1 Steel pipe
b. Route	Liberty Route	Eastern Route	Tern Route	Liberty Route	Liberty Route	Liberty Route	Liberty Route	Liberty Route	Liberty Route
c. Average Trench Depth /Range in (Feet)	10.5 / (8 -12)	10.5 / (8-12)	10.5 / (8-12)	9 / (6.5-10.5)	10 / (7.5 - 11.5)	8.5 / (6-10)	10.5 / (8 -12)	10.5 / (8 -12)	15 feet
d. Quantity of Trench Dredge/ Excavation Material *	724,000 cu yds	499,025 cu yd	652,800 cu yd	557,300 cu yd	673,920 cu yd	498,960 cu yd	724,000 cu yd	724,000 cu yd	1,438,560 cu yd
e. Quantity of Trench Backfill Material *	724,000 cu yds	499,025 cu yd	652,800,000 cu yd	557,300 cu yd	673,920 cu yd	498,960 cu yd	724,000 cu yd	724,000 cu yd	1,438,560 cu yd
f. Minimum Burial Depth	7 feet	7 feet	7 feet	5 feet	6 feet	5 feet	7 feet	7 feet	11 feet
g. Surface Area Disturbed by Trench	59 acres	37 acres	59 acres	52 acres	57 acres	49 acres	59 acres	59 acres	81 acres
h. Offshore Length	6.1 miles	4.2 miles	5.5 miles	6.1 miles	6.1 miles	6.1 miles	6.1 miles	6.1 miles	6.1 miles
i. Onshore Length	1.5 miles	3.1 miles	3.1 miles	1.5 miles	1.5 miles	1.5 miles	1.5 miles	1.5 miles	1.5 miles
j. Construction Seasons	Winter	Winter	Winter	Winter	Winter	Winter	Winter	Winter	Winter
k. Leak-Detection System	MBLPC, PPA, LEOS or Equiv.	MBLPC, PPA, LEOS or Equiv.	MBLPC, PPA, LEOS or Equiv.	MBLPC, PPA, LEOS or Equiv.	MBLPC, PPA, LEOS or Equiv.	MBLPC, PPA, LEOS or Equiv.	MBLPC, PPA, LEOS or Equiv.	MBLPC, PPA, LEOS or Equiv.	MBLPCPPA, LEOS or Equiv.
l. Engineering Calculation of Pipeline Failure Rate but no oil released	3.1%	3.1%	3.1%	2.1%	3.2%	4.6%	3.1%	3.1%	2.2%
m. Engineering Calculation of Pipeline Failure Rate with oil released (any size spill)	0.001%	0.001%	0.001%	0.01%	0.01%	0.1%	0.001%	0.001%	0.0003%
n. Engineering Calculation of Probability of a Spill Larger than 1,000 bbls during project life[2]	1.38%	1.38%	1.38%	0.234%	1.38%	1.38%	1.38%	1.38%	1.38%
GRAVEL MINE SITE									
a. Location	Kadleroshilik River	Kadleroshilik River	Kadleroshilik River	Kadleroshilik River	Kadleroshilik River	Kadleroshilik River	Kadleroshilik River	Duck Island Mine	Kadleroshilik River
b. Number of Haul Days	45-60	40-57	30-45	45-60	45-60	45-60	45-60	90 -120 or use more equipment	45-60
c. Distance from Island	6 miles	5 miles	6 miles	6 miles	6 miles	6 miles	6 miles	20 miles	6 miles

1 Unless otherwise noted all information in this table is from INTEC (2000)
2 Information from Fleet (2000)

Shading indicates components or quantities that are different from Alternative I -- Proposal

Table II.A-2 Pipeline Trench Excavation and Backfill Quantities for Alternatives I, III, IV, and VII

	I Proposal- Liberty Island and Single-Walled Steel Pipe	**III.A Southern Island**	**III.B Tern Island**	**IV.A Steel Pipe in Steel Pipe**	**IV.B Steel Pipe in HDPE**	**IV.C Flexible Pipe**	**VII Bury Pipe Deeper**
PIPELINE TRENCH							
a. Length							
Island to 3-mile limit	8,000 feet	2,376 feet	11,616 feet	8,000 feet	8,000 feet	8,000 feet	8,000 feet
3-mile limit to shoreline	24,400 feet	19,900 feet	17,524 feet	24,400 feet	24,400 feet	24,400 feet	24,400 feet
Total	32,400 feet	22,276 feet	29,140 feet	32,400 feet	32,400 feet	32,400 feet	32,400 feet
b. Width	61-132 feet	61-132 feet	61-132 feet	53-115 feet	53-115 feet	50-110 feet	120-152 feet
c. Fill area							
Island to 3-mile limit	18.2 acres	5.3 acres	25.8 acres	15.4 acres	17.0 acres	14.7 acres	24.9 acres
3-mile limit to shoreline	55.4 acres	44.1 acres	38.9 acres	47.1 acres	51.8 acres	44.9 acres	76.1 acres
Total	73.6 acres	49.4 acres	64.7 acres	62.5 acres	68.8 acres	59.6 acres	101.0 acres
d. Onshore transition zone							
Length and width	150 x 25 feet	205 x 25 feet	205 x 25 feet	150 x 25 feet	150 x 25 feet	150 x 25 feet	150 x 25 feet
Area	0.3 acres	0.41 acres	0.41 acres	0.3 acres	0.3 acres	0.24 acres	0.4 acres
e. Quantity of dredged/ excavated material							
Island to 3-mile limit	(179,000 cu yd)	(53,225 cu yd)	(260,200 cu yd)	(137,600 cu yd)	(166,400 cu yd)	(123,200 cu yd)	(355,200 cu yd)
3-mile limit to shoreline	(545,000 cu yd)	(445,800 cu yd)	(392,600 cu yd)	(419,700 cu yd)	(507,520 cu yd)	(375,760 cu yd)	(1,083,360 cu yd)
Total	(724,000 cu yd)	(499,025 cu yd)	(652,800 cu yd)	(557,300 cu yd)	(673,920 cu yd)	(498,960 cu yd)	(1,438,560 cu yd)
f. Quantity of backfill							
Select backfill							
Island to 3-mile limit	17,000 cu yd	5,800 cu yd	24,250 cu yd	None	17,000 cu yd	17,000 cu yd	17,000 cu yd
3-mile limit to shoreline	50,000 cu yd	40,800 cu yd	36,050 cu yd	None	50,000 cu yd	50,000 cu yd	50,000 cu yd
Total select backfill	67,000 cu yd	46,600 cu yd	60,300 cu yd	None	67,000 cu yd	67,000 cu yd	67,000 cu yd
Native backfill							
Island to 3-mile limit	162,000 cu yd	47,425 cu yd	235,950 cu yd	137,600 cu yd	149,400 cu yd	106,200 cu yd	338,200 cu yd
3-mile limit to shoreline	495,000 cu yd	405,000 cu yd	356,550 cu yd	419,700 cu yd	457,520 cu yd	325,760 cu yd	1,033,360 cu yd
Total native backfill	757,000 cu yd	452,425 cu yd	592,500 cu yd	557,300 cu yd	606,920 cu yd	431,960 cu yd	1,371,560 cu yd
Total native and select backfill	724,000 cu yd	499,025 cu yd	652,800 cu yd	557,300 cu yd	673,920 cu yd	498,960 cu yd	1,438,560 cu yd

Source: BPXA (2000a)

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Table II.C-3 Comparison of Trench Excavation and Backfill for Different Pipeline Designs and Routes

Pipeline Design	Trench Characteristic	Island Location and Pipeline Route								
		Alternative I Liberty Island/Liberty Pipeline			Alternative III.A Southern Island Eastern Pipeline Route			Alternative III.B Tern Island Tern Pipeline Route		
		Gravel Island to 3-Mile Limit	3-Mile Limit to Shoreline	Onshore Transition Pipeline	Gravel Island to 3-Mile Limit	3-Mile Limit to Shoreline	Onshore Transition Pipeline	Gravel Island to 3-Mile Limit	3-Mile Limit to Shoreline	Onshore Transition Pipeline
Alternative 1 Single-Wall Pipe	**a.** Trench Length (ft)	8,000	24,400	150	2,376	19,900	205	11,616	17,524	205
	b Trench Width (ft)	61'-132'	61'-132'	25	61'-132'	61'-132'	25	61'-132'	61'-132'	25
	c. Trench Excavation (yd^3)	(179,000)	(545,000)	(2,200)	(53,225)	(445,800)	(3,000)	(260,200)	(392,600)	(3,000)
	d. Select Backfill (yd^3)	17,000	50,000	2,500	5,800	40,800	3,450	24,250	36,050	3,450
	e. Native Backfill (yd^3)	162,000	495,000	400	47,425	405,000	550	235,950	356,550	550
	f. Total Trench Backfill (yd^3)	179,000	545,000	2,900	53,225	445,800	4,000	260,200	392,600	4,000
	g. Trench Fill Area (acres)	18.2	55.4	0.3	5.3	44.1	0.41	25.8	38.9	0.41
	h. Trench Depth (ft)	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Alternative III.A Pipe-in-Pipe	**a.** Trench Length (ft)	8,000	24,400	150	2,376	19,900	205	11,616	17,524	205
	b. Trench Width (ft)	53'-115'	53'-115'	25	53'-115'	53'-115'	25	53'-115'	53'-115'	25
	c. Trench Excavation (yd^3)	(137,600)	(419,700)	(1,875)	(40,900)	(342,300)	(2,570)	(200,000)	(301,500)	(2,570)
	d. Select Backfill (yd^3)	none	none	2,160	none	none	2,950	none	none	2,950
	e. Native Backfill (yd^3)	137,600	419,700	345	40,900	342,300	470	200,000	301,500	470
	f. Total Trench Backfill (yd^3)	137,600	419,700	2,505	40,900	342,300	3,420	200,000	301,500	3,420
	g. Trench Fill Area (acres)	15.4	47.1	0.3	4.6	38.4	0.36	22.4	33.8	0.36
	h. Trench Depth (ft)	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
Alternative III.B Pipe-in-HDPE	**a.** Trench Length (ft)	8,000	24,400	150	2,376	19,900	205	11,616	17,524	205
	b. Trench Width (ft)	59'-126'	59'-126'	25	59'-126'	59'-126'	25	59'-126'	59'-126'	25
	c. Trench Excavation yd^3	(166,400)	(507,520)	(2,090)	(49,420)	(413,920)	(2,850)	(241,615)	(364,500)	(2,850)
	d. Select Backfill (yd^3)	17,000	50,000	2,400	5,800	40,800	3,275	24,250	36,050	3,275
	e. Native Backfill (yd^3)	149,400	457,520	385	43,620	373,120	525	217,365	328,450	525
	f. Total Trench Backfill (yd^3)	166,400	507,520	2,785	49,420	413,920	3,800	241,615	364,500	3,800
	g. Trench Fill Area (acres)	17.0	51.8	0.3	5.1	42.3	0.39	24.7	37.2	0.39
	h. Trench Depth (ft)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Alternative III.C Flexible Pipe	**a.** Trench Length (ft)	8,000	24,400	150	2,376	19,900	205	11,616	17,524	205
	b. Trench Width (ft)	50'-110'	50'-110'	25	50'-110'	50'-110'	25	50'-110'	50'-110'	25
	c. Trench Excavation (yd^3)	(123,200)	(375,760)	(1,770)	(36,590)	(306,460)	(2,425)	(178,890)	(269,870)	(2,425)
	d. Select Backfill (yd^3)	17,000	50,000	2,035	5,800	40,800	2,790	24,250	36,050	2,790
	e. Native Backfill (yd^3)	106,200	325,760	325	30,790	265,660	445	154,640	233,820	445
	f. Total Trench Backfill (yd^3)	123,200	375,760	2,360	36,590	306,460	3,235	178,890	269,890	3,235
	g. Trench Fill Area (acres)	14.7	44.9	0.24	4.4	36.6	0.33	21.4	32.3	0.33
	h. Trench Depth (ft)	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Alternative VII Bury the Pipe Deeper	**a.** Trench Length (ft)	8,000	24,400	150	2,376	19,900	205	11,616	17,524	205
	b. Trench Width (ft)	120'-152'	120'-152'	25	120'-152'	120'-152'	25	120'-152'	120'-152'	25
	c. Trench Excavation (yd^3)	(355,200)	(1,083,360)	(3,125)	(105,500)	(883,560)	(4,275)	(515,750)	(778,070)	(4,275)
	d. Select Backfill (yd^3)	17,000	50,000	3,590	5,800	40,800	4,920	24,250	36,050	4,920
	e. Native Backfill (yd^3)	338,200	1,033,360	575	99,700	842,760	785	491,500	742,020	785
	f. Total Trench Backfill (yd^3)	355,200	1,083,360	4,165	105,500	883,560	5,705	515,750	778,070	5,705
	g. Trench Fill Area (acres)	24.9	76.1	0.4	60.6	62.0	0.59	36.2	54.6	0.59
	h. Trench Depth (ft)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0

Source: BPXA (2000a)

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Table II.C-4 Pipeline Corrosion and Leakage into the Annulus

Alternative IV.A Pipe-in-Pipe System	Alternative IV.B Pipe-in-HDPE System	Alternative IV.C Flexible Pipe
Corrosion of either the inner or outer pipeline is the most probable cause of this type of damage. If only the inner pipe corrodes, oil would be released into the annulus area between the pipes. If only the outer pipe corrodes, then seawater could enter the annulus between the pipes. If both pipes corrode, oil could be releases into the environment. The table in Section II.A.1.e.(4) provides the engineering failure rate for each of the above failure states.	Corrosion of the inner pipeline is the most likely cause for this type of damage. The outer pipe cannot corrode, so a release of oil to the environment would not occur. The table in Section II.A.1.e.(4) provides the engineering failure rate for this pipeline to release oil into the environment.	This type of damage, although theoretically possible, is extremely unlikely to occur. Because the pipeline is made of layers of plastic and stainless steel, it is very unlikely that the pipeline would be damaged by corrosion. The exception would be at the connectors between the sections of flexible pipe; however, at this location the pipeline would not be able to provide secondary containment. The flexible pipe acts much more like a single pipe than either of the other multiwall pipeline systems. Because of this, it is highly unlikely for either the inner or outer fluid-containment barrier to fail by itself. The table in Section II.A.1.e.(4) provides the engineering failure rate for each pipeline design to release oil into the environment.

Source: INTEC (1999a). **Note:** The single-wall pipe in the Proposal is not included in this table, because it does not have an annulus.

Table II.C-5 Pipeline Failure Rate and Expected Spill Volume

	Alternative I Single-Wall Steel Pipe	Alternative IV.A Pipe-In-Pipe System	Alternative IV.B Pipe-In-HDPE System	Alternative IV.C Flexible Pipe	INTEC's 7-Foot Burial Depth Pipe-In-Pipe System
Damage Category	**Pipeline Failure Probability by Pipeline Design [1]**				
1–Pipeline displacement but no leak	0.031	0.02	0.03	0.04	0.022
2–Pipeline buckle but no leak	0.0012	0.001	0.002	0.006	0.00012
3–Small/medium leak into the environment	0.000013	0.0001	0.0001	0.001	0.00000028
3–Oil leaks into the annulus	NA	0.0001	0.001	NA	0.0001
3–Water leaks into the annulus	NA	0.0001	NA	NA	0.0001
4–Large leak/rupture	0.0000003	0.0001	0.000001	0.00001	0.00000021
	"Expected" Spill Volume—Life of the Pipeline [1]				
	0.0021 bbl (0.088 gal)	0.028 bbl (1.18 gal)	0.014 bbl (0.59 gal)	0.14 bbl (5.88 gal)	0.00034 bbl (0.014 gal)
	"Expected" Spill Volume—Life of the Pipeline [2]				
	28 bbl (1176 gal)	8 bbl (336 gal)	24 bbl (1008 gal)	29 bbl (1218 gal)	13 bbl (546 gal)
	Probability of Spill Larger Than 1000 bbls Occurring During Project Life [2]				
	0.0138	0.00158	0.0138	0.0138	0.00234

[1] Summary information from INTEC pipeline alternatives report (INTEC, 2000).
[2] Summary information from Fleet risk evaluation report (Fleet, 2000).

Table III.C-4 Large and Small Spill Sizes We Assume for Analysis in this EIS by Alternative

	ASSUMED VOLUME FOR SPILLS							
	CRUDE OIL							DIESEL OIL
	GRAVEL ISLAND	OFFSHORE PIPELINE					ONSHORE PIPELINE	GRAVEL ISLAND (Diesel Tank)
		Leak Detection and Location System		Pressure-Point Analysis And Mass-Balance Line Pack-Compensation				
		Leak	Rupture	Summer Leak	Winter Leak	Rupture		
Alternative I BPXA Proposal	925	125	1,580	715	2,956	1,580	720–1,142	1,283
Alternative II, No Action	0	0	0	0	0	0	0	0
Alternative III, Use Alternative Island Locations and Pipeline Routes	925	125	1,580	715	2,956	1,580	720–1,142	1,283
Alternative IV, Use Different Pipeline Designs								
Assumption 1, Neither Outer nor Inner Pipe Leaks								
Alternative IVA Use Pipe in Pipe System	925	0		0			720–1,142	1,283
Alternative IVB Use Pipe in HDPE System	925	0		0			720–1,142	1,283
Alternative IVC Use Flexible Pipe System	925	0		0			720–1,142	1,283
Alternative I Single Wall (for comparison)	925	0		0			720–1,142	1,283
Assumption 2, Both Outer and Inner Pipes Leak								
Alternative IVA Use Steel Pipe in Pipe System	925	125	1,580	715	2,956	1,580	720–1,142	1,283
Alternative IVB Use Pipe in HDPE System	925	125	1,580	715	2,956	1,580	720–1,142	1,283
Alternative IVC Use Flexible Pipe System	925	125	1,580	715	2,956	1,580	720–1,142	1,283
Alternative I Single Wall (for comparison)	925	125	1,580	715	2,956	1,580	720–1,142	1,283
Assumption 3, Only the Inner Pipe Leaks								
Alternative IVA Use Pipe in Pipe System	925	0		0			720–1,142	1,283
Alternative IVB Use Pipe in HDPE System	925	0		0			720–1,142	1,283
Alternative IVC Use Flexible Pipe System	925	125	1,580	715	2,956	1,580	720–1,142	1,283
Alternative I Single Wall (for comparison)	925	125	1,580	715	2,956	1,580	720–1,142	1,283
Assumption 4, Only the Outer Pipe Leaks								
Alternative IVA Use Pipe in Pipe System	925	0		0			720–1,142	1,283
Alternative IVB Use Pipe in HDPE System	925	0		0			720–1,142	1,283
Alternative IVC Use Flexible Pipe System	925	Na	Na	Na	Na	Na	720–1,142	1,283
Alternative I Single Wall (for comparison)	925	Na	Na	Na	Na	Na	720–1,142	1,283
Alternative V, Use Steel Sheetpile	925	125	1,580	715	2,956	1,580	720–1,142	1,283
Alternative VI, Use Duck Island Mine	925	125	1,580	715	2,956	1,580	720–1,142	1,283
Alternative VII, Use a 15-Foot Trench Depth	925	125	1,580	715	2,956	1,580	720–1,142	1,283

Source**:** USDOI, MMS Alaska OCS Region.

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Table III.D-6 Kadleroshilik River Mine Site Land Areal Coverage by Land Cover Type (Class)

Class	Land Cover Description	Wetland	Phase 1 Mine Cell		Phase 2 Mine Cell		Reserve Area		Total Mine Site	
			Acres	Percent of Area	Acres	Percent of Area	Acres	Percent of Area	Acres	Percent of Area
Ia	Water	No	0.15	0.8%	0.01	0.1%	0.06	0.3%	0.21	0.4%
IIIa	Wet Sedge Tundra	Yes	0.15	0.8%	0.00	0.0%	0.00	0.0%	0.15	0.3%
Va	Moist Sedge, Dwarf Shrub Tundra	Yes	0.02	0.1%	1.02	8.2%	0.22	1.0%	1.26	2.4%
Vc	Dry Dwarf Shrub, Crustose Lichen	Yes	7.26	38.1%	4.83	38.8%	3.23	15.1%	15.32	29.0%
IXb	Dry Barren/Dwarf Shrub, Forb Grass Complex	Yes	2.00	10.5%	3.41	27.4%	3.85	18.0%	9.26	17.5%
IXc	Dry Barren/Forb Complex	Yes	1.44	7.6%	2.11	17.0%	9.47	44.2%	13.02	24.6%
IXf	Dry Barren/Dwarf Shrub, Grass Complex	Yes	1.90	10.0%	0.16	1.3%	0.00	0.0%	2.06	3.9%
Xa	River Gravel	No	6.12	32.2%	0.89	7.1%	4.59	21.4%	11.6	21.9%
	Total Land Cover Area		19.03	100.0%	12.43	100.0%	21.42	100.0%	52.87	100.0%
	Total Wetland Area		12.77	67.1%	11.53	92.7%	16.77	78.3%	41.06	77.6%

Source: Noel and McKendrick (2000).
Total Wetland Area is defined by the U.S. Army Corp of Engineers as Land Cover Types (Class) III.a, Va,Vc, IXb, IXc, and IXf.

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Table IV.A-1 List of Alternatives and their Location in the EIS

Alternative Number and Name		EIS Section That Provides: Description of Alternative	EIS Section That Provides: Environmental Effects of Alternative
I	**Liberty Development and Production Plan – (The BPXA Proposal)**	II.A	III
II	**No Action – (Alternative II)**	II.B	IV.B
	Alternative Drilling Locations and Pipeline Route	II.C.1.a	IV.C.1
I	Use Liberty Island Location and Pipeline Route (Liberty DPP)	II.C.1.d	IV.C.1.c
III.A	Use Southern Island Location and Eastern Pipeline Route	II.C.1.b	IV.C.1.d
III.B	Use Tern Island Location and Pipeline Route	II.C.1.c	IV.C.1.e
	Alternative Pipeline Designs	II.C.2	IV.C.2
I	Use Single Steel Wall Pipeline System (Liberty DPP)	II.C.2.e	IV.C.2.h
IV.A	Use Pipe-in-Pipe Pipeline System	II.C.2.b	IV.C.2.i
IV.B	Use Pipe-in-HDPE Pipeline System	II.C.2.c	IV.C.2.j
IV.C	Use Flexible Pipeline System	II.C.2.d	IV.C.2.k
	Alternative Upper Island Slope Protection Systems	II.C.3	IV.C.3
I	Use Gravel Bags (Liberty DPP)	II.C.3.c	IV.C.3.a
V	Use Steel Sheet Pile	II.C.3.b	IV.C.3.b
	Alternative Gravel Mine Sites	II.C.4	IV.C.4
I	Use Kadleroshilik River Mine Site (Liberty DPP)	II.C.4.c	IV.C.4.a
VI	Use Duck Island Gravel Mine	II.C.4.b	IV.C.4.b
	Alternative Pipeline Burial Depths	II.C.5	IV.C.5
I	Use a 7-Foot Burial Depth	II.C.5.d	IV.C.5.a
VII	Use a 15-Foot Pipeline Trench Depth	II.C.5.c	IV.C.5.b
	Combination Alternatives	II.D	IV.D
A	Combination Alternative A	II.D.2.a	IV.D.5
B	Combination Alternative B	II.D.2.b	IV.D.6
C	Combination Alternative C	II.D.2.c	IV.D.7
I	Liberty DPP	II.D.2.d	IV.D.4

Source: USDOI, MMS, Alaska OCS Region (2000)

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Table IV.D-2 Comparison of Selected Features of the Combination Alternatives

Selected Alternative Attributes	**Combination A** Liberty Island Rte Pipe in Pipe Steel sheetpile Duck Island Gravel 7-Foot burial Depth	**Combination B** South Island/Eastern Rte Pipe in HDPE Gravel Bags Kadleroshilik River Gravel 6-Foot burial depth	**Combination C** Tern Island/Tern Rte Pipe in Pipe Steel Sheetpile Duck Is Gravel 11-Foot Burial Depth	**BPXA Proposal** Liberty Island Rte Singled walled pipe Gravel Bags Kadleroshilik River Mine 7-Foot burial depth
Distance from bowhead migration	**closest**	**furthest**	**second furthest**	**closest**
Likelihood of disturbance of bowhead whales and subsistence hunting	**low**	**lowest**	**lower**	**low**
Gravel requirement	**855,000 cu yd** (most)	**684,800 cu yd** (3rd most)	**659,000 cu yd** (least)	**797,600 cu yd** (2nd most)
Gravel haul distance	**20 miles** (2nd most)	**5 miles** (least)	**21 miles** (most)	**6 miles** (3rd most)
Use of existing offshore gravel	**None**	**none**	**most**	**none**
Mine wetland habitat destroyed	**Least**	**most**	**least**	**most**
Impacts from gravel bags	**None**	**low**	**none**	**low**
Newly buried ocean bottom (island)	**25.8 acres** (most)	**21.9 acres** (3rd most)	(least)	**22.4 acres** (2nd most)
Temporarily disturbed habitat from pipeline trench	**59 acres** (2nd most)	**49 acres** (least)	**91 acres** (most)	**59 acres** (2nd most)
Length of offshore pipeline deeper than 8-foot water depth	**Least**	**least**	**most**	**least**
Average depth of pipeline trench	**10.5 ft**	**10 ft**	**15 ft**	**10.5 ft**
Distance from Boulder Patch	**1 mile** (closest)	**2.5 miles** (furthest)	**1.5 miles** (2nd furthest)	**1 mile** (closest)
Likelihood of impacts to the Boulder Patch	**Low**	**lowest**	**lower**	**low**
Length offshore pipeline	**6.1 miles** (most)	**4.2 miles** (least)	**5.5 miles** (2nd most)	**6.1 miles** (most)
Length onshore pipeline	**1.5 miles** (least)	**3.1 miles** (most)	**3.1 miles** (most)	**1.5 miles** (least)
Secondary pipeline spill containment	**Yes**	**yes**	**yes**	**no**
Likelihood of pipeline leak offshore	**Lower**	**lowest**	**lowest**	**low**
Likelihood of pipeline leak onshore	**Lower**	**low**	**low**	**lower**
Directional drilling	**Least**	**most**	**most**	**least**
Risk to maximum recovery of oil	**Least**	**most**	**most**	**least**
Costs over the BPXA Proposal	**$51.5 million** (3rd most)	**$24.5 million** (2nd most)	**$59 million** (most)	same
Economic return to BPXA	**second highest**	**third highest**	**least**	**highest**
Economic benefits to Federal and State government	**second highest**	**third highest**	**least**	**highest**

Source: USDOI, MMS, Alaska OCS Region (2000)

MAP

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Map 1 Liberty Project Area.

Sources: BPXA 1998a; Ban et al, 1999.

The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Royalty Management Program** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.