CHAPTER 11.0

COMPARISON OF PROJECT ALTERNATIVES AND THEIR IMPACTS

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11.0 COMPARISON OF PROJECT ALTERNATIVES AND THEIR IMPACTS

11.1 INTRODUCTION

This chapter summarizes and compares the magnitude and significance of environmental impacts of the alternatives developed in this Environmental Impact Statement (EIS). This comparison is intended to highlight the important environmental issues and principal differences among the alternatives. This chapter is derived from the detailed analyses presented in Chapters 5 through 10.

As explained in Chapter 3, development of the Northstar Unit, or any other oil and gas reservoir, involves several distinct components. Selection of these components will be based on consideration of several factors, including environmental, technical, and economic concerns. As a result, no single alternative consisting of all the essential development components will necessarily be "best" with respect to all factors. Decision-makers selecting a preferred alternative must consider the positive and negative impacts of each alternative with respect to the key concerns, along with consideration of the relative importance of each key concern. This presentation will help focus that effort.

11.2 OVERVIEW OF PROJECT ALTERNATIVES

Analyses presented in Chapter 3 provide the basis for project action alternatives identified in Chapter 4 and evaluated in Chapters 5 through 10. Principal project components, including the redevelopment of Seal Island, installation of buried subsea pipelines, onshore construction using vertical support members (VSMs), etc. are the same or similar among the four action alternatives considered for the Northstar Development Project (Northstar Project). The principal differences among these action alternatives are the pipeline routes and shoreline crossings. Figure 11-1 illustrates these alternatives; specific details are presented in Section 4.4. In addition to these action alternatives, the No Action Alternative is addressed in accordance with the requirements of the National Environmental Policy Act (NEPA).

The BP Exploration (Alaska) Inc. (BPXA) Northstar development proposal (Appendix A) was identified as a reasonable alternative by the selection process used in Chapter 4. Chapter 4 also identified alternative pipeline routing which better meets pipeline route criteria, as developed in Chapter 3. Because each alternative route creates potential impacts that could be avoided by other alternatives, a range of alternatives was developed which allowed consideration of feasible impact tradeoffs. The substantial design differences represented by these alternatives include alternative landfall locations (Point Storkersen area, Point McIntyre area, and West Dock causeway) and onshore routing options (minimum distance/overland routing and maximum use of routing along existing disturbed corridors). These alternatives are presented as specific pipeline routes to allow the evaluation and comparison of impacts, but each should be considered representative of possible variations which include the same general landfall location and approach to onshore routing. An overview of each alternative is presented below.

Alternative 1 - No Action: This alternative eliminates all project-related environmental impacts. It does not accomplish the objective of production of oil from the Northstar Unit.

Alternative 2 - Point Storkersen Landfall/BPXA Proposal: This alternative (the Applicant's preferred alternative) represents the shortest pipeline option with the lowest range of costs. Principal concerns involve: a subsea pipeline in arctic waters (including the control of thaw-induced subsidence wherever expected, as determined by site-specific geotechnical data); subsea pipeline routing through Gwydyr Bay; issues relating to a trenched shoreline crossing through the permafrost transition zone, and a 9.55-mile (15.37 kilometer [km]) overland pipe installation through undeveloped tundra.

Alternative 3 - Point Storkersen/West Dock Staging Pad Pipeline Route: This alternative is identical to the BPXA proposal from Seal Island to the Point Storkersen landfall and includes the issues described above. The subsea pipeline thaw-induced subsidence must be controlled wherever expected, as determined by site-specific geotechnical data. The onshore pipeline route is directed eastward approximately 3.6 miles (5.8 km) across undeveloped tundra before reaching an existing pipeline corridor, which it then follows to the West Dock Staging Pad and on to the Central Compressor Plant and Pump Station No. 1. Approximately 3.1 miles (5 km) of undeveloped tundra are crossed near the southern end of the alignment. This alternative maximizes the use of existing pipeline and roadway corridors within the Prudhoe Bay industrial complex, while maintaining the Point Storkersen landfall.

Alternative 4 - Point McIntyre/West Dock Staging Pad Pipeline Route: Compared to Alternatives 2 or 3, this alternative involves a longer offshore pipeline route to a new trenched shoreline landfall near Point McIntyre. The subsea pipeline thaw-induced subsidence must be controlled wherever expected, as determined by site-specific geotechnical data. The offshore pipeline routing would be through the eastern portion of Gwydyr Bay. The landfall is adjacent to existing Prudhoe Bay area pipelines and roadways, and most of the onshore pipeline is routed along existing disturbed corridors. Approximately 3.1 miles (5 km) of corridor extend through undeveloped tundra near the southern end of the alignment.

Alternative 5 - West Dock Causeway Landfall: This alternative includes nearly the same offshore pipeline route as Alternative 4, but avoids the shoreline permafrost transition zone by routing the pipeline to the West Dock causeway. The subsea pipeline thaw-induced subsidence must be controlled wherever expected, as determined by site-specific geotechnical data. This offshore pipeline routing would avoid Gwydyr Bay. The West Dock causeway would be widened from the landfall location to the shoreline to accommodate the pipelines. Most of the onshore pipeline route is located along existing Prudhoe Bay area pipeline corridors and roadways, identical to Alternative 4 from the West Dock Staging Pad to the Central Compressor Plant and Pump Station No. 1. Approximately 3.1 miles (5 km) of corridor extend through undeveloped tundra near the southern end of the alignment.

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The specific environmental characteristics of each alternative are summarized in the remaining sections of this chapter and in Table 11-1.

11.3 ALTERNATIVE 1 - NO ACTION

The No Action Alternative would not produce any of the project-specific impacts which result from the action alternatives. This alternative would leave Seal Island in its present condition, and no environmental disturbance associated with island reconstruction and related onshore gravel mining operations would occur.

Impacts associated with Northstar offshore facilities operation or the construction and operation of related pipeline facilities would not occur. This alternative would not accomplish BPXA's project objective of producing the Northstar Unit oil and gas resources, which have been projected at an average 158 million barrels of recoverable oil over the 15-year project life. The No Action Alternative would not contribute any of the socioeconomic benefits associated with the action alternatives. These benefits include an estimated $478.9 million gross revenue to the State of Alaska, $306.3 million in revenue to the federal government, $64.3 million in revenues to the North Slope Borough (NSB), and $3 million in revenue to the Municipality of Anchorage (MOA) over the project life. Additionally, the project will create 730 construction jobs, 100 annual operation and project support jobs, and over $307 million in wages.

In addition to action-specific impacts, NEPA requires the consideration of potential cumulative impacts. As defined by 40 CFR 1508.7, cumulative impacts include the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Alternative 1 (No Action) would not contribute any incremental increase to the cumulative impact of other actions. However, none of the cumulative impacts identified would be avoided by selection of Alternative 1. Alternatives 2, 3, 4, and 5 would each result in comparable contributions to the cumulative impacts of other actions, which include:

- Cumulative impacts from other offshore development proposals on subsistence whaling caused by bowhead whale avoidance of industrial noise and resulting potential migration corridor deflection. This potential effect could result in longer travel distances and increased time requirements to achieve a comparable catch, with an increased likelihood of meat spoilage. Whaling is inherently hazardous, and increased time and travel distances correspond to increased personal safety risks. In addition, any increased impact on or risk to the bowhead whale population could result in a reduction of the bowhead whale harvest quota set by the International Whaling Commission (IWC). The contribution to this cumulative effect associated with offshore seismic survey activities could be effectively reduced by management of this activity to avoid whale disturbance.

- Existing and potential future offshore oil and gas development (state and federal) was estimated to result in a 95.2 percent (%) chance of a large oil spill (greater than 1,000 barrels) (Section 10.7). Without Northstar, cumulative spill risk is calculated as 93.7%.

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· Cumulative impacts to visual resources associated with increased industrialization in natural areas and addition of artificial lighting in a broader geographic area.

· Cumulative impacts to the land use associated with the geographic expansion of industrial operations beyond the existing developed Prudhoe Bay/Kuparuk area, and the intensification of operations in developed areas.

· Cumulative revenue decline associated with a projected decline in North Slope oil production from a 1995 level of 1.45 million barrels per day (barrels/day) to 0.384 million barrels/day by the year 2015 (Section 10.2.3). Expanded production from existing development and known fields over this period has been estimated to deliver up to 6.47 billion barrels from 1997 to 2020, which would not fully offset the projected decline. The Northstar Unit development would contribute to this partial offset, and would represent approximately 2.4% of total oil production during the project life.

11.4 ALTERNATIVE 2 - POINT STORKERSEN LANDFALL/BPXA PROPOSAL

Alternative 2, the Applicant's (BPXA's) preferred alternative, would result in several direct impacts that distinguish it from the other identified alternatives (Table 11-1). Construction costs associated with this alternative are the lowest of all action alternatives (total construction cost of approximately $405 million, which includes between $52.8 and $73.48 million estimated costs associated with pipeline and ice road construction). Impacts common to Alternative 2 and all other action alternatives (Alternatives 3, 4, and 5) include the following:

· Addition of visible lighting in an offshore area, and contribution to cumulative visual impacts associated with predicted increased offshore development.

· Project-related impact on subsistence whaling caused by bowhead whale avoidance response to noise generated at Seal Island and project-related vessel and helicopter noise and activity. This response to noise is subject to disagreement among experts, but reports of whale avoidance of similar noise and activity suggest that bowhead whale avoidance of the Seal Island area to a distance of 6 miles (9.6 km) could occur under unusually quiet conditions during their migration through this area. This avoidance is considered significant to subsistence harvesting because it could expose whalers to increased hazards associated with greater travel distances from shore and more time spent at sea. It would also increase the likelihood of meat spoilage and, should increase risks to whales be perceived by the IWC, the subsistence harvest quota could be reduced. However, significant long-term displacement of bowhead whales is not expected to occur as a result of Northstar operations.

· The number and timing of offshore helicopter overflights during construction would result in significant impacts to common eiders and oldsquaw.

· Potential volumes of a large oil spill associated with Northstar Unit development and production

facilities, including 15,000 barrels/day for 15 days from a well blowout, and a total of 2,800 barrels from a Seal Island diesel tank rupture (single discharge). Potential oil spill volumes associated with pipelines vary by alternative, and are addressed separately.

- Within a 3-day period following a spill event, only marine resources located within approximately 12 miles (19.3 km) of Seal Island, have a higher than 3% probability of contact; beyond about 50 miles (80 km) from Seal Island, probability of contact with oil (up to 180 days after a large spill) is generally much less than 10%.

- Possible contact of 100 miles (160 km) of the coast within 3 days by a large oil spill if response actions are not taken.

- The calculated total probability of one or more large oil spills (greater than 1,000 barrels) from any source is approximately 11% to 24% over the 15-year project life (Table 8-6).

- Minor contribution to the cumulative probability (95.2%) of a large oil spill (greater than 1,000 barrels) over the project lifetime. Northstar Unit production would represent 2.4% of the cumulative oil production during the project life, and represents an increased cumulative risk which is less than the uncertainty inherent in this calculation. For this reason, the cumulative spill risk associated with Alternative 2 is considered essentially the same as the ongoing risk associated with the No Action Alternative.

- Project-related socioeconomic benefits over the project life include contribution of $478.9 million gross revenue to the State of Alaska, $306.3 million in federal revenue, $64.3 million in revenue to the NSB, and $3 million in revenue to the MOA. Additional socioeconomic benefits include 730 construction jobs, 100 annual operation and project support jobs, and total wages of over $307 million. This project would contribute 2.4% of the total projected North Slope oil production during the 15-year project life, and would reduce the projected rate of production decline and associated decline in state and NSB revenues.

Alternative 2 would also result in several impacts which distinguish it from one or more of the other action alternatives. These impacts are:

- The offshore pipeline route is directly through Gwydyr Bay and the nearshore lagoon system (common impact with Alternative 3, but not common with Alternatives 4 or 5). In the unlikely event of an oil spill, this route would limit the effectiveness of booming to protect the lagoon habitat from oil contamination.

- Oil spill response equipment would be staged at West Dock. In the event of an oil spill, response time to the nearshore pipeline for Alternative 2 (common with Alternative 3) would be greater than for Alternatives 4 and 5.

- Pipeline landfall issues (common impact with Alternatives 3 and 4, but not common with

Alternative 5) include a concern that trenching across the shoreline transition zone could result in local thaw bulb creation and associated subsidence and instability. An additional concern regarding a trenched shoreline crossing is the possibility of local erosion. Both these concerns (subsidence and erosion) could represent a hazard to pipeline integrity. This may require increased monitoring and maintenance and may pose an increased risk of pipe failure and resulting oil spill, as compared to a causeway shoreline crossing, such as in Alternative 5.

· Contribution to cumulative land use impacts by establishing a new industrial corridor from Point Storkersen which could facilitate the development of the Gwydyr Bay area. This impact also would result from Alternative 3. Alternatives 1, 4, and 5 would not facilitate new development in the Gwydyr Bay area.

· The onshore pipeline route from Point Storkersen to Pump Station No. 1 traverses 9.55 miles (15.37 km) of undeveloped tundra in a roadless area. This pipeline route would add an industrial facility across a large area of presently undisturbed wildlife habitat. The pipeline itself does not represent a significant biological impact, but routine inspections by helicopter could cause disturbances to several species of wildlife. Also of concern is the potential damage associated with equipment and personnel access to the pipeline in response to unplanned maintenance or an oil spill during the summer.

· Project-specific impacts and contribution to onshore cumulative visual impacts by geographic expansion and intensification of industrial development, including the addition of a 9.55-mile (15.37 km) long pipeline route across an undeveloped area. Though other action alternatives also contribute to the cumulative visual impact, Alternative 2 represents the greatest contribution due to the onshore pipeline route.

· The calculated maximum volumes of potential oil spills associated with Alternative 2 pipelines (assuming complete drainage of oil from the pipeline length between valves) include: 3,600 barrels from an offshore pipeline rupture, 6,400 barrels from an onshore pipeline rupture, and 6,600 barrels from an offshore or onshore chronic pipeline leak. Potential volumes from pipeline spills associated with this alternative are the least of all action alternatives. Other potential volumes from a spill are identical for all action alternatives.

· The probability of one or more pipeline spills greater than 1,000 barrels is 4.5% to 19% (Table 8-6). These calculated probabilities do not reflect concerns related to permafrost thawing at the trenched shoreline crossing, which may increase the risk of pipe failure and oil spillage in this area. No statistics are available to calculate spill probabilities associated with this site-specific hazard. A similar site-specific hazard and related spill risk is associated with Alternatives 3 and 4.

11.5 ALTERNATIVE 3 - POINT STORKERSEN LANDFALL TO WEST DOCK STAGING PAD

Alternative 3 includes the same offshore facility (reconstruction of Seal Island) and the same offshore pipeline route (including the Point Storkersen landfall) as discussed for Alternative 2. The onshore pipeline route, however, is directed eastward from Point Storkersen and traverses approximately 3.6 miles (5.8 km) of undeveloped land prior to reaching existing pipeline corridors and roadways in the Prudhoe Bay industrial complex. The remainder of the pipeline mostly follows existing roadways and pipeline corridors to Pump Station No. 1. This alternative involves a total construction cost of approximately $415 million, including pipeline and ice road construction costs of between $57.44 and $83.52 million. Offshore and landfall related impacts of this alternative would be identical to those described for Alternative 2, but onshore impacts would be reduced. (Table 11-1). Additional features of this alternative which distinguish it from other alternatives include:

· The offshore route is directly through Gwydyr Bay and the nearshore lagoon system (common impact with Alternative 2, but not common with Alternatives 4 or 5). In the unlikely event of an oil spill, this route would limit the effectiveness of booming to protect the lagoon habitat from oil contamination.

· Oil spill response equipment would be staged at West Dock. In the event of an oil spill, response time to the nearshore pipeline for Alternative 3 (common with Alternative 2) would be greater than for Alternatives 4 and 5.

· Impacts related to unplanned maintenance access to the Point Storkersen landfall during the summer and potential landfall subsidence and erosion hazards described for Alternative 2 would also apply to this alternative. These concerns do not apply to Alternatives 1 and 5.

· Contribution to cumulative land use impacts by establishing a new industrial corridor to Point Storkersen which could facilitate future development in the Gwydyr Bay area. This impact could also result from Alternative 2. Alternatives 1, 4, and 5 would not facilitate development in the Gwydyr Bay area.

· The onshore pipeline route from Point Storkersen to the existing pipeline and roadway corridor to the east would cross 3.6 miles (5.8 km) of undeveloped land in a roadless area. An additional overland segment approximately 3.1 miles (5 km) long is located in the southern portion of this pipeline route, but this area is in a developed industrial area within 1.5 miles (2.4 km) of existing roads and is not expected to result in impacts comparable to the other open land pipeline corridors. The 3.1-mile (5 km) southern segment is also part of Alternatives 4 and 5.

· Wildlife disturbance from pipeline inspection helicopter overflights would occur along the 6.7-mile (10.7 km) route in undeveloped habitat. This represents less undeveloped tundra habitat disturbance than Alternative 2, and greater disturbance than Alternatives 1, 4, and 5.

· Project-specific impacts and contribution to onshore cumulative visual impacts by geographic expansion and intensification of industrial development, including the addition of a 3.6-mile (5.8 km) pipeline segment which would extend the onshore industrial development approximately 2.7 miles (4.3 km) west of the existing Prudhoe Bay developed area. This impact would be less substantial than

that associated with Alternative 2, due to the shorter length of pipeline in undeveloped areas and proximity to existing development, but represents greater visual impact than that associated with Alternatives 4 and 5.

· The calculated maximum volumes of potential pipeline spills (assuming complete drainage of oil from the pipeline length between valves) include: 3,600 barrels from an offshore pipeline rupture, 8,700 barrels from an onshore pipeline rupture, 6,600 barrels from an offshore chronic pipeline leak, and 8,900 barrels from an onshore chromic pipeline leak. Potential offshore pipeline spill volumes are comparable to Alternative 2, and less than Alternatives 4 and 5. Potential onshore pipeline spill volumes are the greatest of all alternatives.

· The probability of one or more pipeline spills greater than 1,000 barrels is 5.6% to 19% (Table 8-6). These probabilities do not reflect the concern regarding permafrost thawing at the trenched shoreline crossing which may increase the risk of pipe failure and resulting oil spillage. Considering the level of uncertainty inherent in spill risk calculations, the calculated risk of an oil spill associated with this alternative should not be viewed as substantially different than the risk associated with Alternatives 2, 4, or 5.

11.6 ALTERNATIVE 4 - POINT MCINTYRE LANDFALL TO WEST DOCK STAGING PAD

Alternative 4 includes the same offshore facility (reconstruction of Seal Island) as Alternatives 2, 3, and 5, but incorporates a different offshore pipeline route, a different landfall location (near Point McIntyre), and an onshore pipeline route which is located entirely within the existing Prudhoe Bay industrial complex. This alternative involves a total construction cost of approximately $413 million, including pipeline and ice road construction costs of between $54.37 and $81.3 million. Offshore impacts associated with construction and normal operations would be comparable to Alternatives 2, 3, and 5. The pipeline landfall involves a trenched shoreline crossing, and involves the same concerns regarding hazards, repeated maintenance, and possible spill risk associated with permafrost thaw bulb subsidence and shoreline erosion as discussed in relation to Alternatives 2 and 3. Additional features of this alternative which distinguish it from other alternatives include:

· The offshore pipeline route mostly avoids Gwydyr Bay, except for that portion off the eastern end of Stump Island to the shoreline landfall (not common with Alternatives 2, 3, or 5). In the unlikely event of an oil spill, this route would limit the effectiveness of booming to protect the lagoon habitat from oil contamination.

· Oil spill response equipment would be staged at West Dock. In the event of an oil spill, response time to the nearshore pipeline for Alternative 4 (common with Alternative 5) would be less than for Alternatives 2 and 3.

· Although the trenched shoreline crossing could require repeated maintenance associated with shoreline erosion and thaw-related subsidence, the proximity of the Point McIntyre landfall site to

existing roadways substantially reduces potential access-related damage associated with repeated maintenance at the landfall site. The overall onshore impact from Alternative 4 would be less than that of Alternatives 2 or 3. Similar impacts are not associated with Alternatives 1 and 5.

· This alternative would not facilitate the development of the Gwydyr Bay area through the westward extension of the industrial pipeline corridors. Alternatives 2 and 3 could facilitate Gwydyr Bay development; however, Alternative 5 does not.

· Onshore visual impacts would be minimized by routing the onshore pipeline within an existing industrial area.

· Helicopter overflights along the onshore pipeline route would be less likely to disturb wildlife than Alternatives 2 and 3 because the route is in an existing industrial area. Alternative 5 represents a comparable, access-related advantage.

· The location of the onshore pipeline within an existing industrial area in proximity to roadway access reduces access-related damage associated with unplanned pipe maintenance and spill response during the summer. Alternative 5 represents a comparable access-related advantage.

· The calculated maximum volumes of potential pipeline spills (assuming complete drainage of oil from the pipeline length between valves) include: 5,300 barrels from an offshore pipeline rupture, 6,800 barrels from an onshore pipeline rupture, 8,200 barrels from an offshore chronic pipeline leak, and 7,000 barrels from an onshore chronic pipeline leak. This alternative involves the greatest potential volume of spillage from the offshore pipeline, and potential onshore pipeline spill volumes comparable to Alternatives 2 and 5.

· The probability of one or more pipeline spills greater than 1,000 barrels is 5.5% to 19% (Table 8-6). This alternative involves similar concerns regarding permafrost thaw bulb subsidence and shoreline erosion at the landfall site as discussed for Alternatives 2 and 3. Alternative 5 would avoid this risk of pipeline damage associated with permafrost thaw bulb subsidence and shoreline erosion.

11.7 ALTERNATIVE 5 - WEST DOCK LANDFALL

Alternative 5 includes the same offshore facility (reconstruction of Seal Island) as Alternatives 2, 3, and 4, and follows an offshore pipeline route nearly identical to Alternative 4. Instead of crossing a natural shoreline in a pipeline trench, however, this alternative would be routed to a location on West Dock free of permafrost (typically at a water depth greater than 6.5 ft [2.0 m]), as determined by site-specific geotechnical data. The pipeline would be installed on a widened, filled causeway, and would cross the natural shoreline buried within this fill. The pipeline landfall would be within the gravel fill of the widened West Dock causeway and, once through the riser, would continue aboveground on VSMs to the onshore elevated, pipeline facilities. From the West Dock Staging Pad, the onshore pipeline route would

follow the same route as Alternatives 3 and 4. The shoreline crossing on the West Dock causeway and elimination of the Alternative 4 pipeline segment from Point McIntyre to the West Dock Staging Pad are the only differences between this alternative and Alternative 4. Alternative 5 involves the most costly construction, with a total construction cost of approximately $418 million (including between $58.07 and $86.58 million associated with pipeline and ice road construction). Widening of the causeway itself would cost approximately $5.7 million. Offshore impacts of construction and normal operations are comparable to Alternatives 2, 3, and 4. The distinguishing characteristics of Alternative 5 include:

· The offshore pipeline route completely avoids Gwydyr Bay and the nearshore lagoon system. In the unlikely event of an oil spill, Gwydyr Bay could be protected from oil contamination by booming off the lagoon (i.e., placing oil containment booms between West Dock and Stump Island, and between Stump and Egg Islands).

· Oil spill response equipment would be staged at West Dock. In the event of an oil spill, response time to the nearshore pipeline for Alternative 5 (common with Alternative 4) would be less than for Alternatives 2 and 3.

• Alternative 5 would require the widening of the West Dock causeway by the addition of fill. This would cause approximately 5.5 acres (2.2 hectares) of the shallow, previously disturbed seafloor adjacent to the causeway to be covered, which would be considered a minor impact. If this fill activity occurs during summer, temporary water quality impacts would occur that are not associated with the other three action alternatives. Because this fill placement involves the widening of an existing causeway, and the existing causeway breach would not be affected, no impact on local water circulation is expected. Although the shoreline crossing associated with this alternative is different than the other three action alternatives, local water quality effects of this alternative are relatively minor and do not distinguish Alternative 5 from other action alternatives.

• Pipeline landfall on a solid-fill causeway eliminates the permafrost thaw bulb subsidence hazard and shoreline erosion hazard common to all other action alternatives. This represents an advantage in terms of reduced risk of pipeline damage that could result in an oil spill, and elimination of maintenance activity in a natural shoreline area.

• This alternative would not facilitate the development of the Gwydyr Bay area through the westward extension of industrial pipeline corridors. Alternatives 2 and 3 may facilitate Gwydyr Bay development, but Alternative 4 would not.

• Onshore visual impacts would be eliminated by routing the onshore pipeline within an existing industrial area.

• Helicopter overflights along the onshore pipeline route would be less likely to disturb wildlife than Alternatives 2 and 3, because the entire route is in an existing industrial area. Pipeline inspection by vehicle would be accommodated by existing roadway access along this route. Alternative 4 represents a comparable access-related advantage.

- Location of the onshore pipeline entirely within an existing industrial area and in proximity to roadway access reduces access-related damage associated with unplanned pipe maintenance and spill response during the summer. Alternative 4 represents a similar advantage.

- The calculated maximum volumes of potential pipeline oil spills (assuming complete drainage of oil from the pipeline length between valves) include: 5,200 barrels from an offshore pipeline rupture, 6,700 barrels from an onshore pipeline rupture, 8,100 barrels from an offshore chronic pipeline leak, and 6,900 barrels from an onshore chronic pipeline leak. These volumes are comparable to the spill volumes associated with Alternative 4, and involve greater potential volumes of spillage from the offshore pipeline than those associated with Alternatives 2 and 3.

- The probability of one or more pipeline spills greater than 1,000 barrels is 5.4% to 19% (Table 8-6). Concerns related to permafrost thawing at the shoreline crossing and associated spill risk which are common to Alternatives 2, 3, and 4 would be eliminated with this alternative.

11.8 COMPARATIVE IMPACTS OF ALTERNATIVES

The principal differences among alternatives are discussed in relation to specific impacts below. Impacts include both those due to expected general operations of the project and those due to accidental events which are probabilistic (such as large oil spills) and may not occur. Unless otherwise indicated below, Alternative 1 would not result in the impacts discussed.

11.8.1 Shoreline Landfall Issues

Alternatives 2, 3, and 4 all include pipeline landfall sites at natural shorelines. The installation of a buried seafloor pipeline in an excavated trench across the permafrost transition zone could result in local thaw bulb creation and associated subsidence. Such subsidence could result in increased maintenance requirements at the landfall site, including the addition of fill to maintain the shoreline. Repeated maintenance activities could result in repeated disturbances of local vegetation and increase local erosion. Stresses on the pipeline caused by subsidence could also increase the risk of pipe failure and a resulting oil spill. The magnitude of this increased risk and its potential effect on the total probability of a major oil spill associated with Alternatives 2, 3, and 4 cannot be calculated with presently available data. Alternative 5 does not involve pipeline installation across a natural shoreline, and these related impacts would not occur.

11.8.2 Maintenance Impacts on Vegetation

Impacts associated with routine maintenance activities would differ among the alternatives. Alternative 2 is expected to result in the greatest routine maintenance impact, primarily as a result of potential overland access to the 9.55-mile (15.37 km) overland pipeline segment in a presently inaccessible area. Access to this pipeline during summer months could result in damage to native vegetation well beyond the immediate vicinity of the pipeline. Alternative 3 would result in similar potential disturbances along the

3.6-mile (5.8 km) pipeline segment from Point Storkersen to existing oil facility roadways, but access in this area could be confined to the pipeline route itself. Alternatives 3, 4, and 5 all include a 3.1-mile (5 km) onshore pipeline segment on currently undeveloped land, but this segment is within the existing industrial area and intersects existing roadways at either end. For this reason, access to this pipeline segment could be confined to the pipeline corridor, and is not expected to result in substantial routine maintenance impacts.

Additional routine maintenance impacts could be associated with the maintenance of natural shoreline crossings, as mentioned in Section 11.8.1. Alternatives 2 and 3 present the greatest impact in this regard as a result of the location of the Point Storkersen landfall site approximately 2.7 miles (4.3 km) from the nearest roadway (straight line distance). Because access to the landfall site could require overland access during summer months, vegetation disturbances could extend beyond the immediate vicinity of the Alternative 2 pipeline route. Access could be confined to the pipeline corridor in the case of Alternative 3, but this would result in repeated disturbance of natural vegetation along the 3.6-mile (5.8 km) pipeline route from the landfall site to existing roadways. The Point McIntyre landfall site associated with Alternative 4 is located in close proximity to existing roadways (0.3-mile [0.5 km]) within the existing industrial area, and access-related vegetation disturbance in this area would be minor. The Alternative 5 landfall at the West Dock causeway would avoid all landfall maintenance impacts to natural vegetation.

11.8.3 Operational Disturbance of Wildlife

Disturbance of wildlife from operations activities is associated with weekly helicopter overflights along the pipeline route, helicopter transport of personnel/supplies to Seal Island during the spring and fall, and vessel transport to Seal Island during open water. Helicopter overflights along the pipeline associated with Alternative 2 represent the greatest level of impact, as a result of the 9.55-mile (15.37 km) overland pipeline segment across largely undeveloped tundra. These overflights, during the summer months, could result in minor impacts to caribou in the area and to tundra nesting birds (including threatened spectacled eiders) in a corridor along the onshore pipeline. However, appropriate measures to avoid or minimize the potential effect will be recommended by the U.S. Fish and Wildlife Service (USFWS). Alternative 3 would result in similar impacts; however, these would be to a 6.7-mile (10.8 km) pipeline, including the 3.5 mile (5.8 km) pipeline segment from Point Storkersen to the existing road system near Point McIntyre. Alternatives 4 and 5 would require helicopter overflights along the pipeline of approximately 3.1 miles (5 km) for routine inspections.

The impact of helicopter overflights between the mainland and Seal Island will be common to all alternatives routes. These impacts would involve disturbances to nesting common eiders on the barrier islands and occasional disturbances to nesting or brood-rearing brant if flight paths include the Kuparuk River Delta. Helicopter overflights also have the potential to disturb nesting or brood-rearing activities of spectacled eiders within the flight path, which would be considered a minor impact. Noise and activity associated with the operation of the Seal Island facility, and related vessel transport operations, could result in bowhead whale avoidance response during migration periods. This impact is not expected to directly harm individual whales or whale populations, but may be important to the consideration of potential subsistence activity impacts (discussed separately in Section 11.8.4).

Cumulative impacts to sea ducks (common eiders and oldsquaw) due to helicopter flights during construction are considered significant. All action alternatives (Alternatives 2, 3, 4, and 5) would result in the same potential minor bowhead whale avoidance impact.

11.8.4 Impacts of Facility Operations on Subsistence

All action alternatives would have comparable operational impacts to subsistence activities. During normal operation of the Seal Island facility, bowhead whale avoidance of industrial noise and activity could require whalers to travel further offshore in search of whales. This would represent several significant effects on the subsistence activity, including: increased safety risks to whalers, reduced harvest success caused by longer time required for each whale, and potential meat spoilage associated with longer transport distances. In addition, should the IWC perceive any increased impact on or risk to the whale population, the bowhead harvest quota could be reduced. Project-related activities would contribute to cumulative effects on the bowhead whale migration route associated with increased offshore development, which could be significant to subsistence activities.

11.8.5 Expansion of Developed Area

All action alternatives would result in the addition of a new industrial facility in the offshore area. However, these alternatives are distinctly different with regard to onshore land use impacts. Alternative 2 represents the greatest onshore land use impact, and would establish a new overland pipeline corridor in an existing undeveloped area from Point Storkersen to Pump Station No. 1. In addition to the expansion and intensification of the industrial complex in the Prudhoe Bay - Kuparuk area, Alternative 2 could contribute to the further development in the Gwydyr Bay area by establishing a pipeline corridor closer to that area. Alternative 3 would also expand industrial land uses by extension of Prudhoe Bay area pipeline corridors westward to Point Storkersen, but the consolidation of most of the Alternative 3 onshore pipeline along existing industrial corridors reduces the overall impact in comparison to Alternative 2. Alternative 3 is comparable to Alternative 2 in the potential contribution to future development in the Gwydyr Bay area. The consolidation of the onshore pipeline routes with existing industrial corridors represented by Alternatives 4 and 5 effectively eliminates new onshore land use impacts associated with these alternatives. Alternatives 4 and 5 also do not contribute to potential future development in the Gwydyr Bay area.

11.8.6 Socioeconomics

All action alternatives are expected to generate comparable contributions to State of Alaska, federal, and local revenues and create the same number of jobs. This includes the contribution of $478.9 million gross state royalty and tax revenues, $306.3 million in federal tax and royalty revenues, $64.3 million in NSB tax revenues, and $3 million in MOA tax revenues over the 15-year project life. This represents a substantial beneficial impact on State of Alaska revenues, since North Slope oil and gas revenues represent the primary source of state revenues (ADNR, 1997:5-40) (Section 7.6). The Northstar Project would represent approximately 2.4% of the total currently projected North Slope oil production during its

project life. Construction employment would generate 730 jobs, and 100 annual long-term (15-year) facility operation and project support jobs, and total wages of over $307 million.

None of the revenue and employment benefits would result from the No Action Alternative (Alternative 1).

11.8.7 Visual/Aesthetic Impacts

All action alternatives would result in comparable offshore visual impacts associated with the addition of artificial lighting and industrial facilities on Seal Island. However, onshore visual impacts would be substantially different. Alternative 2 would result in the greatest visual impact associated with the addition of a 9.55-mile (15.37 km) elevated pipeline across a currently undeveloped area. Alternative 3 would result in similar impacts along a shorter elevated pipeline segment (3.6 miles [5.8 km]) from Point Storkersen to existing Prudhoe Bay industrial facilities. Alternatives 4 and 5 would not result in new onshore visual impacts because their onshore pipeline routes are within or close to existing industrial corridors of the Prudhoe Bay industrial area.

11.8.8 Likelihood of a Large Oil Spill

Each action alternative presents a risk of 11%/12% to 24% (any cause) over the 15-year project life of an oil spill greater than 1,000 barrels (Table 8-6). Calculated probabilities of one or more pipeline spills greater than 1,000 barrels over the entire project lifetime are: Alternative 2 – 4.5% to 19%; Alternative 3 – 5.6% to 19%; Alternative 4 – 5.5% to 19%; and Alternative 5 – 5.4% to 19%. The calculations used to develop these probabilities consider a large database, including facilities in non-arctic locations. As a result, they are subject to substantial uncertainty and the relatively minor differences resulting from these calculations are not considered substantial enough to effectively distinguish between the action alternatives.

Specific design features of individual facilities are important to the level of spill risk associated with those facilities. The natural shoreline landfalls at Point Storkersen and Point McIntyre associated with Alternatives 2, 3, and 4 are expected to represent some increased risk as compared to the West Dock causeway landfall for Alternative 5. As explained in Section 11.8.1, this increased risk is associated with thaw bulb related subsidence and shoreline erosion at the landfall site. No data are presently available which can be used to verify this impact conclusion, or to quantify the contribution of this impact to spill occurrence probabilities.

11.8.9 Potential Oil Spill Volumes

The potential volume of spilled oil varies among alternatives. This variation is entirely related to differences in pipeline lengths, since Seal Island facilities would be identical for all alternatives. Maximum spill volumes assume complete drainage of oil from the pipeline lengths between valves. The potential pipeline spill volumes would be least for Alternative 2, with calculated rupture/chronic leak volumes of 3,600/6,600 barrels from the offshore pipeline segment and 6,400/6,600 barrels from the

onshore pipeline segment. Alternative 3 would result in the same offshore pipeline spill volume as Alternative 2 (3,600/6,600 barrels), but could result in a substantially greater onshore spill volume of 8,700/8,900 barrels. Alternatives 4 and 5 present substantially greater potential offshore spill volumes (5,300/8,200 barrels and 5,200/8,100 barrels, respectively). Use of buried, remotely operable pipeline valves to reduce these volumes could introduce considerable operational difficulty concerning valve inspection and maintenance, and may introduce a design feature with a much higher risk of failure (and resulting spillage) than a continuously welded steel pipeline. For these reasons, installation of valves along the offshore portion of these pipelines is not considered appropriate. Onshore pipeline spill volumes associated with Alternatives 4 and 5 would be slightly greater than Alternative 2 (6,800/7,000 and 6,700/6,900 barrels, respectively), and these differences are not considered significant.

11.8.10 Potential Oil Spill Impacts

Although the action alternatives could result in different volumes of offshore pipeline spills (refer to Section 11.8.9), other offshore spills associated with Seal Island facilities would be identical. In addition, even the smallest of the calculated offshore pipeline spill volumes of 3,600 barrels could be substantial enough to result in significant adverse impacts, as previously identified in this EIS. However, the offshore pipeline route for Alternative 4 would mostly avoid Gwydyr Bay, except for that portion off the eastern end of Stump Island to the shoreline landfall. Alternative 5 would completely avoid Gwydyr Bay. This would likely reduce the potential oil spill related impacts to the birds and fish using Gwydyr Bay. For Alternative 5, oil spill response tactics for an offshore spill would include the placement of booms which could preclude oil from entering the Gwydyr Bay/Simpson Lagoon system. Additionally, since oil spill response equipment would be staged from West Dock, a more rapid response would be possible for the nearshore portions of the pipeline for Alternatives 4 and 5. Offshore spill responses for Alternative 2 and 3 would not be as rapid, because the nearshore portions of those pipelines would be further from West Dock.

Significant adverse impacts which could occur in connection with a major offshore spill from any of the action alternatives include: direct mortality and injury to birds (e.g., oldsquaw and common, king, Steller's and spectacled eiders); direct mortality of bowhead whales (if oil contacts the spring lead system coincident with migration); mortality of polar bears (caused by oil contact, thermoregulation loss, ingestion of oil-contaminated prey); elimination or severe disruption to subsistence activities; and potential long-term adverse effects on offshore subsistence activities (due to deflection of whales, reduced populations of subsistence resources, and possible oil contamination of available subsistence resources such as bowhead whales, seals, birds, and fish).

Onshore spill impacts vary substantially among the action alternatives. Although the onshore spill volume associated with Alternative 2 is the least of all action alternatives, this alternative would result in the greatest onshore spill impact. The Alternative 2 pipeline route across 9.55 miles (15.37 km) of existing undeveloped land, removed from existing industrial development, would expose relatively undisturbed vegetation and wildlife resources to the impacts of an oil spill. Alternatives 3, 4, and 5 cross 3.1 miles (5 km) of undeveloped tundra near the southern terminus of the alignment. In addition, access to the onshore spill site by response equipment would require overland access. If a spill occurs during

summer months, disturbances to vegetation caused by equipment access could extend the disturbed area well beyond the immediate vicinity of oil contamination. Similar disturbance of vegetation and overland access impacts could occur in connection with Alternative 3, but this impact is not as great as Alternative 2 because only 3.6 miles (5.8 km) of the Alternative 3 pipeline route is located outside the existing developed industrial area. The remainder of the Alternative 3 onshore pipeline route, and all of the Alternatives 4 and 5 onshore pipeline routes, are located within the existing industrial area. These routes follow existing roadways and pipeline corridors over most of their lengths, and one overland segment in the southern portion of these routes occurs near existing roadways and is surrounded by industrial development. Spill impacts in the existing industrial area are considered less substantial than those in undeveloped areas due to available year-round access and the level of existing disturbance already present in the industrial area.

11.8.11 Cumulative Impacts

As discussed in Section 11.3, ongoing and reasonably foreseeable future oil industry activities will result in cumulative impacts in the Alaskan Beaufort Sea, regardless of Northstar development. These impacts, some of which may be significant, include industrial noise and oil spill impacts on subsistence bowhead whaling, mortality and habitat displacement impacts for polar bears from oil spills and noise, noise impacts to molting sea ducks from mortality caused by oil spills or offshore helicopter overflights during construction, mortality of spectacled eiders from oil spills, and habitat displacement of ringed seals from noise. Although Alternatives 2, 3, 4, and 5 add different incremental impacts to the cumulative impacts, the differences are negligible from the perspective of overall cumulative impacts.

11.8.12 Unavoidable Adverse Effects, Relationship Between the Local Short-Term Uses and Long-Term Productivity, and Irreversible and Irretrievable Commitment of Resources

Unavoidable adverse effects, the relationship between local short-term uses and long-term productivity, and irreversible and irretrievable commitments of resources issues are essentially the same among all action alternatives. Therefore, distinctions among individual alternatives have not been identified.

Geology and Hydrology: Primary issues or concerns for resources within the physical environment are related to the potential for direct and long-term impacts to soils, permafrost, sediment quality, accelerated coastal erosion, and hazards that could affect Seal Island and pipeline integrity. However, no unavoidable adverse impacts to geology or hydrology from project construction, operation, maintenance, or abandonment were identified.

The project would require an irreversible commitment of geologic resources (i.e., oil and gas reserves and fossil fuels used for construction and fabrication of facilities). Ground disturbances associated with installation of the subsea pipeline, the onshore VSMs, and gravel mining for reconstruction of the island and associated onshore facilities would be irreversible, as it would be a direct effect to soils and permafrost during the life of the project.

Meteorology and Air Quality: No significant unavoidable adverse impacts to air quality from the

project were identified. Short-term impacts would include those from localized construction activities' emissions, which are negligible. Long-term impacts include emissions from facility operations and vehicles delivering supplies to the offshore site. These air quality impacts are negligible and would occur as a result of routine facility operations and periodic maintenance activities. Irreversible or irretrievable impacts to air quality from construction or operations are not anticipated.

Physical Oceanography and Marine Water Quality: No unavoidable impacts with respect to physical oceanography or marine water quality were identified as a result of the project. This includes any direct or indirect impacts due to construction activities, operational characteristics (with the exception of a large oil spill), maintenance procedures, or abandonment options. No irreversible or irretrievable commitment of resources related to the physical oceanography and marine water quality of the Alaskan Beaufort Sea would result from the project.

Sea Ice: No significant unavoidable adverse effects to sea ice would result from construction and operation activities. All identified effects would be short-term, partly due to the limited duration of activities, and partly due to the seasonal presence of sea ice. The project would not require any irreversible or irretrievable commitment of resources with respect to the sea ice. Project components have been designed to anticipate, accommodate, and alleviate potential impacts from sea ice during all phases of the project.

Plankton and Marine Invertebrates: No significant adverse impacts from the development of the proposed project were identified for phytoplankton, zooplankton and benthic marine invertebrates, or the epontic community, which lives under the sea ice. Impacts to plankton and marine invertebrates identified as a result of Seal Island reconstruction, and trenching and burial of the pipeline include mortality from direct burial, smothering, and displacement.

Reconstruction of Seal Island, trenching and burial of the offshore pipeline, and placement of gravel at West Dock (Alternative 5) could result in short-term impacts to plankton and marine invertebrates. Plankton would be rapidly replaced from production or from adjacent areas. Recolonization of the disturbed bottom substrates would occur after construction, and long-term productivity of the impacted area would not be adversely affected. Pipeline and facilities operation would have no long-term impacts on plankton or marine invertebrates. Maintenance activities that require offshore pipeline repair would result in short-term impacts to plankton and marine invertebrates.

The development of any of these alternatives would not result in irretrievable or irreversible commitment of marine invertebrate resources. Recolonization of the areas affected would replace lost biomass.

Marine and Freshwater Fish: No significant unavoidable adverse impacts to fish resources from project development would occur. The local fishery would continue to experience fluctuations in population levels within the range of natural variation. Reconstruction of Seal Island and trenching of the buried pipeline would result in a temporary increase in turbidity and subsequent short-term displacement of local fish populations in water deeper than 6 ft (1.8 m). Similar impacts could occur from the placement of gravel at West Dock Causeway under Alternative 5.

Overall, construction of the project is expected to result in minor, short-term impacts to local fish populations due to displacement and loss of habitat. No adverse effects which would affect the long-term productivity of the local fishery are anticipated.

Reclamation of the mine site on the Kuparuk River Delta and the side slopes of Seal Island would be beneficial to fish. Creation of additional deep water and overwintering habitat would result in a positive increase in long-term productivity due to a potential improvement to fish habitat.

Marine Mammals: The development of Alternatives 2, 3, 4, or 5 would result in some minor impacts to ringed seals and polar bears during the stable ice period (e.g., noise and construction disturbance on ringed seals). Polar bears may be either attracted or displaced by activity on the ice, but the impacts are considered minor. Impacts to denning polar bears are not expected due to the lack of documented denning in the area affected by the project. Beluga whales are only present during the open water period in fall, and no impacts are anticipated. Reconstruction of Seal Island, construction of the offshore pipeline, and ice road traffic could result in direct, short-term impacts from disturbance and displacement of seals from the vicinity of Seal Island and disturbance or attraction of polar bears to Seal Island. No long-term adverse impacts to marine mammals from planned construction, operation, or maintenance activities have been identified. The abandonment of Seal Island would not create any additional habitat for marine mammals or affect the use of the area by marine mammals. Mortality of polar bears from oil spills would be considered a significant impact.

Coastal Vegetation and Invertebrates: No significant unavoidable adverse impacts were identified for coastal vegetation and invertebrates as a result of the project. Tundra vegetation would be impacted from late melting of ice roads, fill of wetlands for the installation of the valve stations, and placement of the VSMs. Oil spills could potentially have significant adverse impacts on small areas of coastal tundra along the onshore pipeline or on saline tundra vegetation in low-lying areas on the coast. The development of any of Alternatives 2, 3, 4, or 5 would result in the loss of river bar habitat on the Kuparuk River Delta in the gravel mine area, and would also result in the filling of small areas on tundra for the valve station.

Such impacts would result in the long-term loss or commitment of habitat and would be an irreversible commitment of resources. Ice road construction would result in some compression and late green-up of tundra the first year after construction for Alternatives 2, 3, 4, and 5. The impacts would be short-term and would not impact long-term productivity. The onshore pipeline would not require fill, and after abandonment and pipeline removal, this area could be restored to its former habitat.

Birds: Displacement of nesting birds from late melting ice roads on tundra would be considered a minor impact. Impacts from a large oil spill could significantly affect several species of waterfowl, including sea ducks, such as common eiders and oldsquaw, which molt in Simpson Lagoon/Gwydyr Bay during mid-summer. Significant impacts to sea ducks (not including spectacled eiders) would be expected offshore from helicopter overflights during construction. Impact to birds from a spill on land would be considered minor and would only affect a localized area.

Development of the gravel mine and construction of the onshore pipeline could result in a short-term impact on nesting habitat and a long-term increase in aquatic habitat with the restoration of the mine (a negligible beneficial impact for some species). Operation and maintenance of the pipeline and facilities would have no long-term impacts to birds, either onshore or in offshore waters. However, an increase of predatory avian species resulting from additional food sources on the island is likely to occur. Low elevation helicopter overflights to Seal Island and pipeline inspection flights could result in adverse impacts to nesting common eiders on the Barrier Islands, and molting sea ducks in Simpson Lagoon. Collision with structures on Seal Island by migrating birds could potentially be significant to some species.

The development of any of the project alternatives would require commitment of river bar habitat at the gravel mine and the filling of small areas of tundra for the valve stations which would result in an irreversible commitment of habitat. Removal of the onshore pipeline during project abandonment would allow return of the habitat for use by birds and, therefore, would not be considered an irreversible commitment of the resource.

Terrestrial Mammals: No significant unavoidable adverse impacts were identified for terrestrial mammals including caribou, grizzly bears, and Arctic fox, as a result of development of the project. Development of the gravel mine and construction of the onshore pipeline could result in negligible short-term displacement of any caribou wintering in the area. The operation and maintenance of the pipeline and facilities would have no long-term impacts on terrestrial mammals.

Alternatives 2, 3, 4, and 5 require an irreversible commitment of resources for the gravel mine and, for Alternatives 2, 3, and 4, would require the filling of small areas of tundra for the valve stations. Pipeline removal during project abandonment would allow return of the habitat for terrestrial mammals and, therefore, would not be considered an irreversible commitment of resources.

Threatened and Endangered Species: Alternatives 2, 3, 4, or 5 would have similar impacts on threatened and endangered species. Ice road and Seal Island construction would not impact bowhead whales, Steller's eiders, or spectacled eiders because these activities would occur in winter. Construction and abandonment would also take place during the winter. Operational and maintenance activities and drilling at Seal Island would create noise which might be heard by bowheads several miles away from Seal Island. Impacts of such noise on bowheads may alter the migration pattern of whales within the area. Actual impact to whales from the sound is considered minor and limited to the period of project operation.

Disturbance of nesting spectacled eider along sections of the onshore pipeline from late melting ice roads would result in a short-term impact to this species. However, nest site loss would have a negligible impact because of the abundance of suitable nesting habitat in the project area. Low-level helicopter overflights would result in the potential disturbance and minor impacts of a small number of nesting spectacled eiders along each onshore pipeline corridor.

After project abandonment, there would be no further impacts to endangered or threatened species. Project construction or operation would not result in loss of threatened or endangered species habitat. Consequently, irretrievable commitments of resources are not expected.

Subsistence: Construction, operation, and maintenance noise could cause behavioral changes in bowhead whales. However, project design and scheduling would reduce the likelihood of adverse impacts to subsistence harvesting. If large ships were active near Seal Island during the fall bowhead migration and subsistence hunting period, the whale migration pattern could be deflected in the extreme western portion of the Nuiqsut harvest area. Although highly unlikely because of the planned schedule for island construction activities, there is a slight chance that some bowheads could be deflected from their normal migration path. If this were to occur within the western portion of the harvest area and if hunting was unsuccessful within the eastern and central portions of the harvest area, impacts to the fall subsistence harvest during construction would be considered significant. The loss of hunting success would be short-term if it were limited to a single-season (construction), but long-term if it continued throughout the duration of the project as a result of island maintenance or operations. The loss of subsistence harvesting also would be considered to be an irretrievable and irreversible loss of the resource for the period during which such losses occurred. Deflection or mortality of migrating bowhead whales from oil spills or project-related noise could result in significant impacts to subsistence.

Cultural/Archaeological Resources and Human History: Unavoidable adverse impacts to cultural resources as a result of construction, operation, maintenance, or abandonment activities are not anticipated. If such resources are encountered during construction, they will be either avoided or mitigated. However, significant impacts to such resources may result in the event of a large onshore or offshore oil spill (Chapter 8). Contamination of important cultural resources could cause irreparable damage to historic artifacts, and cleanup operations could cause physical damage to existing sites.

Land and Water Use: Unavoidable, adverse impacts as a result of changes to the status of jurisdiction or changes in ownership were identified as minor. The onshore portion of the pipeline for Alternatives 2, 3, 4, and 5 would cross access roads, existing pipelines, and utility lines. Some short-term and minor impacts to land use would occur during construction due to road closures or detours, and interruptions to pipeline flow or utility service. There would be no impacts to onshore industrial land use due to project operation. Because traditional land use of the onshore portion of the project area is infrequent, onshore construction and operation would have a negligible impact on traditional land use.

There would be no impacts on use of submerged lands during project construction or operation. Boat traffic associated with project construction and operation would cause negligible impacts to boat access associated with offshore subsistence uses.

Onshore pipeline route lands will be used for industrial purposes for the duration of the project. However, the area could be used for other purposes following depletion of oil and gas resources. Therefore, short-term uses of the area would not preclude returning land uses to pre-construction condition.

Designated easements would result in temporary commitment of resources for project development and

operation. However, corridors could be used for other purposes following completion of oil and gas production, thus long-term effects of land use changes resulting from this project are not anticipated.

Socioeconomics: Project construction and operation would have a beneficial impact to employment and to local, state, and federal governments through the creation of jobs and oil-related royalty and tax revenues. Short-term benefits would result from the creation of construction jobs for gravel mining, island reconstruction, pipeline installation, facilities fabrication, and drilling. Project construction would generate 730 Alaska construction jobs with estimated wages of $52 million. Long-term benefits would result from the addition of operations personnel and the generation of tax and royalty revenues. Project operation would generate 100 Alaska operation and project support jobs annually, with estimated wages of $255 million over a 15-year project life. Total project revenues from oil and gas taxes and royalties are estimated at $478.9 million for the State of Alaska, $306.3 million in revenue to the federal government, $64.3 million in revenue to the NSB, and $3 million to the MOA, over the 15-year project life. Approximately $64.3 million would be generated in property taxes for the NSB over the 15-year life of the project.

Transportation: Significant adverse impacts to transportation are not anticipated. Increases in equipment and materials transported through the Ports of Seward, Whittier, and Anchorage are expected to represent 1% to 26% of current levels, and incremental increases in truck traffic along the Dalton Highway are expected to be 2% of current levels. Barge and boat traffic associated with project construction would result in a short-term increase in traffic between Seal Island and West Dock, and bus and truck traffic would increase for the transport of materials and workers, which would result in minor impacts to transportation facilities in the project area. Northstar crude oil would total approximately 4% of the Trans Alaska Pipeline System throughput during peak project production years, and contributions to the throughput of the system would be a beneficial impact.

Visual/Aesthetic Characteristics: Construction of Alternatives 2, 3, 4, and 5 would erect structures that would interrupt horizontal views. Construction of facilities on Seal Island and the onshore pipeline approach would be visible for the life of the project (15 years) and would affect the long-term visual resources if not dismantled during abandonment. The glow caused by the lighting and occasional use of the flare seen beyond the horizon from Nuiqsut would be visible for the life of the project, as well; however, visual resources would return to pre-construction levels when the project is decommissioned.

Recreation: Recreation activities that would be affected by the project are limited to those along the Dalton Highway, and significant impacts are not anticipated.

11.9 IDENTIFICATION OF THE PREFERRED ALTERNATIVE

NEPA requires that the lead and cooperating agencies identify their preferred alternative and document the reasons supporting this determination. This selected alternative is commonly referred to as the "agency preferred alternative."

11.9.1 Agency-Preferred Alternative

The agency preferred alternative is that alternative which the agency believes would fulfill its statutory mission and responsibilities, giving consideration to environmental, economic, technical, and other factors. The agency preferred alternative is distinct from the "environmentally preferred alternative." The environmentally preferred alternative is ordinarily the alternative which causes the least damage to the biological and physical environment and best protects historic, cultural, and natural resources. Although the agency preferred alternative and the environmentally preferred alternative may be the same, this is not always the case. Due to the differing missions, responsibilities, and regulations of the cooperating agencies, their perspectives on an "agency preferred" alternative are different. The following information is provided to clarify the agencies' perspectives and the processes followed to reach agency decisions.

11.9.1.1 U.S. Army Engineer District, Alaska

The U.S. Army Engineer District, Alaska (Corps) is neither an opponent nor a proponent of the applicant's proposed alternative action. For the proposed Northstar development, the applicant's final proposal has been identified as Alternative 2 (applicant's preferred alternative) and is fully described in Appendix A to this document.

In order to make a permit decision for activities involving discharges under Section 404 of the Clean Water Act, the Corps applies the U.S. Environmental Protection Agency's (EPA's) 404(b)(1) guidelines on evaluation of alternatives for disposal sites for dredged or fill material (40 CFR Part 230). This EIS has evaluated the applicant's proposal (Alternative 2), the No Action Alternative, and three additional action alternatives. The Corps will also use the range of alternatives in this document when conducting its 404(b)(1) alternative analysis. If the Corps determines that one or more of the alternatives is a substantially less damaging, practicable alternative as compared to the applicant's proposal, the Corps may deny the applicant's request for a permit for Alternative 2. From a NEPA perspective, the Corps could select from the range of all alternatives evaluated in this document. A preliminary 404(b)(1) analysis for the applicant's proposal (Alternative 2) is included in the Corps' public notice soliciting comments on the Final EIS (FEIS).

The Corps also conducts a public interest review of all relevant factors (33 CFR Part 320.4(a)) in order to make a permit decision. The public interest review is still in progress, with the release of this FEIS, the solicitation of public comments on the FEIS, and the solicitation of public comments on the decision of whether or not to grant a permit for the applicant's proposal. This public interest review portion of the decision whether to issue a permit will be based on an evaluation of the probable impacts, including cumulative impacts of the proposed activity and its intended use on the public interest. Evaluation of the probable impacts which the proposed activity may have on the public interest requires a careful weighing of all those factors which become relevant in each particular case. The benefits which reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. The decision whether to authorize a proposal and, if so, the conditions under which it will be allowed to occur, are therefore, determined by the outcome of the general balancing process. That decision should reflect the national concern for both protection and utilization of important resources. All factors which may be

relevant to the proposal must be considered, including the cumulative effects thereof. Among those are: conservation, economics, aesthetics, general environmental concerns, wetlands, cultural values, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shore erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food and fiber production, mineral needs, considerations of property ownership, and, in general, the needs and welfare of the people.

The Corps' permit decision, which includes the public interest review and final 404(b)(1) guidelines analysis, will be completed in the Corps' Record of Decision (ROD). Decision options available to the District Engineer will be to issue the permit, issue with modifications and/or conditions, or deny the permit. The Corps cannot take a position on a proposed project until the evaluation of the project using the 404(b)(1) guidelines is finalized, the public interest review is completed, and a ROD has been prepared and approved. Therefore, the Corps cannot identify its agency preferred alternative in the EIS (see 33 CFR Part 325, Appendix B). The Corps will make its permit decision after the ROD has been approved, which will occur after the 30-day comment period on the FEIS. For activities involving 404 discharges, a permit will be denied if the discharge that would be authorized by such permit would not comply with the EPA's 404(b)(l) guidelines. Subject to the preceding sentence and any other applicable guidelines or criteria (see 33 CFR 320.2 and 320.3), a permit will be granted unless the District Engineer determines that it would be contrary to the public interest.

11.9.1.2 U.S. Environmental Protection Agency

The EPA is proposing to issue a National Pollutant Discharge Elimination System permit as described in Appendix O. Because of the responsibilities that the EPA has under the Clean Water Act, the EPA does not promote the selection of one project alternative over another. The EPA will review and act according to its Clean Water Act authorities following the Corps' decision-making process (Section 11.9.1.1).

11.9.1.3 Minerals Management Service

Under the Outer Continental Shelf (OCS) Lands Act of 1953 (67 Stat. 462), as amended (43 U.S.C. et seq. [1994]), the U.S. Department of the Interior is required to manage the leasing, exploration, development, and production of oil and gas resources on the Federal OCS, and requires that the Secretary oversee the OCS oil and gas program. The Secretary is also charged with balancing orderly resource development with protection of the human, marine, and coastal environments, while simultaneously ensuring that the public receives an equitable return for these resources. As an agency of the Department of the Interior, the Minerals Management Service (MMS) is responsible for the mineral leasing of OCS lands and for the supervision of offshore operations after lease issuance. A lease gives the lessee the exclusive right and privilege to drill for, develop, and produce oil and gas resources on that lease, subject to existing laws and regulations. Once a lease is awarded, the MMS' Regional Supervisor for Field Operations is responsible for approving, supervising, and regulating operations conducted on the lease.

As required by 30 CFR 250.204, the MMS will carefully analyze the information submitted by BPXA for this project, as well as the analysis presented in the FEIS and any comments received, prior to making any final decision on the Development and Production Plan (DPP). In this context, the MMS is a cooperating

agency on this EIS. This EIS has evaluated the applicant's proposal (Alternative 2), plus the No Action Alternative and three additional action alternatives related to pipeline routing. Upon completion of this review, the MMS will either approve, disapprove, or require modifications to the DPP. This action will not take place until after the FEIS is released. The MMS has up to 60 days following release of the FEIS to take action on the proposed DPP pursuant to 250.204(l). No OCS development and production activities can be conducted unless and until a DPP is approved, and the project has received coastal consistency concurrence by the State of Alaska.

Based on available information, the MMS identifies Alternative 2 as its preferred alternative. Among the five alternatives analyzed in the EIS, Alternative 2 meets MMS's legal and regulatory responsibilities for the timely and safe development of offshore oil and gas resources. Two principal benefits are discussed below.

Shortest Offshore Pipeline Segment: One of the most significant public concerns raised throughout the public process has been the risk of oil spills from the proposed subsea pipeline. Although the FEIS finds that there is not a significant difference in the statistical oil spill probability among the alternatives, the MMS concludes that adopting the shortest offshore pipeline segment is prudent and the most responsible alternative given the public's concerns. None of the action alternatives analyzed in the FEIS clearly provide a greater level of safety or reduce oil spill risk.

The State of Alaska, in its comments on the Draft EIS (DEIS), endorsed Alternative 2. The state noted that the shortest offshore segment is preferable. The state, which has direct regulatory authority on project pipelines, also noted that an exhaustive review of the Alternative 2 pipeline route had been completed and that the state was prepared to issue a right-of-way lease for the proposed pipeline route.

The NSB has also endorsed Alternative 2. The NSB Assembly has recommended approval to re-zone the area around Northstar which will allow the project to proceed. The NSB stated that the greater the length of pipeline under water, the greater the risk of a leak or damage to this pipeline. The NSB endorses BPXA's proposal to install offshore pipelines in a trench of sufficient depth to avoid contact with extreme event ice gouge, and to be below the maximum incision depth to avoid damage due to soil motions beneath the ice keel, and placing backfill material over the pipelines will provide protection from ice pounding and ice gouging. The NSB believes BPXA's proposal is consistent with the NSB's policy requiring offshore oil transport systems to be specifically designed to withstand geological hazards, specifically sea ice.

Timely Development Schedule and Lost Royalty Income: Alternative 2 is BPXA's preferred alternative. Site-specific surveys, facilities design, and engineering have been completed for this alternative and have been under review by appropriate state and federal agencies for several years. Construction schedules and first production are directly tied to these efforts. Any and each of the action alternative pipeline routes analyzed in the FEIS (except Alternative 2) would require a new and complete re-engineering of the pipeline, including additional field surveys to support design. The State of Alaska noted in its comments on the DEIS that any and each of the alternative pipeline routes would require submittal of a new right-of-way application, which would require the state right-of-way process to start

over. Conducting additional field studies, pipeline and other facilities re-design, and initiating a new right-of-way application review could delay the project construction schedule another 1 to 2 years. None of the alternative pipeline routes analyzed in the FEIS show a clear or significant environmental benefit or savings over Alternative 2, which would suggest that an additional 1 to 2-year delay in the project start up is not justified.

The Northstar Project will provide direct and significant royalty revenue to the federal government and the State of Alaska. The state in its comments on the DEIS, endorsed Alternative 2 on the basis that it would provide for the most timely completion of the project and, accordingly, royalty income to the state.

Delay of the project would also directly affect employment. The FEIS concludes that 730 jobs will be created and will generate approximately $52 million in Alaskan wages during the construction phase alone. Project operation, with an estimated 100 annual jobs and payroll of $255 million, could be similarly delayed. Substantial public comment was directed at the employment benefits of the project.

The MMS notes that, in selecting an agency preferred alternative in the FEIS, it is providing the public with some anticipation on how the project could proceed. Preferred alternatives are based on regulatory authorities and responsibilities and the information presented within the FEIS. The MMS's final decisions may or may not match the agency preferred alternative, pending any resulting information following publication of the FEIS and completion of their DPP review, and completion of the MMS' ROD.

11.9.1.4 National Marine Fisheries Service

The National Marine Fisheries Service (NMFS) does not promote the selection of one project alternative over another as the preferred action alternative. Rather, since all the alternatives (with the exception of Alternative 1 - No Action) will have impacts on the NMFS' trust resources, the NMFS promotes the incorporation of mitigation measures to avoid, minimize, and/or compensate for impacts to trust resources. The NMFS will provide this information to the Corps and cooperating agencies under the Endangered Species Act, the Marine Mammal Protection Act, and the Fish and Wildlife Coordination Act.

11.9.1.5 U.S. Fish & Wildlife Service

The U.S. Fish and Wildlife Service (USFWS) will not select an alternative for publication in this EIS. The USFWS is presently evaluating the potential impacts of this project on trust resources, particularly migratory birds (including the threatened spectacled eider) and marine mammals (polar bears). Because the management and responsibility of these wildlife resources and the habitats on which they depend are responsibilities of the USFWS as mandated by the Fish and Wildlife Coordination Act, Migratory Bird Treaty Act, Endangered Species Act, and the Marine Mammal Protection Act, the USFWS will not recommend an alternative until publication and review of the FEIS. If the USFWS recommends an alternative other than Alternative 1 (No Action), they will recommend mitigation measures to avoid,

minimize, or compensate for impacts to trust resources.

11.9.1.6 North Slope Borough

The NSB has been a non-federal cooperating agency in the preparation of this EIS and has been constrained by the requirements of its zoning ordinance to render a decision on the Northstar Project prior to publication of the document. BPXA submitted a rezone and Master Plan application to the NSB on September 15, 1998, and did not waive NSB compliance with the review and action timelines specified for such requests in the NSB Municipal Code. Without reliance upon or reference to this FEIS, the NSB Assembly, on December 1, 1998, approved the applicant's proposed rezone of the project area, which included BPXA's proposed project (Alternative 2). The Assembly's approval included several mitigation measures and becomes effective upon final approval of this FEIS.

11.9.2 The Environmentally Preferred Action Alternative

The environmentally preferred alternative(s) [40 CFR 1505. 2(b)] is the alternative that will promote the national environmental policy as expressed in NEPA's Section 101. Ordinarily, this means the alternative that causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves, and enhances historic, cultural, and natural resources. An action alternative must satisfy the applicant's purpose and need [33 CFR 325, Appendix B, 9b (5a)]. In this case, only Alternatives 2 through 5 meet this criteria (e.g., Alternative 1 – the No Action Alternative does not meets the applicant's purpose and need). In addition, identification of an environmentally preferred alternative considers only impacts to the physical, biological, and human environments; it does not take into account agency statutory missions or project cost factors. These two factors are considered by each agency in their determination of a preferred alternative (See Section 11.9.1). The agency preferred alternative need not be the same as the environmentally preferred alternative or the applicant's preferred alternative.

Alternative 5 was identified as the environmentally preferred alternative in the DEIS. A large number of comments regarding the environmentally preferred alternative were received and the need to further describe and discuss the rationale for choosing the environmentally preferred alternative was recognized . After reviewing all comments from the DEIS, and reevaluating the assessment of alternatives and related impacts, the lead and federal cooperating agencies (except for the MMS) are reconfirming Alternative 5 as the environmentally preferred action alternative for the following reasons (for a more complete comparison of alternatives and impacts see the previous sections in Chapter 11, in particular Sections 11.7 and 11.8):

- Although the offshore pipeline length is longer than Alternatives 2 and 3, and the corresponding probability of an oil spill is slightly higher (1.6%, 1.6%, 2.4%, and 2.4% for Alternatives 2, 3, 4, and 5, respectively), considering the level of uncertainty inherent in spill probability calculations, the calculated risk of an oil spill associated with all action alternatives would be similar (starts at 4.5%, 5.6%, 5.5%, and 5.4% for Alternatives 2, 3, 4, and 5, respectively, and ranges to 19% for all action alternatives). Additionally, pipeline design and maintenance considerations could reduce the probability of an oil spill

for any of the action alternatives (Section 8.5.3).

· Although the potential offshore pipeline spill volume is greater for Alternative 5, as compared to Alternatives 2 and 3 (3,600, 3,600, and 5,200 barrels for a pipeline rupture of Alternatives 2, 3, and 5, respectively), even the smallest of the calculated offshore spill volumes of 3,600 barrels could be substantial enough to result in significant adverse impacts. Thus, the offshore pipeline spill volumes for all of the action alternatives could cause significant adverse impacts.

· The offshore pipeline route completely avoids Gwydyr Bay and the nearshore lagoon system, an important area for migrating, rearing, and feeding marine and anadromous fish; and for molting, staging, and brood-rearing migratory birds. In the unlikely event of an oil spill, Gwydyr Bay could be protected from oil contamination by booming off the lagoon (i.e., placing oil containment booms between West Dock and Stump Island, and between Stump and Egg Islands). In comparison, Alternatives 2 and 3 offshore pipelines would be routed directly through the heart of the nearshore lagoon, while Alternative 4 would be routed through the eastern end of the lagoon.

· Oil spill response equipment would be staged at West Dock. In the event of an oil spill, this would allow for a more rapid response to the nearshore pipeline for Alternatives 4 and 5, as compared to spill response to the nearshore pipeline for Alternatives 2 and 3.

· The pipeline landfall on the West Dock causeway is intended to avoid the permafrost thaw bulb subsidence and shoreline erosion issues, which eliminates the permafrost thaw bulb subsidence hazard and shoreline erosion hazard common to all other action alternatives. This could be an advantage in terms of reduced risk of pipeline damage from differential thaw settlement that could result in an oil spill. In addition, this pipeline landfall on to West Dock would result in the elimination of maintenance activity that would otherwise be necessary in a natural shoreline area. In comparison, Alternatives 2, 3, and 4 would not avoid the natural shoreline issues of permafrost and erosion.

· Although approximately 5.5 acres (2.2 hectares) of shallow seafloor adjacent to West Dock causeway would be covered, this impact would be minor. Additionally, the causeway breach, a 650-foot (198 meter) bridged opening, would not be affected and no additional impacts to local water circulation would be expected.

· Location of the onshore pipeline entirely within an existing industrial area and in proximity to roadway access would: increase the probability of leak detection, reduce oil spill response time, and reduce access-related damage associated with oil spill response and unplanned pipe maintenance during the summer.

· Routine inspections and maintenance of onshore pipelines would be performed from existing roads, as opposed to the use of helicopters for Alternatives 2, 3, and 4. This would decrease the disturbance to wildlife from helicopter overflights.

· Locating onshore pipelines in an existing corridor would likely decrease impacts to caribou

moving through the area; other alternatives would require caribou to cross new onshore pipeline corridors.

- Onshore visual impacts would be reduced by routing the onshore pipeline within an existing industrial area.

Because NEPA rules allow more than one alternative to be identified as environmentally preferable, the MMS considers Alternatives 2 and 3 as its preferences for environmentally preferred alternatives. The MMS believes that there are substantive differences between the route of the offshore portion of the pipeline under Alternatives 2 and 3 compared to the Alternative 5 route outside the barrier islands. A major concern identified for the Northstar Project has been the offshore pipeline segment, especially since this is the first such design. MMS believes it is preferable to minimize the length of the offshore segment for this first application. Pipeline construction and monitoring issues, especially as they relate to the different ice characteristics within and outside the barrier islands, will be more manageable within the barrier islands. Alternatives 2 and 3 provide the shortest route to reduce the size and likelihood of an offshore oil spill and associated impacts. These differences lead the MMS to conclude that the offshore segment used in Alternatives 2 and 3 is environmentally preferable. The differences in impacts between Alternatives 2 and 3 are not sufficient to define which of the two would be environmentally preferable at this time. As required by NEPA rules, the MMS will make a final judgment on its environmentally preferred alternative in its ROD for the Northstar Project.

The NEPA process provides each federal agency with the opportunity to state its environmentally preferred alternative(s) in the DEIS, FEIS, and ultimately, in its ROD.

11.10 MITIGATION MEASURES

Mitigation measures are the means by which the range and intensity of project induced changes to the existing baseline conditions are compensated for, avoided, or reduced. In the case of this EIS for the Northstar Project, the cooperating agencies have developed a list of mitigation measures aimed at reducing or avoiding the identified significant environmental impacts expected to result from the project. This EIS is the appropriate means to present environmental impacts and associated mitigation measures.

The mitigation measures identified in this section represent a list of possible means to reduce impacts. If an action alternative is chosen, the mitigation measures will include some or all of the measures identified in this section. However, federal agencies are not limited to selecting mitigation measures from this list. Public comment on the FEIS may identify new mitigation measures. Each federal agency with decision-making authority on the Northstar Project will incorporate its own set of mitigation measures into its ROD that may become conditions or stipulations on their permit or action.

11.10.1 Federal Lease Sale Stipulations

There have been a number of federal offshore lease sales in the Alaskan Beaufort Sea since 1979. The most recent federal lease sale on the North Slope was Lease Sale 170, held August 5, 1998. The granting

of any lease to a private party is accompanied by a list of stipulations addressing issues, such as: the protection of historic and archaeological sites, environmental training, the requirement to use pipelines for transporting oil if technically feasible, special measures to protect biological and subsistence resources, and discharges into marine waters. The original federal lease stipulations for Northstar presently in effect are summarized in Appendix D of this EIS, and must be complied with by the lease holders when developing the Northstar Unit.

11.10.2 Mitigation Measures Under Active Consideration by Cooperating Agencies

Potential mitigation measures were identified by the cooperating agencies participating in the direction of this EIS based on their assessment of the likely environmental consequences of the Northstar Project. It is important to note that many potential environmental consequences of this project have already been minimized or avoided through integration of Traditional Knowledge and modern science into the applicant's project design (See Table 1-3). These design features have been assessed in the impact analyses of Chapters 5 through 11. However, the cooperating agencies identified the following measures to further reduce or avoid the remaining environmental consequences identified in Chapters 5 through 11. The intent of each measure is described; the actual wording of a measure will be developed by each agency according to their regulatory authority and responsibility. Mitigation measures that may be developed as part of the ROD are summarized as follows:

· Avoid potential injury and mortality to migratory birds, especially sea ducks (including threatened spectacled eiders), the applicant will lower and orient in an east-west direction, the construction crane (and any additional equipment of significant height) when equipment is not in use.

· Modify (via paint or lighting) structures or facilities to decrease the potential of bird strikes because Seal Island is within the migratory corridor of spring, fall, and molt-migrating waterfowl (king, common, and spectacled eiders, oldsquaw, black brant) and other birds (Pacific, red-throated, and yellow-billed loons, red and red-necked phalaropes).

· Require the purchase of *Breco* buoys (Navenco Marine Company) or other similar acoustic scaring devices to disperse sea ducks and other migratory birds from an oil spill area to augment secondary oil spill response capabilities.

· Prepare and implement bear-interaction plans to minimize conflicts between bears and humans. These plans shall include measures to: (a) minimize attraction of polar bears to Seal Island; (b) organize layout of buildings and work areas to minimize human/bear interactions; (c) warn personnel of bears near or on Seal Island and along offshore/onshore pipeline routes and identify proper procedures to be followed; (d) if authorized, deter bears from Seal Island and along offshore/onshore pipeline routes; (e) provide contingencies in the event bears do not leave the site or cannot deterred by authorized personnel; (f) discuss proper storage and disposal of materials that may be toxic to bears; and (g) provide a systematic record of bears on the site and in the immediate area. The applicant shall develop educational programs and camp layout and management plans as they prepare operations plans. These plans shall be developed in consultation with appropriate federal, state, and NSB regulatory and resource agencies.

- Because polar bears are known to den predominantly within 25 miles (40 km) of the coast, operators shall consult with the USFWS (907-786-3800) prior to initiating activities in such habitat between October 30 and April 15.

- Establish flight corridors for helicopter traffic to and from Seal Island. The objective of this measure is to minimize the impact of helicopter noise on nesting spectacled eiders, nesting brant, common eiders on the barrier islands, and molting waterfowl in nearshore lagoons. It is also intended to minimize noise impacts on denning seals, polar bears, and migrating whales.

- Establish vessel corridors to maximize separation between vessels and migrating whales. These would likely be seasonal restrictions and would apply during the fall whale migration. In particular, icebreaking barge operations related to maintaining a corridor between West Dock and Seal Island during broken/thin ice conditions cannot commence in the fall prior to October 15.

- Activities shall not be conducted nor pass within 1 mile (1.6 km) of any known polar bear dens and all observed dens shall be reported to the Marine Mammals Management Office, USFWS (907-786-3800) within 24 hours. This buffer zone will remain in effect from the time of detection, until the female bear/cubs leaves the denning area in the spring. The USFWS will evaluate these instances on a case-by-case basis to determine the appropriate action. Potential responses may range from cessation or modification of work to conducting additional monitoring.

- Require the preparation of an agency approved plan that demonstrates: 1) a reduction in oil spill risk, 2) increased leak detection under ice, and 3) increased oil spill response capability.

- Require use of the agitation technique for pile installation instead of pile driving during certain periods. Such a measure is intended to reduce noise impacts on marine mammals.

- Require a barge-based oil spill response plan. Three icebreaking barges would be used as the foundation of an on-site oil spill response plan. The barges would support oil cleanup crews, house equipment, and serve as a holding facility for recovered oil.

- Require complete shutdown of the pipeline during broken ice conditions. Such a measure is intended to minimize the risk of an oil spill when clean-up efficiencies are likely to be low.

- Require pre-staging of oil spill response equipment to protect biologically important sites, such as river deltas, lagoons, and barrier islands. This measure is intended to reduce the risk of an oil spill reaching and adversely affecting sensitive species in these important habitats.

- Require a well relief plan for a well blowout event. This measure is intended to ensure that emergency equipment is close by in the event of a well blow out, so that control of the well will be regained as quickly as possible, to maximize safety and reduce harm to the environment.

- Restrict construction and operation activities that may affect marine mammals (e.g., drilling, ball mill, pile driving). This measure is intended to reduce noise impacts to marine mammals and potential effects on subsistence.

- Prohibit drilling the first development well into the targeted hydrocarbon formation(s) during broken ice conditions. Such a requirement is intended to provide the applicant and the permitting agencies with an opportunity to test well integrity prior to the next development step and reduce the chance of an oil spill.

- Prohibit the drilling of exploration wells into untested formations during broken ice conditions. Such a measure is intended to reduce the chance of an oil spill occurring when oil spill cleanup efficiencies are likely to be low.

- Establish time periods for certain construction activities to minimize environmental consequences. Such activities would likely include: pipeline trenching, onshore and offshore gravel placement, spoil disposal offshore, gravel hauling, road construction, pipe construction, and pipeline testing.

- Establish a citizen's advisory board to address impacts to subsistence and to recommend to the government and the applicant solutions to any identified problems.

- Require additional site-specific geotechnical data prior to construction along the pipeline route in the shoal area and at the pipeline landfall. This data will be employed in a geotechnical analysis as specified in a plan requiring approval prior to construction. This plan will also specify the geotechnical sampling methodologies and sites.

- Require the use, if practicable, of arctic grade, low sulfur (0.05%) diesel fuel during the first year of drilling.

11.10.3 Monitoring Programs and Studies

Where environmental information is lacking, or where monitoring is required as a prerequisite to enforcement of permit conditions, federal agencies may require that the applicant conduct or financially support monitoring programs or further studies on various issues. The following have been identified as potential monitoring programs for the project:

- A monitoring program to investigate avian injury and mortality at Seal Island. The issue centers on whether facilities (towers, buildings, wires, and seawall) on Seal Island pose a hazard to birds. The study would need to be conducted from approximately May 1st through November 15th for a minimum of 5 years to monitor bird collisions during various ice conditions and lead patterns during bird migration periods.

- An acoustic monitoring program to measure actual frequency and noise level at various distances

from Seal Island during the construction and initial operation of facilities on Seal Island. The program should be conducted for at least 3 years, beginning with initial gravel placement on the island. This study is intended to better understand noise impacts to marine mammals and to determine the noise signature from project operations.

- Conduct or support studies that investigate the impact of noise from the project on bowhead whale migration. The intent is to both understand the effects of the Northstar project and to provide information necessary for consideration of future offshore development.

- A monitoring program to characterize pre- and post-construction sediment chemistry. This would be conducted along the pipeline trench with location reference sites.

- A monitoring program to track disposed material from trench excavation. The objective is to document how far these sediments travel and to determine if excessive subsea mounding occurs to determine compliance with permit conditions.

- A monitoring program to measure water quality and sediments around Seal Island. The objective is to gather data that can be used by the applicant and the agencies in determining whether the project is in compliance with permit conditions. In addition, this data may be used to inform the decision-maker when permit reissuance may be sought by the applicant.

- Require an erosion monitoring and remedial action plan to protect the pipeline landfall site in the event of unexpectedly large erosion events or rates. This plan should include both a monitoring component and a description of the remedial actions that may be employed in the event the landfall shoreline requires stabilization.

- Require an ice-override monitoring and action plan to protect the pipeline transition site in the event of unexpectedly large ice-override events.

- Because the specific timing of migration and distribution of sea ducks (common, king and threatened spectacled eiders, oldsquaws) and other migratory birds (e.g., Pacific, red-throated, and yellow-billed loons, red and red-necked phalaropes) have been inadequately described, and because this offshore development may impact these resources, the applicant may be required to conduct research using aerial surveys, migration watches, ground surveys of barrier islands, and the use of radar to describe spring, fall, and molt migrations and potential staging/molting areas of migratory birds.

- The applicant may be required to conduct aerial surveys of polar bears during certain times of the year around Seal Island and along the offshore/onshore pipeline corridors to minimize effects of the proposed development.