3.3.8.5 Bird Strikes

The effects of bird strikes have been described for the SDI expansion (Section 3.1) and facility construction (Section 3.3). Effects from the 250-ft tall drill rig would exist for about 3 years, while it is working on site (2010 through 2013). The effects from these facilities would continue during the life of the project. The effects from some facilities may occur even after production ceases.

BPXA design engineers have committed to consult with the FWS on identifying and implementing ways to reduce how facility lighting attracts/disorients birds in the project vicinity. Effectively reducing escaped lighting is believed to reduce the potential for birds to strike facilities on the MPI and SDI. Systematic monitoring for dead or injured birds on the SDI and MPI could help determine if these design features are effective.

There would be an anticipated increase in vehicle traffic on the Endicott Road to operate the facility, but this is much reduced from the construction phase; no substantial changes in the ability of some tundra-nesting birds and their broods to access coastal habitats is anticipated. The present level of mortality from roadkill is unknown. A reduced speed limit for vehicles during the nesting and/or broodrearing period could help reduce any negative effects of traffic on the Endicott Road. These negative effects are difficult to estimate, but the reporting of roadkill birds could help evaluate whether this is a substantial form of mortality to some species.

Increases to existing bird strike mortality is assumed to be low (<20 birds/year); however, mortality could be larger due to episodic events such as a flock of birds colliding with structures (especially during periods of darkness or inclement weather). Overall, long-term operation of the production facility will increase the potential for bird mortality, but this increase is not anticipated to be major. Per the FWS Final BO, BPXA must report all avian mortalities and collisions (including vehicle collisions) and their circumstances. The transmission of these data will help verify the assumption that collision mortality is low, and negative effects are small.

It remains unclear what would happen to Liberty (SDI) Project facilities at project termination/abandonment. The Liberty DPP states BPXA will make no decision regarding abandonment at this time and did not detail any abandonment procedures. As the expansion of the SDI was essential to obtain resources from Federal lease lands, the long-term effects of these federally permitted facilities, especially in terms of perpetual bird strike hazard, need to be factored into when these facilities (sheet pile, buildings, gravel pad, etc.) would be removed. Information collected during a monitoring/reporting program for bird strikes will contribute toward a careful assessment of the environmental effects of various abandonment scenarios. At the present time, the MMS environmental effects analysis is based on BPXA's expectation that, ultimately, the entire facility would be removed.

The U.S. Army Corps of Engineers has the authority to place the following special condition on the Department of Army, Clean Water Act 404 authorization (if issued):

- Upon abandonment, all on or above ground fills shall be removed unless otherwise identified as part of the final abandonment plan.

The rationale for the special condition refers to a General Condition on the permit form that states that upon abandonment, the site must meet the approval of the District Engineer/Commander.

3.3.8.6 Increased Bird-Predator Populations

Wildlife access to human-use foods during drilling or production operations could increase the abundance and distribution of predatory birds (ravens, gulls) and mammals (foxes, bears) in

the area. Efforts to eliminate wildlife access to human-use foods/garbage will be incorporated into the day-to-day operation of the Liberty (SDI) Project in compliance with policies developed by the NSB. BPXA also commits to preventing the creation of new fox denning sites and will remove any new den sites construction in new facilities for the Liberty (SDI) Project.

This analysis assumes that effective mitigation measures will be implemented, and no increased mortality to ESA-listed birds from enhanced predator populations would occur.

3.3.9 Terrestrial Mammals

Drilling and production operations at the expanded SDI site would be similar to activity levels generated during development of the original Endicott facility. These activities have not appeared to substantially alter the use of the Sagavanirktok River delta area by caribou (Pollard et al., 1996), although reduced crossings of the Endicott Road/pipeline corridor have been noted, especially during periods when traffic levels are greater than 15 vehicles/hour (Lawhead, Byrne, and Johnson, 1993). Before installation of animal-proof dumpsters, numerous grizzly bears and arctic foxes often frequented the Endicott facility and habitats along the Endicott Road. These animals then subsequently caused unusually high levels of depredation of snow geese and other nesting birds at the Howe Island and Duck Island nesting colonies (Johnson and Noel, 2005). After installation of animal-proof dumpsters and the killing in defense of life and property of several food-conditioned bears known to frequent Howe Island, depredation of Howe Island snow geese has diminished (Rodrigues, McKendrick, and Reiser, 2006).

3.3.9.1 Large Oil Spills

Large oil spills (≥200 bbl of crude oil) during drilling and production would have a variety of impacts on mammal habitats depending on the size, time of year, and trajectory of the spill. Details for the mechanisms for oil spill impacts to terrestrial mammals are discussed in Section III of the Liberty FEIS (USDOI, MMS, 2002).

A pipeline rupture along the Endicott Causeway and Road would impact coastal tundra habitats. The severity of the impacts would depend on the size and timing of the spill. A small spill during winter would most likely be contained and removed with little or no damage to terrestrial mammal habitats, while a large spill occurring during the summer would cause more extensive habitat damage. Additional habitat damage and disturbance would occur from the cleanup of a large spill and subsequent site restoration. Spill cleanup in coastal areas would disturb caribou, muskoxen, grizzly bears, and arctic foxes. The number of people anticipated for a large spill (300 workers over 6 months) and the duration of cleanup activities (complete cleanup may take 4 years) would displace large caribou groups from foraging and insect-relief habitats in the Sagavanirktok River delta.

Caribou and muskoxen using coastal and delta habitats during summer for insect relief may become oiled or ingest contaminated vegetation. Oiled caribou calves would likely perish due to loss of thermoinsulation, leading to hypothermia; oiled adults would likely perish due to inhalation, adsorption through the skin, or ingestion of oil. Based on survey data collected between 1998 and 2003 (Figure 2.11-3), 20 caribou groups with an average of 75 and a maximum of 2,250 individuals would potentially be exposed to oil and disturbance from a large oil spill and subsequent cleanup activities in the East and West Channels of the Sagavanirktok River delta. The maximum number of caribou potentially exposed represents 7% of the Central Arctic Caribou Herd based on the 2002 census result of 31,857 caribou. Based on survey data collected

between 1997 and 2003 (Figure 2.11-3), 1 muskoxen group with an average of 12 and a maximum of 18 individuals would be potentially exposed to oil and disturbance from a large oil spill and cleanup activities in the East and West Channels of the Sagavanirktok River delta. The maximum number of muskoxen exposed represents 9% of the Alaskan North Slope muskoxen based on the 2005 census result of 195 muskoxen. It is unlikely that the maximum number of animals exposed would actually perish due to oil toxicity. No population-level effects to either caribou or muskoxen would be expected due to contact with oil, short-term habitat losses, and/or disturbance from spill cleanup.

Large spills originating from SDI drilling activities reaching coastal habitats in the Sagavanirktok River delta and coastlines from Prudhoe Bay to Tigvariak Island would contaminate beaches and tidal flats. Grizzly bears and arctic foxes would likely ingest oiled birds, seals, or other carrion, which would result in the loss of a few bears and foxes. Bears and foxes would be hazed from the spill area, but may still become oiled or ingest contaminated prey. A few individuals would perish, but no population-level effects are anticipated.

3.3.10 Wetlands and Vegetation

3.3.10.1 Small Spills or Leaks

It is unlikely that minor spills (<200 bbl of crude oil) or leaks of oil or chemicals arising from drilling and oil production will impact wetlands and vegetation. Such minor discharges would likely be contained and cleaned up immediately.

3.3.10.2 Large Oil Spills

Because Liberty (SDI) facilities will be located offshore, impact to wetlands, coastal saltmarshes, and vegetation from a large oil spill (≥200 bbl of crude oil) are not likely. Impacts to coastal saltmarshes would be the primary concern. Saltmarshes and other intertidal community types are considered high-value habitat for some species of birds (Sedinger and Stickney, 2000; Johnson, 2000). The degree of impact would vary depending on the concentration of the spill, time of year, and the affected area with regards to vegetation type, soil structure, and moisture regime. Impacts may range from complete die-off to little or no impact to wetland and other vegetative communities, but such impacts are not expected to occur.

3.3.11 Threatened and Endangered Species

3.3.11.1 Noise/Activity Disturbance

Bowhead Whales

Noise and other disturbances from the proposed drilling and oil production activities for the Liberty (SDI) Project are unlikely to impact bowhead whales. Much of the drilling would take place during the winter months when bowhead whales are in the Bering Sea. Drilling which takes place during their annual fall migration would also be unlikely to disturb bowhead whales due to the distance between the source of drilling at the SDI and the bowhead whale migratory corridor 15 km or more offshore. Greene and Moore (1995) concluded that underwater noise originating from drilling on artificial islands is generally inaudible beyond a few kilometers. It was predicted that drilling noise during periods of normal ambient conditions would attenuate to below-audible ranges approximately 2 km from the source. Miles, Malme, and Richardson

(1987) predicted the radii of potential bowhead-whale response to drilling on an artificial island to be 0.05 to 1.8 km.

Underwater sound propagation is dependent on numerous factors including not only the sound pressure level at the source, but also ambient and environmental conditions such as sea state, water depth, bathymetry, and substrate type (Richardson et al., 1995). Underwater drilling noise could be audible up to 10 km from the source during unusually calm periods (Greene and Moore 1995). Blackwell, Greene, and Richardson (2004) reported that underwater broadband-sound levels from drilling on Northstar Island reached background levels about 9.4 km from the island. McDonald et al. (2006) reported subtle offshore displacement of the southern edge of the bowhead whale migratory corridor offshore from Northstar Island, but the bowhead migration corridor is closer to Northstar Island (approximately 8 km) than it is to the SDI (approximately 15 km). The SDI has had a drilling operation for years with no apparent documented impacts to bowhead whales. The Liberty (SDI) Project is also inshore of the barrier islands, which likely act as an additional sound barrier to the bowhead-whale migratory corridor. Eskimo whalers have infrequently observed individuals and groups comprised of a few whales in the bay mouths between and inside the barrier islands. These observations have ranged between 8.8 and 10 km from the SDI. It is unlikely that noise from drilling and oil production activities at the Liberty (SDI) Project will impact migrating bowhead whales offshore. Impacts to individual whales or to the bowhead population are considered negligible. Per the informal consultation dated October 19, 2007 (refer to Appendix D of this EA), NMFS stated "…while the Liberty project may affect these whales, our assessment…finds any such effects are insignificant (such effects could not be meaningfully measured or detected) or discountable (such effects would not reasonably be expected to occur)."

Polar Bears

Small numbers of polar bears using maternal dens or polar bears passing through the area during fall could be affected by drilling and oil production noise. Polar bears would likely habituate to industrial noise if it is not associated with other stimuli (Perham, 2005), and effects on polar bear abundance and distribution would be minimal.

ESA-Listed Birds

Noise and activity disturbances at the drilling and production site during the spring nesting season will not affect nesting spectacled and Steller's eiders, because they select nest sites in tundra habitats that are not located near the SDI.

Noise and activity in the immediate area of the SDI could displace eiders and their broods, Kittlitz's murrelets, or yellow-billed loons to adjacent habitats. If these habitats are similar, then adverse effects to ESA-listed birds would likely be very small (refer to Appendix C of this EA).

Operational traffic along the Endicott Road would decrease from levels associated with SDI expansion and facility construction phases of this project. The return of basic operational levels of traffic on the Endicott Road should allow the preproject distribution and abundance of ESA-listed birds along the Endicott Road to be restored.

3.3.11.2 Small Spills or Leaks

A small spill is defined as <200 bbl, but BPXA estimates 42 bbl of product would be spilled over the life of the Liberty (SDI) Project. The 95% confidence interval on the total volume of

small product spills range from 10 to 125 bbl. An estimated 2 bbl/yr would be spilled. Over a 12-hour period, 15% of a small diesel fuel oil spill into the Beaufort Sea would persist, because 45% would evaporate and 40% would disperse. Over 19 hours, 11% of a 2-bbl spill of light diesel fuel oil in the Beaufort Sea would remain, with 22% evaporating and 67% dispersing. This spill would cover approximately 0.37 acres of the waters surface after 19 hours. Minor discharges would likely be contained and cleaned up immediately and would be unlikely to affect these species.

Bowhead Whales

It is unlikely that minor spills (<200 bbl of crude oil) or leaks or oil, chemicals, or wastewater from the Liberty (SDI) Project will impact bowhead whales.

Polar Bears

It is unlikely that minor spills (<200 bbl of crude oil) or leaks or oil, chemicals, or wastewater from the Liberty (SDI) Project will impact polar bears.

ESA-listed Birds

Preventive measures such as daily visual inspections are required during drilling and production operations to keep small releases of pollutants from entering the marine environment, where they have the potential to impact ESA-listed birds prior to an active spill response.

If minor spills and leaks of oil, chemicals, or wastewater were to enter the marine environment, they could affect the quality and abundance of prey species for eiders, murrelets, and loons in the project area. Discharges of small amounts of petroleum compounds also could reduce water repellency of bird feathers, compromising their insulative capacity, resulting in hypothermia and death/drowning.

3.3.11.3 Large Oil Spills

Refer to Section 3.4.1.1 (page 3-67 of this EA), which explains the assumptions regarding large oil spills.

Bowhead Whales

A large oil spill (≥200 bbl of crude oil) from the Liberty (SDI) Project or a large fuel spill from sea lift operations likely poses the greatest threat to bowhead whales of any development-related consequences associated with the project. Geraci (1990) hypothesized that whales could experience any of the following adverse effects from an oil spill: oiling of the skin, inhalation of harmful vapors, ingestion of contaminated prey/food, fouling of their baleen, decreased food availability, displacement from preferred feeding habitats, death, and other effects. All of these factors have the potential to decrease bowhead whale survival following direct exposure to a large oil spill. There is no empirical evidence supporting bowhead whale mortality as a direct result of contact with spilled oil, but whales could experience death from prolonged exposure to oil (USDOI, MMS, 2002).

Oil-spill response activities could also affect bowhead whales if an oil spill occurred. The extent of consequences to whales from oil spill response efforts would depend on the location, timing, amount, and behavior of spilled oil in marine habitat. Effects would be greatest if a spill took place in the bowhead-whale migratory corridor during fall migration and decrease with

distance from the corridor. An oil spill scenario, using the deterministic GNOME model, during the open-water season in August does not approach the migratory corridor (see Section 3.4.3). The Oil-Spill Risk Analysis (OSRA) stochastic model analysis described in detail in Appendix A, Liberty FEIS (USDOI, MMS, 2002), indicates contact areas outside the barrier islands could occur for a ≥1,000-bbl crude oil spill originating at the original offshore Liberty site. Refer to section 3.4.1.1 of this EA (page 3-67), which explains that, for the purposes of analysis, the large spill size in this EA is 1,000 bbl.

Probabilities of contacting Sea/Ice Segments 10 and 11 and Environmental Resource Areas (ERAs) 24, 29, 30, and 39 that are important from August through October to migrating bowhead whales adjacent to Liberty (SDI) Project are as follows:

One day postspill probability of contact to all ERAs and Sea/Ice Segments+<0.05

ERA	days postspill	winter probability(%)	summer probability(%)
10	3	<0.05	1.0
11	3	<0.05	1.0
24	3	<0.05	1.0
29	3	<0.05	3.0
30	3	1.0	7.0
39	3	1.0	6.0
10	10	1.0	3.0
11	10	1.0	5.0
24	10	<0.05	4.0
29	10	<0.05	7.0
30	10	1.0	11.0
39	10	1.0	13.0
10	30	2.0	4.0
11	30	1.0	8.0
24	30	<0.05	7.0
29	30	1.0	10.0
30	30	2.0	13.0
39	30	3.0	15.0
10	360	5.0	5.0
11	360	5.0	8.0
24	360	8.0	8.0
29	360	11.0	11.0
30	360	11.0	14.0
39	360	15.0	16.0

The OSRA model estimates there is a <0.05% chance that an oil spill would contact the spring lead system over a 360-day period in winter or summer. The probabilities estimated by the model would be modified further by a number of factors including, but not limited to, the

probability of a specific spill being contained or partially contained onshore, the proportion of an Sea/Ice Segment or ERA that is contacted by oil, and the specifics of whale location, numbers, sex/age classes, and movement related to spilled oil and cleanup operations. An oil spill during the open-water season in August does not approach the migratory corridor (see Section 3.4.3). Disturbances likely would be related to displacement from noise and activity of spill response vessels. Oil-spill-response activities could have a positive impact on bowhead whales by displacing individuals to areas away from the spill, thereby reducing the risk of exposure to spilled oil; however, oil-spill-response activities could be of consequence to subsistence hunting success by deflecting migrating whales farther offshore. The ERA 39 would have the highest probability (range of <0.05 to 16% from 1 day to 360 days postspill, respectively) of contact by spilled crude oil from the Liberty (SDI) Project. The potential for bowhead whales to be affected by an oil spill from the Liberty (SDI) Project is relatively small based on the estimated spill size and relative probability of spilled oil contact, ranging from 0.05% for 1 day postspill in all ERAs and Sea/Ice Segments to a maximum of 16% in one of the six ERAs and Sea/Ice Segments used by fall migrating bowhead whales, and <0.05% of contacting the spring lead system, where bowheads migrate in spring. Both deterministic and stochastic models support a conclusion that impacts to bowhead whales from a Liberty (SDI) Project crude oil spill would be negligible.

Polar Bears

A large oil spill could have major effects on polar bears and their main prey – seals (St. Aubin, 1990a,b). In polar bears, oiling can cause acute inflammation of the nasal passages, marked epidermal responses, anemia, anorexia, stress, renal impairment, and death. These effects may not become apparent until several weeks after exposure to oil. Oiling of the pelt causes serious thermoregulatory problems for marine mammals by reducing its insulation value. Skin damage and hair loss also can occur (Oritsland et al., 1981). Bears also are known to be attracted to petroleum products and can be expected to actively investigate oil spills and to consume foods fouled with petroleum products (Derocher and Stirling, 1991). Because bears frequently groom their fur when it is fouled, a spill could result in contaminated bears ingesting oil and, thus, becoming susceptible to lethal and chronic/sublethal effects of hydrocarbon exposure.

Although a small number of bears may be affected by an oil spill initially, effects can be substantial over the long term through interactions between natural environmental stressors and compromised health of exposed animals, and through chronic, toxic exposure as a result of bioaccumulation (Peterson et al., 2003).

Due to the seasonal distribution of polar bears, the times of greatest impact from an oil spill are summer and autumn (Amstrup, Durner, and McDonald, 2000).

Spilled oil can concentrate and accumulate in leads and openings that occur during spring breakup and autumn freezeup periods. The mechanical concentration of spilled oil in leads and openings in the ice would increase the chance that polar bears and their principal prey would be oiled (Amstrup, Durner, and McDonald, 2000). This also holds true during winter, because polar bears prefer the lead system at the shear zone between the shorefast ice and the active offshore ice (USDOI, FWS, 1999a). This narrow zone of moving ice parallels the coastline and creates openings that are used by seals, and polar bears use leads and openings in the ice where prey are most abundant and accessible (Durner et al., 2004). Consequently, they are more vulnerable to winter oil spills. The impact of a large spill entering the marine environment, particularly during the broken-ice period, could have substantial adverse effects to the polar bear population. The number of polar bears affected by an oil spill could be substantially higher, if the spill spread to

areas of seasonal polar bear concentrations, such as Cross Island. Coastal areas provide important denning habitat for polar bears, particularly along the coast of ANWR. Oiling of such habitats could have a negative impact on polar bears.

The proportion of maternal dens located in terrestrial versus pack-ice habitats appears to be increasing in recent years. Durner, Amstrup, and Ambrosius (2001) identified large areas along the coast and adjacent areas along the Sagavanirktok River near the SDI that are suitable for terrestrial maternal den sites. Continued changes in ice quantity and quality related to climate change could result in increased numbers of terrestrial maternal den sites near the Liberty (SDI) Project in future years (Fischbach, Amstrup, and Douglas, 2007). Higher numbers of denning polar bears and cubs in coastal areas could expose more bears to an oil spill from the Liberty (SDI) development.

Overall, the risk of a large oil spill from the Liberty (SDI) Project is considered low. The risk of a spill and the potential for it contacting polar bears is affected by spill response and containment, which is expected to be effective in preventing a spill from reaching areas frequented by polar bears. The MMS is requiring that BPXA specifically address polar bears and polar bear aggregations in their oil-spill-response planning (see Section 4). While the effects from a large spill potentially could be major, this is not considered a likely event, and no major impacts are anticipated from the proposed action.

ESA-Listed Birds

A large oil spill likely would pose the greatest threat to spectacled eiders and, to a lesser extent, Steller's eiders in the Liberty (SDI) Project area. Oiling of bird feathers can lead to shock, hypothermia, and drowning (USDOI, MMS, 2002). Eiders surviving the initial phases of exposure to an oil spill could be susceptible to related impacts, including reduced functioning of the endocrine system (impeding detoxification of other body systems), liver damage, loss of weight and, ultimately, decreased production of young (USDOI, MMS, 1996a). The MMS assumes that any spectacled or Steller's eider, Kittlitz's murrelet, or yellow-billed loon coming in direct contact with oil would die.

Spectacled eiders occur in low densities in the Sagavanirktok River delta. Steller's eiders are a rare occurrence and not expected to be present in the project area. The low densities of threatened eiders in the project area make it unlikely that significant numbers of spectacled or Steller's eiders would be impacted by an oil spill. However, spectacled eiders may occur in flocks in offshore habitats (Fischer, Tiplady, and Larned, 2002), increasing the risk of multiple individuals being affected if a group were to encounter spilled oil. Any consequence affecting population numbers will hinder these species' recovery from their threatened status (USDOI, MMS, 2002).

Oil spill response efforts could impact eiders if a large oil spill were to occur. The extent of consequences to eiders from oil spill response efforts would depend on the location, timing, amount, and behavior of spilled oil. Oil-spill-response activities could have a positive impact on eiders by displacing birds to areas away from the spill, thereby reducing the risk of exposure to spilled oil.

Overall, the risk of a large spill is considered low. The risk of substantial harm to ESA-listed birds is further reduced, considering the time of the year when birds are present. The risk of a spill and potential for contacting ESA-listed birds is affected by spill response and containment, which could be effective in preventing a spill reaching areas frequented by ESA-listed birds. While the effects from a large spill have the potential to affect small numbers of ESA-listed birds,

this is not considered a likely event and no major impacts are anticipated (refer to Appendix C of this EA).

3.3.11.4 Bird Strikes

The effects of bird strikes have been described for the SDI expansion (Section 3.1) and facility construction (Section 3.3). Effects from the 250-foot tall drill rig would exist for about 3 years, while it is working on site (2010 through 2013). The effects from these facilities would continue during the life of the project. Adverse effects from some facilities could continue even after production ceases.

BPXA design engineers have committed to consult with the FWS on identifying and implementing ways to reduce how facility lighting attracts/disorients ESA-listed birds in the project vicinity. Effectively reducing escaped lighting is believed to reduce the potential for birds, like the spectacled eider, to strike facilities on the MPI and SDI.

There would be an anticipated increase in vehicle traffic on the Endicott Road to operate the facility, but this is much reduced from the construction phase and no substantial changes in the ability of some eiders and their broods to access coastal habitats is anticipated. The present level of mortality from roadkill is unknown. The reduced speed limit for vehicles during the nesting and/or broodrearing period could help reduce any negative effects of traffic on the Endicott Road. These negative effects are difficult to estimate, but the reporting of roadkill birds will help evaluate whether this is a substantial form of mortality to threatened eiders.

Birds could be injured or killed if attracted to or disoriented by a gas flares from the drilling facility (Wiese et al., 2005). This has not been identified as a substantial form of bird mortality at North Slope production facilities.

Increases to existing bird strike mortality is assumed to be low (<20 birds/year), however mortality could be larger due to episodic events such as a flock of spectacled eiders colliding with Liberty (SDI) Project facilities (especially during periods of darkness or inclement weather). Overall, long-term operation of the production facility will increase the potential for bird mortality, but this increase is not anticipated to be major. Per the FWS Final BO, BPXA must report all avian mortalities and collisions (including vehicle collisions) and their circumstances. The transmission of these data will help verify the assumption that collision mortality is low, and negative effects are small.

It remains unclear what would happen to Liberty (SDI) Project facilities at project termination/abandonment. The Liberty DPP states that BPXA will make no decision regarding abandonment at this time and did not detail any abandonment procedures. As the expansion of the SDI was essential to obtain resources from Federal leased lands, the long-term effects of these federally permitted facilities, especially in terms of perpetual eider strike hazard, need to be factored into when these facilities (sheet pile, buildings, gravel pad, etc.) would be removed. Information collected during a monitoring/reporting program for bird strikes would contribute toward a careful assessment of the environmental effects of various abandonment scenarios. At the present time, MMS's environmental effects analysis is based on BPXA's expectation that, ultimately, the entire facility would be removed and all bird strike hazards would be eliminated.

The U.S. Army Corps of Engineers has the authority to place the following special condition on the Department of Army, Clean Water Act 404 authorization (if issued):

- Upon abandonment, all on or above ground fills shall be removed unless otherwise identified as part of the final abandonment plan.

The rationale for the special condition refers to a General Condition on the permit form that states that upon abandonment, the site must meet the approval of the District Engineer/Commander.

3.3.11.5 Increased Bird-Predator Populations

Wildlife access to human-use foods during drilling or production operations could help increase the abundance and distribution of predatory birds (ravens, gulls) and mammals (foxes, bears) in the area. Efforts to eliminate wildlife access to human-use foods/garbage will be incorporated into the day-to-day operation of the Liberty (SDI) Project in compliance with policies developed by the NSB.

Other components of the Liberty (SDI) Project may afford foxes new denning sites. For example, the currently proposed mine rehabilitation plan includes retention of portions of an elevated earthen berm and the stockpiles of organic overburden, which could become a site of future new fox dens. Per the FWS Final BO, BPXA intends to monitor the berm and stockpiles weekly from April 15 through June 15. If denning activities are observed, the ADF&G and FWS will be contacted to develop a plan to prevent further activity. An annul report summarizing monitoring efforts will be provided to the FWS by BPXA through MMS before December 31 each year.

The Final BO measures are expected to be implemented, and no increased mortality to ESA-listed birds from enhanced predator populations would occur.

3.3.12 Cultural Resources

In accordance with NHPA provisions of the November 24, 2006, Memorandum of Understanding among MMS, the U.S. Army Corps of Engineers, ADNR, and BPXA:

> The MMS, after consultation with the COE and other cooperating agencies, will notify BPXA if it determines that it is necessary to assess whether the Liberty (SDI) Project may affect archaeological resources within the project area. The MMS will request that BPXA provide archaeological and, if required, traditional cultural properties reports in accordance with the National Historic Preservation Act of 1966 (16 USC § 470 et seq.). The MMS will consult with the State Historic Preservation Officer and applicable Tribal Historic Preservation Officers, if necessary. This consultation will also cover the cooperating agency permit review requiring consultations.

The SHPO, in letters to BPXA on January 26, 2007, and the U.S. Army Corps of Engineers on June 8, 2007, requested that archaeological surveys be conducted in Liberty (SDI) Project area that previously had not been surveyed. These project areas would include locations where project activities such as ice road construction, gravel extraction, SDI expansion, West Sagavanirktok River Bridge upgrade, pipeline construction, facilities installation, and new drill rig construction could occur. BPXA notified MMS on July 2, 2007, that a cultural resources survey contract has been awarded to Reanier & Associates, with a final report expected in late 2007.

The MMS, after consulting the State of Alaska AHRS database, has identified no cultural and archaeological sites offshore, nearshore, or onshore within the area of potential effect of the Liberty (SDI) Project. The SHPO concurred with the MMS determination of no effect to offshore historic or prehistoric resources. The U.S. Army Corps of Engineers agreed to the responsibility to conduct a separate consultation in accordance with NHPA for onshore resources. Refer to Appendix F for SHPO consultation correspondence.

3.3.13 Socioeconomics and Related Impacts

This section discusses the possible socioeconomic and related impacts associated with drilling and oil production. As noted in the above paragraphs, drilling and oil production could result in direct economic impacts, changes in population and employment, impacts on subsistence resources and use, sociocultural impacts, and impacts from a large oil spill and cleanup. Possible socioeconomic impacts are discussed in the Liberty FEIS (USDOI, MMS, 2002), which is incorporated by reference. It is appropriate to provide additional material, however, because of changes in the project and its alternatives. These changes alter the likely environmental impacts of the project, and substantial increases in the price of crude oil (if these prevail in the future) would increase substantially the economic benefits of the project. This section covers the following impacts: economy and sociocultural systems, subsistence, and environmental justice.

3.3.13.1 Economy and Sociocultural Systems

Economy

The direct economic impacts of the Liberty (SDI) Project were addressed in the Liberty FEIS (USDOI, MMS, 2002) and include direct and indirect jobs, royalty revenues to Federal and State governments, and tax revenues to the North Slope Borough (NSB). Additional impacts not considered in the original EIS relate to national impacts, such as those on the balance of payments.

The original EIS assumed that the total Liberty production over the economic life of the field would be 120 MMbbl and that the prevailing crude oil price would be $16.30/ bbl (see Section 3.6.2 of this EA). The revised estimate of cumulative production is 105 MMbbl—12.5% smaller than originally assumed. However, the price of crude oil is more than $70/bbl as of this writing, four times that assumed in the FEIS. The Fall *2006 Revenue Sources Book* issued by the Alaska Department of Revenue (ADOR) (ADOR, 2006) projects lower crude oil prices in the future than those at present: $41.50/bbl postfiscal-year (FY) 2014, still substantially greater than those assumed when the FEIS was written. Long-range forecasting of all commodity prices is difficult, and experience shows that forecasting oil prices is particularly challenging. Nonetheless, both the ADOR and the U.S. Energy Information Administration project crude oil prices substantially greater than $16.30/bbl by the time Liberty begins production. Thus, the revenues to the State of Alaska and the Federal Government are likely to be substantially greater than estimated in the Liberty FEIS. Liberty is obligated to pay MMS a 12.5% royalty (in value or in kind) and, because of the particular location of the lease and the agreement that the MMS has with the State of Alaska, the State will receive 27% of that 12.5% royalty, or 3.375%. Additionally, the NSB will receive tax revenues based on the *ad valorem* value of the onshore infrastructure and the prevailing tax rate.

The Liberty FEIS did not explicitly discuss potential economic impacts at the national level, but these could be material. The U.S., as recently as World War II, was self sufficient in oil but is now a net oil importer. Petroleum imports are an important component of the balance-of-payments deficit. At $41.50/bbl, Liberty's total production of 105 MMbbl has a value of $4.3 billion.

The Liberty FEIS examined the effects of construction activities on the Alaskan economy and the subsistence aspects of the economy and concluded: "We do not expect disturbances to affect the cash economies." The new project proposal should have even smaller economic effects

associated with construction, because the revised plan exploits more of the existing infrastructure. Sections 3.1.13 and 3.2.10 of this EA restate estimates of the number of construction jobs in the Liberty FEIS.

Estimates of the number of workers needed for drilling and production for the current Liberty (SDI) Project provide for a greater number of workers during the initial drilling operation and fewer operators needed during long-term production. The maximum number of annual drilling jobs is estimated to be 120 over a 4-year period. Once production begins, the estimated annual number of production jobs is 20 workers over a 30-year period. The estimated level of employment, while initially higher than that given in the FEIS, is approximately the same over time and is expected to have minimal impact on the local economy.

Sociocultural Systems

The Liberty FEIS (USDOI, MMS, 2002) concluded:

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

As noted above, the new proposed action should result in lower impacts than those anticipated for the original project. Sociocultural impacts would result from a large crude oil spill because of the disruption of subsistence harvests, as discussed above. It is important to note that the total estimated Liberty production is only a very small proportion of the oil already produced on the North Slope and also a small proportion of the oil projected to be produced in the future.

Subsistence and Area Use Patterns

The Liberty FEIS (USDOI, MMS, 2002) addressed possible impacts of this project on subsistence and subsistence-harvest patterns. Potential impacts on subsistence are rightly viewed with concern because of the key importance of subsistence and subsistence harvests to residents of the NSB.

Oil-spill contact in winter could affect polar bear hunting and sealing. During the open-water season, a spill could affect bird hunting, sealing, and whaling, as well as the netting of fish in the ocean. The OSRA analysis done for the Liberty FEIS (USDOI, MMS, 2002) offers a relative comparison of contact from a large spill originating from the Endicott SDI and contacting subsistence Environmental Resource Areas important to the community of Nuiqsut:

> The chance of a summer spill (925-barrel crude oil spill or a 1,283-barrel diesel fuel spill with no diesel remaining after 7 days) originating from the Liberty gravel Island contacting important Nuiqsut environmental resource areas ranges from a 4-15% chance of contact over a 30-day period and a 5-15% chance over a 360-day period. Percentages for winter contact are less for a 30-day period, ranging from 1-4% over a 30-day period but are slightly higher over a 360-day period, ranging from 7-21%.

The potential for bowhead whales to be affected by spilled oil from the Liberty (SDI) Project is relatively small, based on the estimated size of a spill and the relatively low (15% or less) chance of spilled oil reaching the main bowhead subsistence-harvest areas in summer or fall.

The FEIS concluded:

> We do not expect significant impacts to result from any of the planned activities such as discharges and disturbances associated with Alternative I (Liberty Development and Production Plan) or any of the other alternatives. Some significant impacts — adverse effects to spectacled eiders, king and common eiders, long-tailed ducks, subsistence-harvest patterns, sociocultural systems, and local water quality — could occur in the unlikely event of a large oil spill. However, the very low chance of such an event occurring…combined with the seasonal nature of the resources inhabiting the area (for example, eiders are present in the Liberty area 1-4 months of the year), makes it highly unlikely that an oil spill would occur and contact the resources. A resource may be present in the area but may not be contacted by oil…None of the component or combination alternatives evaluated [in this] EIS are expected to generate significant impacts from planned activities. If an unlikely oil spill occurred, similar significant effects could occur to spectacled eiders, king and common eiders, long-tailed ducks, subsistence harvests, sociocultural systems, and local water quality for all alternatives.

More specifically, with respect to subsistence-harvest patterns, the Liberty FEIS [Section II.h(1)] concluded:

> Overall, oil spills could affect subsistence resources periodically in the communities of Nuiqsut and Kaktovik. In the unlikely event of a large oil spill, many harvest areas and some subsistence resources could be unavailable for use. Some resource populations could suffer losses and, as a result of tainting, bowhead whales could be rendered unavailable for use. Tainting concerns in communities nearest the spill event could seriously curtail traditional practices for harvesting, sharing, and processing bowheads and threaten a pivotal underpinning of Iñupiat culture. There is also a concern that the International Whaling Commission, which sets the quota for the Iñupiat subsistence harvest of bowhead whales, would reduce the harvest quota following a major oil spill or as a precaution as the migration corridor becomes increasingly developed to ensure that overall population mortality did not increase. Such a move would have profound cultural and nutritional impacts on Iñupiat whaling communities. Whaling communities distant from and unaffected by potential spill effects are likely to share bowhead whale products with impacted villages. Harvesting, sharing, and processing of other subsistence resources should continue but would be hampered to the degree these resources were contaminated. In the case of extreme contamination, harvests could cease until such time as resources were perceived to be safe by local subsistence hunters. Overall, effects are not expected from routine activities and operations.
>
> Tainting concerns also would apply to polar bears and seals and beluga whales, walruses, fish, and birds. Additionally a large oil spill could cause potential short-term but serious adverse effects to long-tailed ducks and king and common eider populations. A potential loss of one or two polar bears could reduce their availability locally to subsistence users, although they are seldom hunted by Nuiqsut hunters except opportunistically while in pursuit of more preferred subsistence resources.

Addressing bowhead whales specifically, the Liberty FEIS [Section III.h(2)(2)(a)] added:

> The potential for bowhead whales to be affected by spilled oil from the Liberty project is relatively small based on the estimated size of a spill and the relatively low…chance of spilled oil reaching the main bowhead fall migration route outside the barrier islands. However, if a spill occurred and contacted bowhead habitat during the fall whale migration, it is likely that some whales would be contacted by oil. It is likely that some of these whales would experience temporary, nonlethal effects…Traditional practices for harvesting, sharing, and processing subsistence resources could be seriously curtailed in the short term, if there are concerns over the tainting of bowhead whales or their feeding areas from an oil spill.

No new information has been found that would invalidate this original assessment in the Liberty FEIS with respect to the alternatives considered. What has changed is the proposed action, which differs from the evaluation in the Liberty FEIS. Specifically, the new proposed action employs ultra-extended-reach drilling (uERD) from an existing facility rather than a new offshore location. Such a project reduces the offshore impacts of island and pipeline construction. This change in project scope substantially mitigates the potential impacts related to the Boulder Patch, marine mammals, and concerns of the North Slope Iñupiat communities related to the bowhead whale and subsistence whaling. Development using the existing infrastructure at Endicott further mitigates impacts by avoiding construction of a pad on the shoreline of Foggy Island Bay and an access road and pipeline crossing of the Sagavanirktok River delta. In principle, therefore, the probable impacts of the new proposed action would be the same or smaller than those identified in the Liberty FEIS. Because some response equipment would be stationed at the SDI facility, and the SDI is connected by causeway to Deadhorse where major response infrastructure and response personnel are staged, response generally would be expected to be faster and more efficient, than to a drill site without such access.

Oil production with the new proposed alternative also might result in crude oil or product spills. Small operational spills of crude oil or product are virtually certain to occur, but they would not be expected to have major impacts. As discussed in Section 3.4, large crude spills, although unlikely, also might occur. Depending on the location, timing, amount, and behavior of the spill(s), major adverse effects on certain species, subsistence-harvest patterns, and sociocultural systems might result. This conclusion is not unique to the Liberty Project; EIS's/EAs for other development projects (see, e.g., USDOI, MMS, 2003, 2004, and 2006) also conclude that a large oil spill could have significant adverse impacts.

Environmental Justice

> Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (59 *FR* 7629), requires each Federal agency to make the consideration of Environmental Justice part of its mission. Section 1-101 states:
>
> To the greatest extent practicable and permitted by law, and consistent with the principles set forth in the report on the National Performance Review, each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on

> minority populations and low-income populations in the United States and its territories and possessions….

Other portions of this order require agencies to develop strategies to address environmental justice (1-103); research, data collection, and analysis (Section 3-3); and requirements to collect, maintain, and analyze information on the consumption patterns of populations who principally rely on fish and/or wildlife for subsistence (4-401). The EIS's drafted after the effective date of this order must contain an impacts analysis for environmental justice.

In particular, Alaska Iñupiat Natives, a recognized minority, are the predominant residents of the North Slope Borough (NSB). Therefore, it is relevant to consider whether or not the environmental impacts of the proposed Liberty development project will have "disproportionately high and adverse" impacts on NSB residents.

The Proposed OCS Lease Sale 202 EA (USDOI, MMS, 2006b) defines a "significance threshold" for each resource category as a level of effect that equals or exceeds a designated threshold:

> The significance threshold for Environmental Justice would be disproportionate, high adverse human health or environmental effects on minority or low-income populations. This threshold would be reached if one or more important subsistence resources becomes unavailable, undesirable for use, or available only in greatly reduced numbers for a period of 1-2 years; or chronic disruption of sociocultural systems occurs for a period of 2-5 years, with a tendency toward displacement of existing social patterns. Tainting of subsistence foods from oil spills and contamination of subsistence foods from pollutants would contribute to potential adverse human-health effects.

The Liberty FEIS (USDOI, MMS, 2002) reached the following conclusion about environmental justice:

> Alaska Iñupiat Natives, a recognized minority, are the predominant residents of the North Slope Borough, the area potentially most affected by Liberty development. Effects on Iñupiat Natives could occur because of their reliance on subsistence foods, and Liberty development may affect subsistence resources and harvest practices. The Iñupiat community of Nuiqsut, and possibly Kaktovik, within the North Slope Borough, could experience potential effects. In the unlikely event that a large oil spill occurred and contaminated essential whaling areas, major effects could occur when impacts from contamination of the shoreline, tainting concerns, cleanup disturbance, and disruption of subsistence practices are factored together. However, effects are not expected from routine activities and operations. When we consider the little effect from routine activities and the low likelihood of a large spill event, disproportionately high adverse effects would not be expected on Alaskan Natives from Liberty development under the Proposal. Any potential effects to subsistence resources and subsistence harvests are expected to be mitigated substantially, though not eliminated.

The conclusion reached in the Liberty FEIS still holds, and the new proposed alternative for Liberty is likely to be environmentally superior to any of the original alternatives. Therefore, while environmental justice concerns are relevant, disproportionate, high adverse effects would occur only in the unlikely event that a large oil spill (because of location, season, or other factors) significantly impacted key subsistence resources. As stated in the Liberty FEIS, "any potential

effects to subsistence resources and subsistence harvests are expected to be mitigated substantially, though not eliminated." For any of the Liberty Project alternatives, BPXA will implement mitigation measures to minimize the possibility and potential for a large oil spill (see Section 4.2.4; see also the environmental justice impacts discussion in the MMS Beaufort Sea Sale 202 EA (USDOI, MMS, 2006b).

3.3.14 Waste Management

All waste from the Liberty (SDI) Project would be handled in accordance with State, Federal, and local regulations. Use of permitted disposal wells and other approved disposal methods will result in zero surface discharge of drilling wastes, and, in conjunction with BPXA's waste minimization policy, will result in little or no impact from waste disposal. See Section 10 of the Liberty DPP for more information on waste handling.

3.4 FATE AND EFFECT OF OIL SPILLS

3.4.1 Risk of an Oil Spill

As noted in the original offshore Liberty Development Project documents (LGL, 1998) and the FEIS (USDOI, MMS, 2002), BPXA is required by both State and Federal law to implement approved spill-contingency plans (both with MMS and ADEC). Implementation of BPXA's spill-contingency plans also is the primary means of minimizing the risk of a spill and ensuring that spill response will be swift and effective.

However, for planning purposes and to estimate the potential direct and indirect effects of an oil spill from the Liberty (SDI) Project, an oil spill risk analysis has been completed.[1] This section summarizes the oil spill risk analysis presented in detail in Appendix A of this EA. The risk analysis and the summary below incorporate comments and techniques suggested by the North Slope Borough Science Advisory Committee (NSBSAC, 2003). In particular, the summary below provides information in a plain-language format, avoids extrapolation of data from potentially unrepresentative areas,[2] and provides information on the upper and lower confidence limits on the probability of a large spill.

To quantify the probable crude and refined petroleum (product) spill volumes associated with the operation of the Liberty (SDI) Project, a database of historical Alaska North Slope (ANS) crude oil and product spill records was developed. The historical spill database was compiled by analyzing industry and government-agency oil spill databases for ANS facilities, including wells, facilities, and other pipelines up to (but not including) Pump Station 1 (PS-1), which marks the beginning of the Trans-Alaska Pipeline System (TAPS). The spill projection method employed is based on statistical models used by MMS for ANS and other oil fields.

Figure 3.4-1 presents a flowchart of the general method used to develop the oil spill risk analyses. The spill dataset was divided into three categories: large crude oil spills, small crude oil spills, and product spills. Appendix A describes the process in detail.

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[1] Appendix A provides an analysis of potential oil and hydrocarbon spills for the proposed Liberty Development project. Two types of spills are considered in this analysis (1) spills of crude oil and (2) spills of refined products (e.g., aviation fuel, gasoline, diesel fuel, turbine fuel, motor oil, hydraulic oil, transformer oil, transmission oil, and engine lube oil, etc.). Produced water spills are not considered in this analysis. In cases where a "mixed spill" occurs the respective volumes of crude oil and product are calculated by multiplying the total spill volume by the respective percentages of crude or product. For simplicity, these are referred to as crude and product spills.

[2] The NSBSAC specifically noted that extrapolation of data from the Gulf of Mexico might be inappropriate.

The data used for this analysis include historical ANS crude and product spills from 1985 through 2006, a time period believed most appropriate for this purpose.[3] The basic assumption is that the likelihood of future crude and product spills associated with the Liberty (SDI) Project can be accurately estimated from prior ANS experience, i.e., that large crude oil spill rates (per billion barrels produced) for this project will match the average of those for other ANS facilities. This assumption may overstate potential spills from the Liberty (SDI) Project because this project makes efficient use of existing facilities and features few incremental facilities. The Liberty (SDI) Project design and scope have evolved from an offshore stand-alone development in the outer continental shelf (OCS) (production/drilling island and subsea pipeline), as described in the 2002 Liberty DPP FEIS, to maximize use of the existing infrastructure involving an expansion of the Endicott SDI. As a result, development of the Liberty (SDI) Project from Endicott dramatically reduces potential environmental impacts, project footprint and does not require construction of new processing and transportation facilities.

The Liberty (SDI) Project will be developed with very few wells; up to six wells will be drilled from the expanded SDI using a purpose-built drilling rig to reach the offshore Liberty reservoir located on the OCS. The drilling rig will be powered by natural gas, so no handling and storage of large quantities of diesel fuel is required for the project. Production from the Liberty (SDI) Project wells will be tied into the existing Endicott flow line system with production sent from the SDI via the existing 28-in CRA (Corrosion Resistant Alloy) three-phase flow line to the Endicott Main Production Island (MPI) for processing. The Endicott plant internals are constructed of duplex stainless steel for production. After processing at the MPI facilities, Liberty oil will transported through the existing 16-in Endicott sales-oil pipeline (which is a U.S. Department of Transportation-regulated pipeline) to PS-1 of TAPS. This pipeline is internally inspected on a cycle of not less than once every 5 years (the last inspection was 2005) using a magnetic flux pig. The Liberty (SDI) Project will be using the Endicott facilities through a Facility Sharing Agreement (FSA) with the Duck Island Unit Owners, which is currently being negotiated. No buried subsea pipelines (included in the alternatives considered in the original FEIS) are required.

As noted above, the Liberty (SDI) Project will maximize the use of existing infrastructure; the analysis presented here conservatively assumes that the direct and indirect impacts of the Liberty (SDI) Project can be estimated based on a statistical analysis of spills of the other exploration and production fields on the North Slope. This avoids the methodological difficulties of extrapolating oil-spill experience from other areas of the country (or world), such as the Gulf of Mexico.

Because spills are random (not deterministic) phenomena, it is appropriate to use statistical (or probabilistic) methods to describe the number, volume, and likelihood of future spills.

3.4.1.1 Large Crude Oil Spills

Crude oil spills included in this analysis are subdivided into large spills (those ≥200 bbl) and small spills[4] (those <200 bbl). For large crude oil spills:

[3] See Appendix A for more information. This time period spans 22 years of ANS oil spill records and provides thousands of reliable spill records for analysis.

[4] MMS traditionally uses 1,000 bbl as the threshold for a large OCS spill. However, only one ANS spill ≥ 1,000 bbl has occurred from 1977 to the present. The Liberty FEIS used 500 bbl as a threshold, and more recent studies have considered thresholds as small as 50 bbl OCS spills. The choice of 200 bbl provides an adequate sample of large spills

- The expected number[5] of large crude oil spills throughout the operating life of the Liberty (SDI) Project is 0.09 based on the estimated production of 105 MMbbl and the ANS experience that nine large (≥ 200 bbl) crude oil spills occurred during the production of nearly 11 billion bbl (Bbbl) of crude oil produced over the period from 1985 through 2006. We have high (95%) confidence that the estimated number of large crude oil spills lies between 0.039 and 0.163.[6]
- The estimated probability (in percentage terms) that no large crude oil spill will occur from the Liberty (SDI) Project is approximately 92%,[7] if the future is like the past and the assumed model is correct.[8] We have high (95%) confidence that the actual chance that no large spill will occur during the operation of the Liberty (SDI) Project lies between 85% and 96%. That is, large crude oil spills associated with the Liberty (SDI) Project are unlikely.
- The estimated probabilities (based on the Poisson model) that there will be 1, 2, or 3 large crude spills over the life of the Liberty Field are estimated to be approximately 7.8%, 0.3%, and < 0.01%, respectively.
- The estimated probability of one or more large spills occurring over the production life of the project is 8%.
- The odds against one or more large spills occurring over the project lifetime are estimated to be approximately 11:1. The odds against two or more large spills occurring are nearly 285:1.
- If a single large crude oil spill were to occur, then a reasonable estimate of the probable spill volume (using actual data directly as well as fitting statistical models) is 1,000 bbl. Allowing for the possibility of multiple large crude oil spills, the estimated large crude oil spill volume is only slightly larger than 1,000 bbl, because having more than one large spill is very unlikely. However, because large spills are infrequent, the weighted-average large crude oil spill volume is estimated to be 85 bbl.[9]
- Because there is a distribution of large crude oil-spill volumes, it is possible that the cumulative large crude oil spill volume, given the unlikely event that one occurs, would be >1,000 bbl. Monte Carlo simulations described in Appendix A indicate that the 95%

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for statistical purposes and lowers the likelihood that estimates will be biased if the volume distribution of small spills differs from that for large spills.

[5] This is a statistical term of art and denotes the sum of the probabilities of 0, 1, 2, 3…spills times the number of spills, summed over all possible numbers of spills. Another word that might be chosen is the *estimated* number of spills. In this instance the expected or estimated number of large spills is 0.09—an impossibility because the number of large spills must be a whole number (e.g., 0, 1, 2, 3 …). The significance of the expected number is that large spills are expected to be infrequent.

[6] Technically this is known as a *confidence interval*. In statistics, a confidence interval (CI) for a population parameter (the large crude oil spill rate in this example) is an interval with an associated probability (95% in this instance) that is generated from a random sample of an underlying population such that if the sampling was repeated numerous times and the confidence interval recalculated from each sample according to the same method, a percentage (95%) of the confidence intervals would contain the true value of the population parameter in question. The use of confidence intervals was one of the specific recommendations of the NSBSAC. For additional information on confidence intervals, see http://www.cas.lancs.ac.uk/glossary_v1.1/confint.html.

[7] Note that this statement applies only to large crude oil spills. Many small spills (addressed in detail in Appendix A and summarized here) are likely to occur.

[8] This model is conceptually plausible and the adequacy of this approximation has been validated by historical experience in the Gulf of Mexico (see Eschenbach and Harper 2006).

[9] As noted, if a large spill occurs, the volume estimate is approximately 1,000 bbl, but because the probability of a large spill occurring is so low, the weighted average volume of a large spill is much lower.

confidence interval on the volume of large crude oil spills (given that one occurs) ranges from 225 to 4,786 bbl.

Finally, it is important to note that, because the project throughput of Liberty (SDI) is only a small fraction of the total ANS crude oil throughput, it is more likely that any future large crude oil spill will come from one of the other producing fields than from the Liberty (SDI) Project.

The Liberty FEIS (USDOI, MMS, 2002) offered the following comments on the chance of a large spill occurring:

> The analysis of historical oil-spill rates and failure rates and their application to the Liberty Project provides insights, but not definitive answers, about whether oil may be spilled from a site-specific project. Engineering risk abatement and careful professional judgment are key factors in confirming whether a project would be safe.
>
> We conclude that the designs for the Liberty Project would produce minimal chance of a significant oil spill reaching the water. If an estimate of chance must be given for the offshore production island and the buried pipeline, our best professional judgment is that the chance of an oil spill greater than or equal to 500 bbl occurring from the Liberty Project and entering the offshore waters is on the order of 1% over the life of the field….
>
> We base our conclusion on the results gathered from several spill analyses done for Liberty that applied trend analysis and looked at causal factors. All showed a low likelihood of a spill, on the order of a 1 - 6% chance or less over the estimated 15-20 year life of the field.

While not identical, the projections made in this report are broadly consistent with the results of the Liberty FEIS; both estimates indicate that it is unlikely that a large spill would occur. As to differences:

- The original analysis defined a large spill as one ≥500 bbl, whereas this analysis uses 200 bbl as the threshold of a large spill.[10] As shown in Appendix A, the probability that no large spill would occur (assuming a 500-bbl threshold) is 94.4%—numerically closer[11] to that estimated in the FEIS. (The 95% confidence interval on the probability that no large spill would occur assuming a 500-bbl threshold is from 88.3 to 97.9%. This confidence interval overlaps the 94 to 99% range specified in the Liberty FEIS.)
- The original spill estimates were based on the definition of a large crude oil spill from the offshore production island and buried pipeline reaching the water. This analysis addresses the occurrence of a large crude oil anywhere in the facility and makes no assumption regarding whether or not the spill reaches the water.
- The estimate developed in Appendix A is based solely on the assumed production volume of Liberty and actual spill statistics from ANS operations updated through 2006. That presented in the FEIS used data from several sources and ultimately was based on engineering judgment.

Assumptions for the purposes of analysis of large spills in this EA

For purposes of analysis, we assume one large spill occurs at any location. This "what-if" analysis of a large oil spill addresses whether such spills could cause serious environmental

[10] This choice of 200 bbl as the threshold was made on statistical grounds.
[11] This estimate is within the range of plausible estimates given in the FEIS.

impact. The large spill threshold is defined as ≥200 bbl. BPXA estimates an 8% chance of one or more large spills occurring over the production life of the project. At the 95% confidence interval, BPXA estimates a 4 to 15% chance of one or more large spills occurring over the production life of the Liberty (SDI) Project. BPXA estimates a 92% chance of no large spills occurring over the life of the Liberty (SDI) Project.

The MMS bases the analysis of effects from a large crude oil spill on the following assumptions:

- One large spill occurs.
- The large spill size threshold is defined as ≥200 bbl.
- For the purposes of analysis, the large spill size is 1,000 bbl.
- All the oil reaches the environment; the production facility and causeway absorb no oil.
- The large spill starts at the production facility or along the offshore pipeline on the causeway.
- There is no cleanup or containment. Cleanup and containment are considered mitigating factors within the effects analysis.
- The large spill could occur at any time of the year.
- The large spill weathering is as we show in the USDOI MMS Liberty FEIS Appendix A, Tables A-5, A-6 and A-7.
- A large spill that moves into or onto the landfast ice from the production facility or its pipeline does not move dramatically until the ice breaks up.
- The large spill area varies over time, as we show in Liberty FEIS Appendix A Table A-7 and is calculated from Ford (1985).
- The time and chance of contact from a large oil spill are calculated from an oil-spill-trajectory model in the Liberty FEIS (Appendix A, Tables A-12-A-13) using Liberty Island as the hypothetical spill site. These conditional probabilities provide a relative analogy for large oil spills from the SDI. Although the conditional probabilities are not site specific they provide a general framework for the stochastic behavior of large oil spills within Stefansson Sound.
- The chance of contact is analyzed from where it is highest when determining effects.

3.4.1.2 Small Crude and Refined Product Spills

Data from ANS and other areas indicate that small spills of either crude or product are more numerous than large spills, but the average size of a small spill is very much smaller than the average size of a large spill, with the result that (from 1985 through 2006) the aggregate volume of ANS small spills was only about 28% of the total volume spilled (for crude). Other factors held constant, a smaller spill is more likely to be contained, more readily cleaned up, and less likely to have adverse environmental effects than a large spill. For this reason, most spill analyses focus on larger spills. Nonetheless, small spills should be considered out of concern about chronic effects from numerous small spills.

Appendix A also estimates of the volume of small spills associated with Liberty (SDI) Project. For small oil spills:

- The estimated total crude-oil volume (for the operating lifetime of the Liberty Project) based on the observed ratio of the volume of small spills to ANS production is

approximately 34 bbl.[12] The Liberty Project Description (BPXA, 2006) does not specify the economic life of the project. Assuming a 20-year project lifetime, the average small crude-oil volume spilled per year would be approximately 1.75 bbl/year.

- The 95% confidence interval on the total volume of small crude spills over the lifetime of the project ranges from 6 to 100 bbl.
- For purposes of analysis, we assume a small, 2-bbl spill covers approximately a continuous area of 0.38 acres (Payne et al., 1984).

Product spills, though numerous, are very small on average. Using the same method as that employed to project small crude spills, the following estimates are derived for the expected and 95% confidence limits on the volume of refined product spills:

- The estimated total product volume (for the operating lifetime of the Liberty Development Project) based on the observed ratio of the volume of small product spills to ANS production is approximately 42 bbl,[13] equivalent to approximately 2 bbl/year over a 20-year project lifetime.
- The 95% confidence interval on the total volume of small product spills ranges from 10 to 125 bbl.

3.4.2 Behavior of Spilled Oil

This section briefly examines the behavior of oil spilled on the ANS. Much of the information summarized below is developed in detail in the Northeast NPR-A EIS (USDOI, BLM and MMS, 1998); the Northstar EIS (U.S. Army Corps of Engineers, 1999); the Liberty FEIS (USDOI, MMS, 2002); and the Beaufort Sea Planning Area Multiple Lease Sale EIS (USDOI, MMS, 2003). An extensive discussion of the fate and effects of oil spilled on the North Slope is also included in the National Research Council (NRC) report detailing the cumulative effects of oil industry operations on the North Slope (NRC, 2003). All are incorporated by reference in the summary below.

As noted above and in the oil spill risk analysis in Appendix A, crude oil has been spilled during oil production, processing, and transportation on the North Slope. In general, spills are small and contained. However, when oil is released to the environment, the behavior of the oil is controlled by the amount and type of oil spilled, the time of year, and the local environment (USDOI, BLM and MMS, 1998). Oil composition and inherent physical characteristics also govern the behavior of a spill with regard to oil movement, level of damage done to the impacted environment, and the weathering process (USDOI, MMS, 2002; NRC, 2003; U.S. Army Corps of Engineers, 1999).

When spills occur, oil begins to naturally degrade both physically and chemically. This process is known as weathering, or aging, and can occur by spreading, evaporation, dispersion, dissolution, emulsification, microbial degradation, sedimentation, and photo-oxidation (USDOI, BLM and MMS, 1998; USDOI, MMS, 2002; NRC, 2003; U.S. Army Corps of Engineers, 1999). The weathering process is also impacted by wind, waves, current movements, and stranding onto vegetation or shoreline (USDOI, BLM and MMS, 1998).

The weathering processes and properties of Liberty crude oil are described in the Liberty

[12] For comparison, the Liberty FEIS estimated that there might be 17 spills less than 1 bbl and 6 spills greater than or equal to 1 bbl and less than 25 bbl. These estimates are broadly consistent with the estimates given in Appendix A.

[13] For comparison, the Liberty FEIS estimated that there would be 53 refined product spills of 0.7 bbl, for a total volume of 37.1 bbl over the life of the project. This is nearly identical to the volume projected in Appendix A and within the confidence interval.

FEIS (USDOI, MMS, 2002), which focused on spills to open water, spills to broken ice, and underwater spills as was appropriate for an offshore development using an buried pipeline. While spills to open water or broken ice are still possible with the proposed project, undersea spills are no longer relevant, because a buried pipeline is not included. The Liberty FEIS presents information on the behavior of oil spilled to open water and broken ice.

New information on the behavior of stranded oil has been developed since the Liberty FEIS was produced. In particular, a recent study by Irvine, Mann, and Short (2006) indicated that stranded oil can persist within boulder-armored beach soils (i.e., beaches where finer sediment and gravel are covered by boulder-sized rocks) even when moderate- to high-energy wave action would be expected to quickly weather the oil. Researchers found that oil washed onto boulder-armored beaches in the Gulf of Alaska remained in a nearly unweathered state for well over a decade. The findings emphasize the importance of considering local geomorphic features during spill response planning or when modeling the persistence of spilled oil.

Spills to land are also possible, and small spills are usually contained (USDOI, MMS, 2002; TAPS Owners, 2001), but a large spill may impact tundra (NRC, 2003). An oil spill to snow-covered tundra is not expected to spread over a large area, and if the spill occurs during winter, is not expected to penetrate the frozen soil (LGL, 1998; NRC, 2003). A spill during the summer may penetrate the soil but is not likely to penetrate deep because tundra is water-logged or flooded during summer (LGL, 1998). Vegetation also acts as a natural boom and prevents oil from spreading. However, oil can still become widely dispersed to tundra or snow if a pressurized pipeline ruptures and sprays oil into the air (LGL, 1998; NRC, 2003).

3.4.3 Oil-Spill Scenario

An oil spill scenario analysis was completed using the "spray method" of the National Oceanic and Atmospheric Administration (NOAA) GNOME (General NOAA Operational Modeling Environment) model (it was necessary to use the spray method rather than the point source method to force the oil to move past the Endicott Causeway). The GNOME model was developed by the Emergency Response Division of NOAA's Office of Response and Restoration (OR&R). It is the oil spill trajectory model used by OR&R Emergency Response Division responders during an oil spill.

The following specifications were entered into the GNOME model to create the trajectories:

- Model Start Date: August 1, 2006
- Start Time: 12:00
- **Duration:** 24 and 72 hours (each duration shown as a separate figure)
- Wind Type: Constant
- Wind Speed: 10 knots
- **Wind Direction:** East-northeast (predominant direction 47.4% of the time during summer)
- **Oil Released:** 1,000 bbl (during a 4-hour period)
- Spill Response: None

As discussed above and summarized in detail in Appendix A, 1,000-bbl was chosen for the amount of oil spilled for this analysis as a probable spill volume. This is a conservative figure for analysis purposes, and a spill from the Liberty (SDI) Project of this volume is unlikely.

Figure 3.4-2 shows the model output for a 24-hour duration, while Figure 3.4-3 presents the output for a 72-hour duration. It is expected that BPXA would have response activities under way prior to 72 hours and thus contain the spread of the oil. However, 24 and 72 hours were

chosen to represent the spread of spilled oil over a reasonable time frame. As can be seen in the figures, the causeway influences the westward movement of oil from the SDI location. At the end of 24 hours, oil has beached on the causeway and in the Sagavanirktok River delta, while after 72 hours, oil has reached the western shore of Prudhoe Bay.

3.5 EFFECTS OF ALTERNATIVES

Effects conclusions are summarized for the proposed action and alternatives in Tables 3.5-1 through 3.5-9.

3.5.1 Physical

3.5.1.1 Air Quality

The ambient air quality impact differences between the proposed action and the original Liberty Island option are negligible because either option must demonstrate compliance with the applicable ambient air quality standards and Prevention of Significant Deterioration (PSD) increment levels before the required air permit would be issued by the Alaska Department of Environmental Conservation (ADEC). For the same reason, the ambient air quality impact differences between the proposed action and either the Point Brower Pad or Kadleroshilik Pad options are negligible.

Potential stationary source emissions from the Liberty Island option are higher than the proposed action because the Liberty Island emission unit inventory included emitting equipment needed to prepare sales-quality oil. The proposed action will generally use existing equipment at the Endicott MPI, resulting in a smaller increase in potential emissions.

3.5.1.2 Sediment Suspension and Transport

As discussed in Section 3.1.2, the proposed action will result in a temporary increase in TSS concentrations of up to 430 mg/l above ambient levels in the immediate vicinity of the project site during the winter gravel placement. A large portion of the suspended material is predicted to settle within or adjacent to the footprint of the SDI pad expansion, while the finer fractions are expected to migrate up to 6 km along the Endicott Causeway. The release of fine material from the pad following the initial open-water season is expected to be negligible (Section 3.3.2). Turbidity increases associated with marine operations are expected to be negligible due to the limited need for barge support.

The two onshore development alternatives, consisting of coastal pads at Pt. Brower and on the mainland coastline near the Kadleroshilik River, are expected to have no impacts on TSS concentrations in marine waters during construction. Similarly, appropriate pad-setback distances will prevent release of fine material to marine waters during operation. No marine operations are planned for these alternatives.

Suspended-sediment concentrations and turbidity-plume characteristics associated with construction and operation of the original Liberty Island alternative were estimated previously (Ban et al., 1999). During island construction, the TSS concentration at the project site was predicted increase up to 250 mg/l. While the majority of these particles were estimated to fall out of suspension within 1 km of the island, the finer fractions were expected to create a turbidity plume extending up to 17 km to the northwest. Reshaping of the pad sideslopes after breakup was anticipated to produce a temporary increase in turbidity. The release of fine material from the island following slope protection installation was expected to be negligible. Disturbance of

native seafloor sediments during installation of the subsea pipeline was estimated to increase TSS concentrations by as much as 1,000 mg/l at the excavation site. The associated turbidity plume was predicted to extend up to 2 km from the excavation site. Increased turbidity from ocean disposal of accumulated seabed material was estimated to create a 4-km-long plume with TSS concentrations as high as 1,168 mg/l at the stockpile site. Barge activities conducted in support of operations, estimated at a maximum 150 trips per season, were expected to have a modest and temporary effect on turbidity.

3.5.1.3 Oceanography

As discussed in Sections 3.3.2 and 3.3.3, the proposed action is expected to cause only minimal localized effects on oceanography. Stress cracks in the sea-ice sheet propagating from the perimeter of the SDI pad expansion could provide strudel drainage pathways at the time of river overflood. Seasonal ice roads used to support construction or drilling operations may act as a partial barrier to river overflood and divert a portion of the flow. Waves and currents in the immediate vicinity of the pad expansion will be affected during open water, but the conditions are not expected to be substantially different from those at the existing SDI facility.

The two onshore development alternatives are expected to have no impact on regional or local oceanography.

The original Liberty Island alternative is not expected to have any impact on regional oceanography. Minimal localized impacts can be anticipated. Seasonal ice roads used to support drilling and production operations may act as a partial barrier to river overflood and divert a portion of the flow. Waves and currents in the immediate vicinity of the island will be altered during open water, but the impact is expected to be limited to a distance of 2 to 3 times the island diameter (BPXA, 1998).

3.5.1.4 Marine Water Quality

The proposed action will result in a temporary increase in TSS concentrations and the creation of a sediment plume during construction. Turbidity increases associated with operations and barge support are expected to be negligible. A potential for small equipment spills (oil, diesel fuel, and hydraulic fluid) exists during both construction and operations. Operational discharges will be permitted under existing or amended Endicott NPDES permit.

The two onshore development alternatives are expected to have no impact on marine water quality. Operational discharges would be permitted under existing or amended NPDES permits for Endicott or Badami, the host facility alternatives.

The Liberty Island alternative is expected to contribute to turbidity levels temporarily during construction of the island (up to 250 mg/l) and the subsea pipeline (up to 1,000 mg/l). A turbidity plume will be created by both island and pipeline construction. Increased TSS concentrations are expected to be minimal during production (including barge activities). Small equipment spills (oil, diesel fuel, and hydraulic fluid) could occur during both the construction and operations periods. Operational discharges would be permitted under project-specific NPDES permits.

Issues associated with a crude oil spill are discussed in Section 3.5.4.

3.5.2 Biological

3.5.2.1 Benthic and Boulder Patch Communities

The proposed Liberty (SDI) Project will have much less of an impact on the Boulder Patch community than the original Liberty Island alternative (Table 3.5-1). Although both alternatives would permanently cover approximately 20 acres of benthic habitat, the SDI site is entirely outside the Boulder Patch footprint. It was projected that pipeline trenching associated with the Liberty Island would permanently bury up to 14 acres of low-relief kelp and epilithic habitat (USDOI, MMS, 2002). Although this loss is estimated to represent only 0.1% of the Boulder Patch area, the SDI expansion alternative is expected to have no direct loss impact. The area of normal benthic habitat permanently covered by either alternatives constitutes a miniscule portion of available habitat, and neither alternative would have any measurable effect on invertebrate populations. Both the Kadleroshilik and Pt. Brower alternatives are land-based developments and would result in no direct loss of benthos or Boulder Patch.

3.5.2.2 Fish and Essential Fish Habitat

The major advantage that the proposed action has over both the Kadleroshilik and Pt. Brower drilling pad alternatives is that the SDI expansion requires no trans-tundra gravel roadway construction and no trans-tundra pipeline construction (Table 3.5-2). Disturbances to freshwater habitat and freshwater fish from both activities are not issues for the SDI alternative. The only pipeline construction associated with the SDI alternative will be confined to the existing causeway running from the SDI to MPI. The new pipelines will be located entirely on existing structure and will not physically affect fish habitat. There are no indications that deepwater fish overwintering habitat exists anywhere along the proposed route of the ice road that will run from the mine site to the SDI. The section of ice road that will run from the SDI to MPI in support of pipeline construction is in the vicinity of possible fish overwintering habitat, but disturbance can likely be avoided if the road is constructed over grounded ice and as close to the causeway gravel beach as possible.

Gravel roadway construction would require three river crossings for the Pt Brower alternative and two for the Kadleroshilik alternative. There are no specific design details for these crossings, but issues of potential disturbance to fish overwintering habitat and disruptions to fish migrations in summer would need to be addressed. The upgrade of the West Sagavanirktok River Bridge for the Liberty (SDI) alternative would occur in the vicinity of a known major fish overwintering area (see Section 3.2.3). The absence of any details concerning the potential construction project prevents any meaningful impact assessment at this time.

The SDI expansion will require 860,000 yd^3 of gravel, while the Pt. Brower alternative would require 1,600,000 yd^3 (725,000 yd^3 for the pad, 725,000 yd^3 for roadways), the Kadleroshilik alternative 2,260,000 yd^3 (540,000 yd^3 for the pad, 1,820,000 yd^3 for roadways), and Liberty Island 797,600 yd^3 (island only). While proper mine-site planning and reclamation could enhance freshwater fish habitat in all cases, the SDI alternative would potentially leave the smallest footprint.

The SDI and the original offshore Liberty Island alternatives would eliminate about the same area of coastal fish habitat. This area is miniscule compared to the amount of coastal habitat available to fish during the open-water season, and the loss would not have a measurable effect on fish populations.

The nearshore shallows in and around the proposed Liberty (SDI) Project area and Endicott Causeway can be considered important fish habitat for a number of anadromous and amphidromous species from both the Sagavanirktok and Colville rivers (see Section 3.3.6). Based on proximity, a large oil spill associated with the SDI and Pt. Brower alternatives, and to a lesser extent from the original offshore Liberty Island alternative, could dramatically impact shallow-water habitat of the delta.

3.5.2.3 Marine Mammals

Impacts to marine mammal species resulting from the SDI, Pt. Brower, and Kadleroshilik alternatives will be reduced compared to potential impacts of the offshore island alternative (Table 3.5-3). Potential impacts to marine mammals from noise and activity disturbances of the offshore island alternative could result during all phases of the development. Noise and activity disturbance could occur during ice-road construction and use, gravel hauling for island construction, installation of the subsea pipelines and island facilities, island drilling and production activities, and vessel-based and helicopter support during all phases of the development. Ringed, and possibly bearded, seals could be affected by disturbances from the offshore island development during all portions of the year.

In contrast to the offshore island alternative, most activities associated with the other three alternatives would be land-based and would have little effect on marine mammals.

3.5.2.4 Marine and Coastal Birds

The main project components that would have minor effects on marine and coastal birds for the various alternatives are the development pad or island, communication towers, access roads, pipeline routes, construction schedule, and gravel mine site size and location. A summary of these project components and their effects on marine and coastal birds is summarized in the Table 3.5-4. Processing facility locations for the various alternatives are Endicott MPI, Badami, and the originally proposed offshore Liberty Island. Processing facilities on the originally proposed offshore Liberty Island would expose more seabirds to collision mortality during spring and fall migrations than either of the existing processing facilities at Endicott MPI or at Badami. Large oil spills from any of the alternatives could potentially have major effects on marine and coastal birds and their habitats.

3.5.2.5 Terrestrial Mammals

The main project components that would have minor effects on terrestrial mammals under the various alternatives are the development pad or island, access roads, pipeline routes, construction schedule, and the gravel mine site size and location. A summary of these project components and their effects on caribou, muskoxen, grizzly bears, arctic foxes, and arctic ground squirrels is summarized in the Table 3.5-5. Processing facility locations for the various alternatives include Endicott MPI, Badami, and Liberty Island.

3.5.2.6 Wetland and Vegetation

The SDI expansion poses the smallest potential impact to wetlands and vegetation (Table 3.5-6). Onshore developments at Pt. Brower and the Kadleroshilik River would require the construction of the gravel pads and roads. This would require a much larger gravel mine than that proposed for the SDI expansion. The placement of gravel fill for the Pt. Brower and

Kadleroshilik River alternatives would cover approximately 100 and 150 acres of tundra, respectively. In addition, ice roads would be used to construct the necessary roads, pads, and pipelines to tie the Liberty development with the existing Prudhoe Bay infrastructure. Onshore developments would also greatly increase the potential impact to vegetation from oil spills.

The Liberty Island alternative is comparable to SDI expansion regarding the proposed and potential impacts to wetlands and vegetation. The primary difference between the alternatives is the proposed new pipeline construction. Liberty Island would involve 1.5 mi of new onshore pipeline. This would require additional ice road activity as well as increase the impact from potential spills. Using the existing Endicott Causeway for the new pipelines associated with SDI expansion eliminates the need for additional ice roads and greatly reduces the potential impact from spills.

3.5.2.7 Threatened and Endangered Species

Bowhead Whale

Potential impacts to bowhead whales would be greatest for the offshore island alternative compared to the SDI, Pt. Brower, and Kadleroshilik alternatives (Table 3.5-7). The SDI, Pt. Brower, and Kadleroshilik alternatives are primarily land-based options for Liberty development that would result in few potential impacts to bowhead whales. Any potential impacts to bowhead whales would be most likely to occur during the fall migration in August and September. The southern portion of the bowhead migration corridor is located approximately 15 km offshore, and the Liberty land-based alternatives would likely have little effect on bowhead whales. Marine vessel traffic during the sealift of the ***LoSal™*** EOR process plant would have the potential to temporarily displace bowheads along their migratory route. Industrial noise from the offshore island alternative during the fall bowhead migration would have the potential to cause a slight offshore displacement of the southern edge of the migration corridor (McDonald et al., 2006).

Polar Bear

Activities associated with ice-road construction and use for the Liberty (SDI) Project, Pt. Brower, and Kadleroshilik alternatives would have the potential to cause disturbances that may affect polar bears during the initial construction periods. However, annual construction of ice roads would not be planned, and potential impacts would result only during construction of these alternatives. Annual ice-road construction would be planned in support of the offshore island alternative, thus increasing the overall potential of disturbance to polar bears. Denning polar bears could be disturbed by various types of activities during winter or spring when they emerge from dens.

ESA-listed Birds

Potential impacts to spectacled and Steller's eiders would be reduced for the Liberty (SDI) Project alternative compared to the Pt. Brower and Kadleroshilik alternatives (Table 3.5-8). The construction of gravel roads and pad on tundra habitats would cover approximately 107 and 169 acres for the Pt. Brower and Kadleroshilik alternatives, respectively. This tundra would be lost as potential habitat for spectacled or Steller's eiders. The SDI option would not require construction of gravel roads or pads that cover tundra habitats, and the only tundra habitat that would be lost during construction would result from gravel mining. Gravel mining would also occur for the Pt. Brower and Kadleroshilik alternatives.

The potential for noise and activity disturbance to affect spectacled and Steller's eiders would also be reduced for the SDI alternative compared to the Pt. Brower and Kadleroshilik alternatives. Gravel roads would be constructed in areas which have previously been subjected to little disturbance and would cover approximately 7.3 and 15.2 mi for the Pt. Brower and Kadleroshilik alternatives respectively. In contrast, no new roads would be constructed for the SDI alternative. Increased traffic levels along the Endicott Road resulting from construction and operation of the SDI alternative could disturb eiders near the road, although many eiders and other waterfowl would likely be habituated to traffic.

The potential for noise and activity disturbance on pads to affect spectacled or Steller's eiders would be greater for the Pt. Brower and Kadleroshilik alternatives than for the SDI alternative. The Pt. Brower and Kadleroshilik pads would be surrounded by tundra that could be used by threatened eiders, possibly as nesting habitat. The expanded pad for the SDI alternative would be surrounded by marine waters that may be used by spectacled eiders for resting and feeding.

The potential for eider mortality due to collision with structures on pads would likely be greater for the SDI and offshore island alternatives than for the Pt. Brower and Kadleroshilik alternatives. Eider collisions would be most likely to occur during fall migration when flocks of birds are flying at low elevation. Divoky (1984) reported that the primary migration corridor during fall for king and common eiders in the Prudhoe Bay area was offshore between the barrier islands and the 20-m isobath. Day, Prichard, and Rose (2005) reported collisions of 36 eiders (all common or king eiders) with facilities at Northstar Island and the Endicott facilities between 2001 and 2004. Little information is available on fall migration corridors for spectacled eiders in the Prudhoe Bay area, but spectacled eiders migrating in offshore areas near the coast would have the potential to collide with structures on the SDI and offshore island pads. Migrating eiders would be most susceptible to collision during periods of poor visibility such as fog or at night. However, due to the low density of spectacled and Steller's eiders in the project area, collisions of threatened eiders with structures would be unlikely for any other alternatives.

3.5.3 Socioeconomics and Related Impacts

There are no material differences in the economic, subsistence, sociocultural, and environmental justice impacts associated with the variants among the new alternatives being considered. Effects of all these alternatives are discussed in Sections 3.1.12 (effects associated with the SDI expansion), 3.2.9 (effects associated with onshore construction), and 3.3.12 (effects associated with drilling and oil production).

3.5.4 Oil Spills

The risk of a spill and potential effects of oil spills from the offshore island and other likely alternatives are detailed in the Liberty FEIS (USDOI, MMS, 2002), which concluded:

> We do not expect significant impacts to result from any of the planned activities such as discharges and disturbances associated with Alternative I (Liberty Development and Production Plan) or any of the other alternatives. Some significant impacts—adverse effects to spectacled eiders, king and common eiders, long-tailed ducks, polar bears, subsistence-harvest patterns, sociocultural systems, and local water quality—could occur in the unlikely event of a large oil spill. However, the very low chance of such an event occurring…combined with the seasonal nature of the resources inhabiting the

> area (for example, eiders are present in the Liberty area 1-4 months of the year), makes it highly unlikely that an oil spill would occur and contact the resources. A resource may be present in the area but may not be contacted by oil…None of the component or combination alternatives evaluated [in this] EIS are expected to generate significant impacts from planned activities. If an unlikely oil spill occurred, similar significant effects could occur to spectacled eiders, king and common eiders, long-tailed ducks, polar bears, subsistence harvests, sociocultural systems, and local water quality for all alternatives.

The onshore Liberty alternatives at Pt. Brower and Kadleroshilik are expected to have the same or lesser impacts, because they are onshore.

It is clear that a large oil spill from any of the developments might result in major adverse impacts on various species and, therefore, on the availability of subsistence resources with attendant sociocultural and environmental justice impacts.

Oil production with any of the Liberty alternatives also might result in crude oil or product spills. Small operational spills of crude oil or product will occur and, as discussed in Section 3.4, large crude spills, although unlikely, also might occur. Depending on the location, timing, and behavior of a large spill, major adverse effects on certain species, subsistence-harvest patterns, and sociocultural systems would result. Section 3.3 provides more detail on the impacts of oil spills to environmental resources and sociocultural systems.

For any alternative, BPXA would implement mitigation measures (through the ODPCP) to minimize the possibility and potential for a large oil spill.

3.6 CUMULATIVE EFFECTS

3.6.1 Introduction

Climate change is a factor of the existing and future environment. It is a natural process (as, for example, is predation) and is not an "action" for cumulative analysis.

As defined by the National Environmental Policy Act [40 CFR 1508.7 and 1508.25 (a) (2)]:

> Cumulative impact is the impact on the environment which results from the incremental impact of the action when added to the other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions.
>
> Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.
>
> To determine the scope of environmental impact statements, agencies shall consider…. Cumulative actions, which when viewed with other proposed actions have cumulatively significant impacts and should therefore be discussed in the same impact statement.

Cumulative impacts were addressed at length in Liberty FEIS (USDOI, MMS, 2002), which is incorporated by reference. The general conclusions reached in this document were:

> Potential cumulative effects on the bowhead whale, subsistence, sociocultural systems, spectacled eider, Boulder Patch, polar bear, and caribou are of primary concern and warrant continued close attention and effective mitigation practices.
>
> The incremental contribution of the Liberty Project to cumulative effects is likely to be quite small. Construction and operations related to the Liberty Project would be confined to a relatively small geographic area, and oil output

would be a small percentage (approximately 1%) of the total estimated North Slope/Beaufort Sea production.

The Liberty Project would contribute a small percentage of spills…to resources in State and Federal waters in the Beaufort Sea from potential offshore oil spills. Any subsequent spills are not expected to contact the same resources or to occur before those resources recover from the first spill.

Potential Environmental Justice effects would focus on the Iñupiat community of Nuiqsut, and possibly of Kaktovik, within the North Slope Borough. If the one large spill assumed in the cumulative case (although not from the Liberty Project) occurred and contaminated essential whaling areas, major effects could occur when impacts from contamination of the shoreline, tainting concerns, cleanup disturbance, and disruption of subsistence practices are factored together. Such impacts would be considered disproportionately high adverse effects on Alaskan Natives.

The proposed action differs from those addressed in the FEIS. The current project eliminates the offshore impacts of island and pipeline construction and dramatically mitigates the potential offshore impacts related to the Boulder Patch, marine mammals, and concerns of the North Slope Iñupiat communities related to the bowhead whale and subsistence whaling and made issues related to offshore pipeline design moot. The decision to use the existing infrastructure at Endicott further mitigates impacts by avoiding construction of a pad on the shoreline of Foggy Island Bay and an access road and pipelines crossing the Sagavanirktok River delta.

The Liberty FEIS also offered several comments designed to place possible impacts in perspective. These are shown in Table 3.6-1, which also incorporates the above comment on the revised system design.

The Liberty FEIS focused on oil and gas developments, as these are the main agents of industrial-related change on the North Slope. In particular, the FEIS considered continued operation of the Trans Alaska Pipeline System (and associated marine transportation link) and past, present, and reasonably foreseeable future development/production (within the next 15 to 20 years). The FEIS noted the possibility that if oil prices were to rise substantially, it might be commercially feasible to develop presently stranded gas resources. The FEIS acknowledged this possibility but given the uncertainty associated with construction of a gas transportation system in the foreseeable future, did not include this project in the analysis of possible cumulative effects. In the intervening years, there has been continued interest in such a development, but it is unclear whether or not this project will go forward and what form it might take. Therefore, it is not included in this update.

The Liberty FEIS reached the following conclusion regarding cumulative effects:

The MMS does not expect any significant cumulative impacts to result from any of the planned activities associated with the exploration and development of North Slope and Beaufort Sea oil and gas fields…. In the event of a large offshore oil spill, some significant adverse impacts could occur to spectacled eiders, long-tailed ducks, common eiders, subsistence resources, sociocultural systems, and local water quality. However, the probability of such an event combined with the seasonal nature of the resources inhabiting the area makes it highly unlikely that an oil spill would occur and contact these resources….

3.6.2 Cumulative Effects Analyses in Recent NEPA Documents

Since publication of the Liberty FEIS, several additional reports have been published, including EIS's for the TAPS Right-of-Way Renewal (USDOI, BLM, 2002); Beaufort Multiple Sale (USDOI, MMS, 2003); Alpine Satellite Development Plan (USDOI, BLM, 2004a); Northwest National Petroleum Reserve-Alaska Final Integrated Activity Plan (USDOI, BLM and MMS, 2004b); EA for Lease Sale 195 in the Beaufort Sea Planning Area (USDOI, MMS, 2004); the Northeast National Petroleum Reserve-Alaska Final Integrated Activity Plan (USDOI, BLM, 2005); the EA for Lease Sale 202 in the Beaufort Sea Planning Area (USDOI, MMS, 2006b); and the EIS for Lease Sale 193 in the Chukchi Sea Planning Area (USDOI, MMS, 2007b). Additionally, the Committee on Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope of the National Research Council completed a comprehensive study of cumulative environmental effects of oil and gas activities on Alaska's North Slope in 2003 (NRC, 2003). A useful report also has been published on Arctic Climate Impact Assessment (ACIA, 2005) that provides pertinent data and information. These are incorporated by reference.

Results of these newer analyses are broadly consistent with the conclusions of the Liberty FEIS regarding possible cumulative effects. If anything, these newer documents suggest that cumulative effects for all past, present, and reasonably foreseeable future projects might be somewhat greater than originally projected in the Liberty FEIS. For example, the NRC offered the following observation on socioeconomic changes on the North Slope:

> Modern western culture, including oil development and the revenue stream it created, has resulted in major, important, and probably irreversible changes to the way of life in North Slope communities. The changes include improvements in schools, health care, housing, and other community services as well as increased rates of alcoholism, diabetes, and circulatory disease. There have been large changes in culture, diet, and the economic system. Many North Slope residents view many of these changes as positive. However, social and cultural shifts of this magnitude inevitably bear costs in social and individual pathology. These effects accumulate because they arise from several sources, and they interact.

According to the *Petroleum News*, Vol. II, No. 43 published October 22, 2006, Savant Alaska tracts are east of Prudhoe Bay, adjacent to Liberty, and extend east towards BP's offshore/onshore Badami oil field along the Mikkelsen Bay fault zone. The proposed Kupcake No. 1 drilling prospect is "a conventional exploration well targeting several hundred feet of Beaufortian-age sediments located at a depth of approximately -10,600 feet." The proposed exploration site is approximately 8,000 feet west of the Liberty No. 1 discovery well. Also, some new impacts (e.g., those from climate change) have assumed increased importance.

The projected production from Liberty is now estimated to be 105 MMbbl—12.5% smaller than the 120 MMbbl estimated in the Liberty FEIS. Oil prices are volatile and notoriously difficult to forecast; the FEIS used an Alaska Department of Revenue forecast of $16.30/bbl. As this is written, crude oil prices exceed $70/bbl. The *Fall 2006 Revenue Sources Book* (ADOR, 2006) projects lower crude-oil prices in the future than those at present: $41.50 per bbl post-FY 2014.[14] Even so, this revised price estimate is much higher than that assumed in the FEIS. Thus,

[14] The forecasting assumptions used by the State of Alaska Department of Revenue are deliberately (and appropriately) conservative. The Energy Information Administration base level crude oil price forecast for 2014 ranges from $44 to $50 per bbl (see http://www.eia.doe.gov/oiaf/aeo/aeoref_tab.html). In recent years, official government forecasts have typically underestimated the price of crude oil.

although the revised total production estimate from Liberty is smaller than originally assumed, the oil revenues from Liberty are likely to be substantially greater than originally estimated.

Because future oil prices are likely to be substantially greater than assumed in the Liberty FEIS by a factor of approximately 2.5 based on the above priced forecasts, the positive economic impacts from both Liberty and other oil and gas developments included in the FEIS are likely to be substantially greater than estimated originally.

Regarding production, total Liberty output can be placed in context by comparing it to estimated cumulative production from ANS fields through 2011; Liberty accounts for 1/155 of the total cumulative production, which is smaller than projected in the Liberty FEIS. Also, Liberty's output would account for only a relatively small proportion of production post-2011. Because the expected number of oil spills is believed to be proportional to total output, the likelihood of a spill from Liberty operations is substantially smaller than for all fields as a group.

Therefore, Liberty's output is expected to account for a very small percentage of total ANS output (and smaller than originally estimated), but the revenues from Liberty are likely to be substantially larger than originally estimated. Because of changes to the proposed Liberty design, the probable environmental impacts of Liberty are likely to be more modest than originally estimated. Finally, possible cumulative impacts from all past, present, and reasonably foreseeable developments might be the same or slightly larger than originally estimated. Thus, Liberty offers greater economic benefits than originally estimated and lower impacts in both proportional and absolute terms. More detailed comments are offered below.

3.6.3 Resource-Specific Cumulative Effects

The Beaufort Sea Multiple Sale EIS (USDOI, MMS 2003) included a comprehensive cumulative analysis of past, present, and reasonably foreseeable actions in the Beaufort Sea area, including the area of the current proposed action. The multiple-sale EIS cumulative analysis was updated with available new information in the Sale 195 EA (USDOI, MMS 2003), and again in the Sale 202 EA (USDOI, MMS 2006). The cumulative information and analysis in these documents, as well as in the Liberty FEIS are referenced and summarized below. These documents are incorporated by reference.

3.6.3.1 Air and Water Quality, Benthos, and Boulder Patch

The MMS cumulative analysis contained in the multiple-sale EIS (USDOI, MMS, 2003) concluded:

> A spill could affect water quality for 10 or more days in a local area. The effects of discharges and offshore construction activities are expected to be short term, lasting as long as the individual activity and to have the greatest impact in the immediate vicinity of the activity.

This conclusion was supported in the recent analysis (USDOI, MMS, 2006a).

Regarding air quality, the Liberty FEIS concluded that the cumulative effects of all projects affecting the North Slope in the past and occurring now have caused generally little deterioration in air quality, which remains better than required by national standards. Moreover, the Liberty FEIS concluded that reasonably foreseeable future developments would not change this situation.

Based on the information contained in this EA, the current Liberty (SDI) Project is not expected to contribute substantially to overall cumulative impacts to water quality, benthos, and the boulder patch.

3.6.3.2 Fishes and Essential Fish Habitat

Cumulative effects of Alaska North Slope oil and gas activities include those related to possible oil spills and climate changes. Recent analyses (see e.g., USDOI, MMS, 2006a) of climate change effects conclude:

> The climate of the Arctic is changing and affecting fish distributions. Evidence of such change is discussed in the Arctic Climate Impact Assessment report (ACIA, 2005) (the chapter on fish can be found at: http://www.acia.uaf.edu/PDFs/ACIA_Science_Chapters_Final/ACIA_Ch13_Final.pdf). Trends in instrumental records over the past 50 years indicate a reasonably coherent picture of recent environmental change in northern high latitude (ACIA, 2005). It is probable that the past decade was warmer than any other in the period of the instrumental record…. Climate change can affect fish production (e.g., individuals and/or populations) through a variety of means…. Direct effects of temperature on the metabolism, growth, and distribution of fishes occur. Food-web effects also occur through changes in lower trophic-level production or in the abundance of predators, but such effects are difficult to predict. Fish-recruitment patterns are strongly influenced by oceanographic processes such as local wind patterns and mixing and by prey availability during early lifestages. Recruitment success sometimes is affected by changes in the time of spawning, fecundity rates, survival rate of larvae, and food availability.

Regarding possible impacts from oil spills, the Liberty FEIS (USDOI, MMS, 2002) noted:

> While small numbers of fish in the immediate area of an offshore or onshore oil spill may be killed or harmed, an oil spill assumed for this analysis is not expected to have a measurable effect on fish populations. Subsistence and commercial fishing are likely to have a measurable cumulative effect on freshwater and migratory fish populations. However, due to a lack of survey information, the cumulative effect of these activities, and the amount of time required for each population to recover, is unknown.

This conclusion has not changed.

3.6.3.3 Marine Mammals

Recent analyses (USDOI, MMS, 2006b) of possible cumulative effects on other marine mammals conclude:

> Due to the ongoing effects of climate change in the Arctic, continued close attention and effective mitigation practices with respect to nonendangered marine mammal populations and distributions are warranted, particularly with respect to ringed seals, which likely would be among the first marine mammals to show the negative effects of climatic warming.

3.6.3.4 Marine and Coastal Birds

Possible cumulative impacts on marine and coastal birds have been reviewed in the EIS's/EAs incorporated by reference.

Specific potential effects of cumulative factors may include the loss of small numbers of spectacled eiders and other waterbirds as projects are developed. Minor declines in fitness,

survival, or production of young resulting from exposure of these bird populations to disturbances, habitat loss, mortality from increased predator populations or collision with structures, warrant continued close attention and implementation of effective mitigation practices for every project on the Arctic Coastal Plain. There are no indications that these forms of disturbance or collision mortality have resulted in major impacts to marine or coastal birds, including ESA-listed species. Direct mortality can quickly lead to population-level effects. Incremental increases in collision risk (considering the Liberty and other anticipated projects) are not expected to result in major impacts. Required Section 7 consultation under the Endangered Species Act serves to ensure that listed bird populations are not jeopardized and that any incidental take is minimized to the maximum extent practicable (Refer to Appendix C of this EA). Required data collection will improve the body of knowledge regarding the effectiveness of these measures.

As the potential for oil/gas exploration moves further from the Prudhoe Bay area, habitat losses and disturbance effects increase. At the present time, scientific evidence does not suggest that bird populations are limited by nesting habitat, they but could be affected when using sensitive habitats in nearshore coastal areas. Current developments have avoided sensitive areas, and evidence suggests that major impacts to bird populations have not occurred. The minor incremental increases in disturbances or habitat loss from the Liberty (SDI) Project would not appreciably increase negative effects to marine and coastal birds, and major impacts are not anticipated.

Mortality from a large oil spill, typically an unlikely event on a case-by-case basis, becomes more likely in the region as more projects are developed, as infrastructure ages, and as more technically-demanding areas are pioneered. One large spill could represent a major effect for any of several marine or coastal bird species; recovery of these species from such mortality would not be expected to occur if their populations are exhibiting a declining trend, as several species/species groups are. This has not occurred, and the incremental increases from the Liberty (SDI) Project, in maximizing use of existing infrastructure, does not appear to substantially increase this risk. In most situations, current response strategies and practices appear capable of meeting spill risk, but spill response could become more challenging as coastal conditions change.

Continued effects from climate change could benefit some of these species but likely would harm others. It is simply too soon to accurately predict what these effects will be.

The proposed Liberty (SDI) Project avoids or minimizes contributing to the combined impact of past projects where possible. Some potential impacts cannot be avoided, but some conservation measures could help avoid impacts from future projects. As a consequence, we conclude that the combined net effects would not constitute a major impact.

3.6.3.5 Terrestrial Mammals

The Liberty FEIS (USDOI, MMS, 2002) considered possible cumulative impacts on terrestrial mammals including caribou, muskoxen, grizzly bears, and arctic foxes. Impacts could result from encroaching oil development, activities such as gravel mining, the construction of roads and gravel pads, and possible oil spills. Although the FEIS illustrated various possible effects, the overall FEIS conclusion was that these effects would not be significant.

3.6.3.6 Threatened and Endangered Species

Bowhead Whales

Bowhead whales are a key subsistence resource and important to the sociocultural identity of several ANS communities (see Section 2.15). For this reason, Alaskan Natives have continued to express concerns regarding the possibility of any adverse effects on this key resource. And for this reason, EIS's (particularly those dealing with offshore developments) have devoted considerable attention to possible impacts on this resource. Key potential impacts of oil and gas activities in the cumulative case could include those resulting from noise (avoidance) and oil spills (temporary nonlethal effects).

The Liberty FEIS (USDOI, MMS, 2002) concluded that potential cumulative effects would be important, but were unlikely. Because of the changes to the recommended alternative, adverse impacts are even less likely with the new project design. The recent MMS analysis of cumulative effects (USDOI, MMS, 2006a) notes:

> Overall, we conclude…that the cumulative effects on bowhead whales would not be significant. However, we also conclude, as we did in the multiple-sale EIS (USDOI, MMS, 2003), that cumulative effects on bowhead whales are of primary concern and, thus, warrant continued close attention and effective mitigation practices.

Per the informal consultation dated October 19, 2007 (refer to Appendix D of this EA), NMFS stated "…while the Liberty project may affect these whales, our assessment…finds any such effects are insignificant (such effects could not be meaningfully measured or detected) or discountable (such effects would not reasonably be expected to occur)."

Polar Bears

Recent analysis (USDOI, MMS, 2006a) of possible cumulative impacts of oil and gas activities on polar bears stated: "the main effects of concern to polar bears are climate change, overharvest, and oil and fuel spills."

Per the FWS *Federal Register* notice dated January 9, 2007, entitled *Endangered and Threatened Wildlife..Proposed Rule To List the Polar Bear (Ursus maritimus) as Threatened Throughout Its Range ...*, the following statement regarding oil and gas activities is quoted:

> Historically, oil and gas activities have resulted in little direct mortality to polar bears, and that mortality which has occurred, has been associated with human bear interactions as opposed to a spill event. However, oil and gas activities are increasing as development continues to expand throughout the United States Arctic and internationally, including in polar bear terrestrial and marine habitats. The greatest concern for future oil and gas development is the effect of an oil spill or discharges in the marine environment impacting polar bears or their habitat.

ESA-listed Birds

The proposed action would not contribute a major amount to cumulative impacts on ESA-listed birds.

3.6.3.7 Cultural Resources

The Liberty FEIS (USDOI, MMS, 2002) concluded that the cumulative effects of proposed projects would likely disturb the seafloor more often, but remote-sensing surveys made before approval of any Federal or State lease actions should keep these effects low. Federal laws would preclude effects to most archeological resources from these planned activities. The Chukchi Sea Sale 193 FEIS (USDOI, MMS, 2007b) restates this conclusion.

3.6.3.8 Socioeconomics and Related Impacts

Economy

Cumulative effects on the economy could come from changes in regional project development and consequent changes in the local and State revenue stream, as well as changes in employment. These effects are noted in the Beaufort Sea Multiple-Sale EIS (USDOI, MMS, 2003), which noted:

> ...The oil and gas industry with interests in and near Prudhoe Bay and the Trans-Alaska Pipeline System have a strong interest in using the pipeline system many years into the future. The pipeline system represents a tremendous capital investment. Extending the useful life of the pipeline allows society to receive returns from its investment further into the future than would be the case if oil development on the North Slope ceased. In November 2002 an EIS was written and the TAPS Right-of-Way was renewed for another 20 years by both State and Federal agencies.
>
> The oil and gas industry has reduced the costs of drilling wells and bringing new fields into production. This has made it more economic to develop fields that require more pipeline, both onshore and offshore, to connect to the existing pipeline system. Examples of this are the onshore pipelines that in recent years extended eastward and westward from Prudhoe Bay to the Badami and Alpine prospects, respectively. These onshore pipelines, and other possible future extensions proximate to the Beaufort Sea coast, make it more economic to develop offshore prospects. This can be done by extending pipelines northward to the offshore, including the OCS. The North Star development is an example of an extension of pipeline northward from previously existing pipeline infrastructure to the offshore....
>
> The cumulative gains in direct employment would include additive jobs in petroleum exploration, development, and production, plus oil spill cleanup. The direct employment would generate indirect and induced employment and associated personal income for all the workers.

Sociocultural Systems

Cumulative effects on sociocultural systems could come from changes to subsistence-harvest patterns, social organization and values, and other issues, such as stress on social systems. These effects are noted in the Beaufort Sea Multiple-Sale EIS (USDOI, MMS, 2003) and other more-recent Chukchi Sea Sale 193 analysis (USDOI, MMS, 2007b), which noted:

> We conclude that potential overall cumulative impacts on subsistence and sociocultural systems from noise, disturbance, large oil spills, and global climate

> change would be significant, warrant continued close attention, and the development, monitoring, and enforcement of effective mitigation practices. Additionally, the potential effects of the lease sale are assessed within the context of climate change. If any new major effect due to climate changes were to occur, MMS would require changes to exploration or development/production designs and activities.

The Liberty FEIS (USDOI, MMS, 2002) traced other effects, including increases in population growth and employment that might cause long-term disruptions, to (1) the kinship networks that organize the Iñupiat communities' subsistence production and consumption, (2) extended families, and (3) informally derived systems of respect and authority (mainly respect of elders and other leaders in the community). Cumulative effects on social organization could include decreasing importance of the family, cooperation, sharing, and subsistence as a livelihood, and increasing individualism, wage labor, and entrepreneurship. Chronic disruption could affect subsistence-task groups and displace sharing networks, but it would not displace subsistence as a cultural value. Impacts to sociocultural systems have occurred, but there are many contributing factors (e.g., greater social mobility, access to media, particularly television and the media), and the relative importance of oil and gas activities is unclear.

In assessing changes to sociocultural systems, it is important also to consider the possible impacts associated with decreasing throughput and revenues, which will occur in any event, but would have greater impact if development of new fields does not occur. As noted in the Northeast NPR-A Final Amended IAP/EIS:

> Because of impacts from climate change on long-standing traditional hunting and gathering practices that promote health and cultural identify, and, considering the limited capacities and choices for adaptation and the ongoing cultural challenges of globalization to indigenous communities, North Slope peoples would experience cultural stresses, as well as impacts to population, employment, and local infrastructure. The termination of oil activity could result in the outmigration of non-Iñupiat people from the North Slope, along with some Iñupiat who may depend on higher levels of medical support or other infrastructure and services that may [not] be available in a fiscally constrained, post-oil production circumstance.

Because of its possible impacts on subsistence, climate change also could have major sociocultural consequences. This point is made in the proposed OCS Lease Sale 202 EA (USDOI, MMS, 2006b) as follows:

> Because of rapid and long-term impacts from climate change on long-standing traditional hunting and gathering practices that promote health and cultural identity, and considering the limited capacities and choices for adaptation and the ongoing cultural challenges of globalization to indigenous communities, we conclude that communities in the Arctic would experience significant cultural stresses, as well as major impacts on population, employment, and local infrastructure. If subsistence livelihoods are disrupted, communities in the Arctic could face increased poverty, drug and alcohol abuse, and other social problems.

It should be noted, however, that decisions on Liberty and other ANS projects are unlikely to affect climate change in any material way, although all ANS exploration, development, and production projects would contribute to the net effect of overall cumulative impacts in the region.

Subsistence and Area Use Patterns

Some of the key conclusions of the Beaufort Sea Multiple-Sale EIS (USDOI, MMS, 2003) relative to subsistence-harvest patterns included (for references see original):

> …past, present, and reasonably foreseeable projects on the North Slope [might result in] one or more important subsistence resources becoming unavailable or undesirable for use for 1-2 years, a significant adverse effect. Sources that could affect subsistence resources include potential oil spills, noise and traffic disturbance, and disturbance from construction activities associated with ice roads, production facilities, pipelines, gravel mining, and supply efforts. The communities of Barrow, Nuiqsut, and Kaktovik would potentially be most affected, with Nuiqsut potentially being the most affected community because it is within an expanding area of oil exploration and development both onshore (Alpine, Alpine Satellite, and Northeast and Northwest National Petroleum Reserve-Alaska) and offshore (Northstar and Liberty15).

Generally, similar conclusions were reached in more-recent EIS's, as summarized by MMS (USDOI, MMS 2006a). For example, the Alpine Satellite Development Plan FEIS (USDOI, BLM, 2004a) [see original for contained references] noted that:

> Development has already caused increased regulation of subsistence hunting, reduced access to hunting and fishing areas, altered habitat, and intensified competition from non-subsistence hunters for fish and wildlife. Additive impacts that could affect subsistence resources include potential oil spills, seismic noise, road and air traffic disturbance, and disturbance from construction activities associated with ice roads, production facilities, pipelines, gravel mining, and supply efforts. Based on potential cumulative, long-term displacement and/or functional loss, habitat available for caribou may be reduced or unavailable for use. Changes in population distribution due to the presence of oilfield facilities or activities may affect [the] availability for subsistence harvest[s] in traditional subsistence use areas…. Overall, impacts to subsistence harvest[s] and use[s] may have synergistic impacts with community health, welfare, and social structure. To the extent that subsistence hunting success is reduced in traditional use areas near Nuiqsut because of the presence of oilfield facilities and activities, subsistence hunters will need to travel to more distant areas to harvest sufficient resources in order to meet community needs. Greater reliance on more distant subsistence use areas will result in greater time spent away from the community for some household members and competition for resources with members of other communities. These changes in subsistence patterns may result in stress within households, family groups, and the community.

The Northeast NPR-A Final Amended IAP/EIS (USDOI, BLM, 2005) reached the following conclusions regarding cumulative effects on subsistence:

> Exploration and development activities on the North Slope have greatly impacted subsistence activities, as noted during public scoping testimony. In the Planning Area, exploration and development could originate from Inigok, Point Lonely, and Umiat vicinity, and could encompass important subsistence harvest

[15] When this was written, Liberty was believed to be an offshore development. The proposed action for Liberty is now expansion of an existing pad.

> areas for moose, fish, caribou, and furbearers, affecting subsistence users in Nuiqsut, Atqasuk, Barrow, and Anaktuvuk Pass. Subsistence hunters traveling in nearly every direction from Nuiqsut would have to pass through some kind of development en route to subsistence harvest areas. Iñupiat hunters are reluctant to use firearms near oil production facilities and pipelines, so subsistence users would be unlikely to harvest subsistence resources in these areas. Aircraft have interfered with hunts by scaring game away from hunters and the increase in air traffic by fixed-wing aircraft and helicopters would make this worse and over a much greater area if development goes forward. This issue has been raised several times by residents of Nuiqsut, who have also noted that oil and gas development is impacting traditional use areas and their ability to pass on knowledge of subsistence resources in these areas, and use of these resources, to their children.

This same EIS also addressed the impacts of climate change on subsistence resources:

> Climate change and the associated effects of anticipated warming of the climate change regime in the Arctic could significantly affect subsistence harvests and uses if warming trends continue…. Every community in the Arctic is potentially affected by the anticipated climactic shift and there is no plan in place for communities to adapt to or mitigate these potential effects. The reduction, regulation, and/or loss of subsistence resources would have severe effects on the subsistence way of life for residents of Nuiqsut, Atqasuk, Barrow, and Anaktuvuk Pass. If the loss of permafrost, and conditions beneficial to the maintenance of permafrost, arise as predicted, there could be synergistic cumulative effects on infrastructure, travel, landforms, sea ice, river navigability, habitat, availability of fresh water, and availability of terrestrial mammals, marine mammals, waterfowl and fish, all of which could necessitate relocating communities or their populations[s], shifting the population[s] to places with better subsistence hunting and causing a loss of dispersal of community.

Similar conclusions were reached in the EA for Lease Sale 202 in the Beaufort Sea Planning Area (USDOI, MMS, 2006b). It is appropriate to note, however, that the proportional contribution of the Liberty Project to these effects is small. The likelihood of a large oil spill is relatively small, certainly in comparison to the possible contribution of other fields, and the project has been engineered to minimize the additional footprint of facilities.

It is also appropriate to address the possible impact of climate change on the cumulative effects on subsistence in this section. The proposed OCS Lease Sale 202 (USDOI, MMS, 2006b) offered the following summary statement on the possible effects of climate change on subsistence-harvest patterns:

> Because polar marine and terrestrial animal populations would be particularly vulnerable to changes in sea ice, snow cover, and alternations in habitat and food sources brought on by climate change, rapid and long-term impacts on subsistence resources (availability), subsistence-harvest practices (travel modes and conditions, traditional access routes, traditional seasons and harvest locations), and the traditional diet could be expected over the lifetime of Sale 202 development.

Environmental Justice

As noted in other sections of this document that address environmental justice, Alaskan Iñupiat Natives, a recognized minority, are the predominant residents of the North Slope Borough, the area potentially most affected by cumulative oil and gas developments. Effects on Iñupiat Natives could occur because of their reliance on subsistence foods, and cumulative effects might affect subsistence resources and harvest practices. Potential effects from noise, disturbance, and oil spills on subsistence resources and practices and sociocultural patterns could affect many NSB communities. The Liberty FEIS (USDOI, MMS, 2002) concluded:

> Potential effects would focus on the Iñupiat community of Nuiqsut, and possibly Kaktovik, within the North Slope Borough. However, effects are not expected from routine activities and operations. If the one large spill assumed in the cumulative case (although not from the Liberty Project) occurred and contaminated essential whaling areas, major effects could occur when impacts from contamination of the shoreline, tainting concerns, cleanup disturbance, and disruption of subsistence practices are factored together. Such impacts would be considered disproportionately high adverse effects on Alaskan Natives. Oil-spill contamination of subsistence foods is the main concern regarding potential effects on Native health. The MMS believes that serious mitigation for such impacts begins with a commitment to preventing them by employing the highest standards of pipeline technology that include extra-thick-walled pipelines, pipeline burial depths more than twice the maximum 100-year ice gouging event, and advanced leak detection systems.

The current Liberty Project eliminates the potential for impacts from offshore pipelines. More recent reports (see e.g., USDOI, MMS, 2006a) also conclude that oil and gas developments have the potential to cause disproportionate impacts on Alaska Natives. Here is an illustrative summary statement from the Sale 202 EA (USDOI, MMS, 2006b):

> Potential significant impacts to subsistence resources and harvests and consequent significant impacts to sociocultural systems would indicate significant cumulative environmental justice impacts—disproportionate, high adverse environmental and health effects on low-income, minority populations in the region. We still conclude that potential environmental justice effects would focus on the Iñupiat communities of Barrow, Atqasuk, Nuiqsut, and Kaktovik within the NSB; such cumulative effects would be considered disproportionately high adverse effects on Alaska Natives. Any potential effects are expected to be mitigated substantially, although not eliminated.

As noted above, climate change could have cumulative impacts on subsistence resources, subsistence-harvest patterns, and (in consequence) sociocultural impacts. This would have implications for environmental justice. The EA for Proposed OCS Lease Sale 202 (USDOI, MMS, 2006b) offered the following summary:

> Potential impacts on human health from contaminants in subsistence foods and long-term climate change impacts on marine and terrestrial ecosystems in the Arctic—affecting subsistence resources, traditional culture, and community infrastructure of subsistence-based indigenous communities on the North Slope—would be an expected and additive contribution to cumulative environmental justice impacts.

Climate changes are not materially dependent on decisions regarding Liberty or other ANS development options.