OCS EIS/EA
MMS 2007-009

Environmental Assessment

Shell Offshore Inc.
Beaufort Sea Exploration Plan

Beaufort Sea OCS-Y-1743, 1805, 1807, 1808, 1809, 1817, 1828, 1834, 1841, 1842, 1845, and 1849

Prepared by

Office of the Regional Supervisor
Leasing and Environment
Alaska OCS Region

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

February 2007

FINDING OF NO SIGNIFICANT IMPACT

We have evaluated the potential effects of the proposed operations in the Exploration Plan from Shell Offshore Inc. (Shell) for the Beaufort Sea, 2007-2009, submitted on January 17, 2007. Per CEQ regulations at 1501.3 and 1508.9, we have prepared an environmental assessment (EA) to determine whether the proposed action requires preparation of an environmental impact statement (EIS) and to assist MMS planning and decisionmaking. Preparation of an EA is consistent with the Department of the Interior Manual (516 DM 15). Our analysis of the potential effects of the proposed action assumes that all aspects of the proposed activities occur as described in the EP and that Shell's proposed activities will comply with all other statutory and regulatory requirements, lease stipulations, conditions of permits, and conditions of approval of the EP. Based on our analysis in the EA, we have determined that Shell's proposed operations would not significantly affect the quality of the human environment (40 CFR 1508.27) and will not cause "undue or serious harm or damage to the human, marine, or coastal environment." We have determined that the preparation of an environmental impact statement is not required.

I approve: _____ 2/15/07

Regional Supervisor, Leasing and Environment
Alaska OCS Region

Date

I Concur: _____ 2/15/07

Regional Supervisor, Field Operations
Alaska OCS Region

Date

I. PURPOSE OF THE PROPOSED ACTION

Shell Offshore Inc. (Shell) submitted an Exploration Plan (EP), dated January 2007, to the Minerals Management Service (MMS) for exploration drilling over a three-year period to evaluate the oil and gas potential of some of the company's Beaufort Sea leases. In support of the EP, Shell submitted an Environmental Report (ER) (environmental impact analysis pursuant to 30 CFR 250.227), an Oil Discharge Prevention and Contingency Plan (ODPCP) (oil spill response plan pursuant to 30 CFR 254 Subpart B), and additional information required by OCS Sale 195 lease stipulations that apply to the proposed activity. The Shell EP concludes that general effects to the marine and coastal environment are likely to be minimal (ER p. 28) and that the drilling program is not expected to result in new or different impacts to the surrounding environment (ER Sec. 1.0).

Shell's exploration program would be consistent with the overall purpose of the OCS Lands Act Amendments, helping to determine the extent of the oil and natural gas resources of the OCS at the earliest practicable time in a manner that is consistent with protection of the human, marine, and coastal environments.

Per CEQ regulations at 1501.3 and 1508.9, we have prepared an environmental assessment (EA) to determine whether the proposed action requires preparation of an environmental impact statement (EIS) and to assist MMS planning and decisionmaking. Preparation of an EA is consistent with the Department of the Interior Manual (516 DM 15). Section V and Appendix 1 of this EA document the process for stakeholder input on the proposed activities.

II. PROPOSED ACTION AND ALTERNATIVES

II.A. Background

Shell's proposed operations would evaluate the oil and gas potential of some Beaufort Sea leases, including the leases in western Camden Bay where they have identified the Sivulliq Prospect (EA Fig. 1; ER Fig. 2-1). The Sivulliq Prospect was previous named the Hammerhead Prospect, and was explored initially during 1985 and 1986 (EA Fig. 2). The leases were relinquished during 1998. Shell re-leased this prospect and several others in OCS Lease Sale 195 in 2004.

Nine exploratory wells have been drilled previously in the Beaufort Sea during the open water period using floating drilling units. The *Kulluk*, one of the drilling units to be used by Shell, was used to drill 5 of these wells. Drill ships, similar to the *Frontier Discoverer* drill ship to be used by Shell, drilled the other 4 wells. Two of these wells were drilled on the Hammerhead prospect, which is the same prospect as Shell's Sivulliq prospect. One of the Hammerhead wells was determined to be producible under MMS regulations; MMS estimated the reservoir contains 100 to 200 million barrels (MMbbl) of oil (*Petroleum News*, 2006a).

II.B. Proposed Action

Shell is proposing to drill four Outer Continental Shelf (OCS) exploratory wells at the Sivulliq prospect in the 2007 open water season. Shell will use two floating drilling units operating simultaneously. Drilling operations will be supported by two ice breakers. Additional support vessels will be staged between the drilling units to provide near immediate on-site oil spill response capability in the unlikely event of a spill. Shell proposes to drill an undetermined number of wells on additional prospects in 2008/09, depending on the 2007 drilling results. Shell could drill up to 4 wells during any one year.

If time allows, Shell may also construct well cellars (holes dug or drilled in to the sea floor to depths of approximately 30-40 feet (ft) deep) during the 2007 open water season. The MMS requires that blowout preventors be installed in well cellars so that the top of the preventor is located below possible ice gouge depth. Well cellars can take 7-10 days to complete. Pre-construction of the well cellars in 2007 would provide a longer drilling window in 2008.

Shell's EP summarizes their proposed operations as a Beaufort Sea open-water exploration drilling and testing program for 2007, 2008, and 2009 (ER Sec. 1.0). Operations might occur any of the following twelve leases (Fig. 1): Beaufort Sea OCS-Y-1743, 1805, 1807, 1808, 1809, 1817, 1828, 1834, 1841, 1842, 1845, and 1849. The EP explains that operations would be conducted in a manner that is consistent with the lease terms, including two special stipulations: No. 4 Industry Site-Specific Bowhead Whales-Monitoring Program, and No. 5 Conflict Avoidance Mechanisms to Protect Subsistence Whaling and other Subsistence Activities (EP Secs. 11d and e).

II.B.1. Drill Site Locations

The Shell EP identifies twelve leases on six specific prospects as potential exploration targets. Three of the specific prospects are located in Camden Bay—Sivulliq, Lonestar, and Olympia. Shell's first priority prospect, Sivulliq, is located in the western part of the bay in 90-110 ft (28-34 meters [m]) of water and about 45 miles (mi) (70 kilometers [km]) to the east of Cross Island (EA Fig. 2; ER Fig. 2-1). Two other prospects are located about 25 and 40 mi to the east of Barter Island and about 10 mi offshore. The sixth prospect—Cornell—is located about 20 mi north of the Colville River delta. Drilling operations were conducted previously in Camden Bay at Hammerhead, Kuvlum, and Corona Prospects during 1985, 1986, 1991, 1992, and 1993, as summarized in the MMS human activities database (Wainwright, 2002) and on the MMS website (http://www.mms.gov/alaska/fo/wellhistory/BS_WELLS.HTM).

II.B.2. Drillships

Shell proposes to use two drilling vessels, the *Kulluk* and *Frontier Discoverer*, with each vessel drilling up to two wells between early July and mid-November, depending on the ice conditions. The *Kulluk* drilling unit (Fig. 3), which was used by ARCO to drill the Kuvlum wells during 1992 and 1993. The *Kulluk* is moored (anchored) on location with a 12-point mooring system

that is attached to large anchors. The *Kulluk* is designed to operate in water as shallow as 60 ft (20 m) (EP App. F Sec. 2.1), but the shallowest OCS water in which drillships like the *Kulluk* have been used is about 90 ft; Figures 1 and 2 indicate the 100-ft (30-m) isobath. The icebreakers and mooring system would allow the round drilling vessel to stay on location with up to 4 ft (1.3 m) of first-year ice moving against its hull (*Petroleum News*, 2006a; Clark et al., 1997:48). In the event drilling operations must be curtailed and the *Kulluk* moved off location, an underwater acoustic positioning system would be used to help relocate the exact drill site (EP Sec. 10a). Thrusters are being added to the *Kulluk* to help the vessel move independently between local drill sites (Shell, 2006, pers. comm.). The *Kulluk* would be moved to the Canadian Beaufort each winter and back to the Alaskan Beaufort Sea the following summer (EP Sec. 13e).

The *Frontier Discoverer* (Fig. 4) is a 514 ft (156 m) moored drillship with drilling equipment on a turret amid ship. An 8-point mooring system is attached to the bottom of the turret. The vessel is equipped with thrusters which are used to rotate around the turret, keeping the vessel's bow into the weather (or ice flow). The vessel is being refurbished with a reinforced hull for ice (*Petroleum News*, 2006c). The drillship is designed to operate in water over 125 ft (40 m) deep, which excludes the inner leases in Camden Bay. The *Discover* will be moved into and out of the Beaufort Sea for each annual operation, going to and from the Bering Sea (EP Sec. 13e). The moves would occur probably during early July and mid-November.

II.B.3. Additional Vessels

Two large icebreakers and several ice-strengthened supply boats would support the drillships. The large icebreakers would be the *Kapitan Dranitsyn* and the *Vladimir Ignatyuk* (EP Sec. 13a). The *Vladimir Ignatyuk* is the former *Arctic Kalvik* (Fig. 5). The *Vladimir Ignatyuk*, is an Arctic Class IV icebreaker, about 300 ft (88 m) long with 23,500 HP (Clark et at., 1997; http://en.wikipedia.org/wiki/CCGS_Terry_Fox is the website for the *Vladimir Ignatyuk*'s sister ship the *Terry Fox*). The *Kapitan Dranitsyn* is about 425 ft (131 m) long with 24,000 HP (Fig. 6 and http://www.eaglescry.com/Kapitan_Dranitsyn.htm). Both icebreakers would be located in the area during drilling (early July to mid-November).

Three other vessels would be used for ice management, anchor handling, and supplies, making a total of five ice-management vessels. The *Jim Kilabuk*, an icebreaking supply boat, would be located permanently in area during drilling. The icebreaking supply boat *Nordica* would be located in the area during 2007 and the similar *Fennica* would used during 2008-09.

The *Tor Viking* would be used for crew changes once every two weeks, and for marine mammal monitoring. The *M/V Peregrine,* an oil-spill response vessel, would be kept in the area during all operations in prospective hydrocarbon bearing zones (Shell, 2007:p. 1). The *Arctic Endeavor,* a 500,000-bbl tanker barge, and an associated tug would be kept in the area for acceptance of any recovered liquids.

II.B.4. Vessel and Aircraft Traffic

Shell would have about ten vessels in the exploration area each season, excluding the fuel resupply vessel. Per Sections 13a and 13b of the EP, support vessels in the area at any time could include the following:

Type	Maximum Number in Area at Any Time	Trip Frequency or Duration
Offshore Support Vessels	1	Permanently in Area
Tug Boats	1	Permanently in Area
Anchor Handling / Supply Vessels	3	Permanently in Area
Ice Breaker	2	Permanently in Area
Oil Spill Response Vessel	1	Permanently in Area
Diesel Oil Supply Vessel	1	Once Per Season

Per Section 13a of the EP, aircraft in the area at any time could include the following:

Type	Maximum Number in Area at Any Time	Trip Frequency or Duration
Fixed Wing	3	Once Per Day
Helicopter	3	Twice Per Day

Additional aircraft, including unmanned drone, will be used for marine mammal and other monitoring.

II.B.5. Other Aspects of the Proposal

Oil spill response information (EP Section 8). Oil spill information is outlined in Shell's ODPCP for Beaufort Sea open water drilling program. The referenced location of the ODPCP as located in Appendix E of the EP was modified, and now is a stand alone document under separate review by the MMS. The ODPCP outlines actions and techniques for various spill circumstances, response times, and availability of equipment. The ODPCP provides a cross reference to MMS response plan requirements [30 CFR 254 Subpart B], including the following worst case discharge volumes:

Sum of Capacity of Oil Storage Tanks	594,274	(BBL)
Daily Production Volume of Highest Capacity Well	5,500	(BBL)
Total Worst Case Discharge (WCD)	165,000	(BBL)

Discharges. Per Section 6a of the EP, solid and liquid waste will be generated during the course of the project execution. The wastes are generated at both drilling units and all of the ice management vessels. The wastes listed in the EP reflect waste streams and disposal methods for a full-scale operation. Per Section 6b of the EP, the projected ocean discharges will be as per the requirements of the General NPDES permit, latest approved version, subject to all testing described therein. The discharges listed in the EP reflect both generated waste streams and disposal at sea for a full-scale operation. Per Section 6c of the EP, Shell has applied for coverage under the General Permit for Offshore Oil and Gas Operations on the OCS and Contiguous Sate Waters of Alaska (AKG-284-0000), which became effective June 26, 2006, and expires midnight June 26, 2011.

Site-Work. Shell would continue site-survey work for future drill sites, making well-cellars in preparation for the following year's drilling program, looking for features such as shallow hazards, and drilling 400-ft deep boreholes to obtain soil strength data for the sea floor, for evaluating the design, cost, and feasibility of future offshore oil facilities (*Petroleum News*, 2006c). The proposed starting date is July 2007 and the proposed ending date is December 2009 for these activities.

Ancillary Activities. Geotechnical coring is described in the Shell EP. The proposed coring program would not involve penetration of the seabed greater than 500 ft and does not require and MMS permit. The geotechnical coring program is the same program proposed by Shell in 2006 and authorized by the MMS as an ancillary activity under 30 CFR 250.209. Per 15 DM 15, such ancillary activities are categorically excluded from NEPA review. The MMS conducted a categorical exclusion review of the proposed 2006 activities. Shell was unable to conduct the program in 2006 because of ice conditions that restricted mobilizing the coring vessel into the project area. At MMS request, Shell included the 2007 coring program in the proposed EP to provide for a consolidated review of the activities under 30 CFR 250.209. Most of the coring would occur off-lease, between the Sivulliq Prospect and shore (*Petroleum News*, 2006a).

The *Fugro Explorer* (Fig. 7), a geotechnical coring vessel, would be used. The Shell request to NMFS for an IHA explains that Shell will bore several holes, and that the boring of each hole will require about a week. Overall, the coring would be conducted during eight weeks of a 12-week period, and would be finished by mid-October.

Additional high-resolution site-clearance seismic surveying operations might be conducted from late July until early October in shallow State waters near the Point Thomson unit with another vessel, the *Henry Christofferson* (*Petroleum News*, 2006b). These site-clearance surveys activities are included in Shell's application to NMFS for an IHA. As ancillary activities, these surveys are subject to further review and authorization.

Authorizations under the Marine Mammal Protection Act (MMPA). Because of the widespread occurrence of marine mammals, including endangered species, in Alaskan waters and the increasing level of proposed offshore activities, MMS and other agencies are scrutinizing the potential for oil and gas related activities to involve incidental takes. The taking of marine mammals is subject to the requirements of the MMPA and ESA. Incidental taking of marine mammals and endangered and threatened species is allowed only when the statutory requirements of the MMPA and/or the ESA are met.

Section 101(a)(5) (A-D) of the MMPA, as amended (16 U.S.C. 1371(a)(5)), provides a mechanism for allowing, upon request, the incidental, but not intentional, taking, of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographic region. To obtain such authorization, OCS operators need an MMPA Incidental Take Authorization and can apply to the USDOI, Fish and Wildlife Service (FWS) for polar bears, walrus, and sea otters and to NMFS for whales, dolphins, porpoise, seals, and sea lions. Procedural regulations implementing the provisions of the MMPA are found in 50 CFR 18.27 for FWS and at 50 CFR 228 for NMFS. An ESA Incidental Take Statement also needs to be authorized by FWS and/or NMFS for marine mammals listed under the ESA. For the activities proposed in this EP, Shell has submitted applications for incidental take under the MMPA to both NMFS and FWS.

When MMS identifies during an environmental review that an activity has the potential to take marine mammals, MMS advises the OCS operators to contact NMFS and/or FWS to request authorization for take under the MMPA and/or ESA. OCS operators are then not permitted to commence activities under MMS permits or approvals until these MMPA or ESA authorizations are obtained. This helps ensure that MMS-approved activities comply with authorizations required under the MMPA and ESA.

II.C. Alternatives

Alternative 1 is the action as proposed by Shell in the EP. Alternative 2 is the proposed action with additional measures to further mitigate potential adverse effects. Alternative 3 is the No Action alternative (disapproval of the EP).

III. DESCRIPTION OF THE ENVIRONMENT

The potential areawide effects of exploratory drilling were assessed in three recent MMS NEPA documents, including the Environmental Impact Statement (EIS) for Beaufort Sea Lease Sales 186, 195 and 202 (USDOI, MMS, 2003), which is available on the MMS website. The EIS was updated in 2004 with an EA for Sale 195 (USDOI, MMS, 2004) that is available on the MMS website. And the EIS was updated further during 2006 with an EA for Sale 202 (USDOI, MMS, 2006a), which is also on the MMS website.

III.A. Physical Environment

III.A.1. Ice Cover

As summarized in the Sale 195 EA (USDOI, MMS, 2004), arctic sea ice is undergoing changes in extent, thickness, distribution, age, and melt duration. Analyses of long-term data sets indicate substantial reductions in both the extent (area of ocean covered by ice) and thickness of the arctic sea-ice cover during the past 20-40 years, with record minimum summer extent in 2002 and again in 2005, and extreme minima in 2003 and 2004 (Stroeve et al., 2005; NASA, 2005; Comiso, 2006). In September 2002, sea ice in the Arctic reached a record minimum during summer, 4% lower than any previous September since 1978 and 14% lower than the 1978-2000 mean (Serreze et al., 2003). Three years of low ice extent followed 2002. Taking these 3 years into account, the September ice-extent trend for 1979-2004 declined by 7.7% per decade (Stroeve et al., 2005) and from 1979-2005 declined by 9.8% per decade (Comiso, 2006). Within the Arctic, the Chukchi and Beaufort Seas have some of the largest declines in sea ice extent during summer; however, in 2005, the Beaufort Sea was not as wide open as the previous 3 years (Comiso, 2006).

III.A.2. Acoustic Environment

There is a great deal of naturally occurring noise in the ocean from volcanic, earthquake, wind, ice, and biotic sources (Richardson et al., 1995:Chapter 5). Ambient noise levels affect whether a given sound can be detectable by a receiver, including a living receiver, such as a whale. In addition, ambient-noise levels can change greatly throughout the course of a season at a particular site, and vary from site to site.

Properties of sound that influence how far that sound is transmitted, what species hear it, and what physical and behavioral effects it can have include: its intensity, frequency, amplitude, wavelength, and duration; distance between the sound source and the animal; whether the sound source is moving or stationary; the level and type of background noise; and the auditory and behavioral sensitivity of the species (Richardson et al., 1995). The perceived loudness of any given sound is influenced by many factors, including both the frequency and pressure of the sound (Gausland, 1998), the hearing ability of the listener, the level of background noise, and the physical environment through which the sound traveled before reaching the animal.

Sounds generated by the oil and gas industry in the Arctic are propagated into a marine environment that already receives sounds from numerous natural and human sources. Ambient noise levels in the Beaufort Sea can vary dramatically between and within seasons because of: (1) variability in components of environmental conditions such as sea ice, temperature, wind, and snow; (2) the presence of marine mammals; (3) the presence of industrial shipping, research activities, and subsistence activities; and (4) other miscellaneous factors. The ambient noise in the Arctic marine environment varies widely and seasonally. In the Beaufort Sea, Burgess and Greene (1999) measured ambient noise in September from about 63 to 133 dB re 1 μPa.

Natural sound sources in the Beaufort Sea include the wind stirring the surface of the ocean, lightning strikes; animal vocalizations and noises (including whale calls, echolocation clicks, and snapping shrimp); subsea earthquakes; and ice movements.

At least seasonally, marine mammals can contribute significantly to the background noise in the acoustic environment of the Beaufort Sea. Frequencies and levels are highly dependent on seasons. For example, source levels of bearded seal songs have been estimated to be up to 178 decibels re 1 μPascal at 1 meter (178 dB re 1 μPa at 1 m) (Cummings et al., 1983). Ringed seal calls have a source level of 95-130 dB re 1 μPa at 1 m, with the dominant frequency under 5 kHz (Richardson et al., 1995). Bowhead whales, which are present in the Arctic Region from early spring to mid- to late fall, produce sounds with estimated source levels ranging from 128-189 dB re 1 μPa at 1 m in frequency ranges from 20-3,500 Hz. Richardson et al. (1995) summarized that most bowhead whale calls are "tonal frequency-modulated (FM)" sounds at 50-400 Hz. There are many other species of marine mammals in the arctic marine environment whose vocalizations contribute to ambient noise.

Human sound sources include noise from vessels (motor boats used for subsistence and local transportation, commercial shipping, research vessels, etc.); navigation and scientific research equipment; airplanes and helicopters; human settlements; military activities; and marine development.

In shallow water, vessels more than 10 km away from a receiver generally contribute only to background noise (Richardson et al., 1995). Shipping traffic is most significant at frequencies from 20-300 Hz (Richardson et al., 1995). Barging associated with activities such as onshore and limited offshore oil and gas activities, fuel and supply shipments, and other activities contributes to overall ambient noise levels in some regions of the Beaufort Sea. The use of aluminum skiffs with outboard motors during fall subsistence whaling in the Alaskan Beaufort Sea also contributes noise. Fishing boats in coastal regions also contribute sound to the overall ambient noise. Sound produced by these smaller boats typically is at a higher frequency, around 300 Hz (Richardson et al., 1995).

Icebreaking vessels produce louder, but also more variable, sounds than those associated with other vessels of similar power and size (Richardson et al., 1995). Even with rapid attenuation of sound in heavy ice conditions, the elevation in noise levels attributed to icebreaking can be substantial out to at least 5 km (Richardson et al., 1991). In some instances, icebreaking sounds are detectable from more than 50 km away. In general, spectra of icebreaker noise are wide and highly variable over time (Richardson et al., 1995).

III.A.3. Air Quality

The air quality for most of the North Slope and offshore areas in the Beaufort Sea Planning Area is considered to be relatively pristine with concentrations of regulated air pollutants well within the National Ambient Air Quality Standards (NAAQS) and State of Alaska ambient air quality standards (18 AAC 50). Because concentrations of criteria pollutants are far less than federal and

state standards, the area is classified as an attainment area under the Clean Air Act. Sources of emissions in the area are generators in villages, transportation, and industrial sources at existing oil production facilities onshore and in state waters. During the spring and winter, winds transport pollutants from industrial Europe and Asia across the Arctic Ocean to arctic Alaska (Rahn, 1982). These pollutants cause a phenomenon called arctic haze.

III.A.4. Water Quality

Physical and chemical characteristics determine the quality of the marine aquatic environment. The constituents of the water mainly are composed of naturally occurring substances at nontoxic concentrations. The principal sources of pollutants entering the marine environment in general include discharges from industrial activities and accidental spills or discharges of crude or refined petroleum and other substances. Because of limited municipal and industrial activity around the Arctic Ocean coast, most pollutants occur at low levels in the Arctic. The rivers (Colville, Kuparuk, Sagavanirktok, and Canning) that flow into the Alaskan Beaufort Sea remain relatively unpolluted by human activities, but carry into the marine environment sediment particles (fine enough to be suspended) with trace metals and hydrocarbons. The broad arctic distribution of pollutants is described in a report by the Arctic Monitoring and Assessment Program (1997) entitled *Arctic Pollution Issues: A State of the Arctic Environmental Report.* Concentrations of pollutants in the water and sediments of the Alaskan Beaufort Sea have been monitored as part of the Beaufort Sea Monitoring Program. These data have been analyzed by Shaw et al. (as cited in USDOI, MMS, 2002).

Turbidity in the Beaufort Sea varies greatly between the summer open-water period and the winter ice-covered period. Satellite imagery and data on suspended-particulate matter suggest that in general, turbid waters are confined to waters less than 16 ft (5 m) deep and do not extend seaward of the barrier islands. Turbidity is caused by fine-grained particles suspended in the water column. These particles come from rivers discharging into the marine environment, coastal erosion, and resuspension by wave action of particles deposited on the seafloor. In mid-June through early July, the shallow, inshore waters generally carry more suspended material, because runoff from the rivers produces very high turbidity adjacent to the river mouths.

The principal method for controlling pollutant discharges is through Section 402 (33 U.S.C. § 1342) of the Federal Water Pollution Control Act (commonly referred to as the Clean Water Act of 1972), which establishes a National Pollution Discharge Elimination System (NPDES) (Laws, 1987). The USEPA or authorized States can issue permits for pollutant discharges, or they can refuse to issue such permits if the discharge would create conditions that violate the water-quality standards developed under the Clean Water Act.

III.B. Resources

The EP summarizes information for biological and cultural resources in Section 3 of the ER (EP App. G). The proposed drilling areas support bowhead whale, spectacled eider, polar bear, beluga and gray whales, walrus, and ringed, spotted, and bearded seal; and regional subsistence

activities include whaling, fishing, waterfowl and sea duck harvests, and hunting for seals, polar bears, walrus and beluga whales. The following EA section provides summary information on these resources.

III.B.1. ESA-Protected Species

III.B.1.a. Bowhead Whales

Bowhead whales are listed as endangered under the Endangered Species Act (ESA). The EP summarizes information on bowhead whales in Appendix G, Sec. 3.14.7, and illustrates their distribution in EP Figure 3-4. Additional information on bowheads is provided in Shell's request to NMFS for an IHA (Shell, 2007). Information on bowheads is summarized also in the Beaufort Sea multiple-sale EIS, Sale 195 EA, and Sale 202 EA (USDOI, MMS, 2003, 2004, 2006a).

Shell's request to NMFS for an IHA explains also that during fall migration ". . . most bowheads migrate west in water ranging from 15 to 200 m deep (Miller et al., 2002 *in* Richardson and Thomson, 2002); some individuals enter shallower water, particularly in light ice years, but very few whales are ever seen shoreward of the barrier islands" (Shell, 2007: Sec. 4). The Shell request explains further that the Bering-Chukchi-Beaufort bowhead stock is increasing slowly.

> ". . . abundance estimate for 2001 results in a rate of increase of 3.5 percent (confidence intervals [CI] = 2.2 to 4.9 percent) (Brandon and Wade 2004 *cited in* Angliss and Outlaw 2005). Calve counts in 2001 was the highest recorded at 121 individuals, and lends building evidence of a growing population."

The Shell IHA request summarizes the growth of the Bering-Chukchi-Beaufort bowhead stock in spite of changes in arctic climate (Shell, 2007). The slow, steady growth of the Bering-Chukchi-Beaufort stock is summarized also in the NMFS Biological Opinion (BO) (NMFS, 2006). The BO covers OCS activities such as those proposed in the Shell EP. The BO documents a non-jeopardy finding for bowhead whales in the Beaufort Sea.

All bowhead whale sightings from the 1982 to 2005 MMS Bowhead Whale Aerial Survey Project (BWASP) near the Shell prospects in the eastern Alaskan Beaufort Sea are illustrated in Figure 8. The figure illustrates that the shoreward edge of the bowhead migration corridor across Camden Bay is around the 20-m isobath and 5 to 10 mi offshore, but to the east of Kaktovik the corridor is within a couple miles of the shore. Figure 8 excludes the bowhead sightings from industry-sponsored, marine-mammal monitoring surveys during previous operations at Hammerhead, Kuvlum, and Corona, but the latter sightings are illustrated in subsequent figures. While thousands of bowheads migrate through the project area during the autumn, almost no bowheads have been sighted in the project area during summer.

The dates and depths of those Camden Bay sightings are illustrated in Figures 9 and 10, showing the time and depth of the main migration through Camden Bay. The graphs indicate that the

October, and that the main migration corridor in Camden Bay extends out to the 50-m isobath.

We have reviewed also the marine-mammal monitoring reports for previous Camden Bay drilling operations, specifically, the reports for the 1985 and 1986 operations at Hammerhead prospect (McLaren et al., 1986; and LGL and Greeneridge Sciences, 1987), the 1986 operations at the Corona prospect (McLaren et al., 1986), the 1991 operations at the Galahad prospect in outer Camden Bay (Gallagher, Brewer, and Hall, 1992), and the 1992 and 1993 operations at Kuvlum prospect (Brewer et al., 1993; Hall et al., 1994). Information from these monitoring reports is included in the assessment in Section IV.A.

The MMS BWASP has shown that the location of the bowhead whale migration corridor changes slightly from year to year. The location of the BWASP sightings near the prospects in the eastern Alaskan Beaufort Sea during the years of previous operations there (1985, 1986, 1992, and 1993) is illustrated in Figure 11. The illustration shows that about as many bowheads were sighted (1) between the drill sites and shore as (2) farther offshore from the drill sites.

III.B.1.b. Spectacled and Steller's Eiders

The spectacled eider and Steller's eider remain listed as threatened under the ESA. The Kittlitz's murrelet (*Brachyramphus brevirostris*) is designated a candidate species under the ESA.

Spectacled Eider. As explained in the Beaufort Sea multiple-sale EIS and subsequent EA's for Sales 195 and 202 (MMS 2003, 2004, 2006), the spectacled eider breeding population on the North Slope currently is the largest breeding population in North America.

Aerial surveys of spectacled eiders conducted in June 2006 on the Arctic Coastal Plain (ACP) resulted in a population index of 6,731, which was below the 2005 index of 7,820 and the long-term average of 6,903 (Larned, Stehn, and Platte, 2006). The 14-year trend has remained level, and the mean annual population growth rate for the last 7 years was not significantly different than 1.0 (a stable population = 1.00) (Larned, Stehn, and Platte, 2006). The spatial distribution of eiders during the 2006 surveys was similar to those of previous years.

Spectacled eiders were surveyed in marine waters within 100 km of the Beaufort Sea shoreline between Barrow and Demarcation Point during the summers 1999-2001 (Fischer and Larned, 2004). Overall, spectacled eiders were observed in low densities throughout the survey area but were all seen offshore of the Colville River Delta while staging for migration during the 1999 and 2000 summers.

Steller's Eider. So few Steller's eiders were detected during the annual eider breeding population survey of the ACP in 2005 that Larned, Stehn, and Platte (2006) concluded it was of little value in calculating a population trend. 2006 was a breeding year for Steller's eiders in the Barrow area. Larned, Stehn, and Platte (2006) reported an index of 300, which was above the long-term average of 166. Similarly, very few Steller's eiders are observed during annual aerial population surveys designed for common eiders in nearshore and along barrier islands (Dau and Larned,

2004, 2005). Steller's eiders were surveyed in marine waters within 100 km of the Beaufort Sea shoreline east of Barrow to Demarcation Point by Fischer and Larned (2004) during the summers 1999-2001. Steller's eiders were the least numerous (n = 3) of all the birds (27, 517 total) observed during the surveys (Fischer and Larned 2004).

Kittlitz's Murrelet. This species is thought "likely to occur" in the Beaufort Sea by the USDOI, FWS (2006). The MMS, however, has no records of its occurrence in the project area. If any Kittlitz's murrelets occur in or near the project area, their numbers would be expected to be very small and there would be a low potential for effects on this species. No new information on the distribution of the Kittlitz's murrelet in the Beaufort Sea is available.

III.B.1.c. Polar Bear (Proposed for Listing)

According to the FWS, the status of polar bears worldwide is declining as a result of climate changes, loss of ice habitat, and unregulated hunting pressures (USDOI, FWS, 2005). On December 27, 2006, the FWS submitted a proposal to list the polar bear as a threatened species under the ESA (FWS, 2007).For oil and gas activities, the FWS concluded that based on mitigation measures in place now and likely to be used in the future, historical information on the level of oil and gas development activities occurring within polar bear habitat within the Arctic, the lack of direct quantifiable impacts to polar bear habitat from these activities noted to date, and because of the localized nature of the development activities, or possible events such as oil spills, they do not threaten the species throughout all or a significant portion of its range.

Two polar bear stocks are recognized in Alaska: the southern Beaufort Sea stock (SBS) and the Chukchi/Bering Seas stock (CBS), though there is considerable overlap between the two in the eastern Chukchi Seas (Amstrup et al., 2005). The SBS population ranges from the Baillie Islands, Canada west to Point Hope, Alaska. On an annual basis, more than 90% of the bears in the SBS subpopulation occur between the Colville River in Alaska and the Mackenzie River in Canada (Cronin, Amstrup, and Scribner, 2006). Similarly, more than 90% of the bears in the CBS subpopulation occur west of Cape Lisburne (Cronin, Amstrup, and Scribner, 2006). The CBS stock ranges from Point Barrow, Alaska, west to the Eastern Siberian Sea.

Polar bears are a classic *K*-selected species, meaning they have delayed maturation, small litter sizes, and high adult survival rates (Bunnell and Tait, 1981). Because polar bears exist in relatively small populations and have low reproductive rates, populations may be detrimentally impacted by even small reductions in their numbers (Amstrup, 2000). Their low reproductive rate requires that there must be a high rate of survival to maintain population levels (Amstrup, 2003). Mating occurs from March to May, followed by a delayed implantation in the autumn (Ramsay and Stirling, 1988). A complete reproductive cycle is energetically expensive for female polar bears. When nutritionally stressed, female polar bears can forgo reproduction rather than risk their own survival (Amstrup, 2003).

In northern Alaska, pregnant females enter maternity dens by late November and emerge as late as early April. Maternal dens are typically located in snow drifts in coastal areas, stable parts of

the offshore pack ice, or on land-fast ice (Amstrup and Garner, 1994). Studies have shown that more bears are now denning near shore, rather than in far offshore regions. The highest density of land dens in Alaska occur along the coastal barrier islands of the eastern Beaufort Sea and within the Arctic National Wildlife Refuge (Amstrup and Garner, 1994; USGS, pers. comm.).

Polar bears usually forage in areas where there are high concentrations of ringed seals, as these are their primary prey, (Stirling and McEwan, 1975; Larsen, 1985), though bearded seals, walrus and beluga whales are also taken opportunistically (Amstrup and DeMaster, 1988). Polar bears are almost completely carnivorous though they will opportunistically feed on a variety of foods including carrion, bird eggs, and vegetation (Smith, 1985; Smith and Hill, 1996; Derocher, Wiig, and Bangjord, 2000). Polar bears prefer shallow water areas, perhaps reflecting similar preferences by their primary prey, ringed seals, as well as the higher productivity in these areas (Durner et al., 2004). In the spring, polar bears in the Beaufort Sea overwhelmingly prefer regions with ice concentrations >90% and composed of ice floes 2-10 km in diameter (Durner et al., 2004). In the summer, bears in the Beaufort Sea select habitats with a high proportion of old ice, which takes them far from the coast as the ice melts. In fact, 75% of bear locations in the summer occur on sea ice in waters >350 m deep, which places them outside the areas of greatest prey abundance. This is because ringed seals tend to aggregate in open water areas in the late summer and early fall where primary productivity is thought to be high (Harwood and Stirling, 1992), thus placing them well out of reach of polar bears summering on the pack ice.

Polar bears' preferred habitat is the annual ice over the continental shelf and inter-island archipelagos that encircle the polar basin (Derocher et al., 2004). Polar bears are excellent swimmers and swim while actively hunting, while moving between hunting areas, and while moving between sea ice and terrestrial habitats.

Polar bear use of coastal areas during the fall open water period has increased in recent years (Kochnev et al., 2003; Schliebe et al., 2005). In fact, near-shore densities of polar bears can be two to five times greater in autumn than in summer (Durner and Amstrup, 2000). For example, aerial surveys flown in September and October from 2000-2005 have revealed that 53% of the bears observed along the coast have been females with cubs, and that 71% of all bears observed were within a 30 km radius of the village of Kaktovik. Congregations of more than 60 polar bears and as many as 12 brown bears have been observed feeding on whale carcasses near Kaktovik in recent years during the fall open water period (Miller, Schliebe, and Proffitt, 2006), and as many as 140 polar bears have been observed at walrus haul-out sites on Wrangel Island and the north coast of Chukotka (Kochnev, 2002; Kochnev et al., 2003). In the autumn of 2002, North Slope Borough and FWS biologists documented more than 100 polar bears that came ashore in and around Barrow (USDOI, FWS, pers. commun.). These observed changes in polar bear distribution have been correlated with the distance to the pack ice at that time of year. The further from shore the leading edge of the pack ice is, the more bears are observed on shore in the fall (Kochnev et al., 2003; Ovsyanikov, 2003; Schliebe et al., 2005; Kochnev, in prep.).

In 2006, the SBS population was estimated at ~1,526 individuals (Regehr et al., 2006), down from previous estimates of ~1,800 animals (Lunn, Schliebe, and Born, 2002).

Neither the SBS nor CBS stock is listed as "depleted" under the MMPA. The SBS is assumed to be within optimum sustainable population levels, although new population information puts that assumption in question (USDOI, FWS: http://alaska.fws.gov/fisheries/mmm/polarbear/reports.htm).

III.B.2. Subsistence-Harvest Patterns and Sociocultural Systems

The Shell EP summarizes information on the subsistence-harvest patterns and sociocultural systems in Section 3.14.9 of the ER (EP Appendix G). The section explains that subsistence hunting of bowhead whale is the most valued activity in the subsistence economy, and that land use in the region has traditionally revolved around subsistence resources. Additional information on subsistence and sociocultural resources around the eight Shell lease blocks near Cross Island and Kaktovik that are specifically analyzed in the EP, as well as four lease blocks that are identified as part of Shell's exploration program, is summarized in Section I of Appendix D of the Sale 202 EA (USDOI, MMS, 2006a).

Exploration drilling with accompanying vessel and aerial support is proposed for the four Olympia Prospect lease blocks 12 mi northwest of Kaktovik and the four Sivulliq Prospect lease blocks 45 mi west of Cross Island, the traditional staging location for Nuiqsut subsistence whaling. The locations of whale harvests around Cross Island and Kaktovik are shown on Figures 12 and 13, respectively. Also cleared for potential future exploration in this EA but not analyzed in the EP are the Fosters and Fireclaw Prospects 25 mi east of Barter Island and the Cornell Prospect 20 miles north of the Colville River Delta. Ancillary activities (high-resolution seismic surveying and geotechnical coring) are planned also for these leases.

This section updates the information on subsistence-harvest patterns and sociocultural systems and incorporates by reference information from the Beaufort Sea multiple-sale EIS, the EA's for Sales 195 and 202, and the 2006 Arctic Seismic Programmatic EA (PEA) (MMS 2003, 2004, 2006a[PEA], 2006b[202]). These documents discuss subsistence and sociocultural systems in the communities of Barrow, Nuiqsut, and Kaktovik that have offshore subsistence-harvest areas potentially affected by the activities proposed in the Shell EP. No new subsistence information has become available since the publication of the Beaufort Sea Sale 202 in August 2006.

The MMS is conducting long-term environmental monitoring around the Northstar development, which is near the Nuiqsut subsistence-whaling area. As part of this monitoring effort, MMS has conducted a multiple-year collaborative project with Nuiqsut whalers that describe present-day subsistence whaling practices at Cross Island to empirically verify any changes to whaling due to weather, ice conditions, or oil and gas activities. The project findings were summarized during the 2005 MMS Information Transfer Meeting (USDOI, MMS, 2005). Overall, the project has shown that the Nuiqsut whalers have continued to obtain their quota of whales. However, Nuiqsut whalers reported the following recent changes in whale behavior and whaling practices:

In 2004:

- Ice conditions in 2004 were even more moderate than in previous years.

- Weather prevented scouting a significant number of days but not as many days as in 2003.
- The level of whaling effort, as measured by time spent out on the water, was about twice that of 2003, but still much less than in 2002 or 2001.
- Whalers reported seeing many whales; whalers did not compare one year to another, but 2004 was probably comparable to 2003 in terms of whales sighted, and "better" than in 2002 or 2001.
- Whalers found whales relatively close to Cross Island; whales were harvested about the same distance from Cross Island in 2004 as in 2003 (which was closer than in 2001 or 2002).
- Whalers took shorter trips, both in terms of length and time duration, than in 2002 or 2001, but longer than in 2003 (which is why total effort was greater in 2004 than in 2003).
- No whaler explicitly mentioned observing skittish or "spooky" whale behavior.

Possible causes suggested by whalers for these behavioral changes were:

- The lack of ice that could have moderated the effects of the wind.
- Weather generally was poor, and whalers sometimes went scouting in relatively marginal conditions.
- Whales may have been more difficult to spot, due to wave height.
- Whales could have been traveling more rapidly than in past years (Galginaitis and Funk, 2006a).

In 2005:

- Whalers encountered a great deal of ice in 2005, which was a dramatic change from the previous four years.
- Weather also was very unfavorable and was dominated by strong east winds.
- Whalers saw relatively few whales in 2005 compared to previous years; swells and waves due to wind made spotting and observing difficult.
- In most cases, whalers were not able to follow or chase whales long enough to have a good opportunity for a strike.
- Whalers indicated that whales were traveling fast, not staying on the surface very long, and changing directions in unpredictable ways when first sighted.
- Ice and weather were not considered to be factors in making whales more "skittish."
- There were no reports of whale feeding behavior.

Possible causes suggested by whalers for these behavioral changes were:

- Heavy ice cover was encountered on most days.
- Significant ice cover allows whales to "hide" and makes them more difficult to spot.
- Significant ice cover allows whales that are seen to escape more easily and makes them more difficult to follow.
- "Spooked" behavior by whales was attributed to their reactions to encounters with barges and other vessel activity in the area.

- Whalers believed that the migration of whales in 2005 was similar to that of previous years, but that ice and weather conditions prevented them from reaching the whales.
- The same ice and weather conditions made nearshore waters the preferred operating areas for nonwhaling vessel traffic and increased potential encounters with whalers (Galginaitis and Funk, 2006b).

According to Galginaitis, "the need for a better mechanism to implement the common goal of conflict avoidance for years of extreme environmental conditions as 2005 is quite obvious" (Galginaitis and Funk, 2006b).

The Nuiqsut subsistence-whaling area is discussed in the Sale 195 EA (USDOI, MMS, 2004: Appendix H). Appendix H illustrates the extent of Nuiqsut whaling crew voyages for the 2001 and 2002 whaling seasons. The data just cited have been updated. Updates were gathered as part of the ongoing MMS Arctic Nearshore Impact Monitoring in Development Area (ANIMIDA) monitoring effort in development regions (Galginaitis and Funk, 2004, 2005), which includes reports on recent data about the level of subsistence activity around Cross Island. For example, the reports explain that during 2001, the four whaling crews on Cross Island spent more than 10 hours on each scouting trip looking for whales. The total amount of time scouting was about 600 hours (Galginaitis and Funk, 2004). Rough weather prevented scouting during about one-third of the time that the whalers were on Cross Island during 2001 (Galginaitis and Funk, 2004:24) and about half of the time during 2003 (Galginaitis and Funk, 2005: 18).

The unusually rough water that restricted the scouting for whales might have been related to the unusual retreat of the summer ice cover in the Beaufort Sea during recent years, which created an unusually long fetch (EA Sec. IV.A.1). The changes in the ice cover and some of its effects on coastal erosion were summarized by Comiso (2005) and Wisniewski (2005). Comiso (2005) showed the minimum extent and minimum area for the arctic ice cover from 1979-2003, depicted in a graph as determined by satellite imagery. The graph illustrated that the ice cover was unusually small during 2003-the year when Nuiqsut subsistence-whaling activity was cut to half of its normal time by rough water.

In summary, the recent offshore subsistence-whale hunts have been affected by the retreat of the ice cover far from the coast. This contrasts with the situation decades ago, when the whale hunts were sometimes limited by heavy ice covers.

III.B.3. Other Resources

III.B.3.a. Other Marine and Coastal Birds

The Shell EP summarizes information on marine and coastal birds in Sections 3.14.6 and 3.14.7 of the ER (EP App. F). Birds protected by the ESA are described in Section III.B.1.b.

This section summarizes the updated information on marine and coastal birds since completion of the Lease Sale 202 EA (USDOI, MMS, 2006a). The updated information includes recently

obtained research results on size, status, trends, and distribution of king eiders, the long-tailed duck, the yellow-billed loon, and other bird populations potentially at risk of substantial effects from the proposed action.

King Eider. Aerial surveys of king eiders conducted on the ACP during June 2006 yielded a population index of 12,896, which was below the 14-year mean of 13,070. The index also was below the 2005 index of 14,934 (Larned, Stehn, and Platte, 2006). The long-term (14 year) growth rate was 1.017 (Larned, Stehn, and Platte, 2006). The growth rate for the last 7 years is 0.986. Distributions during the 2006 surveys were similar to previous years.

Satellite telemetry was used to determine that most king eiders spent more than 2 weeks staging offshore in the Beaufort Sea prior to migrating to molt locations in the Bering Sea (Phillips, 2005; Powell et al., 2005). Female king eiders may need to remain in the Beaufort Sea longer than males to replenish fat stores depleted during egg laying and incubation (Powell et al., 2005). Prior to molt migration, king eiders in the Beaufort Sea usually were found about 13 km offshore; however, during migration to molting areas, king eiders occupied a wide area ranging from shoreline to >50 km offshore (Phillips, 2005).

Long-tailed Ducks. Aerial breeding-pair surveys have been conducted on the ACP for the past 20 years. The long-tailed duck population index for 2005 was 84,241 and was below the 2004 index of 101,091. The 20-year trend for long-tailed ducks remains negative (0.9774), attributed primarily to a decrease in the flock or group component (Mallek, Platte, and Stehn, 2006).

Yellow-Billed Loon. Aerial surveys of yellow-billed loons conducted in mid-June 2006 on the ACP resulted in a population index of 1,268, which was slightly below the 2005 index of 1,282, but above the long-term average of 1,102 (Larned, Stehn, and Platte, 2006). The distribution of yellow-billed loons appeared to expand southeast of Teshekpuk Lake in 2006.

Aerial breeding-pair surveys have been conducted in late June on the ACP for the past 20 years (Mallek, Stehn, and Platte, 2006). The yellow-billed loon population index for 2005 was 1,871 and was below the 2004 index of 2,262. The 20-year growth trend is flat at 0.9938 (Mallek, Stehn, and Platte, 2006).

Tundra Swan. Aerial breeding pair surveys have been conducted on the ACP for the past 20 years. The tundra swan population index for 2005 was 12,002 and was 22% above the previous 19-year mean of 9,854 (Mallek, Platte, and Stehn, 2006). The 20-year trend for tundra swans was significantly positive, attributed primarily to large numbers of swans observed during the 1997-2000 surveys (Mallek, Platte, and Stehn, 2006).

Red-throated Loon. Annual eider breeding-population surveys are conducted on the ACP in mid-June. Numbers of other breeding waterbird species are recorded during these surveys. Results from the 2006 survey include that the red-throated loon index remained well below average, recording the lowest on record. This index factors into a significantly negative long-term (15 year) growth rate of 0.934 and a negative growth rate of 0.902 for the last 7 years

(Larned, Stehn, and Platte, 2006). Distribution of the densest breeding concentrations of red-throated loons appears to have changed among early and late time periods, as the population declined (Larned, Stehn, and Platte, 2006).

Aerial breeding pair surveys have been conducted on the ACP for the past 20 years. The red-throated loon population index in 2005 was 3,038 and was 4% below the previous 19-year mean. The population index has historically been highly variable, but the overall growth trend is significantly positive (Mallek, Platte, and Stehn, 2006).

Pacific Loon. Annual eider breeding population surveys are conducted on the ACP in mid-June. Numbers of other breeding waterbird species are recorded during these surveys. Results from the 2006 survey include that the Pacific loon index was slightly below average, continuing a long-term (15 year) stable trend, but the growth rate for the last 7 years is significantly negative at 0.964 (Larned, Stehn, and Platte, 2006).

Aerial breeding pair surveys have been conducted on the ACP for the past 20 years. The pacific loon population index in 2005 was 24,955 and was 7% below the previous 19-year mean (Mallek, Platte, and Stehn, 2005). The 20-year growth trend is flat.

Black Brant. Aerial surveys conducted during early June 2006 resulted in a population index of 10,276, which was below the 2005 index of 14,264 (Larned, Stehn, and Platte, 2006). There are certain limitations of the survey design (brant are primarily colonial nesters), but population indices suggest that the last 7-year and 15-year growth rates are 1.201 and 1.127, respectively.

Breeding pair surveys have been conducted on the ACP for the last 20 years. The population index for black brant in 2005 was 15,609, a dramatic increase from the 2004 index of 5,305; however, Mallek, Platte, and Stehn, (2006) reiterated that these data probably do not accurately represent population indices or trends.

Numbers of black brant ranged between 1,319 and 3,836 during surveys of nearshore and barrier islands along the North Slope in late June 1999-2005 (Dau and Larned, 2005). Fischer and Larned (2004) reported observing small flocks of brant during nearshore surveys of the Arctic coast during June-July 1999-2001.

Snow Goose. Aerial surveys for breeding eiders have been conducted during early June on the ACP for the last 15 years. The population index for snow geese in 2006 was 270, which was well below the 1992-2006 average of 2,934 (Larned, Stehn, and Platte, 2006). Survey data (1992-2006) showed a significantly positive long-term growth trend of 1.128 (Larned, Stehn, and Platte, 2006). The authors reiterated that these data probably do not accurately represent snow geese population indices or trends because of survey timing and the nature of colonial-nesting by snow geese.

Aerial surveys for breeding waterfowl have also been conducted in late June on the ACP for the last 20 years. The population index for snow geese in 2005 was 14,695, a dramatic increase from

the 2004 index of 3,802 (Mallek, Platte, and Stehn 2006). The population index between 1986 and 2006 has ranged between 0 and 29,257 (Mallek, Platte, and Stehn, 2006). The authors reiterated that these data probably do not accurately represent population indices or trends because of survey timing and the nature of colonial-nesting by snow geese.

Ritchie et al. (2006) continued to report snow geese nesting in coastal areas near the Kogru River, inshore of eastern Harrison Bay, east of the Colville River Delta. Most snow geese nesting continues to be found concentrated on the Ikpikpuk River Delta, at Smith Bay (Ritchie et al., 2006).

III.B.3.b. Other Marine Mammals

Shell summarizes information on marine mammals in ER Section 3.14.5 (EP App. G) and in Section 3 and 4 of their request to NMFS for an IHA (Shell, 2007). This section updates the information on other marine mammals in the multiple-sale EIS and the 195 and 202 EA's, incorporating information from the seismic survey PEA, and recent research (USDOI, MMS, 2003, 2004, 2006a, 2006b).

Several species of non-ESA-listed marine mammals occur in or near the Beaufort Sea area:

Pinnipeds
- Ringed seal (*Phoca hispida*)
- Spotted seal (*Phoca largha*)
- Bearded seal (*Erignathus barbatus*)
- Pacific walrus (*Odobenus rosmarus divergens*)

Cetaceans
- Beluga whale *(Delphinapterus leucas)*
- Gray whale *(Eschrichtius robusta)*

This summary is focused on updated information on two species that are particularly abundant in the region—ringed seal and beluga whales.

Ringed Seals. The only ice-dependent seal in the proposed action area is the ringed seal. No reliable estimate for the size of the Alaska ringed seal stock is currently available (Angliss and Outlaw, 2005), although past estimates ranged from 1.0 million to 3.6 million (Frost et al., 1989). Ringed seal numbers are closely associated with ice and have the unique ability to maintain breathing holes in thick ice; therefore, they are able to exploit the ice-covered parts of the Arctic during the winter when most other marine mammals have migrated south (Rosing-Asvid, 2006).

In winter and spring, the highest densities of ringed seals are found on stable shorefast ice. In the summer, ringed seals often occur along the receding ice edges or farther north in the pack ice. Ringed seals seem to prefer large icefloes >48 m in diameter and often are found in the interior pack ice, where sea ice concentrations exceed 90% (Simpkins et al., 2003).

Ringed seal densities in the Beaufort Sea are greatest in water with >80% ice cover (Stirling, Kingsley, and Calvert, 1981) and depths of 5 and 35 m (Frost et al., 2004). Densities also are highest on relatively flat ice and near the fast-ice edge, declining both shoreward and seaward of that edge (Frost et al., 2004). Ringed seal densities historically have been substantially lower in the western than the eastern part of the Beaufort Sea (Burns and Kelly, 1982; Kelly, 1988). The lower densities to the west appear to be related to very shallow water depths in much of the area between the shore and barrier islands. Surveys flown from 1996-1999 indicate that the highest density of seals along the central Beaufort Sea coast in Alaska occurred from approximately Kaktovik west to Brownlow Point (Frost et al., 2004). This may be due to the fact that relative productivity, as measure by zooplankton biomass, is approximately four times greater there than the average biomass in other areas of the eastern Beaufort Sea (Frost et al., 2004).

Beluga Whales. Beluga whales are found throughout the arctic and subarctic waters of the Northern Hemisphere. They inhabit seasonally ice-covered waters and are closely associated with open leads and polynyas in ice-covered regions (Hazard, 1988). In summer months, they migrate to warmer coastal estuaries, bays, and rivers (Finley, 1982). Within the proposed action area, only the Beaufort Sea stock and eastern Chukchi Sea stocks of beluga whales are present. Belugas generally are associated with ice and relatively deep water throughout the summer and autumn, which may reflect their preference for feeding on ice-associated arctic cod (Moore, DeMaster, and Dayton, 2000). Late-summer distribution and fall-migration patterns are poorly known, wintering areas are effectively unknown, and areas that are particularly important for feeding have not been identified (Suydam et al., 2005). The majority of belugas in the Beaufort stock migrate into the Beaufort Sea in April or May, although some whales may pass Point Barrow as early as late March and as late as July (Braham et al., 1984; Ljungblad, Moore, and Van Schoik, 1984; Richardson et al., 1995). Most belugas move into shallow coastal or estuarine waters during at least a portion of the summer (Caron and Smith, 1990; Frost and Lowry, 1990). These areas of summer concentration are consistent from year to year, and the waters are usually brackish and relatively warm (Suydam et al., 2005). The low saline content and warmer water exiting the lagoons may facilitate the molting process (Suydam et al., 2005). During the late summer and autumn, most belugas migrate far offshore near the pack-ice front (Frost et al., 1989; Hazard, 1988; Clarke, Moore, and Johnson, 1993; Miller, Elliott, and Richardson, 1998). During the remainder of the summer, beluga whales also can be found in large aggregations further offshore and associated with deeper slope water. Recent research suggests that belugas are not necessarily limited by heavy ice cover (>90%) during this time and are able to travel great distances in short time periods (Suydam et al., 2005). Whales may remain in pods for weeks or months or may move as much as 700 km apart and converge again later (Suydam et al., 2001). From satellite-tagged animals, it appears that all belugas that move north of 75° N. latitude are males, whereas females remain at or near the shelf break throughout summer and early fall (Suydam et al., 2005). Belugas of all ages and both sexes prefer water deeper than 200 m along and beyond the continental shelf break.

The main fall-migration corridor of beluga whales is ~100+ km north of the Beaufort Sea coast. During that time, belugas can be found in large groups exceeding 500 animals (Lowry et al., 1993). In the eastern Beaufort Sea, the westward fall migration begins in late August to mid-

September (Treacy, 1994; Richard et al., 1998; Richard, Heide-Jorgensen, and St. Aubin, 1997; Richard, Martin, and Orr, 2001).

The NMFS has set the minimum population estimate for the Beaufort Sea beluga whale stock at 32,453 (Angliss and Outlaw, 2005). Neither the Beaufort Sea nor the eastern Chukchi Sea stocks are listed as "depleted" or classified as a strategic stock under the MMPA. Beluga whales from both stocks are an important subsistence resource for Alaskan Native hunters. Annual subsistence take for the Beaufort Sea stock averaged 53 animals for 1999-2003 (Angliss and Outlaw, 2005).

III.B.3.c. Fish and Essential Fish Habitat

The EP summarizes information on fish and Essential Fish Habitat (EFH) in Sections 3.14.1 and 3.14.2 of the ER (EP App. F). The ER states that a number of marine fish species are likely to be abundant near the drilling locations year round. Due to the offshore location, however, anadromous and amphidromous fish would not be expected near the drill site.

The Beaufort Sea multiple-sale EIS and EA's for Sales 195 and 202 provided comprehensive descriptions of what is known about the distribution and abundance of marine and freshwater fish in the Alaskan Beaufort Sea (USDOI, MMS, 2003, 2004, 2006a). The importance of noise to fish is described in the seismic survey PEA (USDOI, MMS, 2006b). This section does not repeat those descriptions as they remain accessible for public review. No additional recent information is available to increase our current understanding on the abundance and distribution of fish resources in the Beaufort Sea. Similarly, there are no changes in the general description of EFH.

III.B.3.d. Additional Resources

Lower trophic-level organisms. Information about these organisms is contained in the ER (App. G: Sec. 3.14.3 and 4). Additional information on these organisms is contained in the multiple-sale EIS (USDOI, MMS. 2003:Sec. III.B.1). The latter explains that the organisms are particularly abundant in the area to the east of Kaktovik, which is the area in which Shell's Fosters and Fireclaw Prospects are located. Bowhead whales feed frequently in this area (Thompson and Richardson, 1987). Ashjian et al. (2007) summarize research on another area in which bowheads frequently feed—to the east of Pt. Barrow. Their research indicates that bowheads feed on organisms near Pt. Barrow that are flushed out of coastal lagoons by tidal currents. The bowheads that feed to the east of Kaktovik also may be feeding on zooplantktonic and epibenthic organisms that are flushed out of coastal lagoons and bays, including Pokok Bay and Beaufort and Jago Lagoons. The proposed action areas are deeper than 20 m, which means that they are in water where ice gouging occurs frequently. The ice gouging would prevent the growth of large, diverse biota benthic communities, such as kelp communities. The ER explains also that benthic biodiversity beyond 15-20 m declines due to ice gouging.

Archaeological Resources. The EP summarizes information for archaeological and cultural resources (EP pg. 30, App. G Sec. 3.10, Apps. A and B). The potential for encountering or

damaging prehistoric archaeological resources by drilling activities at the proposed well sites is remote because, even if sites may once have existed, they have almost certainly been destroyed by repeated ice scour events. Additional information on archaeological resources as it relates to exploration activities proposed for the eight Shell leases near Cross Island and Kaktovik and the remaining four leases that are listed as part of Shell's exploration program is summarized below.

This section incorporates information on archaeological resources from the Beaufort Sea multiple-sale EIS, the Sales 195 and 202 EA's, and the seismic survey PEA (MMS 2003, 2004, 2006a[PEA], 2006b[202]). These documents discuss potential impacts on archaeological resources in areas potentially affected by the activities proposed in the Shell EP. No new archaeological information has become available since 1984-1985 when geotechnical and geophysical data was acquired for the Erik (now Olympia) and Hammerhead (now Sivulliq) Prospects. Existing data will be augmented with bathymetry and an ROV survey before drilling operations commence (EP App. F, Sec. 2.2). It is this data that will be used to clear drill sites and assess the potential for historic and prehistoric archaeological resources.

Environmental Justice. The EP does not directly address the topic of environmental justice, but does summarize information on local Inupiat subsistence-harvest patterns and sociocultural systems in the ER (EP App. G Sec. 3.14.9). The section explains that subsistence hunting of bowhead whales is the most valued activity in the subsistence economy, and that land use in the region has traditionally revolved around subsistence resources. Additional information on environmental justice as it relates to proposed exploration activities for the eight Shell lease blocks near Cross Island and Kaktovik and the remaining four lease blocks part of the exploration program is summarized below.

Exploration drilling, aircraft and vessel support activities, and high-resolution seismic surveying is proposed for the four Olympia Prospect lease blocks 7 mi northwest of Kaktovik and the four Sivulliq Prospect lease blocks 45 mi west of Cross island, the traditional staging location for Nuiqsut subsistence whaling. Also cleared in this EA but not specifically analyzed in the EP are the Fosters and Fireclaw Prospects 25 mi east of Barter Island and the Cornell Prospect 20 mi north of the Colville River Delta.

This section incorporates the information on environmental justice from the Beaufort Sea multiple-sale EIS, the Lease Sales 195 and 202 EA's, and the seismic survey EA (MMS 2003, 2004, 2006a[PEA], 2006b[202]). These documents discuss potential impacts on subsistence and sociocultural systems in the communities of Barrow, Nuiqsut, and Kaktovik that have offshore subsistence-harvest areas potentially affected by the activities proposed in the Shell EP. Environmental justice impacts are a function of impacts on these resources. New environmental justice information that has become available since the publication of the Beaufort Sea Sale 202 in August 2006 is mentioned below.

The MMS conducted government-to government meetings related to the proposed project with the Native Village of Kaktovik on January 29, 2007, and the Native Village of Barrow and the Inupiat Community of the Arctic Slope (ICAS) on February 1, 2007; a scheduled meeting in

Nuiqsut on January 30, 2007, was not held due to local circumstances. The AEWC sponsored community meetings with the whaling captains' associations in the same communities on these same dates at which Shell discussed details of the EP and progress on the developing Conflict Avoidance Agreement. Concerns were raised about helicopter flights along shore scaring caribou and curtailment of activities if conflicts do occur with caribou and other subsistence activities. The ICAS approved a resolution calling on MMS not to approve the EP and to prepare an EIS that contained more robust analyses of human health and social impacts. Previously, Shell held community meetings in Nuiqsut on June 6 and October 16, 2006; in Barrow on June 8 and October 17, 2006; and in Kaktovik on June 9 and November 28, 2006 (EP, Appendix J). Further, MMS has participated in a recently initiated series of meetings with the NSB and the Alaska Inter-Tribal Council to discuss ways to incorporate a more systematic appraisal of human health concerns into the EIS process, specifically within the environmental justice analysis.

Residents of the NSB have for many years expressed human health concerns related oil and gas development in the region. This discussion reflects the MMS' initial efforts to synthesize and analyze these concerns. Human health and illness result from a complex interplay between genetic, behavioral, environmental, and sociocultural "determinants."

Statewide, Alaska Native health status has undergone profound changes over the past 50 years, and the evolution of health status on the North Slope has mirrored the statewide transitions. The following discussion of the patterns of health and disease and the determinants of health in North Slope Inupiat communities provides a foundation from which to evaluate the potential human health effects of oil and gas activities in the region. MMS has included this information in response to growing concerns expressed by North Slope residents regarding the potential impact of expanding oil and gas activities on their health and general well-being.

Standard population health indicators reveal considerable improvement in Alaska Native health since 1950, with the most rapid improvements occurring in the years between 1950 and 1970. Nevertheless, in recent years, the field of public health has focused on efforts to explain and address health disparities between ethnic groups and social classes. That health disparities tend to accrue predominantly in minority and low-income populations is an indication of the vulnerability of these groups to outside societal-level influences on health status.

Perhaps more importantly, MMS has recognized the importance of local consultation, and the important role that the NSB, the NWAB, and other local organizations and institutions can play in the development and evaluation of specific actions. Such a consultation process will also be a part of all actions addressed in this EA. Although MMS has amassed an astounding body of public testimony—much of it from Alaskan Natives—as a result of the public hearing process, the Agency's consultation process extends far beyond these formal hearings. The MMS now routinely includes Native representation on the Scientific Review Boards for its major projects, and tries to conduct at least occasional Information Transfer Meetings (discussing the findings of recently concluded and ongoing studies and proposed efforts) near those communities most likely to be affected. The most recent meeting, the Chukchi Sea Science Update Meeting, was held in Anchorage in October 2005.

Major concerns expressed at public meetings included:

- Identifying and protecting important subsistence areas
- Restricting access to subsistence areas and resources
- Studying and maintaining the health of wildlife
- Providing natural gas to local communities
- Studying caribou and fish
- Mitigating seismic disturbance of caribou, fish, and whales
- Making better use of traditional knowledge;
- Providing more local hire
- Updating outdated resource data)
- Involving local people in scientific studies of resources
- Including local people in the planning process

Many of these issues are discussed in government-to-government consultation with tribes and the ICAS and in meetings with the NSB and the AEWC. See Section III.B.4.g, Environmental Justice, for a summary of these meetings. One overarching way MMS has tried to address Native concerns has been to include local Inupiat traditional knowledge in its environmental assessments and environmental impact statements.

IV. ENVIRONMENTAL EFFECTS

IV.A. Introduction

This section outlines the assumptions related to the proposed action and oil spill risk that underlie the analyses of the proposed action (Alternative 1) and the identification of additional mitigation measures (Alternative 2).

IV.A.1 Assumptions about the Proposed Action

The analysis of the potential effects of the proposed action assumes that all aspects of the proposed activities occur as described in the EP and that Shell's proposed activities will comply with all other statutory and regulatory requirements, lease stipulations, conditions of permits, and conditions of approval of the EP.

- Shell's ODPCP will be completed and approved, and include specific protection of sensitive biological resources per Lease Stipulation 1. In particular, the ODPCP will acknowledge aggregations of polar bears at coastal bone piles, for example at Kaktovik and Cross Island, as sensitive resources and will provide plans to protect those areas in the event of an oil spill.

- OCS Sale 195 Lease Stipulation 4 requires operators to conduct a site specific bowhead whale monitoring program during the conduct of exploratory drilling operations during

specific periods and depending on the drilling location. The stipulation requires that daily monitoring results be reported to the MMS. The stipulation also requires that the monitoring program must be reviewed and approved each year before exploratory drilling can commence.

The applicable dates when monitoring is required will depend on the drilling location and the whale migration periods as listed in Lease Stipulation 4. No exploratory drilling activities can be conducted from August 1 through October 31 without an approved site-specific bowhead whale monitoring program.

As noted in Lease Sale 195 Information to Lessee clause (j), "Lessees are further advised that the RS/FO has the authority and intends to limit or suspend any operations, including preliminary activities, as defined under 30 CFR 250.201, on a lease whenever bowhead whales are subject to a threat of serious, irreparable, or immediate harm to the species." Should information obtained from MMS BWASP or Shell's monitoring program indicate that there is a threat of serious, irreparable, or immediate harm to the species, the RS/FO will take action to protect the species. The ITL further notes that the MMS and the NMFS will establish procedures to coordinate results from monitoring surveys required by Lease Stipulation 4 and NMFS's IHA's to determine if modification to lease operations are necessary. To administer this responsibility, the MMS will develop a coordination plan with Shell, NMFS, AEWC, and NSB to assure that information from Shell's monitoring program, BWASP, subsistence hunting activities, and conflict avoidance programs are available on a daily basis.

- As indicated in the EP, Shell will obtain MMPA authorizations from NMFS and FWS before commencing operations. Lease Stipulation 5 and NMFS's IHA process require that conflict avoidance measures are negotiated and agreed to between the operator and the affected communities. The final conflict avoidance agreement must be submitted to MMS for MMS to make a determination on the adequacy of measures taken to prevent unreasonable conflicts with subsistence harvests before proposed activities can commence.

  In accordance with Sale 195 Lease Stipulation 5, if necessary because no agreement on conflict avoidance measures can be reached between the parties, MMS will call a meeting with representatives from the subsistence communities, AEWC, NSB, NMFS, and Shell to specifically address the conflict and attempt to resolve the issues before MMS and NMFS make a final determination on the measures to be taken to prevent unreasonable conflicts with subsistence harvests.

  Lease Stipulation 5 also requires that Shell notify the RS/FO of all concerns expressed by subsistence hunters during operations and of steps taken to address such concerns and that the RS/FO work with agencies and the public to assure potential conflicts are identified and efforts taken to avoid conflicts.

- In accordance with Lease Stipulation 7, Shell must also develop a plan for recording and reporting bird strikes that occur during approved activities to the MMS. Bird collisions must be reported to MMS and FWS as described in Lease Stipulation 7.

  Shell must submit a final lighting configuration plan that demonstrates how lighting on the two drilling units will be configured to minimize outward radiation of light and reduce potential for bird collisions. This plan should include a discussion on Shell's plans to use strobe lights to minimize attraction of birds to the drilling structures. The MMS will provide a copy of the final plan to the FWS.

- Shell will collect meteorological and oceanographic data pursuant to 30 CFR 250.282.

- The EP will be deemed consistent with the State of Alaska Coastal Management Program or consistency is conclusively presumed before commencement of activities.

IV.A.2. Assumptions for the Analysis of Accidental Oil Spills in this EA

For purposes of this EA analysis, no crude oil spills are assumed from exploration activities. This assumption is based on the low rate of exploratory drilling blowouts per well drilled and the history of exploration spills on the Arctic OCS discussed in Appendix II.

It is assumed a small spill could occur. For purposes of analysis we chose a 48 bbl fuel transfer spill as identified in Shell Beaufort Sea ODPCP Summary of Potential Discharges. A summary of these potential discharges is shown in Appendix II, Table II-3 along with the characteristics of the fuel supply vessel in Appendix II, Table II-1.

To judge the effect of a 48-bbl diesel fuel oil spill, we estimate information regarding how much oil evaporates, how much oil is dispersed, and how much oil remains after a certain time period. We derive the weathering estimates of diesel fuel oil from modeling results from the SINTEF Oil Weathering Model (OWM) Version 3.0 (Reed et al., 2005) for up to 30 days. A 48-bbl diesel spill could evaporate and disperse within approximately 48 hours. Appendix II, Table II-2 summarizes in detail the results we assume for the fate and behavior of a 48 bbl diesel fuel spill.

IV.A.3. Underwater Noise

The Shell EP contains summary information on the acoustic noise from the vessels. The Shell request to NMFS for an IHA (dated January 24, 2007) contains additional information. Additional information on acoustic monitoring during previous drilling operations in Camden Bay is included in the recent NMFS BO (NMFS, 2006). Specifically, the BO explains that:

> The ice-strengthen *Kulluk*, a specialized floating platform designed for arctic waters, was used for drilling operation at the Kuvlum drilling site in western Camden Bay in 1992 and 1993. Data from the *Kulluk* indicated broadband source levels (10-10,000 Hz) during drilling

and tripping were estimated to be 191 and 179 dB re μPa at 1 m, respectively, based on measurements at a water depth of 20 m in water about 30 m deep (Richardson et al., 1995).

There is additional detailed information on the acoustic monitoring during the 1992 and 1993 operations at Kuvlum with the *Kulluk* in the monitoring reports (Brewer et al. 1993; Hall et al., 1994). For example, the report on the 1993 operations contains about 100 pages of acoustic information plus an appendix with acoustic data. Figure 14 in this EA is a copy of the report's illustration of the radius around the drill site of the peak 1/3-octave band 20 received level for the overall project (Hall et al., 1994: Data Appendix-Vol. 2, Acoustics Program). The figure shows that, even with open water conditions and relative inactivity of the icebreakers during the 1993 operations, the calculated 120 dB isopleth extended to the shoreline.

There are multiple studies on noise from drilling operations from the *Kulluk* and from drillships similar to the *Frontier Discoverer*. Shell's IHA monitoring plan explains that the objectives of the planned monitoring are to (1) measure the distances from the various sound sources to broadband received levels of 190, 180, 160, and 120 dB rms re 1 μPa , and (2) to measure the radiated vessel sounds vs. distance for the source and support vessels. The measurements will be made at the beginning of specific activities (Shell, 2007: Attachment B, p. 2). For the drilling operation, a subsequent mid-season assessment will be conducted to measure sound propagation from combined drilling operations during "normal" operations.

IV.B. Effects of Alternative I (Proposed Action)

The sections are organized in the same sequence as for the preceding section. The level of effect has been assessed specifically with the available information in relation to our significance thresholds (USDOI, MMS, 2003: Sec. IV.A.1).

IV.B.1. Effects on ESA-protected Species

IV.B.1.a. Bowhead Whales

Effects of Disturbance. The Shell request to NMFS for an IHA explains that the company seeks authorization for potential incidental harassment of small numbers of bowhead whales, and that the harassment would consist of temporary and short-term displacement within the zones affected by noise from drilling activities and associated support vessels (Shell, 2007: Sec. 5, 6 and 7). The underwater noise from drillships and icebreakers is summarized in EA Section IV.A.3 and illustrated in Figure 14. The IHA request estimates a maximum non-lethal "take" of about 500 whales, based on 160 and 120 dB re 1 μPa (rms) criteria, which are assumed to be the respective limits for impulsive (e.g., seismic) and continuous sound (Shell, 2007: Table 6-2). The take is not estimated at lower criteria for continuous (e.g., drilling) sound sources. Shell's request explains further that this is a very low percentage of the Beaufort Sea stock, that there is no conclusive evidence that bowheads have been displaced from feeding activities, and that bowheads return to the swim paths they were following at relatively short distances after their exposure to sounds over 160 dB.

For consultation under section 7 of the ESA, the MMS prepared a biological evaluation (BE) of the potential impacts of potential Arctic Ocean OCS oil and gas exploration activities on ESA-protected species, and submitted it to NMFS (USDOI, MMS, 2006c). Using the information in the BE, the NMFS prepared a BO about the potential environmental consequences generated by potential exploration activities (NMFS, 2006).

Regarding the responses of bowhead whales to noise from drillship and associated icebreaking, the BO states in part:

> The ice-strengthen *Kulluk*, a specialized floating platform designed for arctic waters, was used for drilling operation at the Kuvlum drilling site in western Camden Bay in 1992 and 1993. Data from the *Kulluk* indicated broadband source levels (10-10,000 Hz) during drilling and tripping were estimated to be 191 and 179 dB re μPa at 1 m, respectively, based on measurements at a water depth of 20 m in water about 30 m deep (Richardson et al., 1995).
>
> Hall et al. (1994) conducted a site-specific monitoring program around the Kuvlum drilling site in the western portion of Camden Bay during the 1993 fall bowhead whale migration. Results of their analysis indicated that bowheads were moving through Camden Bay in a significantly nonrandom pattern but became more randomly distributed as they left Camden Bay and moved to the west. The results also indicated that whales were distributed farther offshore in the proximal survey grid (near the drill site) than in the distant survey grid (an area east of the drill site), which is similar to results from previous studies in this general area. The authors noted that information from previous studies indicated that bowheads routinely were present nearshore to the east of Barter Island and were less evident close to shore from Camden Bay to Harrison Bay (Moore and Reeves, as cited in Hall et al., 1994). The authors believed that industrial variables such as received level were insufficient as a single predictor variable to explain the 1993 offshore distribution of bowhead whales, and they suggested that water depth was the only variable that accounted for a significant portion of the variance in the model. They concluded that the 1993 bowhead whale distribution fell within the parameters of previously recorded fall-migration distributions.
>
> Davies (1997) used the data from the Hall et al. study in a Geographic Information System model to analyze the distribution of fall-migrating bowheads in relation to an active drilling operation. He also concluded that the whales were not randomly distributed in the study area, and that they avoided the region surrounding the drill site at a range of approximately 20 km (12.4) mi). He noted that the whales were located significantly farther offshore and in significantly deeper water in the area of the drilling rig.

The BO states also that:

> Richardson and Malme (1993) point out that the data, although limited, suggest that stationary industrial activities producing continuous noise, such as stationary drillships, result in less dramatic reactions by bowheads than do moving sources, particularly ships.

The BO assumed that two drilling rigs with icebreaker support might operate during any year, and that a total of 12 exploration/delineation wells might be drilled sometime during an eight-year period, so the BO covers the proposed Shell operations. The BO concludes that such exploratory drilling would not jeopardize the population; i.e., would not have a population-level effect on bowheads.

The NMFS BO refers to the offshore displacement of bowheads but does not specify whether some whales remained nearshore. This aspect can be examined in more detail with the database from the MMS BWASP and the results of the marine-mammal monitoring during previous drilling operations in Camden Bay. The BWASP surveys sighted whales between shore and the three Camden Bay drill sites (Hammerhead, Kuvlum and Corona) during the years of operations at those prospects (1985, 1986, 1992, and 1993) (Figs. 2 and 11). In contrast, almost no bowheads were sighted between the drill sites and shore during the actual operations, as documented by five marine-mammal monitoring reports. The Kuvlum Prospect in Camden Bay was drilled with the *Kulluk* during 1992 and 1993. During the 1992 Kuvlum operations, the marine mammal monitoring was conducted by the Coastal & Offshore Pacific Corporation (COPAC) (Brewer et al., 1993). The drilling operations were conducted in heavy ice, and COPAC sighted bowheads only offshore of the drillship (EA Fig. 15, which is a portion of Figure 9 in Brewer et al., 1993). About one third of the COPAC sightings (blue circles) near the outer edge of the COPAC Survey Area were due to unequal survey effort; however, the MMS BWASP sightings (red circles) indicate a similar distribution of whales. Specifically, none were sighted between the drillship and shore, and very few were sighted "downstream" of Kuvlum, indicating again that bowheads had not migrated back into the shoreward portion of the corridor as they approached Cross Island. Acoustic monitoring indicated that the sound levels were over 180 dB at times (Brewer, et al., 1993: p. 72).

The 1993 Kuvlum operations were conducted in very light ice; in such conditions, the ice-management vessels would not have been active. Bowheads avoided the area around the drill site but several were sighted between the drill site and shore, and several sightings "downstream" of Kuvlum indicate that bowheads had migrated into the shoreward port of the corridor as they approached Cross Island (Fig. 16; Hall et al., 1994). As noted in Section IV.A.3, acoustic monitoring showed that, in spite of the open water conditions and relative inactivity of the icebreakers, the 120 dB isopleth extended to the shoreline (EA Fig. 14).

The marine mammal monitoring reports for drilling operations at the Hammerhead, Corona, and Galahad obtained similar results, indicating that very few bowheads migrated between the drill sites and shore (Figs. 17, 18, 19, and 20; McLaren et al. 1986; LGL and Greeneridge Sciences, 1987; Gallagher, Brewer, and Hall, 1992) even though some of these drill sites are in the outer portion of the migration corridor (EA Figs. 2 and 8). In summary, the monitoring during the operations with a single drillship and icebreakers indicate that whales migrated between the drill site and shore only during a year of very light ice, and that only a few whales returned to the inner portion of the migration corridor downstream as they approached Cross Island. In spite of the usual displacement of bowheads from the area between the shore and drill sites, the BWASP

surveys for each of these years indicate that the overall migration was displaced in neither the eastern nor western parts of the Beaufort Sea (Treacy, 2002: Table 8).

The sound level around one drillship at the Kuvlum prospect indicated a source level over 180 dB at times (Brewer et al., 1993: p. 72), and that the 120 dB isopleth had a radius of 8.5 km and extended to the shoreline (Shell, 2007: Sec. 5; Hall et al., 1994; EA Fig. 19). The previous monitoring has detected behavioral changes in bowheads around drillship operations near Camden Bay (EA Figs. 14-21). With regards to the MMS significance criteria, there is no evidence that the offshore displacement (i.e., the change in distribution) in Camden Bay persisted for more than a generation (about 17 years). So, the level of effect of a drillship in Camden Bay is probably not significant by MMS NEPA standards. However, the same type of displacement to the east of Kaktovik where whales frequently feed would affect growth and could have a more serious biological effect. Also, even though there isn't a significant biological effect from in Camden Bay operations, there could be a significant sociocultural effect if the bowheads do not migrate back into the shoreward portion of the migration corridor as they approach Cross Island. A desirable situation might be to keep disturbing noise to a low enough level so the monitoring sightings were similar to those during Kuvlum 1993 operations (EA Fig. 15) when many bowheads were sighted nearshore to the downstream side of the prospect. The ice conditions during the past five years have been unusually light and similar to the ice conditions during 1993. Even with light ice, the level of effect on bowheads is likely to be greater than for Kuvlum during 1993 because of Shell's proposal to use two drillships, two large icebreakers, and several associated vessels.

Stipulation No. 4 requires that Shell conduct a site-specific monitoring program during exploratory drilling operations. Shell has proposed to conduct both acoustic and aerial monitoring. The monitoring plan is contained in Shell's request to NMFS for an IHA (Shell, 2007). The plan explains that Shell will provide daily maps of sightings, a 90-day report, and a final technical report (Shell, 2007: p. 18). Some of the acoustic monitoring would be conducted during July and August 2007 before the start of the bowhead migration. The specifics of the aerial monitoring will be negotiated further with MMS, NMFS, and AEWC, but the plan as outlined, stating that the monitoring would be consistent with the MMS BWASP techniques (Shell, 2007: pp. 6-10), is sufficient to assure MMS that the aerial monitoring will be able to detect indications of displacement around the operations. The specific details of the monitoring methodology will be determined during the annual spring NMFS Open-water Meeting. The information from monitoring surveys will be reviewed by MMS to determine if there is any indication that bowheads have been displaced out of the areas in which they frequently feed, such as the area to the east of Kaktovik; and if there is any indication that bowheads have been displaced out of areas in which subsistence whaling is conducted. The MMS has the authority to modify approved operations to ensure that significant biological populations or habitats deserving protection are not subject to a threat of serious, irreparable, or immediate harm.

Effects of Spills. The ODPCP summarized the methods by which Shell would respond quickly to any spills, such as the assumed 48 bbl fuel transfer spill (EA Sec. IV.A). Most of the fuel oil from such a spill would probably dissipate into the water column within about two days

(Appendix I, Table 1-2), so the effects on bowheads would probably be immeasurable even during the migration. The Beaufort Sea multiple-sale EIS assessed the fate and effects of larger spills and includes the OSRA trajectory model results for spills ≥1,000 bbl. The OSRA model included launch areas (LA) that correspond with the locations of Shell's proposed operations (LA 10, 15, 17, and 18). The OSRA model estimated a <0.5-35% chance of a spill ≥1,000 bbl contacting the central portion of the migration corridor (Environmental Resource Areas 29-37) within 30 days during the summer open-water period (USDOI, MMS, 2003:Tables A2-19 to -27). Specifically, the OSRA model estimates. As all the proposed drill sites are located within the broad corridor through which bowheads migrate (EA Fig. 8), any spill that occurred at a drill site would contact the bowhead migration corridor. Even though the chance of contact between drill-site spills and the migration corridor is high, the chance of contact with individual bowheads might be low. The EP explains that Shell will pre-deploy booms during fuel transfers during the bowhead migration (EP Sec. 11f).

Conclusion. With regard to disturbance, marine-mammal monitoring reports for four previous operations in moderate and heavy ice with a single drillship and active icebreakers indicate that bowheads were displaced about 20 km from the operation, leaving the nearshore portion of migration corridor. However, during a similar operation in very light ice and no icebreaking, displacement occurred only locally around the drillship; importantly, bowheads were sighted (a) between the drill site and shore and (b) "downstream" of the drill site (EA Fig. 15). The activities as proposed in the EP include IHA's from NMFS. NMFS must make a determination of negligible impacts to affected marine mammals in order to issue an IHA under the MMPA. Thus, only negligible impacts to bowhead whales are expected to occur as a result of proposed activities. The likelihood that bowheads would be affected by spills is very low, and no significant spill impacts are expected from the proposed activities. Further, the NMFS 2006 BO concluded that exploratory drilling would not jeopardize the population; i.e., would not have a population-level effect on bowheads.

IV.B.1.b. Spectacled and Steller's Eiders

The Shell EP summarizes four activities could adversely affect threatened Steller's and spectacled eiders: 1) helicopter overflights, 2) exploration and support activity, 3) oil spills, and 4) collisions with drilling structures.

Helicopter Overflights. There are several difficulties in evaluating the potential impacts from the EP on birds. For example, page 32 of the ER states:

> Helicopter traffic supporting the drilling ships could displace eiders from preferred habitats. Displacement during the nesting period may lead to increased predation on eggs or nest abandonment. The intensity of helicopter traffic may vary due to length and number of trips needed which could play a role in the amount of disturbance on eiders. With such variability, it can be difficult to predict adverse effects on Steller's and spectacled eiders.

While helicopters overflights potentially could cause adverse effects to individuals of threatened eiders, their low nesting densities and low use of nearshore areas during migration, suggests that few individual birds would likely be impacted. Although the projected number of helicopter overflights per day proposed in the Shell EP is at least double those evaluated under the MMS Biological Evaluation on the Beaufort Sea multiple sales and subsequent FWS BO, the general findings remain valid. We are unaware of any information that would change this conclusion.

Exploration and Support Activity. Encounters between drilling support vessels and threatened eiders at sea are a possibility. The FWS BO described how extensive nearshore and offshore aerial surveys in the Beaufort Sea failed to detect concentrations of threatened eiders, except for two flocks offshore of Harrison Bay. Given the rarity of these species, the FWS assumed in their BO that few threatened eiders would encounter vessel traffic and surmised that eiders would avoid such encounters by diving or flying away, that the frequency of those disturbances will not reach the threshold that would impair survival, and that alternative suitable habitat is available. Under those conditions, the FWS concluded that take was unlikely and would not reach a population-level effect. We are unaware of any information that would change this conclusion.

Oil Spills. The ER states that:

> Oils spills are also a factor to take into consideration, with varying degrees of severity depending on the oil spill volume, location in respect to bird concentrations, emergency response, and ice conditions. ... These effects can cause major declines in some bird species, especially those designated as threatened or endangered.

The potential impacts from accidental spills are best described by the Beaufort Sea multiple-sale EIS (MMS 2003) and subsequent NEPA analyses in the Sales 195 and 202 EA's (MMS 2004, 2006). A more specific OSRA analysis for a summer incident over 30-days predicts an up to 16% percent chance that a large oil spill originating from any of the launch areas containing exploratory drilling sites would reach Environmental Resource Areas (ERA) important to threatened eiders, such as near Harrison Bay or the Colville River delta (ERA 69) (Appendix I). The MMS estimates the chance of a large ($\geq$1,000 bbl) oil spill from exploratory activities to be very low. For the purposes of analysis, no large spills are assumed to occur during exploration drilling.

Small ($\leq$25 bbl) operational spills of diesel, refined fuel, or crude oil may occur and would be typical during the proposed action. The Shell EP described the potential amount of diesel spilled during a fuel transfer to be approximately 2,000 gal (48 bbl). Pre-booming would likely contain this spilled fuel and if spilled fuel were to escape containment, much of it would likely evaporate or disperse before reaching bird concentration areas. While unlikely to occur, even a small amount of spilled petroleum could impact a large number of at-sea birds, including eiders. Threatened eiders, however, have been documented to occur only in flocks of 40-100 offshore of Harrison Bay. A diesel spill of this size would persist for only about 2 days (Appendix I). It is

unlikely that a small spill would persist to reach this area. Any eiders contacted within this 2-day period would be expected to be oiled and die.

The risk of oil spills affecting threatened eiders was evaluated in the MMS BE on the Beaufort Sea multiple-sale EIS (MMS 2003), which incorporated findings from the 2002 FWS BO (USDOI, FWS, 2002). The BO for lease sales 186, 195, and 202 concluded that while accidental oil spills can have significant impacts on birds as a result of direct and indirect contact, the coincidence of the number of factors, including spill response, that would have to occur simultaneously in order to appreciably reduce the likelihood of survival and recovery is improbable. The FWS concluded that such an impact is not "reasonably certain" to occur. We are unaware of any information that would change this conclusion.

Collisions with Drilling Structures. The ER states that:

> Although drilling activity may displace and/or disturb eiders, the relative area affected is small and well offshore where few Steller's and spectacled eiders are expected to be found during the open-water season. Collisions with vertical structures could result in injury or mortality of migrating spectacled or Steller's eiders. However, this is expected to be a rare occurrence.

The ER cites a website by Arctic Power as the basis for bird migration information. Petersen, Larned, and Douglas (1999) presented the most accurate information on the fall migration of spectacled eiders in the Beaufort Sea and concluded that males typically migrated out as far as 13.8 km (8.3 mi) offshore. Females tended to migrate out to greater distances offshore (24.8 km, 14.9 mi). The differences appear to be attributed to coastal ice distribution during the migration season, with ice being further offshore when females begin their fall migration. If ice is farther from shore when post-breeding eiders move to offshore areas, they could be farther out than the distances found by Petersen, Larned, and Douglas (1999).

The proposed drilling sites (as close as 10 mi from shore) appear to be well within the migration corridor for spectacled eiders and collisions with drill structures or support vessels could occur. For this reason, Stipulation 7 of the Lease Sale 195 EA remains a valid means of reducing the potential for the drill rigs to attract or disorient migrating eiders, which could create a collision hazard.

The Beaufort Sea multiple-sale EIS analyses included information from the 2002 FWS BO (USDOI, FWS, 2002). That BO included an incidental take statement for threatened eiders:

> The Service believes that no more than five spectacled eider and one Steller's eider will incidentally taken during the life of the project.

Stipulation 7: Implementation of a Lighting Protocol. Pages 46 and 47 of the Shell EP describe a Prospective Drilling Rig Lighting Plan. In accordance with Lease Stipulation 7, Shell must also develop a plan for recording and reporting bird strikes that occur

during approved activities to the MMS. Bird collisions must be reported to MMS and FWS as described in Lease Stipulation 7.

Shell must submit a final lighting configuration plan that demonstrates how lighting on the two drilling units will be configured to minimize radiated light and reduce potential for bird collisions. This plan should include a discussion on Shell's plans to use strobe lights to detract birds from the drilling structures. The MMS will provide a copy of the final plan to FWS.

The ER included two memoranda from David Evans and Associates, Inc. summarizing background information on avian collisions and making specific recommendations for reducing collision risk associated with operating the *Kulluk* and *Frontier Discoverer* in the Beaufort Sea during periods of darkness or inclement weather.

We generally concur with the David Evans and Associates, Inc. recommendations on changes in lighting design, however MMS has not seen specific plans for the *Kulluk* or *Frontier Discoverer.*

David Evans and Associates, Inc. recommended stationing an Avian Specialist aboard the EP vessels after mid-August. We believe this recommendation has merit in monitoring and reporting bird collisions from proposed drilling structures. In the past, companies have used contract Marine Mammal Observers to address this issue, but it is unclear if these observers are qualified to conduct these activities or that they are allowed to divert from their routine marine mammal duties to conduct searches for injured/dead birds that collide with the drill rigs during darkness or inclement weather. MMS has not received any recent reports of bird collisions, but cannot assume that none have occurred.

The David Evans and Associates, Inc. memorandum indicates that the Avian Specialist would have authority to temporarily halt drill rig operations in order to turn off on-deck lighting. We disagree that the Avian Specialist would be able to evoke a shut-down during periods of darkness/inclement weather or when migratory birds are in the area. Therefore, MMS cannot concur that there would be any mitigative benefit from this assumed authority as it is, in our view, unlikely that it would be granted.

It is important to consider that an Avian Specialist would not be able to reduce the occurrence of collisions, but would merely be able to more systematically document whether collision events occurred (or not). Accurate reporting of weather/searches could, over time, be an indication that implementation of a lighting protocol was effective. Absent this documentation, the lack of collision reports cannot be assumed to indicate any lighting protocol design changes are effective.

MMS cannot concur that radar monitoring would be effective in reducing the risk of eiders and other birds striking the drilling structures. Radar is problematic in terms of costs for equipment and personnel, the inability to discern low-flying birds (especially eiders) from sea clutter and ice bergs, and the likely inability of the knowledge that there are incoming birds to influence the operation of the drill rig.

To remain in compliance with the Incidental Take Statement of the BO, Shell is required to:

> Document and report all bird-vessel collisions to MMS annually. Minimum information required will include species, date/time, location, weather, and vessel/drillship operational status when the collision occurred. Due to the threat of avian influenza, the FWS no longer recommends recovery of birds injured or killed via collisions.

Exceeding the incidental take would require MMS to immediately initiate re-consultation with the FWS.

Conclusion. The EP commits Shell to three specific mitigation measures that would avoid or minimize impacts to threatened bird resources. These are implementation of Stipulation 7, reporting bird collisions, and aircraft maintaining vertical (1,500 ft) and horizontal buffers from bird concentration areas. No large spills are assumed to occur during exploration drilling; the most likely spill would be during a diesel fuel transfer (pre-booming requirements). Fuel transfer procedures are designed to further reduce the potential for a small oil spill to contact biological resources. If preventive measures failed, a small number of eiders at-sea could be killed.

IV.B.1.c. Polar Bear (Proposed for Listing)

This section updates the assessment of effects on polar bears as a result of the Proposed Action. The section includes four subsections, which summarize the multiple-sale EIS and Sale 195 EA assessments that are being updated, update those effects, incorporate the benefits of the standard mitigation, and summarize the conclusion (i.e., the mitigated effect). Shell also assessed the effects on polar bears, and proposed mitigation, in a LOA application to FWS during December 2006.

The description of the environment summarized the recent changes in the polar bear habitat and population (Sec. IIIB.1.c). More polar bears are staying on the coast during autumn, particularly near Cross Island, Kaktovik, and Barrow where there are the remains of subsistence harvests. More polar bears are in the water, where they are vulnerable to severe autumn storms (Monnet and Gleason, 2006). Recent USGS population analysis indicates that the SBS polar bear population now contains approximately 1500 animals, down from previous estimates of ~1800 (Regehr et al., 2006). This means that the Maximum Sustained Yield (MSY), or the number of animals that can be sustainably removed from the population in any given year, is also reduced.

Effects from Routine Permitted Operations. The multiple-sale EIS concluded that "no significant effects are anticipated from routine permitted activities" as a result of proposed Lease Sales 186, 195, and 202 (USDOI, MMS, 2003:Sec. ES.1.e(1)). Though the projected amount of seismic activity has increased since the multiple-sale EIS was written, the effects from routine, permitted operations on polar bears are still expected to be about the same as described in that document, with the exception of oil spill impacts.

Effects from Oil Spills. For purposes of this analysis, no large spills are assumed from exploration activities, as explained in Section IV.A.2 and Appendix II. This assumption is based on the low rate of exploratory drilling blowouts per well drilled and the history of exploration spills on the Arctic OCS discussed below. For purposes of analysis, we chose a 48-bbl fuel transfer spill as identified in Shell ODPCP. A 48-bbl diesel spill could evaporate and disperse with approximately two days (Sec. IV.A.2).

The MMS regulations require operators to submit oil spill response plans (OSRP's) with proposals for exploration and/or development (CFR 250.203, 204, and 254). The OSRP's must identify methods to protect marine and shoreline resources (30 CFR 254.23), including polar-bear aggregations on shore.

Because of the limited size and persistence, polar bear would probably not be contacted by the fuel. Furthermore, the drill sites are located within the bowhead migration corridor, so the operations would be subject to the requirement for pre-booming during large fuel transfer while bowheads are migrating.

Standard Mitigation. Potential impacts to polar bears are an increasing concern because of ongoing changes in their sea-ice habitat, their distribution, and the uncertain status of their populations. For these reasons, it is reasonable to review the effectiveness of the mitigation measures currently in place.

Three standard ITL's (ITL No. 4, Information on Bird and Marine Mammal Protection; ITL No. 9, Information on Polar Bear Interaction; and ITL No. 11, Information on Sensitive Areas to be Considered in Oil-Spill-Contingency Plans) are relevant to protection of polar bears. ITL No. 4 advises lessees that they are subject to the MMPA and ESA during the conduct of their operations. As noted previously, Shell submitted a completed LOA application to FWS in December 2006. ITL No. 4 also encourages lessees to "exercise particular caution when operating in the vicinity of species whose populations are known or thought to be declining and which are not protected under the ESA; such as the Pacific walrus." This ITL has been modified to also emphasize polar bears. ITL No. 4 also notes that disturbance at "major wildlife concentration areas" are of "particular concern", and that "maps depicting major wildlife concentration areas in the lease area are available from the RS/FO." The ITL on polar bear interaction advises lessees to confer with the FWS and to conduct their activities in a way that limits potential encounters and interaction between lease operations and polar bears. ITL No. 11 has been expanded to include a statement that coastal aggregations of polar bears during the open water/broken ice period are particularly vulnerable to the effects of an oil spill, which lessees must account for in their ODPCP's. As a result of the Sale 202 EA, a new ITL, entitled *Planning for Protection of Polar Bears*, was developed. This ITL describes the increased vulnerability of polar bears to oil spills during the open water period as a result of recent changes in their distribution, and specifically identifies polar bears in and around Kaktovik as requiring additional protections. This new ITL advises lessees to consult with the FWS to get updated information on polar bear so that it may base decisions on the most current information available.

The BWASP program collects sightings of both bowhead whales and polar bears. The benefits of this program are summarized in the Beaufort Sea multiple-sale EIS (USDOI, MMS, 2003:Sec. II.H.2.e).

IV.B.2. Effects on Subsistence-harvest Patterns and Sociocultural Systems

IV.B.2.a. Subsistence-Harvest Patterns

Disturbance. High-resolution seismic survey, drilling, and aircraft and vessel support is proposed for the four Olympia Prospect lease blocks 7 miles northwest of Kaktovik and the four Sivulliq Prospect lease blocks 45 miles west of Cross island, the traditional staging location for Nuiqsut subsistence whaling. The locations of whale harvests around Cross Island and Kaktovik are shown on Figures 12 and 13, respectively. Also cleared for potential future exploration in this EA but not analyzed in the EP are the Fosters and Fireclaw Prospects 25 mi east of Barter Island and the Cornell Prospect 20 miles north of the Colville River Delta.

Section IV.B.1.a, Bowhead Whales reviewed marine-mammal monitoring reports on previous drillship operations in Camden Bay, and the evidence that bowheads were displace out of the nearshore area (i.e., between the drill sites and shore). The Shell EP acknowledges that reasonably foreseeable adverse impacts potentially include the migratory deflection of bowhead whales that may result in increase effort, risk, and expense associated with additional travel to conduct the subsistence hunt, and may contribute to an unsuccessful hunt (Shell EP Alaska Coastal Management Program Consistency Analysis, Sec. 11 AAC 112.270 (e)(b)). To help avoid such effects, the Shell EP explains that all offshore work would be done in accordance with the terms of a conflict avoidance agreement (CAA) with the North Slope whalers. The Shell EP documents that Shell has consulted with subsistence communities on the North Slope, as required by Stipulation No. 5 – Conflict Avoidance Mechanisms to Protect Subsistence Whaling and Other Subsistence Activities (EP Sec. 11c). Shell's application for a NMFS IHA explains that the CAA will cover their proposed drilling, geotechnical coring, and seismic operations. Stipulation 5 requires that Shell consult with affected subsistence communities prior to submitting an exploration plan, and make "every reasonable effort" to assure that company activities are compatible with subsistence whaling. Consultation is discussed in more detail in Section III.B.4.g, Environmental Justice. The EA describes the consultation process for 2007, but the specific negotiations will be conducted for each year's activities.

As discussed in Section IV.B.1.a, Bowhead Whales, in the past, operations with one drill ship and associated icebreakers have displaced the migration slightly, and no whales were sighted between the operations and shore, but it is unknown what the increased level of effect of two proposed drillships and associated icebreakers and other attendant vessels would be.

The Olympia Prospect is located west of Kaktovik and, ideally, drilling and high resolution seismic activity would not deflect whales until after they had passed by Barter Island and Kaktovik whalers had harvested whales. This scenario suggests that Kaktovik could potentially escape adverse noise and disturbance from effects from activities at the Olympia Prospect. If ice

conditions pushed mobilization and start up of these activities later into the fall, noise disturbance could deflect whales away from their migration normal route and away from traditional Kaktovik harvest areas. Onshore, helicopter and aircraft supply flights have the potential to disturb caribou movements and alter the subsistence hunt.

Noise disturbance produced from seismic survey and drilling activities at the Sivulliq Prospect west of Kaktovik and 45 miles east of Cross Island could displace migrating bowhead whales further offshore. Such disturbance could pose a serious threat to the Nuiqsut fall 2007 subsistence whaling season by potentially forcing hunters to travel further offshore to find whales. Displacements of the hunt further offshore increase the time and effort needed to hunt, as well as increasing the objective danger of the enterprise. Also, the farther out a whale is struck the further it must be towed before it can be butchered; thus, increasing the potential for meat spoilage. A carefully constructed CAA and scrupulous monitoring of whale deflections produced from Sivulliq disturbances could produce some remedy to the hunt.

Migrating bowhead whales may have returned to their normal migration path by the time they passed Barrow and Barrow whalers would not then have to deviate from traditional hunting areas to find whales.

In 2008 and 2009, exploration activities are anticipated for the Fosters and Fireclaw Prospects 25 mi east of Barter Island and the Cornell Prospect 20 miles north of the Colville River Delta. Noise disturbance west of Kaktovik at the Fosters and Fireclaw Prospects could deflect whales offshore and disrupt Kaktovik's subsistence whale harvest. Conflict avoidance measures would be the necessary remedy for potential subsistence and oil activity conflicts. Migrating whales may have returned to their normal migration path by the time they passed Cross Island, and Nuiqsut whalers would not then have to deviate from traditional hunting areas to find whales.

If oil exploration activities were also occurring at the Cornell Prospect north of the Colville River Delta in the same season, migrating whales could deflect further offshore, and such disturbance could pose a threat to the Barrow fall subsistence whaling season by potentially forcing hunters further offshore to find whales. Displacements of the hunt offshore increase the time, effort, and the objective danger. Additionally, the farther out a whale is struck, the further it must be towed before it can be butchered; thus, increasing the potential for meat spoilage. Only a carefully constructed and monitored CAA could produce some remedy to disturbances to bowhead whales and the subsistence hunt.

Mitigation. To ensure compliance with the MMPA, Shell has applied to NMFS and FWS for Incidental Take Authorization (ITA), which could be in the form of an IHA or LOA. Shell must obtain these authorizations before commencing MMS-permitted activities. The ITA's mitigation and monitoring requirements would further ensure that impacts to marine mammals will be negligible and that there will be no unmitigable adverse impact on subsistence uses of marine mammals.

To achieve this standard, operators negotiate a CAA with the AEWC and the affected villages' Whaling Captains Associations. The CAA will likely address mobilization periods, sound thresholds, bowhead whale-hunting seasons in the Beaufort Sea, describe a dispute-resolution process, and provide emergency assistance to whalers at sea, as well as other requirements for monitoring and the employment of local marine mammal observers. Implementation of the CAA further ensures that there will not be significant impacts on the subsistence resources and practices in the Beaufort Sea by avoiding adverse impacts on subsistence marine mammal-harvest activities.

Stipulations and required mitigation and conflict avoidance measures under MMPA authorization as defined by NMFS and FWS should be followed in locations where the subsistence hunt is affected. The MMPA authorization obligates operators to demonstrate no unmitigable adverse impacts on subsistence practices. Conflict avoidance agreements between permittees, the AEWC, and local whalers, work toward avoiding unreasonable conflicts and disturbances to hunters and bowhead whales. Similar avoidance measures could be required for the subsistence polar bear harvest by the Nanuk Commission (NC). Such conflict avoidance agreements likely would follow protocols similar to those reached annually between Permittees and the AEWC for the subsistence bowhead hunt and address industry drilling and seismic-vessel activities under provisions of the MMPA. The AEWC generally prefers to negotiate a conflict avoidance agreement with industry on an annual basis using a regional rather than a project-specific approach, so as to address potential impacts from all ongoing projects. With the use of the conflict avoidance agreement methodology, Native subsistence-whale hunters generally have been successful in reaching their annual whale "take" quotas. Without such conflict avoidance measures in place, significant impacts to the subsistence resources and hunts for bowhead whales, seals, and polar bears could occur.

The Shell EP states that all offshore work will be done in accordance with the terms of a CAA with subsistence whalers. The CAA, which part of the IHA application to NMFS, and Shell's Marine Mammal Monitoring and Mitigation Program (MMMMP), which will be specified in the IHA, are designed to avoid, minimize, and mitigate potential adverse impacts on subsistence resources and harvests. If Shell obtains a CAA with the AEWC and whalers in Barrow, Nuiqsut, and Kaktovik before operations begin, the agreement would be sufficient to assure MMS that the overall level of effect on subsistence resources and practices would not be significant.

It is assumed that Shell will obtain an appropriate IHA from NMFS and an accompanying CAA between Shell, the AEWC and local whaling captains' associations will be approved before MMS would approve an Application for permit to Drill (APD). In the event that a CAA is not obtained, conflict resolution language in Stipulation 5 defines a method for resolving subsistence whaling conflicts, specifying that the RS/FO may assemble a group to address conflicts before making a final determination. Potentially, some agreement could be reached under this process that would allow whaling and exploration activities to continue. To mitigate exploration activities' impacts below the level of "significant," these conditions must apply. If the appropriate IHA is not obtained, this EA's environmental review as it applies to subsistence-

harvest patterns and sociocultural systems would no longer be applicable and further environmental review would be necessary.

Oil Spills. For purposes of analysis, no large spills are assumed for exploration drilling. It is likely that a small spill could occur. For purposes of analysis we chose a 48 bbl fuel transfer spill as identified in Shell's ODPCP. Most of the fuel oil from such a spill would probably dissipate into the water column within about two days, so the effects on subsistence resources and practices would be negligible.

Shell's leases obtained in Sale 195 include a requirement for pre-booming during large fuel transfers in the migration corridor during whale migration. Shell plans pre-transfer booming of the fuel barge (EP Sec. 11f). Although measure does not reduce the likelihood of a fuel spill, it does increase the speed of response to any fuel spill and reduces the likelihood that a spill would contact environmental resources.

The Beaufort Sea multiple-sale EIS defines "significant" effects on subsistence-harvest patterns as: One or more important subsistence resources becoming unavailable, undesirable for use, or available only in greatly reduced numbers for a period of 1-2 years. The analyses for Sales 186, 195, and 202 use the lower threshold of I year and interpret this to mean unavailable, undesirable for use, or available only in greatly reduced numbers for one (1) harvest season.

Sale 195 lease stipulation 5 requires that Shell make every reasonable effort, including such mechanisms as a conflict avoidance agreement, to assure that exploration, development, and production activities are compatible with whaling and other subsistence hunting activities and will not result in unreasonable interference with subsistence harvests. In the EP, Shell noted that Shell has initiated discussion with the NSB, AEWC, and potentially affected villages in late 2006, and that additional discussions are planned in 2007.

Shell has noted that the 2007 CAA will include a number of components to minimize potential interference with the subsistence harvest. These provisions include the following.

- Establishment of a communications and call center with Inupiat communicators. This enables coordination and communication between industry vessels and subsistence vessels and for Shell to redirect its vessel activities if there is potential for interference.
- Establishment of subsistence mitigation caches.
- Establishment of on site marine mammal observation program using local residents who would be familiar with the program area, environmental conditions, biological resources, and subsistence activities.

These provisions are similar to the provisions in conflict avoidance agreement adopt in 2006 between industry and the AEWC for open water seismic activities. During the 2006 operating season, the communications and call center was also available to notify industry of potential conflicts with other subsistence activities (in addition to bowhead whales). The MMS will require Shell to make similar arrangements for Shell's 2007 open-water drilling program.

Shell has advised the MMS that Shell and the AEWC have agreed to a timeline for negotiation of the 2007 CAA. The AEWC sponsored community meetings with the Whaling Captains Associations in Kaktovik, Nuiqsut, and Barrow the week of January 29th. During these meetings, Shell presented their proposed exploration program and the AEWC requested comments and recommendations for minimizing potential conflicts. Shell has committed to providing a final version of the 2007 CAA prior to the NMFS Open Water meeting scheduled for April 2007.

As provided for under Sale 195 lease stipulation 5; in the event no agreement is reached between the parties, the lessee, the AEWC, the NSB, NMFS, or any of the subsistence communities that could be affected directly by the proposed activity may request that the RS/FO assemble a group consisting of representatives from the subsistence communities, AEWC, NSB, NMFS, and the lessee(s) to specifically address the conflict and attempt to resolve the issues before making a final determination on the adequacy of the measures taken to prevent unreasonable conflicts with subsistence harvests. Upon request, the RS/FO will assemble this group if the RS/FO determines such a meeting is warranted and relevant before making a final determination on the adequacy of the measures taken to prevent unreasonable conflicts with subsistence harvests.

Conclusion. Before exploratory drilling activities can commence, Shell must have an IHA from the NMFS and a conflict avoidance agreement. In the event there is not an agreement, the MMS must make a final determination on the adequacy of the measures taken to prevent unreasonable conflicts with subsistence harvests following meeting with the parties in accordance with lease stipulation 5. To mitigate exploration activities' impacts below the level of "significant," these conditions must apply. Potential long-term impacts from climate change would be expected to exacerbate overall potential effects on subsistence resources and subsistence-harvest patterns.

IV.B.2.b. Sociocultural Systems

Effects on the sociocultural systems of the communities of Barrow, Nuiqsut, and Kaktovik could come from disturbance from exploration activities, including periodic interference with subsistence-harvest patterns from seismic survey and drilling. Altogether, effects are not expected to disrupt nor displace ongoing social systems, community activities, and traditional practices for harvesting, sharing, and processing subsistence resources. However, in the unlikely event that a large oil spill occurred and contaminated essential whaling areas, major effects could occur when combined impacts from contamination of the shoreline, tainting concerns, cleanup disturbance, and disruption of subsistence practices are factored together. Such impacts would be considered significant. All subsistence whaling communities and other communities that trade for and receive whale products and other resources from the whaling communities could be affected. A large spill anywhere within the habitat of bowhead whales or other important migratory subsistence resources could have multiyear impacts on the harvest of these species by all communities that use them. In addition, harvests could be affected by the IWC to limit harvest quotas in response to a perceived increased threat to the bowhead whale population. Beyond the impacts of a large spill, long-term deflection of whale migratory routes or increased skittishness of whales due to increased industrialization in the Beaufort Sea would make subsistence harvests more difficult, dangerous, and expensive. To date, no long-term deflections of have bowheads

have been demonstrated and CAA's have tended to mitigate on and offshore seasonal oil industry activities.

The multiple-sale EIS defines "significant" effects on sociocultural systems as: "A chronic disruption of sociocultural systems that occurs for a period of 2-5 years, with a tendency toward the displacement of existing social patterns..." The analyses for Sales 186, 195 and 202 use the lower threshold of 2 years. This increment is used because it is believed it would take at least 2 years for such an effect to become evident in the social system. It should be noted that the significance threshold for subsistence-harvest patterns of a subsistence resources becoming unavailable, undesirable for use, or available only in greatly reduced numbers for 1 year (meaning one (1) harvest season) would be reached long before the significance threshold for sociocultural systems could be applied.

Effects on the sociocultural systems of the communities of Barrow, Nuiqsut, and Kaktovik could come from noise disturbance produced by exploration drilling activities. Because activity staging would not be from local communities, stresses to local village infrastructure, health care, and emergency response systems are expected to be minimal. Social systems in these communities would experience little direct disturbance from the staging of people and equipment for exploration.

The long-term deflection of whales from their migratory routes or increased skittishness of whales due to increased exploration activities in the Beaufort Sea would make subsistence harvests more difficult, dangerous, and expensive. To date, no long-term deflections of bowheads have been demonstrated. On the other hand, drilling activity of the magnitude discussed in the scenario for the Shell EP has not been approached since the 1980's, and potential whale deflections are likely.

Required mitigation, monitoring, and conflict avoidance measures under IHA's issued by NMFS and FWS would serve collectively to mitigate disturbance effects on Native lifestyles and subsistence practices and likely would mitigate any consequent impacts on sociocultural systems. With such measures in place, impacts would be minimized.

Conclusion. Before exploratory drilling activities can commence, Shell must have an IHA from the NMFS and a conflict avoidance agreement. In the event there is not an agreement, the MMS must make a final determination on the adequacy of the measures taken to prevent unreasonable conflicts with subsistence harvests following meeting with the parties in accordance with lease stipulation 5. Potential long-term impacts from climate change would be expected to exacerbate overall potential effects on sociocultural systems.

IV.B.3 Effects on Other Resources

IV.B.3.a. Effects on Other Coastal and Marine Birds

The Shell EP summarizes four activities could adversely affect coastal and marine birds: 1) helicopter overflights, 2) exploration and support activity, 3) oil spills, and 4) collisions with drilling structures and aircraft. Effects on threatened and endangered birds are addressed in Section IV.B.2.

Helicopter Overflights. The ER states that:

> Most of the disturbance experienced by these birds will be negligible and non-lethal, as they will be displaced to other areas.

This conclusion does not clarify what disturbances would be non-negligible or lethal and also assumes that birds would not be impacted by being displaced to other, perhaps less suitable, areas. It is also unclear if this disturbance is limited to at-sea operations or includes disturbances from associated aircraft activities as well. At-sea disturbances are addressed in the next section. The potential impacts from disturbance are described in the Beaufort Sea multiple-sale EIS (MMS 2003) as updated in the subsequent EA's for Sales 195 and 202 (USDOI, MMS, 2004, 2006a). Low-level helicopter flights could disturb birds nesting on barrier islands (e.g., common eiders) or birds molting in coastal lagoons. Disturbance during the early stages of incubation could result in the loss or abandonment of nests. Disturbance during the molt period, an energetically-demanding life stage for waterfowl, could reduce fitness that would compromise winter survival. Bird concentration areas also include coastal areas used as migratory pathways for a wide variety of coastal and marine birds.

OCS Drilling Alaska Coastal Management Program Consistency Analysis, Sec. 11 AAC 112.300 Habitats (page 7) requires that:

> [B]arrier islands and lagoons must be managed to avoid, minimize, or mitigate significant adverse impacts...from activities that would decrease the use of barrier islands by coastal species, including ...nesting birds.

The EA for Sale 195 restates information contained in ITL No. 4: Information on Bird and Marine Mammal Protection. This ITL states:

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

The Shell EP acknowledges this potential mitigation measure, as described in their response to applicability of NSBCMP Policy 2.4.4 Required Features for Applicable Developments (page 10), stating:

> Horizontal and vertical buffers for aircraft would be employed where applicable to avoid disturbing... bird concentrations.

Vertical buffers could be effective, particularly if they were at least 1,500 ft (~450 m). We assume Shell will implement this altitude restriction for aircraft operations and, as a consequence, will assume it will be effective in minimizing significant adverse impacts of aircraft operations to bird concentration areas.

Exploration and Support Activity. Encounters between drilling support vessels and coastal and marine birds at sea are possible. The ER states that:

> Most of the disturbance experienced by these birds will be negligible and non-lethal, as they will be displaced to other areas.

This conclusion does not clarify what disturbances would be non-negligible or lethal and assumes birds would not be impacted by being displaced to other, perhaps less suitable, areas. Vessel activity associated with this project would not likely occur within coastal lagoons, where many post-breeding birds would be molting. These birds would essentially be buffered from vessel traffic. Birds that use more offshore areas during migration would tend to avoid close encounters by diving or flying away from approaching vessels. Given the unknown distribution and timing of vessel activity, as well as the unknown distribution of coastal birds, it would be impossible to determine how many birds would be affected to a level that would impact their fitness. We assume that vessel disturbance would be short-term in duration and be distributed across a fairly wide area of open water. We also assume that if birds are displaced from favored habitats, they will return once the vessel disturbance has passed.

Given the distribution and duration of vessel activity in juxtaposition with seasonal bird distribution, we expect the frequency of bird/vessel encounters would not reach the level of impacting individual birds.

Oil Spills. The ER states that:

> Oils spills are also a factor to take into consideration, with varying degrees of severity depending on the oil spill volume, location in respect to bird concentrations, emergency response, and ice conditions. ... These effects can cause major declines in some bird species, especially those designated as threatened or endangered.

The ER fails to fully evaluate the potential significance of accidental spills on birds. The potential impacts from accidental spills are best described by the Beaufort Sea multiple-sale EIS (MMS 2003) and subsequent NEPA analyses in the Environmental Assessments for Lease Sales 195 and 202 (MMS 2004, 2006). A more specific OSRA analysis for a summer incident over 30-days predicts an up to 16% percent chance that a large oil spill originating from any of the launch areas containing exploratory drilling sites would reach Environmental Resource Areas (ERA) important to birds, such as Harrison Bay or the Colville River delta (ERA 69)(Appendix I). The MMS estimates the chance of a large ($\geq$1,000 bbl) oil spill from exploratory activities to

be very low. For the purposes of analysis, no large spills are assumed to occur during exploration drilling.

Small (≤25 bbl) operational spills of diesel, refined fuel, or crude oil may occur and would be more typical during the proposed action. The Shell EP described the potential amount of diesel spilled during a fuel transfer to be approximately 2,000 gal (48 bbl). Pre-booming would likely contain this spilled fuel. If spilled fuel were to escape containment, much of it would likely evaporate or disperse before reaching bird concentration areas. A diesel spill of this size would persist for about 2 days (Appendix I). While unlikely to occur, even a small amount of spilled petroleum could impact a large number of at-sea birds. Given the low density of birds around the drill sites, however, only a small number of birds would be expected to be oiled and die.

No large spills are assumed to occur during exploration activities. The most likely spill would occur during a diesel fuel transfer. Fuel transfer procedures are designed to further reduce the potential for a small oil spill. If preventive measures failed, a small number of at-sea birds could be killed.

Collisions with Aircraft and Drilling Structures. There are two primary ways that operations proposed in the Exploration Plan can result in direct mortality to birds via collisions: aircraft activities and birds striking exploration structures.

Implementation of aircraft altitude restrictions would reduce the risk that aircraft would strike and kill birds. Implementing an altitude restriction would also decrease the risk of aircraft striking birds, thus increasing the protection of human life and property.

The lighting on exploration structures can attract/disorient migrating birds, particularly during periods of darkness or inclement weather. Sale 195 lease stipulation 7 required implementation of a protocol to reduce radiated light from exploration structures. This protocol was intended to minimize the incidental take to Threatened Steller's and spectacled eiders, but would also reduce the collision strike hazard to other bird species, including those species that are much more abundant than listed eiders (e.g., king eiders). Lighting of exploration structures is addressed under Section IV.B.2 Effects on Threatened and Endangered Birds.

Summary of Effects to Other Coastal and Marine Birds. The Shell EP, as received, commits Shell to three specific mitigation measures that would avoid or minimize impacts to bird resources. These are implementation of Stipulation 7, reporting bird collisions, and aircraft maintaining vertical (1,500 ft) and horizontal buffers from bird concentration areas. No large spills are assumed to occur during exploration activities; the most likely spill would occur during a diesel fuel transfer. Fuel transfer procedures are designed to further reduce the potential for a small oil spill (pre-booming requirements). If preventive measures failed, a small number of at-sea birds could be killed. No unavoidable effects would result in losses requiring more than three generations to replace and, therefore, do not exceed MMS' significance threshold.

A number of additional mitigation measures to reduce avoidable impacts have been identified and are recommended (see Section IV.B.1.b.5).

IV.B.3.b. Effects on Other Marine Mammals

The multiple-sale EIS concluded that "no significant effects are anticipated from routine permitted activities" (USDOI, MMS, 2003:Section ES.1.e(1)). Underwater noise during previous operations in Camden Bay with a single drillship and a few icebreakers is summarized in EA Section IV.A.3.

The 195 EA concluded that the new information on other marine mammals did not change the conclusion of no significant population-level effects due to the proposed lease sale (USDOI, MMS, 2004: Sec IV.C.1.e (1)).
Pinnipeds. The Shell request to NMFS for an IHA explains that the company seeks authorization for potential "taking" of small numbers of ringed seal and other pinnipeds, and that the impacts would consist of temporary and short-term displacement within zones affected by noise from drilling activities and associated support vessels (Shell, 2007: Sec. 5). The maximum expected "take" is estimate as 42 ringed seals, 3 bearded seals, and 1 spotted seal (Shell, 2007: Table 6-2). Shell based its take estimates on the 160 and 120 dB re 1 μPa (rms) criteria for most cetaceans, because these ranges are assumed to be the sound source level at which marine mammals may change their behavior sufficiently to be considered "taken by harassment." Little information is available with respect to the impact of icebreaker noise on seals. If ice forms in the project area, the two icebreakers associated with proposed operations will likely be conducting ice management operations.

Few walrus are expected to be in the project area, and significant impacts to them are not anticipated.

Cetaceans. The Shell request to NMFS for an IHA explains that the company seeks authorization for potential "taking" of small numbers of beluga and gray whales, and that the impacts would consist of temporary and short-term displacement within zones affected by noise from drilling activities and associated support vessels (Shell, 2007: Sec. 5). The maximum expected "take" is estimated as one beluga whale and one gray whale (Shell, 2007: Table 6-2). Shell based the take estimates on the 160 dB re 1 μPa (rms) criteria for most cetaceans, because this range is assumed to be the sound source level at which marine mammals may change their behavior sufficiently to be considered "taken by harassment." If ice forms in the project area, the two icebreakers associated with proposed operations will likely be conducting ice management operations. Belugas are most likely to be impacted by icebreaker noise. Gray whales may also be most impacted by ice breaker noise, though few gray whales are likely to be in the project area.

Conclusion. No significant effects are anticipated from the routine activities proposed in the EP. Any incidental take of marine mammals by harassment occurs, such "take" would be authorized

by the MMPA authorizations that Shell has committed to obtaining. The MMPA authorizations are considered part of the proposed action.

IV.B.3.c. Effects on Fish and Essential Fish Habitat

Section 4.14 of the ER concludes that most of the expected effects to fish species will be negligible and non-lethal, in the form of displacement. The ER does not describe the expected effects that are non-negligible and lethal. Oil spills were described as posing a negligible to moderate effect.

The Beaufort Sea multiple-sale EIS and subsequent EA's for Sales 195 and 202 generally conclude that disturbance/displacement and oil spills are the primary ways that exploration and delineation drilling operations can affect marine fish and their habitat.

Drilling Operations and Underwater Noise. While there may be important differences between the impulsive nature of noise generated during seismic operations and noises generated during drilling operations (drilling and associated vessel noises), this analysis treats all noise the same. We assume animals move away from sound levels that disturb them. Bowhead whales, for example, move away from seismic surveying activity as well as avoid areas around drilling operations (EA Figure 15). Unfortunately there are no comparable examples for fish. We are unable to distinguish between the effects on fish from seismic activities compared to effects from drilling and associated vessel activity. Consequently, we assume that the same sound level that affects fish during seismic operations would be similar to those effects from similar sound levels originating from drilling and associated vessel activity.

In the past, noise effects on fish were considered temporary as the source vessel moved across large areas of open ocean, encountering fish and then moving away. The effects of noise radiating from a fixed location would be expected to have different effects because the noise radiates from the same site and fish encounter it as they move along the coast.

Appendix K of the EP describes the results of a sound monitoring project conducted in 1993 on exploratory drilling operations that used the Kulluk and ice management and other support vessels. The combined sound profile for the Kulluk indicated cumulative sound of approximately 180 dB within 0.01 km of the drill vessel, 160 dB at approximately 0.2 km, 140 dB at 5 km, and 120 dB at approximately 100 km (60 mi). The overall project peak 1/3-octave band 20 received level of 120 dB generated at the Kuvlum #2 prospect reached the nearby coastline (EA Sec. IV.A.3 and Figure 14). We assume that the proposed project would generate similar levels of noise.

Effects from Mortality and Physiological Harm. As discussed in the seismic survey PEA (MMS 2006c), sound sources that have resulted in documented physiological damage and mortality of adult, juvenile, and larval fish have all been at or above 180 dB re 1 μPa. Damage to hearing and tissues may occur to these age-classes if the animals are in close proximity to the drill rig and associated vessels. In the above example for the Kuvlum #2 prospect, direct damage to fish

would be expected to occur within about 10 m of the drill site. Few fish would be expected to approach or remain within close proximity to this sound source and few fish would ever be expected to experience direct mortality or physiological harm from drilling operations.

Arctic cisco along the eastern Alaskan Beaufort Sea are believed to originate in the Mackenzie River along the Canadian Beaufort Sea. In certain years, prevailing winds are believed to move the outfall plume westward, carrying young-of-the-year larvae into the Alaskan Beaufort. Those larvae reaching the Colville River find favorable conditions for rearing and over-wintering. If a larval cisco fails to reach the Colville River vicinity, it may attempt to rear/over-winter in suboptimal habitats where it would have a much lower probability of survival.
The wind-driven current does not always carry larval cisco to the Colville River area. In some years larval cisco may be carried westward, but farther offshore where they would be expected to experience high mortality.

Larval cisco do not appear capable of leaving the current. Some larval ciscos could be carried into the 180 dB zone (about 20 m diameter) around the drilling operation (being unable to avoid it) and be killed or injured. While some larval ciscos could be swept into the 180 dB zone, it would likely be a small proportion of those in the current plume. These effects would be extremely difficult to document.

Effects from Disturbance and Displacement. Many fish species are sensitive to certain ranges of sound and use sound in a number of ways to maintain school structure, find food and mates, and avoid predators (MMS, 2006b). Short-term loss of schooling structure, predator avoidance, and foraging behaviors would be likely until fish are out of the range of noises that disturb them.

Noise generated during seismic surveys, however, were documented to displace fish out to a distance of 33 km (20 mi) (Engas et al., 1996). The minimum noise threshold to cause this displacement was not known. Larger fish were disproportionately displaced more than smaller fish, a finding that was attributed to their greater swimming ability.

Direct mortality or physiological harm could occur if fish were in close proximity (~10 m) of drilling operations. Few fish would be expected to approach or remain in an area having 180 dB of constant sound. Some larval fish could be swept into this zone and be injured or killed. The number of fish injured or killed is anticipated to be small.

Displacement of fish is a larger concern. In the absence of clear evidence that noise levels in nearshore migration areas would not result in displacement of large numbers of important fish species, we recommend acoustic monitoring, as discussed in Section IV.A.3. That section summarizes the objectives of Shell monitoring; specifically:

The objectives of the planned work are to (1) measure the distances from the various sound sources to broadband received levels of 190, 180, 160, and 120 dB rms re 1 μPa, and (2) to measure the radiated vessel sounds vs. distance for the source and support vessels. The measurements will be made at the beginning of each specific activity. For the drilling operation

a subsequent mid-season assessment will be conducted to measure sound propagation from combined drilling operations during "normal" operations.

As explained in Section IV.A.3, Shell should be required to provide MMS with a copy of the above acoustic information for 2007 before August 25th. Further, because the pertinent information was not contained in the EP, MMS will make the 2007 information publicly available on the MMS web site before August 25, 2007. The MMS regulations give the RSFO authority to direct the lessee to conduct any necessary, additional geophysical or other monitoring programs (30 CFR Ch. II 250.203(q)). Implementation of this acoustic monitoring would provide information that could help evaluate potential fish assessments in the future as well as helping MMS work with local commercial and subsistence users to avoid impacts to fish resources.

Drilling operations conducted in the Beaufort Sea 1985-1986 and 1991-1993 (Figure 2; MMS 2007) were not documented to interfere with the coastal migration or spawning activities of fish, however this particular topic did not receive specific scientific investigation. While scientific study is unlikely to occur to evaluate the effects of Shell's exploration drilling program noise on fish, there are several anecdotal observations that could indicate a lack of substantial adverse effects to fish, including: credible observations of seals and piscivorous seabirds using nearshore areas, the absence of fish stranding events on beaches shoreward of the drilling site, or no appreciable change in the local commercial or subsistence harvest of certain species in the area. The opposite observations could indicate that large-scale problems associated with the exploration drilling could exist.

Shell anticipates using about 10 vessels for their exploration activities 2007-2009. Once the drilling operation is underway, the constant noise from a drillship and associated vessel activity could create a zone-of-influence that may be devoid of those fish that chose to avoid a certain level of underwater noise. For example, if the noise level reaching shore was 130 dB and certain fish species avoided this sound level, these fish would not be expected to enter the 130 dB zone-of-influence adjacent to shore. As each fish species is sensitive to different sound levels, the lowest sound level at which each fish species reacts is unknown.

As species vary in their life history strategy and habitat preferences, some species would be expected to be potentially more affected by underwater noise than others. Arctic cisco larvae reaching the Colville River find favorable conditions for rearing and over-wintering. They are believed to remain in the vicinity of the Colville River until sexual maturity (~6 years later). Upon reaching sexual maturity, these fish migrate to the Mackenzie River to spawn. Differential age-class distribution indicates that the Mackenzie River population consists of older, larger fish compared to younger, smaller fish in the Colville River.

Sexually-mature Arctic ciscos leaving the Colville River may chose to avoid certain noise levels near the coast when migrating east to spawning areas in the Mackenzie River. If these mature fish were unwilling or unable to move through the zone-of-influence (ZOI), they may be blocked, delayed, or be forced to attempt to move around the ZOI in offshore marine waters. Moving

around the ZOI could force them into waters that are less favorable to them (colder, higher salinity, etc). A blockage, delay, or decrease in fitness could result in decreased adult cisco survival and decreased spawning activity during three seasons of exploration drilling activity. These effects would be extremely difficult to document.

It remains unclear what potential effects rearing ciscos could result from an offshore drilling operation that is located more directly offshore of the Colville River delta, such as on Lease YO1743 Block 6222 (see former Hammerhead drill site, Figure 2). If young Arctic ciscos are displaced from preferred foraging areas near the Colville River delta, there could be slowed growth, delayed maturity, increased predation to all immature age-classes of ciscos in that vicinity. These effects would be extremely difficult to document. The MMS has recently funded a study on factors affecting subsistence harvest of Arctic cisco in the Colville River (Murphy et al., 2007). This study has tentatively concluded that at least 70% of the annual variation in abundance of juvenile Arctic cisco in the central Beaufort region can be explained by wind conditions during summer. None of the anthropogenic activities analyzed showed clear effects on Arctic cisco recruitment, survival, or abundance. Particularly noteworthy is the prediction that low harvest rates will occur starting in 2008 (Murphy, 2007).

Other species of fish are more widespread in their distribution and are less dependent upon specific locations for completing important life-stages. The Atlantic cod (*Gadus morhua*; of the same genus as arctic cod) was found to leave marine areas esonified by seismic surveys and remained out of the area within 33 km (20 mi) for at least 5 days. If Arctic cod avoided a zone-of-influence around an exploration drilling operation, they would be more concentrated in adjacent areas, which could force more fish to compete for limited resources. Arctic cod would likely recolonize the ZOI shortly after noise decreases to threshold levels or drilling activity ceased. Any decrease in fitness, increase in mortality, or decreased recruitment, however would likely be recovered the next year or by emigration from surrounding areas. Also, Arctic cod have a greater potential to avoid or move around the ZOI using offshore movements because they are more accustomed to marine conditions in these areas. These effects, however, would be extremely difficult to document.

The same situation could be true for other fish species, such as capelin. If capelin reacted to sound in the same way as cod, spawning and foraging aggregations of capelin in nearshore areas would be displaced during drilling activities. This same scenario could apply to other fish species foraging in nearshore coastal areas.

Given scientific uncertainty surrounding how several important fish species would react to varying levels of drilling program noise, we believe it possible there will be more than a minimal level of effect on some species. Therefore, we cannot concur with the Shell EP conclusion on page 4 of the Shell EP ACMP Coastal Management Consistency Analysis that "...the temporary and seasonal exploration program may have minimal to no impact on fish ... migration patterns."

The MMS also cannot concur that the effects on all fish species would be "short term" or that these potential effects are insignificant, nor would they be limited to the "...localized

displacement of fish....", because they could persist for up to five months each year for three consecutive years and they could occur during critical times in the life cycle of important fish species.

The MMS remains concerned that the potential adverse effects described for several fish species will occur to an unknown degree, however, none are expected to exceed the level that would require three generations to recover (the threshold for a significant effect). As a consequence, and consistent with the findings of the Beaufort Sea multiple-sale EIS and subsequent Sale 195 EA (MMS 2003, 2004), these factors are not likely to result in significant adverse effects to fish.

Effects from Oil Spills. Section 4.14 of the ER describes how oil can move through the food chain. Oil spills can also affect the reproductive systems of fish.

The Beaufort Sea multiple-sale EIS and subsequent EA's for Sales 195 and 202 (MMS 2003, 2004, 2006a) best describe the primary mechanisms that spilled oil could adversely affect fish resources and Essential Fish Habitat, including direct mortality of eggs and larvae, contamination of prey items and rearing/spawning habitats, and sub-lethal physiological impairment. The relative degree to which these effects would occur is related to the probability that certain-sized events would occur.

The MMS estimates the chance of a large (≥1,000 bbl) oil spill from exploratory activities to be very low. A specific OSRA analysis for a summer incident over 30-days predicts an up to 16% chance that a large oil spill originating from any of the launch areas containing exploratory drilling sites would reach the Environmental Resource Area (ERA) most important to fish, the Colville River Delta (ERA 69)(Appendix I; Map A-2a, Appendix A-1, MMS 2003). There is a 2% chance that the same spill would reach the mouth of the Sagavanirktok River (LS 39, Map A-3b, Appendix A-1, MMS 2003). For the purposes of analysis, no large spills are assumed to occur during exploration drilling.

Small (≤25 bbl) operational spills of diesel, refined fuel, or crude oil may occur and would be more typical during the proposed action. The Shell EP described the potential amount of diesel spilled during a fuel transfer to be approximately 2,000 gal (48 bbl). Pre-booming would likely contain this spilled fuel and if spilled fuel were to escape containment, much of it would likely evaporate or disperse over a two day period (Appendix I). Even a relatively small amount of spilled petroleum could impact certain age-classes of important fish species, such as larval and sub-adult Arctic cisco or juvenile pink or chum salmon rearing in or near the Colville River Delta. One of the sites proposed for exploration drilling is Lease YO 1743 Block 6222, directly offshore of the Colville River Delta (see former Hammerhead drill site, EA Fig. 2).

No large spills are assumed to occur during the proposed exploration activities. The most likely spill would occur during a diesel fuel transfer. Fuel transfer procedures are designed to reduce the potential for a small oil spill. If preventive measures failed and the spill persisted until making contact with estuarine habitats near the Colville River Delta, a large number of 0-year Arctic ciscos and pink or chum salmon, and lower proportions of immature Arctic ciscos, could

be killed. Small numbers of other fish species may be killed or impacted as well. Even if all these low-probability events were to occur simultaneously, most of these populations would be expected to recover to their former status in fewer than three generations if oil contaminated areas were restored to a pre-spill condition.

Summary of effects on Fish and Essential Fish Habitat. The MMS remains concerned that adverse effects from underwater noise to important fish populations will occur; however, none are expected to exceed the level that would require three generations to recover to their former status (the threshold for a significant effect). We recommend acoustic monitoring, as discussed in Section IV.A.3. That section summarizes the objectives of Shell proposed monitoring. The objectives of the planned work are to (1) measure the distances from the various sound sources to broadband received levels of 190, 180, 160, and 120 dB rms re 1 μPa, and (2) to measure the radiated vessel sounds vs. distance for the source and support vessels. The measurements will be made at the beginning of each specific activity. For the drilling operation, a subsequent mid-season assessment will be conducted to measure sound propagation from combined drilling operations during "normal" operations. The MMS should require this monitoring and distribute the information, so this assessment is based on the following condition:

The MMS requires Shell to conduct acoustic monitoring and to provide MMS with a copy of the above acoustic information for 2007 before bowhead whales migrate into the area and subsistence whaling begins. Details of the monitoring can be determined during the annual spring Open-water Meeting. Further, because some pertinent information was not contained in the EP, MMS will make the 2007 information publicly available on the MMS web site before August 25, 2007. We note that MMS regulations give the RSFO authority to direct the lessee to conduct any necessary, additional monitoring programs (30 CFR Ch. II 250.203 (q).

Implementation of this acoustic monitoring would provide information that could help evaluate potential fish assessments in the future as well as helping MMS work with local commercial and subsistence users to avoid impacts to fish resources.

In the highly unlikely event a small (≤48 bbl) fuel spill reaches nearshore habitats to local fish populations, particularly Arctic cisco and pink or chum salmon, a large proportion of rearing juveniles could be killed. These populations would be expected to recover to their former status in fewer than three generations if oil contaminated areas were restored to a pre-spill condition.

IV.B.3.d. Effects on Additional Resources

Air Quality. Shell has applied for minor source air permits from the U.S. Environmental Protection Agency (USEPA) (EP Appendix D). As Shell would be required to meet all of the provisions in the air quality permits issued by USEPA, emissions from the proposed activities are not expected to exceed the NAAQS. No significant adverse effects to air quality are expected to result from the proposed activities.

Water Quality. Commencement of activities under an approved EP is contingent upon receipt of applicable and necessary NPDES permits (EP App. C). Discharges to the marine environment (EA Sec. II.B.4; EP Sec. 6) will be regulated per NPDES permit restrictions and requirements. Oily liquids will be stored and transported to approved disposal facilities. Shell intends to have the tanker barge *Arctic Endeavor* and an associated tug on site to receive liquids from drilling and well tests. Trash and debris will be stored and transport to approved disposal facilities. Turbidity associated with mooring, drilling, and discharges under NPDES permit are expected to be highly localized and short-term. The proposed activities will be conducted in compliance with an NPDES permit. No significant water quality impacts are expected to occur from activities as proposed in the EP.

Lower Trophic-level Organisms. These organisms might be affected by discharges, disturbance, and spills. Discharges are summarized in the EP Section 6a, EA Section II.B.5, and assessed in the multiple-sale EIS (Sec. IV.C.2.a). The toxic or chronic effect of the discharges on lower trophic-level organisms would be immeasurable at most of the drill sites because the drilling would occur during the open-water season and because of the water depth (greater than 20 m). Usually, there are restrictions on discharges only in shallow water during the ice-covered season, when and where the underice circulation is restricted. However, the consequences of chronic effects on lower trophic-level organisms at Shell's Fosters and Fireclaw Prospects would be slightly greater (minor) because the organisms are frequently consumed by an important subsistence species—bowhead whales. The area around the drill sites is gouged frequently by sea ice, so the dredging of cellars for well-head equipment or the deployment of anchors for the drilling vessels would be negligible. The effect of the assumed 48 bbl fuel spill on lower trophic-level organisms would be immeasurable. Overall, the effect of the proposed exploratory drilling on lower trophic-level organisms would be minor.

Archaeology. No new archaeological information has become available since 1984-1985 when geotechnical and geophysical data were acquired for the Erik (now Olympia) and Hammerhead (now Sivulliq) Prospects. It is these data that will be used to clear drill sites and assess the potential for historic and prehistoric archaeological resources in both prospect locations (EP App. F, Sec. 2.2).

More specifically, existing site clearance data gathered in the mid-1980s for the Erik (now Olympia) and Hammerhead (now Sivulliq) Prospects to determine prehistoric archaeological potential of the proposed drill sites is evaluated in EP (EP Apps. A and B). Evidence from the ROV and scanning-sonar surveys for these prospects indicates that there are no shipwreck remains, large or small, in the proposed project area. A shallow geophysical and geological survey was conducted over some of the drill sites. These data, including scanning sonar, subbottom profiler, and ROV video, were analyzed for indicators of archaeological potential such as drowned or buried terrestrial landforms, the existence and survivability of terrestrial sediments and depositional environments, and location of these with respect to the proposed drilling footprint. The Shell preliminary evaluation of geophysical and geological data indicates that there are some geomorphic features similar to drowned terrestrial landforms. The analysis identified a buried channel-like feature north of the proposed ice island location, along the flank

of the shoal. However, no undisturbed terrestrial sediments were encountered in any of the core holes. The cores and ROV video indicated that the shoal is covered only by loose sand.

The literature review in the EP (Sec. 6.2.2) indicates that the shoal may also represent an ice-push event documented by researchers in the region, and not a paleo-barrier island structure. The Shell preliminary analysis of the channel-like feature concludes that it is probably an ice-erosional feature along the northern flank of the shoal, and not a paleo-channel. A final determination on the nature of these features will be included in a full archaeology analysis and review that will be conducted prior to approval of the APD.

Drilling activities are proposed for the four Olympia Prospect leases 7 mi northwest of Kaktovik and the four Sivulliq Prospect leases 45 mi east of Cross island. Also cleared in this EA but not analyzed in the EP are the Fosters and Fireclaw Prospects 25 mi east of Barter Island and the Cornell Prospect 20 mi north of the Colville River Delta. As identified in MMS's Beaufort Sea multiple-sale EIS, blocks associated with the 20-m isobath are assumed to have prehistoric archaeological resource potential based on prevailing geological theory. All eight blocks in the Olympia and Sivulliq Prospects analyzed in the EP are deeper than 20 m, and, therefore, not identified as having prehistoric archaeological potential. The same is true for the two blocks associated with the Fosters and Fireclaw Prospects and the single lease block 6765, located midway between the Olympia and Sivulliq Prospects. Block 6222 north of the Colville Delta and within the Cornell Prospect is associated within the 20-m isobath and archaeological survey and data analyses would be required under MMS NTL No. 05-A03, Archaeological Survey and Evaluation for Exploration and Development Activities, before Section 106 consultation could be initiated with the State of Alaska SHPO.

None of the twelve blocks examined under this EA are associated with known shipwrecks or have any identified historic archaeological resource potential. The MMS will continue to review site-specific site-clearance data for the presence of potential historic shipwrecks at each of Shell's proposed drill sites. Because the Sivulliq site clearance data is older, the MMS will require Shell to perform visual confirmation that there is not a historic shipwreck at the drill site before construction of well cellars.

Environmental Justice. Alaskan Inupiat Natives, a recognized minority, are the predominant residents of the NSB, the area potentially most affected by exploration activities described in the Shell EP. Effects on Inupiat Natives could occur because of their reliance on subsistence foods, and exploration may affect subsistence resources and harvest practices. Potential effects could be experienced by the Inupiat communities of Barrow, Nuiqsut, and Kaktovik within the NSB. The sociocultural and subsistence activities of these Native communities could be affected by oil spills. The Environmental Justice Executive Order includes consideration of potential effects to Native subsistence activities.

Race: Minority, low-income populations in the NSB are relevant to the Environmental Justice analysis. The 2000 Census counted 7,385 persons resident in the North Slope Borough; 5,050 identified themselves as American Indian and Alaskan Native for a 68.38% indigenous

population. Inupiat Natives are the majority population of the region, as well as a defined minority population. It is the only minority population allowed to conduct subsistence hunts for marine mammals in the region, and, in potentially affected Inupiat communities, there are no substantial numbers of "other minorities." Additionally, "other minorities" would not be allowed to participate in subsistence marine mammal hunts and, therefore, would not constitute a potentially affected minority population (North Slope Borough, 1999).

Because of the North Slope homogenous Inupiat population, it is not possible to identify a "reference" or "control" group within the potentially affected geographic area, for purposes of analytical comparison, to determine if the Inupiat are affected disproportionately. This is because a non-minority group does not exist in a geographically dispersed pattern along the potentially affected area of the North Slope.

Income: The U.S. average median household income in 2000 was $42,148, and the U.S. average per-capita income was $29,469. The Alaskan average median household income in 2000 was $50,746, and the Alaska average per-capita income was $29,642. The average NSB median household income ($63,173) was above State and national averages, but the average per-capita income ($20,540) was below the State and national averages. The median household incomes in all subsistence-based communities in the NSB were above State averages except Nuiqsut ($48,036), and all were above national averages. Per-capita incomes in all these communities were below State and national averages.

The thresholds for low income in the region were household incomes below $57,500 in the NSB. Poverty level thresholds were based on the U.S. Census Bureau, Census 2000 Survey; low income is defined by the U.S. Census Bureau as 125% of poverty level. Subsistence-based communities in the region qualify for Environmental Justice analysis based on their racial/ethnic minority definitions alone. Nevertheless, the figures indicate that low income also commonly correlates with Native subsistence-based communities in the region (USDOC, Bureau of the Census, 2000, 2002). The 2000 Census "Tiger" files (files from the U.S. Census' Topologically Integrated Geographic Encoding and Referencing [TIGER] database) identify no nonsubsistence-based coastal communities in the North Slope with median incomes that fall below the poverty threshold.

Consumption of Fish and Game: As defined by the NSB Municipal Code, subsistence is "an activity performed in support of the basic beliefs and nutritional need of the residents of the borough and includes hunting, whaling, fishing, trapping, camping, food gathering, and other traditional and cultural activities" (State of Alaska, DNR, 1997). This definition gives only a glimpse of the importance of the practice of the subsistence way of life in Inupiat culture, but it does underscore that it is a primary cultural and nutritional activity on which Native residents of the North Slope depend.

Human Health Effects: The determinants of health status in North Slope Inupiat communities are complex, and reflect a wide array of considerations, including genetic susceptibility, behavioral change, environmental factors, diet, and sociocultural inputs. Identifying the potential

influences, or "determinants," of health status is an essential step for public health programs seeking to address health disparities. State, regional, and village-specific influences on health and health behavior can be identified with on- and offshore to oil and gas activities. For example, modernization and socioeconomic change are common to all of rural Alaska, and are one of the dominant influences on the evolution of health status.

Public health data support the link between contaminants which can be associated with oil development, and the risk of cancer, endocrine, and cognitive disorders (Jacobsen et al., 1996; Arctic Monitoring and Assessment Program, 2003; Cone, 2005.) However, the small size of the North Slope population and the bioaccumulation of contaminants from worldwide sources render assessment of the contribution of local industrial activity to contaminant-based health problems extremely difficult, outside of a scenario such as a large-scale contamination occurring from a large oil spill.

The NSB has maintained an extensive program of monitoring and testing subsistence resources for contaminants. The results have been encouraging, in that to date, the levels of contaminants such as PCBs in subsistence foods have been substantially lower than those reported in similar resources in Canada and Greenland. One important study also documented the presence of PCBs in store-bought foods, and made the point that there is no available food source which prevents exposure to such contaminants altogether (O'Hara, 2005). The Alaska Department of Health has also summarized data on PCBs and mercury in subsistence foods, and concluded with a strong recommendation that people continue eating subsistence foods because given the relatively low levels of contaminants present, the health benefits clearly outweigh the risks (Alaska Department of Health, 2004a and 2004b). A 1999 report by the Alaska Native Health Board: *Alaska Pollution Issues* assessed the risks from radionuclides, persistent organic pollutants, heavy metals, polychlorinated biphenyls, dioxins, and furans, and concluded that the "benefits of a traditional food diet far outweigh the relative risks posed by the consumption of small amounts of contaminants in traditional foods" (Alaska Native Health Board, 1999).

In 2001, the Alaska Native Health Board put out the *Alaska Pollution Issues Update* report – the first real attempt in Alaska to come up with health advisories based on contaminant levels in subsistence foods, actual subsistence food consumption levels by Alaska Natives, and USFDA and USEPA action levels. Its overall conclusion was that "a small number of traditional foods contain contaminants with concentrations that are over the USFDA action level, but most have levels below the action level. With the wide margin built in for establishing the USFDA action level, the results should be reassuring to consumers of traditional foods. To determine definitively if these low levels are harmful only ongoing research that measures contaminant levels in Native populations will provide the answer" (Alaska Native Health Board, 2002).

The MMS socioeconomics studies agenda has emphasized the documentation of subsistence uses, and the potential impacts of OCS activities on such uses, along with the more general characterization of rural (Native and non-Native) social organization and the incorporation of local and traditional knowledge. The MMS-sponsored studies have focused most heavily on communities on the North Slope (the area of most onshore and offshore oil and gas activity) and

MMS has funded projects to synthesize local and traditional knowledge. The MMS has recognized the extreme importance of whales and whaling to the North Slope communities, and has conducted a bowhead whale aerial survey annually since 1987. The MMS study, *Quantitative Description of Potential Impacts of OCS Activities on Bowhead Whale Hunting and Subsistence Activities in the Beaufort Sea*, is ongoing.

Avoidance planning, stipulations and required mitigation, and conflict avoidance measures (under IHA requirements as defined by NMFS and FWS) would serve collectively to mitigate disturbance effects on EJ.

Conclusion: As discussed in Section IV.D, Effects on Subsistence-Harvest Patterns and Sociocultural Systems, coastal communities could experience impacts on subsistence resources, subsistence-hunting practices, and sociocultural systems. These changes could occur as a result of noise and disturbance from seismic surveys, drilling activities, aircraft and vessel traffic, and oil spills. The EIS defines "significant" effects on environmental justice as disproportionate, high adverse impacts to low-income and minority populations. Potential effects could be experienced by the Inupiat communities of Barrow, Nuiqsut, and Kaktovik. Any potential effects to subsistence practices from exploration activities are expected to be mitigated substantially, though not eliminated, through avoidance planning, stipulations and required mitigation, and conflict avoidance agreements between the AEWC and the oil industry under IHA requirements as defined by NMFS and FWS.

IV.C. Effects of Alternative 2

Alternative 2 is the proposed action as described in the EP with additional mitigation measures to further reduce potential adverse impacts. As for Alternative 1, no significant adverse impacts to environmental resources and sociocultural systems are expected to occur from the proposed activities as described in the EP. The additional mitigation measures discussed below would further reduce the potential for adverse impacts identified in the analysis for Alternative 1. No significant impacts are expected to occur from proposed activities under Alternative 2.

There are additional, discretionary measures that Shell could implement to more fully mitigate potential adverse impacts to threatened eiders and other coastal and marine birds:.

The following additional measures would reduce the risk to threatened eiders (and other coastal and marine birds) that could be involved in collisions with aircraft or vessels:

- The MMS, FWS, and Shell should work together to develop project-specific aircraft flight route strategies. This was a conservation recommendation from the FWS October 2002 Biological Opinion and is intended to cover those times when weather prevents following a flight altitude restriction.

- All exploration program vessels should minimize operations that require high-intensity work lights, especially within the 20-meter bathymetric contour. High-

intensity lights should be turned off, if possible, in inclement weather or periods of darkness; however, navigation, deck lights, and interior lights may remain on for safety. The intent of this measure is to reduce the risk of coastal and marine birds striking vessels.

- An avian specialist or personnel qualified or trained in bird identification should be stationed aboard the exploration program vessels to monitor for and report bird collisions. All bird collisions should be reported, especially during darkness or inclement weather. A summary of monitoring activities and collisions should be submitted annually to MMS. This measure would help document the potential benefit of implementing the lighting protocols required under Stipulation 7. Stipulation 7 was intended to avoid or minimize the risk that migrating birds, including threatened eiders, would collide with exploration structures.

IV.D. Effects of Alternative 3 (No Action)

Under Alternative 3 (No Action) the exploration activities proposed by Shell in their EP would be disapproved. No impacts to resources would occur from the proposed activities. Disapproval of the EP might result in the delay of activities and potential impacts or in the displacement of activities and potential impacts to other locations. Disapproval of the EP might result in lost opportunities for discovery and production of oil and gas resources and any associated economic benefits.

IV.E. Cumulative Effects Analysis

The level and types of activities proposed in Shell's EP are within the range of activities described and evaluated in the Beaufort Sea multiple-sale EIS (USDOI, MMS, 2003), and updated in EA's for Sales 195 and 202 (USDOI, MMS, 2004, 2006a). The cumulative effects scenarios and analyses in these documents included projected activities for both the exploratory and development phases, including the types of activities proposed in this EP. These documents are incorporated by reference.

Past, present, and reasonably foreseeable activities were identified in the cumulative scenario for the multiple-sale EIS (USDOI, MMS, 2003), and the scenario was reviewed and revised as needed before preparation of the EA's for proposed Sales 195 and 202 (USDOI, MMS, 2004, 2006a). The cumulative scenarios included activities that could occur near Camden Bay, including exploratory drilling and support activities, ancillary coring and seismic surveying activities, and exploration seismic surveying. The cumulative analysis in the multiple-sale EIS assessed past, present, and reasonably foreseeable activities in the context of reasonably foreseeable changes in the environment and resources, including arctic warming. The multiple-sale EIS concluded that the incremental contribution from activities that would reasonably result from an OCS lease sale in the Beaufort Sea Planning Area to overall cumulative impacts would likely be quite small (USDOI, MMS, 2003:Section V.A.6). The cumulative analyses in the Sale 195 and Sale 202 EA's reconfirmed this conclusion.

Cumulative activities and impacts in the Arctic OCS were also addressed in the 2006 Arctic Seismic Surveying Programmatic EA (USDOI, MMS, 2006b).

Other reasonably foreseeable activities expected to occur in the Beaufort Sea area during the timeframe of the activities proposed in Shell's EP are (a) Shell's proposed ancillary activities including geotechnical coring and high-resolution site-clearance seismic surveys, (b) exploration seismic surveying, and (c) and non-OCS vessel traffic.

Shell's proposed ancillary activities are described in Section III.B.5.

Shell proposes to conduct seismic surveys in the Beaufort Sea OCS during the next two to three open-water seasons (ER Sec. 2.4; *Petroleum News*, 2006b). Shell's proposed exploration seismic surveying is also described in Shell's draft marine mammal monitoring plan in Shell's

application to NMFS for an IHA (EP App. 3; Shell, 2007: p. 11). ConocoPhillips also has proposed high-resolution site-clearance seismic surveys for the 2007 open-water period. Mitigation measures required for any seismic surveys in OCS waters would include ramp-up, marine-mammal observers, and shut down if a marine mammal comes within the specified exclusion zone. Additional aerial surveys, vessel based surveys, and acoustic monitoring may also be required.

Vessel traffic in the proposed action area is expected to include vessels used for fishing and hunting, cruise ships, icebreakers, Coast Guard vessels, and supply ships and barges (LGL Alaska Research, 2006). Overall vessel traffic in the proposed action area is expected to be limited. Most vessels are expected to transit through the area within 12.5 mi (20 km) of the coast. During ice-free months (June to October), barges are used for supplying the local communities, Alaskan Native villages, and the North Slope oil-industry complex at Prudhoe Bay with larger items that cannot be flown in on regular commercial air carriers. Usually, one large fuel barge and one supply barge visit the villages per year and one barge per year traverses through the Arctic Ocean to the Canadian Beaufort Sea. Vessels are the greatest anthropogenic contributors to overall noise in the sea. Sound levels and frequency characteristics of vessel noises underwater generally are related to vessel size and speed. Larger vessels generally emit more sound than smaller vessels, and those underway with a full load, or those pushing or towing a load, are noisier than unladen vessels. The primary sources of sounds are engines, bearings, and other incidental mechanical parts. The sound from these sources reaches the water through the vessel hull. Other than during ice-breaking activities, the loudest sounds from these vessels are made by the spinning propellers. Navigation and other vessel-operation equipment also generate subsurface sounds. Vessel strikes with marine mammals in the Arctic Ocean are rare, in part because overall vessel traffic in the Alaska Beaufort Sea is very limited.

Exploration seismic surveying and active ice-management are expected to be the greatest noise sources in the Beaufort Sea OCS during the time period of the proposed activities addressed in this EA. Shell's applications to NMFS and FWS for incidental take authorization under the MMPA cover the potential need for active ice management by ice breakers. Per MMS policy, permits for exploration seismic surveys are conditioned upon the permittee obtaining appropriate MMPA authorizations from NMFS and FWS. The adverse effects of these noise sources to marine mammals and subsistence activities are expected to be mitigated by requirements in the MMPA authorizations.

The proposed exploration drilling activities are short term and potential effects other than noise are expected to be localized. The exploration and drilling activities proposed in Shell's EP are expected a small incremental adverse effect to the stresses on coastal and marine birds, marine mammals, fish, and subsistence activities. Noise associated with the proposed activities is expected to have adverse impacts on marine mammals and subsistence activities. These impacts are expected to be negligible as a result of measures required in the MMPA authorizations that are an integral aspect of the proposed action. The incremental contribution of noise associate with the proposed activities is expected small.

Arctic warming is an observable phenomenon in the Beaufort Sea area. Many scientists attribute this climate change, at least partly, to emissions of greenhouse gases. The exploration drilling and supporting activities proposed in Shell's EP are expected to contribute an extremely small amount to overall hydrocarbon emissions into the planet's atmosphere.

The cumulative analyses in the Beaufort Sea multiple-sale EIS and subsequent sale EA's concluded that the incremental contribution from activities that would reasonably result from an OCS lease sale in the Beaufort Sea Planning Area to overall cumulative impacts would likely be quite small. The activities proposed in Shell's EP represent a small portion of the projected activities originally analyzed for a Beaufort Sea lease sale. Therefore, the incremental contribution of the proposed activities to cumulative impacts is expected to be quite small, and thus not significant.

V. CONSULTATION AND COORDINATION

Pursuant to 30 CFR 250.232, MMS is only required to submit a copy of the EP to the Governor of Alaska and the State coastal management agency. The MMS sent the EP to the Office of Project Management and Permitting as both the Governors designated contact and as the state coastal management agency. The Governor of Alaska submitted comments on February 8, 2007, supporting the exploration program and encouraging the MMS to continue to work with the State and North Slope Borough (NSB) to minimize potential conflicts with subsistence activities.

By letter dated December 21, 2006, the MMS notified the Mayor of the NSB; Mayor's of the cities of Kaktovik, Nuiqsut, and Barrow; the Native Villages of Kaktovik, Nuiqsut, and Barrow; the Inupiat Community of the Arctic Slope (ICAS); and AEWC that Shell's proposed exploration plan was anticipated to be submitted in early January. The MMS acknowledged the short regulatory review schedule and offered to meet with the any of the parties to discuss the project. No request for a meeting was made.

It is MMS practice to distribute the EP to other Federal and State agencies, local and Tribal governments and the AEWC. The MMS also notifies third parties on the availability of the EP for review. By letter dated January 17, 2007, the MMS distributed copies of the EP to the Mayor of the NSB; the NSB Wildlife and Planning Departments; city and Native Villages of Kaktovik, Nuiqsut, and Barrow; ICAS; and AEWC and to other Federal and State agencies. The copies were accompanied by a request for comments by February 15, 2007. Copies of the distribution letter without the attachments were also sent to third parties and additional representation in the NSB. This consultation helps MMS meet the requirements of Executive Order 12898 on Environmental Justice.

The MMS made invitations to meet with the Mayor's and City Councils in Kaktovik, Nuiqsut, and Barrow. The city of Kaktovik declined the invitation. While the meetings in Nuiqsut and Barrow were being arranged, the AEWC was also arranging community meetings with each village Whaling Captains Association – under a grant from the MMS, the AEWC to assist in negotiating a conflict avoidance agreement pursuant to lease stipulation 5. After discussions

with the village coordinators the MMS agreed that separate meetings would be an unnecessary burden on the communities and deferred to the AEWC. The MMS attended the AEWC sponsored community meetings in Kaktovik and Nuiqsut.

A copy of the Shell EP was made available on the MMS Alaska website (http://www.mms.gov/alaska/fo/ExplorationPlans/shell_exploration_plan/Exploration%20Plan.pdf).

The EP explains that Shell employees met with the AEWC, and continued negotiating a Conflict Avoidance Agreement during October 2006 at the Alaska Federation of Natives conference (EP Sec. 11e). Summaries of the meetings in Nuiqsut and Barrow on October 16-17, 2006 are contained in EP Appendix J. Shell's recent request for a NMFS IHA for bowheads during drilling explains that additional Plan of Cooperation meetings are scheduled for May or June 2007 (Shell, 2007, Sec. 12). Shell conducted a meeting with the Kaktovik Inupiat Corporation in Kaktovik on November 28, 2006. If requested, Shell will hold post-season meetings to assess the effectiveness of mitigation.

To meet the direction of Executive Order 13084 (*Consultation and Coordination with Indian Tribal Governments*), which states that the U.S. government will continue "to work with Indian tribes on a government-to-government basis to address issues concerning Indian tribal self-government, trust resources, and Indian tribal treaty and other rights," on September 22, 2000, MMS sent copies of the EP to the tribal governments of Barrow, Nuiqsut, and Kaktovik as well as the Inupiat Community of the Arctic Slope (ICAS) and representatives of NSB Native corporations. These governments and representatives were provided with a copy of the Shell EP, and invited to comment on it.