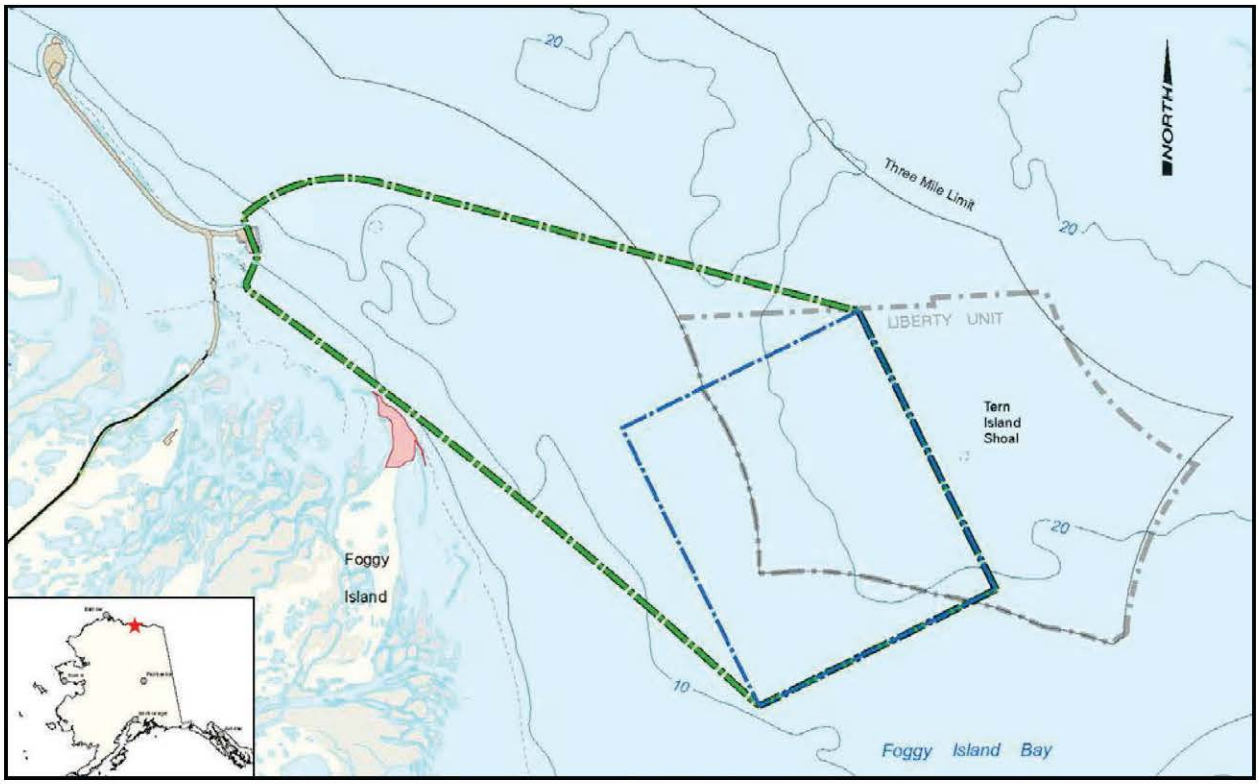
Alaska Outer Continental Shelf

OCS EIS/EA
BOEM 2014-056

BP Exploration (Alaska) Inc.
2014 Liberty Ancillary Activities
Shallow Geohazard Seismic Survey
Beaufort Sea, Alaska

ENVIRONMENTAL ASSESSMENT

Prepared By:
Office of Environment
Alaska OCS Region



BOEM
Bureau of Ocean Energy Management
U.S. Department of the Interior
Bureau of Ocean Energy Management
Alaska OCS Region

April 2014

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Acronyms and Abbreviations

ADEC .....Alaska Department of Environmental Conservation
ADF&G .....Alaska Department of Fish and Game
BOEM .....Bureau of Ocean Energy Management
BOEMRE .....Bureau of Ocean Energy Management, Regulation and Enforcement
BPXA .....BP Exploration (Alaska) Inc.
CAA .....Conflict Avoidance Agreement
CEQ .....Council on Environmental Quality
CFR .....Code of Federal Regulations
CO .....carbon monoxide
CWA.....Clean Water Act
EA.....Environmental Assessment
EFH .....Essential Fish Habitat
EIS.....Environmental Impact Statement
EP .....Exploration Plan
USEPA .....U.S. Environmental Protection Agency
ESA .....Endangered Species Act
FR.....Federal Register
LOA.....Letter of Authorization
MMS.....Minerals Management Service
NAAQS .....National Ambient Air Quality Standards
NEPA .....National Environmental Policy Act
NMFS.....National Marine Fisheries Service
NMML .....National Marine Mammal Laboratory
NO_2.....Nitrogen Dioxide
NOAA .....National Oceanic and Atmospheric Administration
NSB .....North Slope Borough
OCSLA.....Outer Continental Shelf Lands Act
OCS .....Outer Continental Shelf
PEA .....Programmatic Environmental Assessment
PM_{10}..... Coarse Particulate Matter
POC .....Plan of Cooperation
PSO.....Protected Species Observer
U.S.....United States of America
USDOC .....U.S. Department of Commerce
USDOI.....U.S. Department of the Interior
USFWS.....U.S. Fish and Wildlife Service
VOC .....Volatile Organic Compounds

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1.0 INTRODUCTION

On February 14, 2014, BP Exploration (Alaska), Inc. (BPXA), under 30 Code of Federal Regulations (CFR) 550.208, provided an Ancillary Activity Notice to the U.S. Department of the Interior, Bureau of Ocean Energy Management (BOEM) to complete a shallow geohazard survey in support of the Liberty Development in the Beaufort Sea during the open water season of 2014 (The Noticed Activities) (BPXA, 2014a). The Noticed Activities lie primarily in the Liberty Unit, but also includes portions of the Duck Island Unit as well as non-unit areas (Figure 1). Federal leases associated with the Noticed Activities are OCS-Y-1585 and OCS-Y-1650 (BPXA, 2014b).

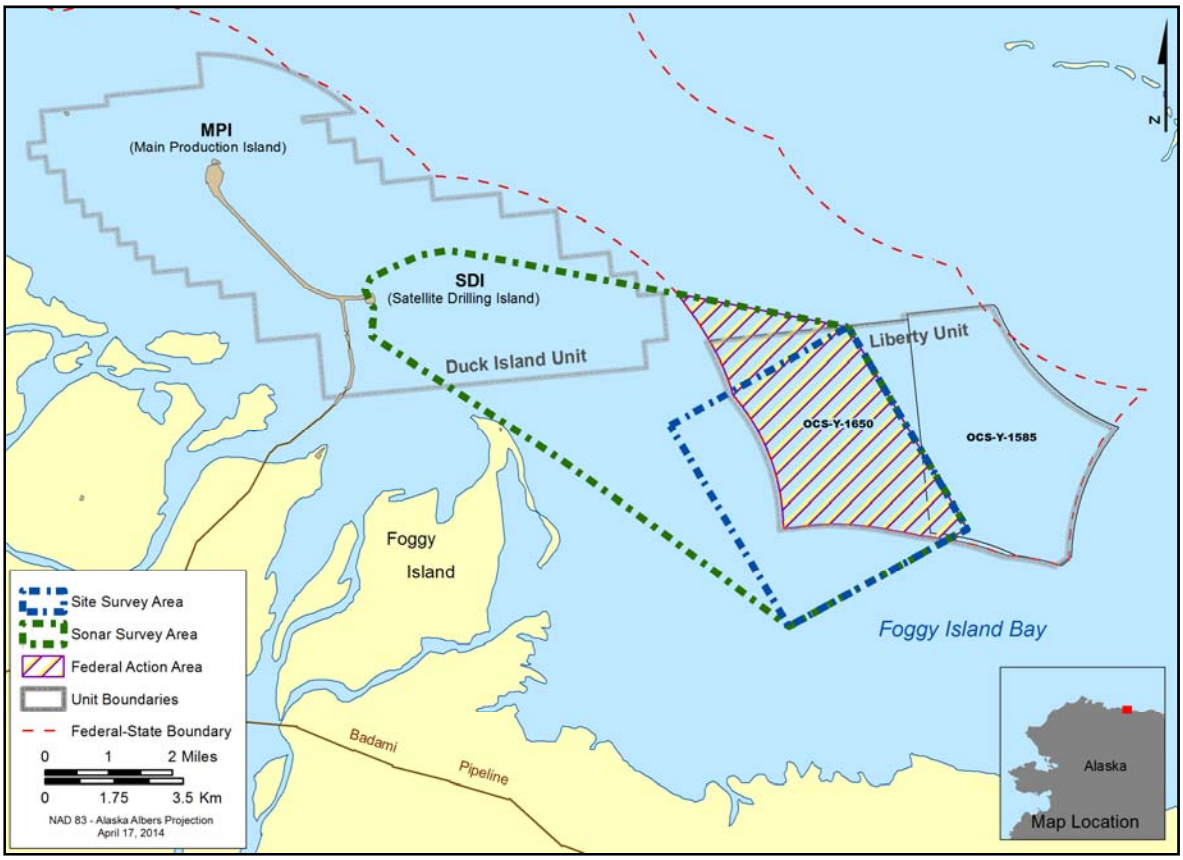

Figure 1. Noticed Activities Area. *The blue dashed line indicates the site (shallow geohazard) survey area. The green dashed line (which encompasses the site survey area) indicates the sonar survey area.*

1.1. Purpose of the Noticed Activities

The purpose of the Noticed Activities is to conduct a shallow geohazard survey and associated activities in support of the Liberty Development. BPXA intends to complete a site survey of the location of the planned gravel island (Site Location), with emphasis on obtaining two-dimensional high-resolution (2DHR) shallow geohazard data. This data would be collected with an airgun array and a towed streamer. In addition, BPXA intends to conduct a sonar survey of the Site Location and the planned pipeline location using a multibeam echosounder, sidescan sonar, subbottom profiler, and magnetometer. The need for the Noticed Activities is to evaluate the existence and location of archaeological resources and potential geologic hazards on the seafloor and in the shallow subsurface.

Per regulations at 30 CFR Part 550.207 these types of geophysical surveys are considered ancillary activities. A permit is not required from the Bureau of Ocean Energy Management (BOEM) for ancillary activities (30 CFR Part 550.105); however, prior to commencement of any work, the

operator is required to notify BOEM at least 30 days in advance of the planned surveys (30 CFR Part 550.208). Upon receipt of the requisite notice, BOEM reviews the notice to ensure that the ancillary activities comply with the regulations at 550.202(a), (b), (d), and (e).

BOEM has prepared this Environmental Assessment (EA) to aid in its determination of whether the Noticed Activities interfere with other uses of the OCS or cause undue or serious harm or damage to the human, marine, or coastal environment (30 CFR Part 550.2(d) and (e)).

1.2. Previous Applicable Analyses

BOEM has completed numerous environmental reviews of Beaufort Sea and Chukchi Sea OCS activities. The following EIS's and EA's are relevant to this analysis:

- Environmental Assessment, Liberty Development and Production Plan Ultra Extended Reach Drilling From Endicott - Satellite Drilling Island, (OCS EIS/EA MMS 2007-054) October 2007 (USDOI, MMS, 2007) (hereafter Liberty DPP UERD EA)
- Final Environmental Impact Statement, Beaufort Sea Planning Area Oil and Gas Lease Sales 186, 195 and 202—2003 (OCS EIS/EA MMS 2003-001) February 2003 (USDOI, MMS, 2003) (hereafter "Beaufort Sea Multiple-Sale EIS").
- Environmental Assessment - Shell Gulf of Mexico, Inc., 2012 Revised Outer Continental Shelf Lease Exploration Plan, Camden Bay, Beaufort Sea, Alaska. (OCS EIS/EA BOEM 2011-039) (USDOI, BOEMRE, 2011a) (hereafter "2012 Shell Camden Bay EP EA").
- Final Programmatic Environmental Assessment, Arctic Ocean Outer Continental Shelf, Seismic Surveys – 2006 (OCS EIS/EA MMS 2006-038) June 2006 (USDOI, MMS, 2006a) (hereafter "2006 Seismic PEA").

These documents above are available on the BOEM Alaska website at: http://www.boem.gov/ak-eis-ea/. This EA builds upon these previous analyses by analyzing site- and project-specific information, and by incorporating new information from recent scientific studies. The EA also considers information and analysis submitted by BPXA.

This EA considers and incorporates relevant data and issues raised during the public involvement period from March 7, 2014, through March 19, 2014. Further information is available at Section 4.3, Public Involvement.

2.0 ALTERNATIVES

2.1. Summary of Alternatives

This Environmental Assessment (EA) examines the following alternatives:

Alternative 1 - No Action. BPXA does not conduct ancillary activities in the Beaufort Sea during the open water season in 2014.

Alternative 2 – Noticed Activities. BPXA conducts the following types of surveys in offshore federal waters in the Beaufort Sea during the open water season in 2014:

- A Site Survey with an emphasis on obtaining two-dimensional high-resolution (2DHR) shallow geohazard data using an airgun array and a towed streamer.
- A Sonar Survey, using multibeam echosounder, sidescan sonar, subbottom profiler, and magnetometer over the Site Survey location and subsea pipeline corridor area.

2.2. Description of the Alternatives

2.2.1. Alternative 1 – No Action

Under the no action alternative, BPXA would not conduct the Noticed Activities during the 2014 open water season.

2.2.2. Alternative 2 – BPXA conducts a Site Survey and a Sonar Survey

BPXA plans to conduct the following types of surveys in offshore Federal waters in the Beaufort Sea during the open water season in 2014 (BPXA, 2014b):

- A 2DHR shallow geohazard survey using an airgun array and a towed streamer.
- A Sonar Survey using multibeam echosounder, sidescan sonar, subbottom profiler, and magnetometer.

The activities associated with this project include mobilization of equipment and personnel, equipment staging, testing airguns, and data acquisition and demobilization. The scope of work includes the acquisition of 2DHR seismic, multibeam echosounder, sidescan sonar, subbottom profiler, and magnetometer data in the Site Survey area. In the Sonar Survey area, multibeam echosounder, sidescan sonar, subbottom profiler, and magnetometer data will be acquired. Survey data shall be acquired, processed, and reported in accordance with all applicable requirements.

The surveys will be conducted within the portions of the Beaufort Sea indicated in Figure 1 between July 1 and October 31, 2014. The offshore ice gouge surveys and the site clearance and shallow hazards surveys will be conducted from the same survey vessel, the R/V *Thunder*.

Up to 3 airguns (each 2,000 psi) would be shot every 3-4 seconds for 24 hours/day during a total estimated 20 days of survey work. The planned total trackline would be 342 miles (550 km). The streamer (984 ft long (300 m)) would be towed at a depth of 3 feet (0.9 m) below the surface. In addition, a multibeam echosounder (200 - 400 kHz; ~220 dB re 1µPa @1 m), sidescan sonar (110 - 130 kHz, 390 - 410 kHz; ~215 dB re 1µPa @ 1 m), subbottom profiler (2 - 16 kHz; ~216 dB re 1µPa @ 1 m) and magnetometer would be employed during the project.

For more information on the Noticed Activities, refer to the "Liberty 2014 Shallow Geohazard Survey, Liberty Development, Beaufort Sea, Alaska" at: http://www.boem.gov/uploadedFiles/BOEM/About_BOEM/BOEM_Regions/Alaska_Region/Leasing_and_Plans/Plans/2014-02-14_BPXA_AAnotice_Liberty.pdf

Additional Information

BPXA has obtained a Letter of Authorization (LOA) from USFWS (hereafter "USFWS 2013 LOA") for take of small numbers of polar bears and Pacific walrus incidental to oil and gas activities associated with this project. BPXA has also applied to NMFS for authorization for the incidental take of marine mammals under the Marine Mammal Protection Act (MMPA) (BPXA, 2014c). Receipt of this authorization by BPXA before commencing seismic-survey activities would be required by BOEM. The mitigation and monitoring requirements in these incidental take authorizations (ITAs) will further ensure the Noticed Activities will affect only small numbers of marine mammals and have a negligible impact on the species or stock, and there will be no unmitigable impacts on the availability of these resources for subsistence use.

2.3. Mitigation and Monitoring of Marine and Coastal Birds

The following mitigation measures have been included in the design of the Noticed Activities to reduce any potential impacts to the localized avian populations and habitats:

1. Crew awareness training to avoid wildlife interactions; and
2. Vessel operators will maneuver to avoid high-density areas whenever possible.
3. BPXA is required to implement the following special conditions related to the 2012 Biological Opinion to avoid or minimize adverse effects to ESA-listed birds (spectacled eiders, Steller's eiders, and yellow-billed loons).
   a. BPXA will minimize the use of high-intensity work lights on their vessels, especially within the 20-m bathymetric contour. Exterior lights will only be used as necessary to illuminate active, on-deck work areas during periods of darkness or inclement weather; otherwise they will be turned off. Interior and navigation lights should remain on as needed for safety.
   b. All bird encounters on BPXA vessels are to be reported within 3 days to BSEE-Environmental Enforcement Division and BOEM-Leasing and Plans. Each report shall include the following items to be considered complete:
      - Date and Time the bird was first observed;
      - Location of vessel in decimal degrees (format: latitude XX.XXXX longitude -XXX.XXXX);
      - Species, identified to lowest possible taxonomic level using standardized AOU codes;
      - Weather (at time bird first observed): wind speed, fog, rain/snow;
      - General weather 24 hours prior to bird observation;
      - Photographs of each bird (if practicable). For dead birds, clear images of wing spread, top and bottom, and head views should be provided;
      - Vessel operational status: at anchor/adrift or underway/in transit;
      - Any indications that lighting may have factored into attracting birds to the vessel (e.g., was extra lighting on because it was dark or a specific activity was ongoing?); and
      - Any additional comments on bird behavior, physical description, injury or fate.

3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1. Expected Operating Conditions

3.1.1. Climate Change

The Council on Environmental Quality (CEQ), which oversees the implementation of the National Environmental Policy Act (NEPA), recognizes there may be potential health and environmental effects associated with emissions of greenhouse gases (GHG) and climate change. The Noticed Activities are located in the Beaufort Sea OCS of the Arctic region, which is of particular importance to global climate and especially sensitive to climate change. Appendix B, Section 2.6 discusses climate and climate change in the Arctic and how changes in Arctic climate may affect the natural resources evaluated in this environmental review.

3.1.2. Climate and Meteorology of the U.S. Arctic OCS

The BPXA Shallow Geohazard Survey would occur from July 1 through October 30, 2014, in Beaufort Sea OCS off the Alaska North Slope. The area is characterized as having a polar tundra climate according to the Köppen classification system, which is based on the amount of annual sunshine, distribution of land and water, ocean currents, prevailing winds, synoptic weather patterns, mountain barriers, and altitude (Ahrens, 2013). The land area adjacent to the Beaufort Sea is affected by most of these factors, including a sea-land interface, prevailing winds that are at least partially driven by the Brooks Range, and a semi-permanent synoptic weather pattern.

Surface Pressure Centers

During the summer months of ice-free water, the influence of maritime polar air masses is greatest and the ocean has a moderating influence resulting in higher temperatures in the winter and lower temperatures in the summer than compared to the inland areas of Alaska. This is due to the semi-permanent area of low pressure referred to as the Aleutian Low (Shulski & Wendler, 2007). The center is most intense in the winter, has little effect in the summer, but tends to intensify through autumn months and accounts for the drop in Prudhoe Bay's mean temperature in September (29.3°F (1.5°C)) as compared with August (36.7°F (2.6°C)). The temperatures at Prudhoe Bay drop off to a mean of just 10.8°F (11.8°C) in October.

Precipitation and Relative Humidity

While the annual precipitation is relatively low (4.04 inches (10.3 cm)), more than half of this amount will fall as rain over the months of July, August, and September, averaging 0.79 inches (.02 cm) per month (total of 2.37 (6.0 cm) inches for the three-month period).

Temperatures

The average mean temperature at Prudhoe Bay has risen over the last 30 years, as seen in the data recorded by the National Climatic Data Center (NCDC) and compiled by the Western Regional Climate Center (WRCC) during the period from 1981 through 2010, as compared with the same area throughout the period from 1971-2000 (WRCC, 2014a). As a result, the average mean high temperatures in Prudhoe Bay have increased by an average of 0.4°F (0.22°C) during the months of July to September, by an average of 1.0°F (0.56°C) on an annual basis; whereas the average mean low temperature in the same months has increased by an average of 1.6°F (0.89°C), and by 1.8°F (1.00°C) on an average annual basis. The average mean daily high temperature in Prudhoe Bay will be 47.4°F (8.56°C) throughout the months of the survey, and the average mean daily low temperature will be above freezing, 35.2°F (1.78°C).

Wind Velocity

A multiyear meteorological study that includes data from stations along the Beaufort Sea coastline at Barter Island, Kaktovik, Deadhorse, and Nuiqsut, Alaska, suggests the trend for wind patterns on the North Slope are influenced by the Brooks Range (Veltkamp and Wilcox, 2007). The study shows that regardless of whether the winds are from the east or west, the flow over the eastern portion of the Beaufort Sea coastline is influenced by the Brooks Range, which can affect wind direction as far as 30 miles (48.3 km) offshore along the area extending from Camden Bay to Mackenzie Bay. The incidence of wind channeling is strongest on the eastern coastline near Barter Island. Influence from the mountain range decreases to the west and shows little impact west of Barrow where wind direction in the Chukchi Sea is influenced more by surface pressure systems. Historical wind data is available for Deadhorse, Alaska, 15 miles (24.1 km) southeast of Prudhoe Bay, and was compiled by WRCC based on hourly wind data during the period from 1992 through 2002. The data indicates prevailing winds will occur from the east northeast during July, turning easterly with the approach of the autumn months (WRCC, 2014b). Wind speeds compiled from data collected at Barrow, Alaska, 197 miles (317 km) northwest of Prudhoe Bay, will average 12.4 mph (5.54 m/s), with occasional gusts averaging 43 mph (19.2 m/s).

Solar Radiation

A unique climate feature of the Alaska North Slope is the extreme seasonal variations in the amount of solar radiation (Shulski & Wendler, 2007). The sun will rise in Prudhoe Bay early on the morning of May 15, 2014, and will not set again until July 29, 2014. The survey will operate in 24-hour sunlight during July, 15 to 20 hours per day of sunlight in August, and 11 to 15 hours daily in September (U.S. Navy, 2014). While the summer days are in sunlight, the sun is low and near the horizon, and some of that sunlight is reflected by the snow and ice. Consequently summers are chilly, and when considering the effect of the wind, outside temperatures may drop to uncomfortable levels in the lower to middle twenties, Fahrenheit (–6.67 to –3.89°C). Given the occasional wind gusts detected in Barrow, wind chills could drop to around 10°F (–12.2°C).

3.1.3. Ice Conditions

This sea-ice description builds upon discussion in sections III.A.4 of the Sale 186, 195, 202 Final EIS and Section 2.4.6.1 of the Liberty DPP UER EA. Salient points from these documents are summarized as follows. There are three general forms of sea ice in the Noticed Activities Area:

- Landfast ice, which is attached to the shore, is relatively immobile, and extends to variable distances offshore;
- Stamukhi ice, which is grounded and ridged ice; and
- Pack ice, which includes first-year and multiyear ice and moves under the influence of winds and currents.

The Noticed Activities are planned for the Arctic summer “melt” and “open-water” season from July through October 2014. The planned survey covers portions of the landfast ice zone which generally becomes ice free from around June 22 to July 12 (Mahoney et al., 2012, Figure 4.3.6). Stamukhi ice is not anticipated in the Noticed Activities Area; however, pack ice could be pushed by wind into the area at any time during the period of operations.

The concentration of Arctic sea ice reaches its northern minimum in mid to late September. The Arctic sea ice begins growing southward again with the onset of freezing temperatures. In the Noticed Activities Area, the landfast ice begins forming in the last week of September in the lagoons and late September to early October in the nearshore region (Mahoney et al., 2012, Leidersdof, Scott, and Baudry, 2012). A weekly analysis of the National Ice Center sea ice data, from 2009 through 2012,

shows great variability year to year in sea ice coverage from July to October (Figure 2). Sea ice coverage in the survey area generally increases from south to north.

The predominant ice stages within the survey area in late September are thin first-year ice (30-70 cm (11.81-27.56 8 in)), new ice, and young ice (10-30 cm (3.94-11.81 in) in patches and small floes; however, multiyear ice floes can be blown by wind into the survey area at any time.

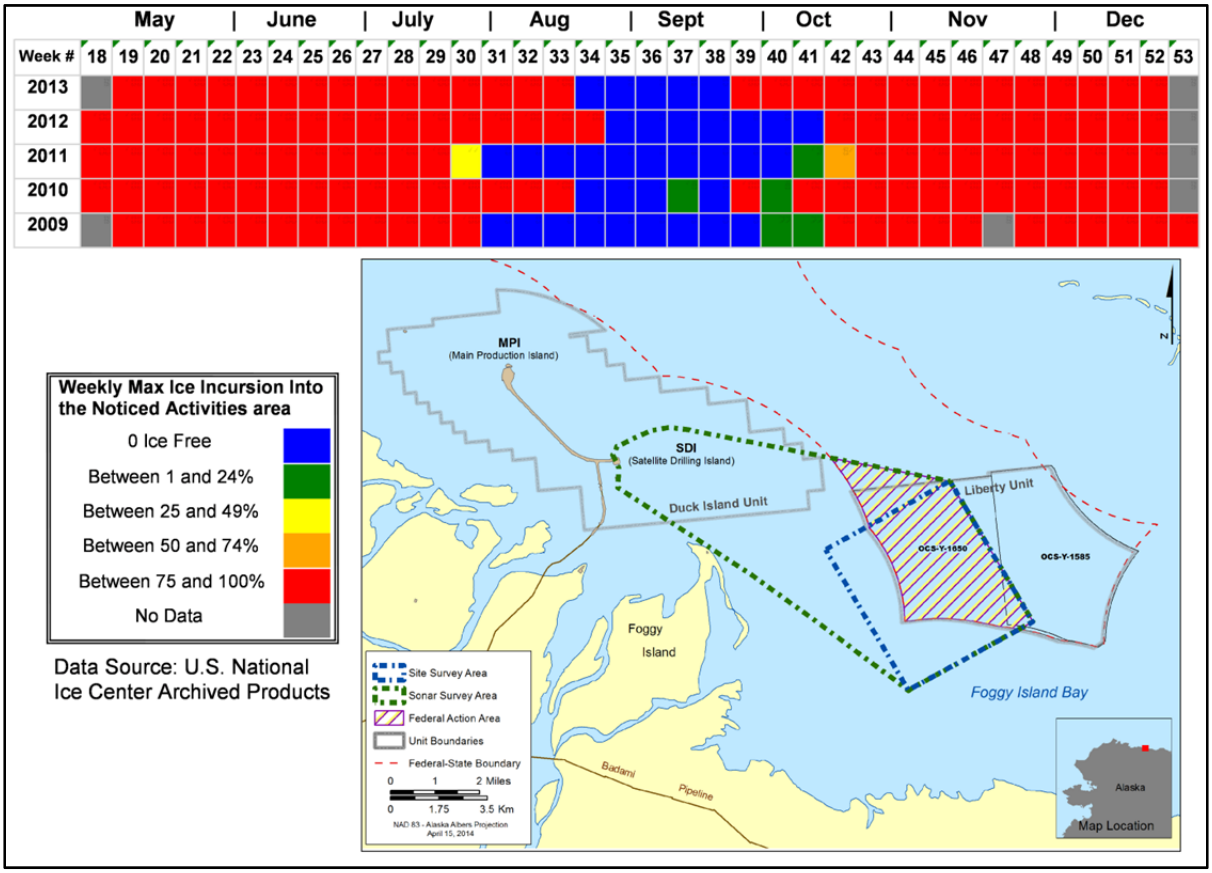

Figure 2. Weekly maximum percentage of ice incursion into any portion of the Noticed Activities Area.

3.1.4. Sea State

During the open-water season, wave heights are limited by the shallow waters adjacent to the coast and the shelter provided by the barrier islands. Westerly storms produce elevated water levels and easterly storms produce lower than normal water levels. Wave heights are generally less than 0.6 m (1.9 ft) and are up to approximately 2 m (6.6 ft) maximum (USDOI, MMS, 2007: p. 2–11).

3.1.5. Fuel Spills

- **Refueling.** It is reasonably foreseeable that an accidental small spill during refueling could occur during any project. Most spills (50-99.8%) are less than 10 gallons in volume (37.85 liters (L)) (ADEC, 2007; Anderson, Mayes and LaBelle, 2012; Etkin, 2009, NRC, 2003). The volume of potential at sea vessel transfer spills is estimated to range from <1 bbl up to 13 bbls. Previous NEPA analyses, such as those for Statoil (USDOI, BOEMRE, 2010a), ION (USDOI, BOEMRE, 2010b; USDOI, BOEM, 2012) and TGS (USDOI, BOEM, 2013), determined that a <1-13 bbl fuel spill would likely be localized and temporary.
- Initial fueling will occur in West Dock or Endicott (BPXA, 2014b, p.4). The vessel will be fueled from a shore based location (BPXA, 2014b, p.7). Fuel transfers will be conducted in

accordance with applicable regulatory requirements and meet BPXA's Fluid Transfer Procedure requirements per BPXA's approved Greater Prudhoe Bay and Endicott Oil Discharge Prevention and Contingency Plans. (BPXA, 2013).

- BPXA's fluid transfer procedure requirements are mitigation measures aimed at preventing a fuel transfer spill from occurring. BPXA fueling procedures include spill management practices such as drip pan placement under any vehicle parked; and placement of liners or pads under all valves or connections to diesel fuel tanks. If a diesel spill were to occur, oil spill response procedures and equipment are in place to respond quickly, thereby minimizing the volume spilled and its distribution. For these reasons, small fuel transfer spills are not further analyzed in this document.

3.2. Alternative 1 – No Action

3.2.1. Alternative 1 Direct and Indirect Effects

Under Alternative 1 – No Action, BPXA's Noticed Activities would not occur. BPXA would not conduct shallow geohazard surveys in support of the Liberty project in waters under Federal jurisdiction. This could result in delayed or lost opportunities to develop leases (OCS-Y-1585 and OCS-Y-1650), which would not meet the regulatory mandate of Outer Continental Shelf Lands Act (OCSLA) (43 USC 1332): "the outer Continental Shelf is a vital national resource reserve held by the Federal Government for the public, which should be made available for expeditious and orderly development, subject to environmental safeguards, in a manner which is consistent with the maintenance of competition and other national needs."

Under Alternative 1 –No Action, there would be no disturbance attributable to the Noticed Activities to any resources described in Section 3.0. There would then be no seismic survey effects on air or water quality, fish, lower trophic populations, marine and coastal birds, marine mammals, or subsistence resources.

3.2.2. Alternative 1 Cumulative Effects

The Arctic Ocean ecosystem is rapidly changing, with melting sea ice and increasing sediment input from numerous regional river systems. Activities currently ongoing in the U.S. Arctic region or which may occur in the foreseeable future and affect OCS resources include: increased marine vessel and air traffic, oil and gas exploration and development, fuel and petroleum spills, permitted and non-permitted discharges, long-distance aerosol-transported pollutants, climate warming, sea ice melting, ocean acidification, and risk of invasive species from ship hulls and deployed equipment. Specific activities known to be scheduled to occur during 2014 are summarized and included in Appendix B.

The 2006 Seismic PEA and the Beaufort Sea Multiple-Sale EIS provide detailed descriptions of past activities, reasonably foreseeable future activities, and the environmental consequences of these activities in the Beaufort Sea. If the Noticed Activities do not take place, no additional effects would be added to the effects associated with ongoing or reasonably foreseeable future activities in the Beaufort Sea.

3.3. Alternative 2 Affected Environment and Impacts

3.3.1. Air Quality

3.3.1.1. Affected Environment

The air quality in the vicinity of the Noticed Activities is very high. Healthful air quality in the vicinity of the Noticed Activities is largely a function of few emission sources existing on the coastline of the North Slope and meteorological conditions, mainly wind, over the open sea. The offshore waters of the Beaufort Sea typically experience steady winds averaging 12.4 mph (5.54 m/s)

and have periods of stronger winds, which have a tendency to disperse and mix air pollutants within the surrounding air. The stronger the wind, the more turbulent the air, and pollutants are diluted, which decreases pollutant concentrations and reduces the environmental impact both onshore and offshore (Ahrens, 2013). Thus, the wind conditions over the Noticed Activities Area together with the relatively few pollutant sources either onshore or offshore causes the quality of the air to be consistently better than required by Federal standards (ADEC, 2010).

3.3.1.2. Direct and Indirect Effects

The operation of diesel marine engines on the survey vessel, R/V *Thunder* would cause emissions of regulated air pollutants. A thorough examination of emission sources is included in Appendix C, Air Quality, and includes the inventory of projected emissions.

The emissions would occur primarily from operation of the main engines, propulsion engines, and generator sets aboard the ship. The survey would use equipment that is mobile, non-stationary, and is not expected to be used in one specific area for a long period of time. The engines and all equipment would be operated according to the manufacturer's recommended specifications.

The emissions analysis shows that the combination of emissions from the main engines, propulsion engines, and the generator sets would not cause emissions of any of the regulated pollutants to exceed 100 tons (90.72 metric tons) per year, indicating a negligible effect on air quality. Persistent moderate winds, and episodes of strong winds, which are typically found over the open waters of the Beaufort Sea, have a tendency to disperse and mix air pollutants within the surrounding air. The stronger winds cause greater turbulence in the air and greater dilution of pollutants which decreases pollutant concentrations and reduces the environmental impact (Ahrens, 2013). Likewise, due to the transitory and mobile nature of the emission sources expected for the Noticed Activities, pollutants emitted from the Noticed Activities would likely disperse rapidly. As such, they would be unlikely to build up in high concentrations. In light of the wind conditions over the Noticed Activities Area, the relative lack of onshore sources, together with the relatively low emissions caused by the Noticed Activities, the quality of the air over the affected area would remain better than required by Federal standards (ADEC, 2010). As such, the potential impacts on air quality would be negligible.

3.3.1.3. Cumulative Effects

Any additional activities occurring during the same time period and in the same general area requiring the use of marine vessels may contribute to the cumulative effects of air emissions from the Noticed Activities. A thorough description of cumulative operations on the Beaufort Sea OCS is provided in Appendix B, Section B-3, Impact Sources.

The 2011 Alaska Department of Environmental Conservation (ADEC) report, Emissions, Meteorological Data, and Air Pollutant Monitoring for Alaska's North Slope (Section 6, Ambient Monitoring on the North Slope), provides results from the most recent air quality monitoring on the North Slope using equipment installed by various sources. Monitors sponsored by the U.S. Environmental Protection Agency (USEPA) detect and record concentrations of pollutants at Prudhoe Bay, and have been doing so since 2010. A monitor sponsored by Shell is operating at Badami oil field, 35 miles east of Prudhoe Bay; and a monitor used by BPXA and Exxon Mobile is located at Endicott Island 2.5 miles offshore and 15 miles from Prudhoe Bay. Other monitors are located at Point Thomson, 60 miles east of Prudhoe Bay, and Nuiqsut, a city south-southeast of Harrison Bay. The data collected from the Shell and BP/Exxon Mobile monitors, and data from Point Thomson and Nuiqsut are included in the ADEC database in the 2011 report. The monitors detect and record impacts from onshore sources of emissions, as well as impacts from vessel traffic, if present, for the pollutants and averaging periods reported by each monitor.

More recent data is provided from the Badami, Edicott, and Point Thomson sites for 2009 and 2010. The monitored data reporting during the period from 2001 to 2005 at Nuiqsut showed ambient

concentrations below the National Ambient Air Quality Standards (NAAQS). The pollutant most commonly linked to vessel traffic and other combustion sources is nitrogen dioxide (NO_2). The Nuiqsut monitor shows average one hour average concentrations of NO_2 to be 76.0 micrograms per cubic meter ($\mu g/m^3$), 40.0 percent of the NAAQS, which is established at188 $\mu g/m^3$. The recorded data at the Badami and Endicott sites show an average concentration of 83.7 $\mu g/m^3$, or 44.5 percent of the NAAQS for the one hour concentration of NO_2; no data for the one-hour concentration of NO_2 was recorded.

The 24-hour average concentration of coarse particulate matter (PM_{10}) is 57.0 $\mu g/m^3$ at Nuiqsut, 38.0 percent of the NAAQS set at 150 $\mu g/m^3$. Badami and Edicott monitors report average 24-hour PM_{10} concentrations of 7.9 $\mu g/m^3$, or just 5.3 percent of the NAAQS. The ozone monitor at Point Thomson indicates the concentration is 39.1 percent of the NAAQS standard of 235 $\mu g/m^3$. Concentrations of carbon monoxide are less than 10 percent of the average eight-hour NAAQS and the other pollutants show even lower percentages. Consequently, when considering the wind conditions over the open sea and the transitory and mobile nature of the emission sources associated with the Noticed Activities, additional emissions from other operations in the Beaufort Sea and onshore appear to be well diluted and dispersed. Thus, based on the information currently available concerning the recent past, present, and foreseeable future projects in the Beaufort Sea, and considering the negligible to minor air quality effect of the Noticed Activities, only negligible to minor cumulative air quality impacts would be expected.

3.3.2. Water Quality

3.3.2.1. Affected Environment

Rivers and streams that flow into the Beaufort Sea contribute substantial freshwater to the marine system. This affects salinity, temperature and other aspects of water quality, which is particularly prominent in a band of water that runs along the seacoast. Spring melt and river runoff greatly influence the characteristics of the inshore and nearshore Beaufort Sea. This freshwater influx creates a band (2-10 km (1.24-6.21 mi) wide) of brackish waters along the coast that then diminishes in late summer due to decreased runoff and mixing by wind.

The Sagavanirktok River Delta channels cover a broad area adjacent to the southwest portion of the Noticed Activities Area. Spring melt and floods carry river plumes from the Sagavanirktok River under and on top of the riverine and sea ice. The Sagavanirktok River plumes have been detected through constituent monitoring as far as 15-20 km (9.32-12.43 km) north from the river mouth (Savoie, Trefry, and Trocine, 2008; Alkire et al., 2006; Trefry et al., 2006). The smaller watershed of the Kadleroshilik River and Shaviovik River flow into the Beaufort Sea adjacent to the southeast portion of the Noticed Activities Area.

Anthropogenic (human-generated) pollution in the Beaufort Sea is primarily related to: aerosol transport and deposition of pollutants (AMAP, 1997, 2004); pollutant transport into the region by sea ice, biota and currents (Chernyak, Rice, and McConnel,1996); discharges from international ship traffic; and effects from increasing carbon dioxide in the atmosphere. The greatest degree of ocean acidification worldwide is predicted to occur in the Arctic Ocean. This amplified scenario in the Arctic is due to the effects of increased freshwater input from melting ice and snow and increased carbon dioxide uptake by the sea as a result of sea ice retreat (Steinacher, et al, 2009).

Wind, currents and drifting sea ice play an important role in the long-range transport and redistribution of constituents and contaminants in the Beaufort Sea. Pollutants, such as polycyclic aromatic hydrocarbons (PAH) are introduced by human activities around the globe and ultimately affect the arctic. Pollution in the Arctic is described in “Arctic Pollution Issues: A State of the Arctic Environmental Report” (AMAP, 1997).

Several important scientific studies have contributed to the knowledge of water quality and seafloor surface sediment characteristics in the U.S. Beaufort Sea outer-continental shelf waters including: Dunton et al. (2005) and Dunton, Schonberg, and McTigue (2009), Trefry et al. (2003), Trefry and Trocine (2009), and Trefry et al. (2013).

Existing Regulatory Control of Discharges

At this time, the water quality of the Beaufort Sea is within the criteria for the protection of marine life according to the CWA, Section 403, and no waterbodies are identified as impaired in the Arctic Region by the State of Alaska Department of Environmental Conservation.

The primary regulation for controlling pollutant discharges into waters of the U.S. is the Clean Water Act (CWA) of 1972, as amended; Section 402 established the NPDES permit program. Accordingly, USEPA regulates discharges incidental to the normal operation of commercial vessels (greater than 79 feet (24.08 m) in length) through the NPDES Vessel General Permit (VGP), which was issued by USEPA in March 2013.

The RV *Thunder* is approximately 70 ft (21.34 m) long. Vessel general permits are not required for discharges (except for ballast water) from vessels less than 79 feet (24.08 m) in length that are classified for non-recreational uses. A moratorium for the requirement to obtain permit coverage for these smaller vessels expires December 18, 2014. In the interim, USEPA published a draft small Vessel General Permit (sVGP) in 2013 to provide for permit coverage for vessels less than 79 feet 24.08 m).

The latest information on water-quality standards for the USEPA is available in 40 CFR 131 *et seq* or at the agency's internet web site (www.epa.gov). State of Alaska water quality information is available in the most recent version of 18 AAC 70 or at the Alaska Department of Environmental Conservation website at http://dec.alaska.gov/water/index.htm (ADEC. 2014).

3.3.2.2. Direct and Indirect Effects

The Noticed Activities would occur in Foggy Island Bay and adjacent coastal area, at the West Dock, Endicott, East Dock, and road accessible gravel pads.

The Noticed Activities could affect water quality in the area through:

- Vessel discharges (permitted by USEPA under vessel permit);
- Wastewater discharge at camps (under State permit); and
- Staging activities on the shoreline.

The potential direct and indirect effects from these Noticed Activities on water quality include:

- Vessel Discharge: Temporary water quality degradation at localized sites due to non-fuel contaminants from seismic vessel discharge and deck runoff.
- Non-point Runoff: Temporary water quality degradation at localized sites due to physical disturbance and sediment runoff from activities (at docks, field camp, access roads, gravel pads).

The level of effects of the Noticed Activities during July through October, 2014, on water quality would be temporary and negligible. Depending on the specific activity, the effects would be localized (e.g. vessel discharge according to permit limitations) or dispersed (e.g. non-point runoff from gravel pads and access roads).

3.3.2.3. Cumulative Effects

Past activities in the region include exploration drilling, seismic surveys, and shipping traffic. Activities that are known to likely occur in the reasonably foreseeable future include additional

seismic surveys, geological surveys, and scientific research surveys (Appendix B). Overall, the cumulative effects of the Noticed Activities on water quality from past, current and reasonably foreseeable activities would be minor and localized.

3.3.3. Lower Trophic Levels

3.3.3.1. Affected Environment

Complete descriptions of the lower trophic biota are found in the Beaufort Sea Multiple-Sale EIS, Section III.B.1 (pp. III 29-30). Further information is found in the 2012 Shell Camden Bay EP EA, Section 3.2.3 (pp. 45-46). The following is a brief summary of the above references and new information regarding the lower trophic organisms and their environment.

The lower trophic organisms living within the Noticed Activities Area in Foggy Island Bay and near the Liberty Project in the Beaufort Sea of the Alaska OCS consist of three diverse and abundant groups (Hopcroft et al., 2008). These are the pelagic (organisms living in the water column), epontic (organisms living on or in ice), and benthic organisms organisms living on or in sediments at the ocean bottom). During the open water period, the epontic organisms (those living on or in the ice) are not abundant and therefore will not be discussed in this document.

The components of the pelagic communities are made primarily of two groups living at the surface and near-surface levels, the phytoplankton and zooplankton. Phytoplankton are the one-celled algae adapted to living in the photic zone (the areas of the ocean where enough light penetrates to allow growth and reproduction of phytoplankton) in the upper layers of the ocean surface (Steidinger and Garcces, 2006). Phytoplankton blooms (including concurrent zooplankton organisms) tend to occur in two separate events of early and late summer, generally from July to August, with density and duration dependent upon weather conditions and nutrient fluxes (Kirchman et al, 2009). Zooplankton consist of permanent residents of the planktonic mass such as copepods, and animals exhibiting complex life cycles that include a developmental stage within the plankton blooms. Examples include the larvae of fish, crustaceans, barnacles, polychaetes, and mollusks (Brusca and Brusca, 2002). The pelagic expanses between surface and benthic realms support diverse and abundant populations, including the larvaceans, pteropods, ctenophores, jellyfish, salps, squid, and other invertebrate organisms that contribute to the productivity of the region (Hopcroft et al., 2008).

Benthic organisms consist of both those groups living within the upper sedimentary matrix (infaunal organisms) and those living on or just above the benthic surface, or strongly associated with the benthic surface (epifaunal organisms). Offshore benthic communities can be diverse, but organisms commonly found in surveys include echinoderms, sipunculids, mollusks, polychaetes, copepods, and amphipods (Norcross, 2013; Dunton, Schonberg, and McTigue, 2009).

Most seafloor substrates on the Beaufort Sea OCS consist of aggregations of fine sands, muds, and silts, with percentages of substrate consisting of mud ranging from 17% to 84% (cANIMIDA, 2010; Trefry and Trocine, 2009). Limited extents of scattered cobblestone or pebbles may be found at shallower depths (Dunton, Schonberg, and McTigue, 2009). A focus on differences in communities based on physical factors is addressed in the BOEMRE-sponsored cANIMIDA studies on hydrocarbon chemistry and substrate composition (cANIMIDA, 2010), and the 2006 Final Seismic PEA. No known unique geological surface features or key reproductive sites exist in the area of the Noticed Activities. One unique area, the kelp beds collectively known as the Boulder Patch, is considered a unique biological community (Dunton, Schonberg, and McTigue, 2009).

3.3.3.2. Direct and Indirect Effects

Only towed arrays will be used in areas identified as Boulder Patch, therefore no benthic disturbances are expected.

No adverse effects from the Noticed Activities on lower trophic organisms are anticipated, due to the fact that the towed arrays will not be in contact with the benthic surface.

3.3.3.1. Cumulative Effects

If the Noticed Activities occur, no additional effects would be added to the effects associated with ongoing or reasonably foreseeable future activities in Foggy Island Bay and near the Liberty Project in the Noticed Activities Area.

3.3.4. Fish

3.3.4.1. Affected Environment

Spring melt and river runoff greatly influence the characteristics of the inshore and nearshore Beaufort Sea. This freshwater influx results in a band (2-10 km (1.24-6.21 mi) wide) of brackish waters along the coast that then breaks down in later summer due to decreased runoff and mixing by wind. This Beaufort Sea inshore habitat and the fish that depend on the band were examined by Craig (1984). He found that arctic cisco, least cisco and Arctic char were dominant species in the coastal Beaufort. In late summer, two marine species, Arctic cod and four-hour sculpin, moved nearshore as the salinity in the band increased.

Glass (1988) examined fish species in nearshore waters of the Central Beaufort Sea, including Foggy Island Bay and the Sagavanirktok River Delta. The dominant species found were arctic char, arctic cisco, least cisco, broad whitefish, fourhorn sculpin, and Arctic cod. Fish dispersed from overwintering river and inshore habitats during early summer to more offshore feeding grounds, and then returned to overwintering areas in late summer. Glass concludes that fish distribution varies between and within years due to wind, mixing, coastal and river plumes, and offshore marine water characteristics.

Jarvela and Thorsteinson (1999) studied the occurrence of epipelagic fish along the eastern Beaufort Sea coast up to 30 km (18.64) offshore. The study area stretched from the Colville River east to the U.S.-Canada boundary, including Foggy Island Bay. The most abundant epipelagic fish caught were Arctic cod, capelin and snailfishes. Surface water temperatures and salinities varied seasonally and interannually and this influenced the spatial and temporal distribution patterns of the fish species.

In the summer of 2008, a field survey of fish and benthic invertebrates of the Beaufort Sea was conducted by NOAA, University of Washington and University of Alaska (Logerwell et al., 2010; Rand and Logerwell, 2011; Logerwell, Rand, and Weingartner, 2011). They caught and identified 36 fish species. Arctic cod (*Boreogadus saida*) were the most abundant fish caught during the 2008 survey, both by weight and numbers. Fifteen species of smaller fish (eelpouts and sculpins) contributed a great number of fish to the total catch of the 2008 survey; however, they did not contribute much in terms of total biomass.

Based on the studies described above and other studies (Fruge et al. 1989; Thorsteinson, Jarvela and Hale, 1992), Table 1 presents a list of fish species most likely to occur in the Noticed Activities Area.

Table 1. Fish species most likely to occur in the Noticed Activities Area.

Common Name	Taxonomic Name
Arctic cod	*Boreogadus saida*
Arctic flounder	*Pleuronectes glacialis*
Saffron cod	*Eleginus gracilis*
Capelin	*Mallotus villosus*
Dolly Varden	*Salvelinus malma malma*

Common Name	Taxonomic Name
Arctic Char	*Salvelinus alpinus*
Fourhorn sculpin	*Myoxocephalus quadricornis*
Arctic cisco	*Coregonus autumnalis*
Least cisco	*Coregonus sardinella*
Humpback whitefish	*Coregonus pidschian*
Broad Whitefish	*Coregonus nasus*
Kelp Snailfish	*Liparis tunicatus*
Ninespine Stickleback	*Pungitius pungitius*
Pink salmon	*Oncorhynchus gorbuscha*
Chum salmon	*Oncorhynchus keta*

Pacific salmon adults and juveniles occur in the Beaufort marine and estuarine Essential Fish Habitat (EFH), however, their numbers are low compared to the Bering Sea. Primarily pink and chum salmon (*Oncorhynchus gorbuscha* and *O. keta*), have been captured in the Beaufort nearshore (Craig, 1984; Craig and Haldorson, 1986; Fechhelm and Griffiths, 2001; Fechhelm et al., 2009). As climate change occurs (ice reduction, warming waters) salmon are moving further north in greater numbers (Moss et al., 2009; Kondzela et al., 2009). According to the Anadromous Waters Catalog to date, pink and chum salmon have been documented as present in anadromous water bodies adjacent to the Noticed Activities Area (Table 2).

Arctic cod is widely distributed in the U.S. Arctic in the pelagic, demersal and nearshore environments. The absolute numbers of Arctic cod and their biomass is one of the highest of any finfish in the region (Logerwell et al., 2010, Logerwell, Rand, and Weingartner, 2011; Rand and Logerwell, 2011; Frost and Lowry, 1983). The abundance, wide distribution and the role in the food web of the Arctic cod in the Beaufort Sea make this species very important in the overall ecosystem of the U.S. Arctic region.

The various life stages of Arctic cod occur across a broad range of habitats. Commonly they are associated with sea ice, using it as forage habitat to feed on microorganisms on the underside and as shelter.

Table 2. Pink and chum salmon documented in anadromous waters near the Noticed Activities Area.

Anadromous Waters	Pink Salmon	Chum Salmon	Note
East Sagavanirktok Creek			Dolly Varden rearing, but salmon not documented to date
Sagavanirktok River,East Channel	present and spawning	present	
Shaviovik River	present and spawning		
Kadleroshilik River			Dolly Varden rearing, but salmon not documented to date.

Source: Alaska Department of Fish and Game (ADF&G, 2014).

The ongoing effects of climate change in the Arctic, such as warming sea temperatures and increased acidity, affect fish in many ways including changes in lower trophic food sources and changes in ice habitat extent and qualities (Hopcroft et al., 2006).

3.3.4.2. Direct and Indirect Effects

The Noticed Activities would occur in Foggy Island Bay and adjacent coastal area, at the West Dock, Endicott, East Dock, and road accessible gravel pads.

The Noticed Activities listed below during the open water season of 2014, (approximately July 15 through October 31, 2014), could affect fish in the Noticed Activities Area:

- Noise from survey methods (airgun discharge, multibeam echosounder, sidescan sonar, subbottom profiler, magnetometer);
- Vessel traffic throughout the Noticed Activities Area;
- Vessel discharges (permitted by USEPA under vessel permit);
- Wastewater discharge at camps (under state permit); and
- Staging activities at road-accessible gravel pads along the coast.

Noise: The potential direct and indirect effects from these Noticed Activities on fish species include Airgun Discharge, Sonar and Vessel Noise. Noise from ships, airgun shots, and sound from other survey methods could affect fish through interference with sensory orientation and navigation, decreased feeding efficiency, scattering of fish away from a food source and redistribution of fish schools and shoals (Fay, 2009; Radford et al., 2010; Simpson et al., 2010; Slabbekoorn, et al., 2010; Purser and Radford, 2011).

Pelagic species, such as capelin, Arctic cod, adult salmon, and similar species could startle and scatter as noise continues and, in theory, escape to a distance that receives reduced levels of sound. Adult Arctic cisco, least cisco, broad whitefish, and Dolly Varden, that are more obligated to migrate and feed along the coast in the seasonal band of water may not be as able to move from the area of seismic airguns.

Similarly, Arctic flounder that are in shallow waters in the summer and other nearshore benthic-obligated fish (such as sculpin species) may not be capable of escaping seismic exposure. Foraging and reproduction behaviors of benthic-obligate fish could be affected negatively by noise from the Noticed Activities. Fish eggs and fish larvae (such as Arctic cod young-of-year in summer) in the immediate area of airgun operations would have greater seismic exposure due to their limited swimming behaviors, and behavioral traits; morbidity or mortality of fish eggs and larvae in the Noticed Activities Area are expected to occur.

Vessel Discharge: Vessel discharges and deck runoff (limited by permit specifications) would cause temporary water quality degradation at localized sites and which could reduce visibility for visual-feeders and could expose fish in the immediate area to low-level contaminants.

Non-point Runoff: Temporary water quality degradation could occur at localized sites due to physical disturbance and sediment runoff from dock and shoreline activities. Nearshore fish would be affected by potential increase in suspended sediment (which could reduce visibility) and constituents in runoff which may contain contaminants.

Overall, the Noticed Activities would most affect coastwise-migratory anadromous fish (Arctic cisco, least cisco, broad whitefish, and Dolly Varden) and nearshore benthic obligate fish (particularly Arctic flounder and sculpin species).

The level of effects of the Noticed Activities (July through October, 2014) on fish would be temporary and negligible.

3.3.4.3. Cumulative Effects

Past activities in the region include exploration drilling, seismic surveys, and shipping traffic. Reasonably foreseeable future activities include additional seismic surveys, geological surveys, and scientific research surveys (Summarized in Appendix B). Overall, the cumulative effects of the Noticed Activities on fish from past, current and reasonably foreseeable activities would be minor in a regional context.

3.3.5. Marine and Coastal Birds

3.3.5.1. Affected Environment

Most marine birds that occur in the Beaufort Sea are there during the open-water season. Arrival times usually coincide with the formation of leads during spring migration to coastal breeding areas. Spring migration for most species takes place between late March and late May.

Some birds that breed on the North Slope migrate to or through the Noticed Activities Area (Figure 1) twice each year. Some marine and coastal birds may breed outside the Noticed Activities Area, but spend time in the Beaufort Sea after breeding or during their non-breeding seasons. Departure times from the Beaufort Sea for the fall and winter vary between species and often by sex within the same species, but most marine and coastal birds will have moved out of the Beaufort Sea by late October before the formation of sea ice.

Full descriptions of the most important marine and coastal bird species in the Beaufort Sea were provided in the Beaufort Sea Multiple-Sale EIS (USDOI, MMS, 2003) and the Lease Sale 193 Final SEIS (USDOI, BOEMRE, 2011b), Environmental Assessments for Lease Sales 195 and 202 (USDOI, MMS, 2004, 2006b), 2006 Seismic PEA (USDOI, MMS, 2006a), and the recent Biological Evaluation for the USFWS (USDOI, BOEMRE, 2011c). These descriptions are summarized and updated below. Existing information is sufficient to fully evaluate the potential effects of the two alternatives.

Descriptions of Species or Species Groups

Marine and coastal birds potentially affected by this action can be grouped according to certain aspects of their life-history or status: ESA-listed birds or those abundant in the Noticed Activities Area (Table 3). The timing and specific location of the Noticed Activities influence which birds could be affected. Birds listed as threatened or candidate (three species) or abundant in the Noticed Activities Area (five species) have the greatest potential for adverse effects and are described further.

Table 3. Marine and coastal birds most likely to be affected by the Noticed Activities.

Species	Threatened or candidate species	Abundant in Noticed Activities Area	Carried forward under effects analysis
ESA-Listed Species			
Spectacled Eider	Yes	No	Yes
Steller's Eider	Yes	No	Yes
Yellow-billed Loon	Yes	No	Yes
Abundant Species			
Long-tailed Duck	No	Yes	Yes
Common Eider	No	Yes	Yes
King Eider	No	Yes	Yes
Northern Fulmar	No	Yes	Yes
Short-tailed Shearwater	No	Yes	Yes

Sources: USDOI, MMS (2003, 2004, 2006a & b) and USDOI, BOEMRE (2011a & b).

ESA-listed Birds and Candidate Bird Species

The distribution, abundance, and legal status of birds designated as threatened or listed as candidate species under the ESA are most recently described in the ESA Section 7 Biological Opinion (USDOI, FWS, 2012). These include the Steller's eider (*Polysticta stelleri*; threatened), the spectacled eider (*Somateria fisheri*; threatened), and the yellow-billed loon (*Gavia adamsii*; candidate species) and are often collectively referred to as ESA-listed birds.

Spectacled Eider. The North Slope spectacled eider population seems to be stable, at least since the initiation of aerial surveys of the Arctic Coastal Plain (ACP) in 1992 (Larned, Stehn, and Platte, 2009). Spectacled eiders breed in low densities across the Alaskan ACP east to about the Shaviovik River. Males leave the breeding grounds along the ACP for the ocean around mid - to late June at the onset of incubation by female eiders. Males are followed by females whose nests fail, and finally by successful breeding females and young birds in August and September. Female spectacled eiders migrate west along the Alaska coast as far as 40 km (24.85 mi) offshore. Most spectacled eiders will have migrated from the Beaufort Sea by mid-October, although small numbers of spectacled eiders could be encountered in nearshore locations of the Beaufort Sea.

Steller's Eider. A small number of Steller's eiders breed on the ACP of Alaska, most conspicuously near Barrow. Steller's eiders are rare east of Barrow to the Prudhoe Bay area. They are even rarer as the season progresses due to molt migration, failed breeding, etc. As with the more common spectacled eider, these birds move to nearshore coastal waters after their breeding season. Few if any Steller's eiders would likely be in the southern Beaufort Sea during or after the open-water season.

Yellow-billed Loon. The yellow-billed loon is relatively rare in the U.S. Arctic region (North, 1994). Dau and Bollinger (2009) reported an average of fewer than 50 yellow-billed loons during late-June surveys of the coast and barrier islands between Omalik Lagoon and the Canadian Border (2005-2009). Of the approximately 3,300 yellow-billed loons present on the breeding grounds on the North Slope, primarily between the Meade and Colville Rivers in the National Petroleum Reserve-Alaska (NPR-A), it is likely that there are fewer than 1,000 nesting pairs because some of the 3,300 are nonbreeders. Additionally, there are approximately 1,500 yellow-billed loons (presumably juvenile nonbreeders) that remain in nearshore marine waters or in large rivers during the breeding season. In total, there are fewer than 5,000 yellow-billed loons on the Arctic coast breeding grounds and near shore marine habitat (Earnst et al., 2005). There may be approximately 1,500 yellow-billed loons, presumably non-breeding adults and immatures, in near shore marine waters or in large rivers during the breeding season. Yellow-billed loon numbers were thought to be declining (74 *FR* 12932, March 25, 2009), but the population is now considered stable (Stehn, Larned, and Platte, 2013).

Yellow-billed loons typically nest on low islands or narrow peninsulas on the edges of large, deep, tundra lakes. Breeding yellow-billed loons typically remain on their lakes until young are fledged.

Most yellow-billed loons from the ACP have moved into nearshore coastal waters by September. In addition, approximately 8,000 yellow-billed loons from the Canadian Arctic travel across the Chukchi Sea during spring and fall migration between Canada and wintering grounds in eastern Asia. Most loons stay very close to shore during fall migration until they reach the Lisburne Peninsula, where they head farther out to sea towards the Bering Strait (Rizzolo and Schmutz, 2010).

Low numbers, patchy distributions, and specific habitat requirements may make yellow-billed loons more susceptible to environmental perturbations such as disturbance, habitat alterations, and oil spills than species that are more abundant, widely distributed, and able to exploit a greater diversity of habitats.

Other Birds

Loons and Waterfowl. The Pacific loon (*Gavia pacifica*), red-throated loon (*G. stellata*), Pacific brant (*Branta bernicla nigricans*), lesser snow goose (*Chen caerulescens caerulescens*), greater white-fronted goose (*Anser albifrons frontalis*), and tundra swan (*Cygnus columbianus*) occur in nearshore coastal waters of the Beaufort Sea and Chukchi Sea (USDOI, MMS, 2003, 2007a; USDOI, BOEMRE, 2011a). Waterfowl species that are more abundant and occur in more offshore areas of the Beaufort Sea include the long-tailed duck (*Clangula hyemalis*), the common eider (*Somateria mollissima*), and the king eider (*Somateria spectabilis*) and are described below.

Long-Tailed Duck. The long-tailed duck population has decreased considerably since 1989, but it remains a common species in the Beaufort Sea during the open-water period (Mallek, Platte, and Stehn, 2007). Many long-tailed ducks molt in the lagoons along the Beaufort Sea coast. In late June and early July, most male and nonbreeding female long-tailed ducks migrate to coastal molting areas where they are flightless for a 3- to 4-week period. Breeding females molt on freshwater lakes during the last phases of duckling development before departing the North Slope in fall. While most long-tailed ducks migrate within 45 km (28 mi) of shore, infrequent observations of long-tailed ducks in pelagic waters occur in late September (Divoky, 1987).

The molt is an energetically costly time, and long-tailed ducks have abundant food resources in the shallow water lagoons (Flint et al., 2003). During the molt, long-tailed ducks tend to stay in or near the lagoons, especially near passes between lagoons and the open ocean (Johnson, Frost, and Lowry, 1992; Johnson, Wiggins, and Wainwright, 1992; Kinney, 1985).

Molting long-tailed ducks tend to stay in or near the lagoons, feeding heavily in passes between barrier islands. Aerial surveys along coastal habitats of the entire ACP typically observe fewer than 7,500 long-tailed ducks, with about two-thirds of these associated with mainland habitats (Dau and Bollinger, 2009).

Common Eider. Common eiders nest on barrier islands or spits along the Beaufort Sea coast. Dau and Larned (2005) observed 1,819 common eiders along the Beaufort Sea coast with 652 on barrier islands and 1,167 on the mainland. Dau and Larned (2007) observed a total of 1,936 common eiders. Of these, 871 were along the Beaufort Sea coast with 423 along the barrier islands and 448 along the mainland. The highest concentrations were on survey segments on both sides of Kaktovik. In 2007, total birds and indicated breeding pairs were down 37.6% and 44.0%, respectively, from 2006 counts of 3,102 birds and 1,207 pairs. Total birds and indicated breeding pairs in 2007 were down 30.0 and 27.8%, respectively, from the 1999-2006 averages of 2,766+885 (1 standard deviation, range 1,353-4,449) birds and 937+264 (1 standard deviation, range 572-1,340) pairs (Dau and Larned, 2007).

After the molt is completed, some common eiders move offshore into pelagic waters, but most eiders remain close to shore (Divoky, 1987). When traveling along the northwest coast of Alaska, these eiders tend to stay along the 20-m isobath, approximately 48 km (29 mi) from shore. Most males are out of the Beaufort Sea by late August or early September, and most females were gone by late October or early November. Most breeding female common eiders and their young begin to migrate to molt locations in late August and September.

The common eider population in the Beaufort Sea declined by 53% between 1976 and 1996 (Suydam et al., 2000). Common eiders were surveyed in marine waters within 100 km (62 mi) of the Beaufort Sea shoreline between Barrow and Demarcation Point by Fischer and Larned (2004) during summers in 1999-2001. In general, common eiders were concentrated in waters <10 m (<33 ft), with the highest densities occurring in segments between Oliktok Point and Prudhoe Bay and between Tigvariak Island and Brownlow Point. Common eiders were most commonly associated with barrier islands in these segments, becoming less commonly observed up to 50 km (31 mi) seaward. Common eider densities were highest in areas of low ice cover.

Fischer and Larned (2004) concluded that because eider densities did not vary between summer months, the eiders they observed near barrier islands were local breeders rather than molt or fall migrants. This is consistent with Petersen and Flint (2002), who showed that satellite-tagged common eider hens remained in shallow waters close to their breeding sites through September.

Male common eiders begin moving out of the Beaufort Sea beginning in late June. Most males are out by late August or early September, and most females were gone by late October or early November. Most common eiders migrate within 48 km (29.8 mi) of the coast when traveling west along the Beaufort Sea.

King Eider. Most king eiders begin to arrive in the Beaufort Sea by the middle of May. Arrival times in the Beaufort Sea are dependent upon the location and timing of offshore leads along the Chukchi Sea (Barry, 1986). Most king eiders nesting on the North Slope between Icy Cape and the western boundary of ANWR nested in three general areas: between the Colville River and Prudhoe Bay, southeast of Teshekpuk Lake and a large area near Atqasuk (Larned, Stehn, and Platte, 2009). Dau and Larned (2005, 2006, 2007, 2008) surveyed the Chukchi Sea and Beaufort Sea coastlines and found 810, 3,048, 1,621, and 2,227 king eiders in 2005, 2006, 2007, and 2008, respectively.

The king eider population in the Beaufort Sea appeared to remain stable between 1953 and 1976 but declined by 56% between 1976 and 1996 (Suydam et al., 2000). Fischer and Larned (2004) surveyed king eiders in marine waters within 100 km (62 mi) of the Beaufort Sea shoreline between Barrow and Demarcation Point during summers in 1999 and 2001. King eiders were the second most abundant species counted during the survey periods. King eider densities varied according to water depth, offshore distance, and percent of ice cover. Large flocks of king eiders concentrated in the mid-depth (10-20 m (([33-66 ft)) zone offshore of Barrow and Oliktok Point. In 1999 and 2000, these flocks were in waters >10 m (>33 ft) deep but were found in the shallow (<10 m (<33 ft)) and mid-depth zone in July 2001. King eiders were unique among species surveyed by occurring in higher densities in low (31%) and moderate (31-60%) ice cover (Fischer and Larned, 2004).

Satellite telemetry was used to determine that most king eiders spent more than 2 weeks staging offshore in the Beaufort Sea prior to fall migration (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 (8 mi) offshore; however, during migration to molting areas, king eiders occupied a wide area ranging from shoreline to >50 km (>31 mi) offshore (Phillips, 2005).

Seabirds

The common murre (*Uria aalge*), thick-billed murre (*U. lomvia*), tufted puffin (*Fratercula cirrhata*), horned puffin (*F. corniculata*), black-legged kittiwake (*Rissa tridactyla*), black guillemot (*Cepphus grylle*), Ross' gull (*Rhodostethia rosea*), ivory gull (*Pagophila eburnea*), Arctic tern (*Sterna paradisaea*), pomarine jaeger (*S. pomarinus*), parasitic jaeger (*S. parasiticus*), long-tailed jaeger (*S. longicaudus*), and glaucous gull (*Larus hyperboreus*) occur in the Chukchi Sea and Beaufort Sea (USDOI MMS (2003, 2007a); USDOI, BOEMRE (2011a). Species that nest at Cape Lisburne (i.e., murres, puffins, kittiwakes) are more concentrated in that area of the Chukchi during the open water season. Seabird species that are more abundant and occur in the Beaufort Sea include the northern fulmar (*Fulmarus glacialis*) and the short-tailed shearwater (*Puffinus tenuirostris*) and are described below.

Northern Fulmar. Fulmars do not breed in the Arctic region, and those observed during the summer are nonbreeders or failed breeders from southern areas. Fulmars are most numerous from late August to mid-September. Divoky (1987) estimated 45,000 northern fulmars in pelagic waters of the southern Chukchi Sea during late August to mid-September. Flocks totaling in the low hundreds were

observed during the late summer and early fall around the Klondike and Burger prospects during seabird surveys in 2008-2011 (Gall and Day, 2012). Similar distributions are anticipated to occur in the adjacent Beaufort Sea.

Short-Tailed Shearwater. Shearwaters do not breed in the Arctic region. These birds breed in the Southern Hemisphere. At northern latitudes, short-tailed shearwaters likely forage at highly productive patches of euphausiids and amphipods. Divoky (1987) reported short-tailed shearwaters north of Barrow and into Arctic Canada, depending on the presence of sea ice. In certain years, an estimated 100,000 short-tailed shearwaters passed Point Barrow in one day in mid-September (Divoky, 1987).

Gall and Day (2012) suggested that the shearwaters can rapidly respond to changes in oceanic conditions and exploit food resources when and where they are available. For example, Kuletz (2011) reported a single flock numbering over 15,000 short-tailed shearwaters in the western Beaufort Sea in late August–early September, 2011. Kuletz (2011) reported over 4,000 shearwaters during a seabird survey in the Chukchi Sea in late August – early September 2011 (the most abundant species reported), with many flocks numbering between 150-300 birds. These observations were consistent with those of Bankert (2012). Similarly, flocks totaling in the low hundreds were observed during the early fall around the Klondike, Burger, and Statoil prospects during seabird surveys in 2008-2011 (Gall and Day, 2012); however, during the early fall period in 2009, almost 12,000 short-tailed shearwaters were observed near the Klondike Prospect. Similar distributions are anticipated to occur in the adjacent Beaufort Sea.

3.3.5.2. Direct and Indirect Effects

Potential effects of the Propose Action on coastal and marine birds are summarized in categories of:

- Disturbance from the physical presence of vessels.
- Disturbance from noise by vessels or seismic airguns.
- Birds encountering vessels.

Vessel activity could disturb birds. Flocks of migrating or flightless birds would generally move away from vessel activity. There is an energetic cost to repeatedly moving away from vessel disturbances as well as a cost in terms of lost foraging opportunities or displacement to an area of lower prey availability. Seismic survey activity is expected to have localized disturbance effects on certain marine bird species that are distributed across the Noticed Activities Area. The more abundant species (long-tailed ducks, common and king eiders) would be affected more than ESA-listed species that are less common in the action area. Migrating birds would likely experience temporary impacts as they moved through the Noticed Activities Area. Molting birds could be disturbed repeatedly if they were unable to relocate (i.e., flightless) to another area when seismic operations were occurring.

During the course of normal feeding or escape behavior, some birds could conceivably be near enough to an airgun to be injured by a pulse. The reactions of birds to airgun noise suggest that a bird would have to be very close to the airgun to receive a pulse strong enough to cause injury, if that were possible at all. Injury to birds in offshore waters is expected to result in a negligible level of effect because birds are most likely to move away from slow-moving seismic vessels well in advance of the towed seismic-airgun array. Flightless birds at sea remain capable of slowly moving away from disturbances.

Mitigation measures 1and 2 of Section 2.2.3 could minimize adverse effects to marine and coastal birds.

Seabirds, attracted to lights and vessels in nearshore waters, could collide with a vessel and be injured or killed. Marine and coastal birds could be disoriented by storms or collide with vessels during inclement weather (e.g., fog, rain) or darkness. Vessels operating in marine environments often

encounter passerines and shorebirds species during when the birds are migrating. In 2012, Shell Gulf of Mexico, Inc. and Shell Offshore, Inc. (collectively referred to as Shell) conducted an exploration drilling program in the Chukchi and Beaufort seas. Shell reported that at least 131 birds were observed on their drilling units and support vessels, 83 of which were dead. In some cases, it appeared that some birds sought refuge on a vessel in inclement weather and used it to rest and continue migration. In other cases, exhausted birds alighted on a vessel, but did not survive. Some injuries and mortalities, however, strongly indicated birds collided with vessel structures and died or later succumbed to injuries. Industry reported 18 bird/vessel encounters during the 2013 open-water season, with a much reduced number of vessels in operation.

Based on the 2012 Shell bird encounter reports, BPXA could experience up to 7 (1 vessel, 7 encounters per vessel per season) bird encounters over their operational period; this is a conservative estimate and not all encounters would be expected to be fatal. On average, shearwaters, auklets and passerines would be the most frequent species groups anticipated to be reported, but as the BPXA vessel would operate much closer to shore than the Shell fleet did, especially later in the open-water season, a larger proportion of seaducks and passerines would be expected. The number of bird:vessel encounters/strikes affecting a broad diversity of species over a season would not be expected to affect any particular bird population. The level of bird mortality from vessel collisions for most species would be considered a minor level of effect.

While no listed eiders or yellow-billed loons were documented by Shell to interact with their vessels, king and common eiders and a grebe were reported. These reports suggest that it is possible listed spectacled or Steller's eiders or a loon could be involved in future vessel encounters. BPXA would work primarily in areas nearer to shore where ESA-listed bird densities are typically higher. While unlikely and not reasonably expected to occur, an eider or yellow-billed loon killed striking a BPXA vessel would not be considered a significant effect because these species populations appear stable and the loss of an eider or loon could be recovered in a generation.

This assessment is predicated on implementation of specific Mitigation Measures in Section 2.2.3. BPXA must report specific information to BOEM on all birds found on their vessels within specified timeframes. This reporting is intended to allow BOEM (and USFWS) to monitor the incidental take under the Endangered Species Act and to review or modify ongoing BPXA operations if large numbers of migratory birds or ESA-listed species are being harmed.

Overall, the Noticed Activities are expected to have a minor level of effect on marine and coastal birds.

3.3.5.3. Cumulative Effects

The level of effects for the Noticed Activities with respect to marine and coastal birds is minor. When considered in combination with other past, present, and reasonably foreseeable actions (Appendix B), effects on marine and coastal birds would remain minor. Past projects include seismic surveys and exploration drilling, but the effects of these projects were temporary and no longer impact marine and coastal birds. BPXA plans to conduct seismic activities west of the Endicott Causeway, but these activities would not overlap in space with the Noticed Activities. These activities would not combine to appreciably increase the level of effect on marine and coastal birds because the impact of the Noticed Activities is incrementally small.

3.3.6. Marine Mammals

3.3.6.1. Affected Environment

Bowhead whales, beluga whales, ringed seals, bearded seals, and spotted seals regularly occur in the Noticed Activities Area during the open water season. Less common marine mammal species include gray whales, polar bears, and Pacific walrus. Other marine mammal species are typically absent,

rarely documented, or non-existent in the Beaufort Sea. Only species that typically occur in the central Beaufort Sea will be described and analyzed further.

Bowhead Whale

The Western Arctic stock of bowhead whales are seasonal inhabitants of the Beaufort Sea during the open water season, with a current population estimate of 10,314, and an estimated 3.2% annual rate of increase (Allen and Angliss, 2013). During summer, bowhead whales concentrate near nutrient-rich upwellings around Barrow Canyon and the Mackenzie Shelf to feed on marine invertebrates, and small fish (Sheffield and George 2014; Moore, Clarke, and Ljungblad, 1989; Moore and Reeves, 1993; Moore, DeMaster, and Dayton, 2000; Moore et al., 2002). However individuals and smaller groups, particularly juveniles and postnatal females with calves may be observed feeding in sub-optimal habitat throughout the Beaufort Sea (Clarke et al., 2014). In September most bowheads leave the Beaufort Sea, traveling to the Chukchi Sea and then Bering Sea wintering areas (Moore et al., 1995).The Noticed Activities Area is in shallow waters where some bowhead whales are likely to feed, but south of the main fall bowhead whale migration route in the Beaufort Sea. Bowhead whales in the Western Arctic stock are listed as endangered under the ESA.

Beluga Whale

Portions of the Beaufort Sea (BSS) and the Eastern Chukchi Sea (ECS) stocks of beluga whales use the Beaufort Sea during summer, particularly areas over the outer continental shelf break which is well north of the Noticed Activities Area. Moore (2000) and Moore, DeMaster, and Dayton (2000) suggest belugas select deeper water near the continental shelf break to feed on fish, independent of ice cover. Both stocks use spring lead systems to migrate around western and northern Alaska during April and May (Richard, Martin, and Orr, 2001; Allen and Angliss, 2013) from their wintering areas in the Bering Sea. These stocks collectively number over 36,000 with stable or possibly downward trending population trajectories (Allen and Angliss, 2013), and few are likely to be in the Noticed Activities Area which is over relatively shallow water.

Gray Whale

Eastern Pacific gray whales are seasonal visitors to the Arctic Ocean, numbering approximately 18,017. Their arrival in the Arctic during late spring occurs after bowhead whales have migrated and most sea ice has receded. Gray whales mostly occur in coastal and shoal areas, and few are known to use the Beaufort Sea (Allen and Angliss, 2013). They primarily feed on shallow water benthic invertebrates, pelagic invertebrates, and small fishes which have limited distribution on the narrow continental shelf of the Beaufort Sea. Small numbers of gray whales have been documented in the Beaufort Sea; consequently, few gray whales should occur in the Noticed Activities Area.

Bearded Seal

Bearded seals in the Beaufort Sea are part of the Beringian Distinct Population Segment (BDPS) of the circumpolar bearded seal population (Allen and Angliss, 2013). Allen and Angliss (2013) provides a rough population estimate of 155,000 for the BDPS of bearded seals based on previous analyses of Cameron et al. (2010), which assigns a theoretical maximum annual net productivity rate of 12% for the BDPS. Though most BDPS bearded seals summer in the Chukchi Sea, a smaller number occupies the Beaufort Sea, feeding on benthic invertebrates and fishes (Burns, 1970; Stirling, Kingsley and Calvert, 1982; Stirling, 1997). Physiological limitations on their diving abilities restrict bearded seals to continental shelf waters ≤ 200 m (656 ft) deep and, though they are commonly observed by surveys in the Chukchi Sea, they are seen less frequently in the Beaufort Sea. Only a few should occur near the Noticed Activities Area. In 2012 the BDPS of bearded seals were listed as threatened under the ESA because of potential climate change effects on their sea ice habitat (77 *FR* 76740, December 28, 2012). Species listed as endangered or threatened under the ESA are, by default, also considered "depleted" under the MMPA.

Ringed Seal

The Arctic subspecies of ringed seal is the most abundant seal species in the U.S. Arctic and conservative population estimates exceed 1,000,000, with an estimated annual maximum theoretical net productivity rate of 12% (Kelly et al., 2010). During summer the resident population of ringed seals in the Beaufort Sea is supplemented by an influx of migrant ringed seals from the Bering and Chukchi Seas. Arctic ringed seals are dispersed in the open-water season, preferring water depths >20 m (66 ft) where they foraging on fishes and pelagic invertebrates, and during the open water season, they are the most commonly encountered seal and marine mammal species in the U.S. Arctic and are very likely to be observed in the Noticed Activities Area (Lowry, Frost, and Burns, 1980; Reeves, 1998; Moulton et al., 2002; Clarke et al., 2014). Species listed as endangered or threatened under the ESA are, by default, also considered "depleted" under the MMPA. In 2012 ringed seals were listed as threatened under the ESA, without designated critical habitat or a recovery plan (Kelly et al., 2010; Allen and Angliss, 2013; 77 *FR* 76705, December 28, 2012).

Spotted Seal

The Alaskan spotted seal stock inhabits the Bering, Chukchi, and Beaufort Seas. Habitation of the Chukchi and Beaufort Seas occurs seasonally during the open water season. Though recent estimates place spotted seal numbers at 141,479 in the eastern and central Bering Sea during winter with a theoretical net productivity rate of 12%, only a small fraction of this population is believed to use the Beaufort Sea (Allen and Angliss, 2013). Spotted seals in the Beaufort Sea have a few small haulout sites at Harrison Bay, Smith Bay, and a few other protected coastal areas. Spotted seals use such coastal haulouts for resting, molting, and whelping when they are not hunting pelagic fishes and invertebrates and have no suitable sea ice resting areas. Due to the low numbers of spotted seals in the Beaufort Sea few should occur in the Noticed Activities Area.

Polar Bear

Polar bears occur throughout the continental shelf of the Beaufort Sea. The Chukchi/ Bering Sea and the Southern Beaufort Sea populations of polar bears may occur within the Noticed Activities Area. During the open water season, a portion of the polar bear population remains onshore along the coastline or on the barrier islands. Some bears may be observed swimming between offshore ice and the shoreline or barrier islands.

Pacific Walrus

Pacific walrus occur during the open water season in very low numbers in the Beaufort Sea. Most sightings are west of Cape Halkett, but walrus have occasionally been observed as far east as Kaktovik (USDOI, MMS, 2003).

3.3.6.2. Direct and Indirect Effects

The potential effects from geophysical and geologic surveys on marine mammals in the Beaufort Sea have been evaluated in the 2006 Seismic PEA (USDOI, MMS, 2006a), Beaufort Sea Multiple-Sale EIS (USDOI, MMS, 2003), the National Marine Fisheries Service Incidental Harassment Authorization application (BPXA, 2014c) , the Programmatic Biological Opinion (NMFS, 2013) and are evaluated by BPXA in their Ancillary Activity Notice.

Potential effects of the noticed ancillary-survey activities on marine mammals are summarized in categories of:

- Disturbance from the physical presence of vessels;
- Disturbance from vessel noise;
- Disturbance from Airguns, Multibeam Echosounder. Sub-bottom Profiler. And Sidescan Sonar noise; and

- Vessels striking marine mammals.

Presence of Vessels

Generally, walruses and seals enter the water if approached too closely. PSOs and vessel crew would be on the constant look-out for marine mammals on ice or in the water and would avoid disturbing them with close approaches. Careful monitoring and avoidance procedures will minimize impacts to marine mammals from vessel disturbance.

Vessel Noise

Vessels have a transitory and short-term presence in any specific location. Marine mammals often avoid vessels operating in open water, including survey vessels (Richardson et al., 1995a; Richardson et al., 1995b). Vessels produce continuous low frequency noise at around 160 dB which is detectable by marine mammals at distances sufficient to allow a marine mammal to avoid operations.

In the case of whales or seals that do not avoid survey vessels the associated noise, operations procedures provided in the incidental harassment authorization application (BPXA, 2014c) would reduce or eliminate any potential effect on marine mammals in the area. BPXA requested an IHA from NMFS for these activities on February 11, 2014. Mitigation measures included in this application include reducing vessel speeds when in the presence of marine mammals and the use of PSOs to monitor a safety zone out to 180 and 190 dB during seismic operations. The IHA application details seismic array ramp up and power down procedures, protocol for PSO's during poor visibility conditions, and reporting requirements.

Airguns, Multibeam Echosounder, Sub-bottom Profiler, and Sidescan Sonar noise

Firing airgun arrays produce pulses of noise, typically in 8–14 second intervals, with most energy releasing within a narrow frequency range. PSOs would be on duty during periods of airgun operation to prevent airguns from discharging in close proximity to marine mammals. NMFS uses a 160 dB noise level standard to assess Level B harassment impacts, and estimates of incidental take by harassment. PSOs will monitor the identified exclusion zones according to procedures to be outlined in the incidental harassment authorizations to minimize incidental takes and ensure that the Noticed Activities will not have more than a negligible level of effect on marine mammals (BPXA, 2014c (IHA); USDOI, FWS, 2014).

If a marine mammal approaches to within the 180 dB (for whales) or 190 dB (for seals) exclusion zones of the survey, the airgun array would power down or shut down. BPXA has committed to grant PSOs "authority and responsibility to call for immediate power down (or shutdown) of airgun operations" before a marine mammal enters the exclusion zone (BPXA, 2014d, p. 43). Shut downs are seldom required, as power downs reduce the size of the exclusion zone and most marine mammals avoid seismic operations.

Table 4. Source characteristics of geophysical and seismic survey equipment for the planned Liberty geohazard survey.

Equipment	Operating Frequency	Along Track Beam Width	Across Track Beam Width	Source Level
Multibeam echosounder	200-400 kHz	1-2	0.5-1	220 dB re 1µPa@1m
Sidescan Sonar	120-135 kHz	1.5	50	215 dB re 1µPa@1m
	400-450 kHz	0.4	50	215 dB re 1µPa@1m
Subbottom Profiler	2-16 kHz	15-24	15-24	216 dB re 1µPa@1m
30 in3 airgun array Option 1	20-300 Hz	--	--	240 dB re 1µPa@1m
30 in3 airgun array Option 2	20-300 Hz	--	--	237 dB re 1µPa@1m

Source: Data taken from BPXA 2014 Incidental Harassment Authorization Request (BPXA, 2014c)

The sidescan sonar and multibeam echosounder use very narrow beam widths and frequency bands in the high frequency range. With the exception of beluga whales, marine mammals in the Beaufort Sea hear and vocalize in the low frequency bands. Consequently, the noise produced by sidescan sonars and multibeam echosounders should remain inaudible to marine mammals in the vicinity of the Noticed Activities. Beluga whales hear/vocalize in the range of 0.15 kHZ to 160 kHz. The would be unable to hear the echosounder (200-450 kHz), but could be disturbed by the sidescan sonar (120-135 kHz; 400-450kHz). The narrow beam width and downward orientation of those beams (Table 4) should reduce the likelihood of affecting marine mammals, including beluga whales, because of the short distance between the noise source and the sea floor.

Table 5. Auditory bandwidth range for Beaufort Sea marine mammal species.

Species	Underwater Auditory Bandwidth
Bowhead Whale	20 Hz – 5 kHz
Gray Whale	7 Hz – 22 kHz
Beluga Whale	150 Hz – 160 kHz
Bearded Seal	75 Hz – 75 kHz
Ringed Seal	75 Hz – 75 kHz
Spotted Seal	75 Hz – 75 kHz
Pacific Walrus	75 Hz – 75 kHz
Polar Bear	14- Hz – 25+ kHz

Source: Data taken from Southall et al. (2007).

Southall et al. (2007) finds that the noise produced by subbottom profiler use lies within the frequency range used by marine mammals occurring in the Noticed Activities Area (Table 5). However the narrow beam width and orientation of the subbottom profiler and the inclusion of PSOs and mitigations in this project should prevent any adverse effects to marine mammals.

Furthermore, noise-producing equipment (Table 4) would operate for brief segments of the Noticed Activities, limiting the potential to affect marine mammals.

Collisions.

The absence of collisions involving industry vessels and marine mammals in the Arctic over decades of spatial and temporal overlap suggests the probability of such an incident is remote (NMFS, 2013). A collision between a seismic vessel and a marine mammal is unlikely because seismic vessels move at speeds of around 5 kts, slowly alter their direction, and produce noise audible to marine mammals. The USFWS 2013 Letter of Authorization (LOA) (hereafter USFWS 2013 LOA) and the IHA application include mitigations intended to further prevent close proximity or adverse effects to marine mammals, including collisions with whales or pinnipeds. Pinnipeds are quick, agile swimmers who easily detect and avoid vessels, making the likelihood of a striking a seal or walrus remote. Though polar bears swim more slowly than pinnipeds or cetaceans, few are expected to be in the Noticed Activities Area concurrent with BPXA's Noticed Activities. Furthermore, polar bears are highly visible and swim with their heads exposed above the water line, which would allow vessels the opportunity to detect and easily avoid them. No vessel/marine mammal collisions are anticipated to occur during the Noticed Activities.

Species-Specific Effects

BPXA requested an IHA from NMFS for these activities on February 5, 2014 (BPXA, 2014c). Mitigation measures included in this application include reducing vessel speeds when in the presence of marine mammals and the use of PSOs to monitor a safety zone out to 180 and 190 dB during seismic operations. The IHA application also details BPXA commitments to seismic array ramp up and power down procedures, protocol for PSO's during poor visibility conditions, and reporting requirements.

Bowhead Whale.

The Noticed Activities would begin after most bowheads have migrated out of the Chukchi Sea and into the Beaufort Sea. Bowhead whales are responsive to noise in their environment, and their primary response to seismic surveys has been to avoid such operations, though responses have varied. The area of effects from operating airgun arrays often extends to 12 miles (19 km), as evidenced by bowhead whale behavior in the vicinity of operating airguns (Richardson et al. 1995b). The larger area of effects for operating airguns would act to divert most marine mammals away from an active seismic survey, long before the less intense vessel noise becomes a concern. In the absence of active airgun arrays, the mitigations and protocols described in the IHA application (if an IHA is subsequently issued) would reduce impacts to negligible levels of effect. Moreover in the periods of the survey when airguns would not be used, bowhead whales would be able to detect vessels and the other operating equipment well in advance of adverse impacts occurring.

Monitoring and operational procedures as identified in the NMFS 2013 Biological Opinion (BO) (NMFS, 2013) and those described in the IHA application would reduce the potential for adverse impacts, including disturbance from vessel presence, vessel noise, airgun noise, multibeam echosounders, sidescan sonar, subbottom profilers, or collisions to a negligible level of effect on bowhead whales.

Beluga Whale.

Some belugas in the Beaufort Sea could be encountered during the Noticed Activities. The main fall migration corridor of beluga whales is ~100+ km (62 mi) north of the coast and few are observed near the Noticed Activities Area. Research has shown belugas may temporarily be displaced by seismic noise (Erbe and Farmer, 2000) with some possible increased energetic costs. However, belugas associate with sea ice and waters near the continental shelf break, both of which lie north of the Noticed Activities Area. Belugas in the vicinity of ancillary activities should be few in number and would be affected in a manner similar to bowhead whales. Mitigation, monitoring and operational procedures identified in the IHA application would reduce adverse impacts, including disturbance from vessel presence, vessel noise, airgun noise, multibeam echosounders, sidescan sonar, subbottom profilers, or collisions to a negligible level of effect on beluga whales.

Gray Whale.

Gray whales feed widely across the continental shelf waters of the Chukchi Sea but a few venture into the Beaufort Sea. They are most commonly observed in shallow, nearshore areas feeding on benthic species. Primary concentration areas occur along in coastal areas, particularly protected waters and bays, and near the Barrow Canyon upwelling. Gray whales would be affected in a manner consistent with that described for bowhead whales (above). Few gray whales are expected to be encountered in the Beaufort Sea.

Monitoring and operational procedures identified in the IHA application would reduce the potential for adverse impacts, including disturbance from vessel presence, vessel noise, airgun noise, multibeam echosounders, sidescan sonar, subbottom profilers, or collisions to a negligible level of effect on gray whales.

Bearded Seal.

Bearded seals occur in the Noticed Activities Area and a few individuals could be encountered during the Noticed Activities. Past observations indicate that effects from the Noticed Activities would amount to displacing bearded seals, though based on previous observations made during Ancillary Activities conducted in the Beaufort Sea, fewer than 50 bearded seals are anticipated to be observed. Typically, Industry surveys noted bearded seal often responded to vessels by sticking their heads out of the water to watch vessels passing (spyhopping) (Funk et al., 2010; Blees et al., 2010; Brueggeman

et al., 2009). NMFS uses the 160dB and 190 dB sound source level standards to respectively assess Level B and Level A harassment or potential injury levels to ice seals. NMFS (2013) suggested bearded seals mostly remain unaffected by noises up to 189 dB in intensity, implying injuries could occur when noise levels equal or exceed 190 dB (as far as 180–600 m (590–1968 ft) from the airguns).

Mitigation, monitoring and operational procedures identified in the NMFS 2013 BO and IHA application should reduce adverse impacts, including disturbance from vessel presence, vessel noise, airgun noise, multibeam echosounders, sidescan sonar, subbottom profilers, or collisions to a negligible level of effect on bearded seals.

Ringed Seal.

Ringed seals should be the most commonly encountered marine mammal during the Noticed Activities. Impacts to ringed seals should amount to brief disturbance or displacement, similar to bearded seals. Mitigation, monitoring and operational procedures identified in the NMFS 2013 BO and BPXA 2014 IHA application should reduce adverse impacts, including disturbance from vessel presence, vessel noise, airgun noise, multibeam echosounders, sidescan sonar, subbottom profilers, or collisions to a negligible level of effect on ringed seals.

Spotted Seal.

Few spotted seals would be encountered by the Noticed Activities and impacts to spotted seals should be similar to those described for bearded and ringed seals. Mitigation, monitoring and operational procedures identified in the IHA application would reduce adverse impacts, including disturbance from vessel presence, vessel noise, airgun noise, multibeam echosounders, sidescan sonar, subbottom profilers, or collisions to a negligible level of effect on spotted seals.

Polar Bear.

Seismic operations are planned for the open water season when there is less than 10% ice cover in the survey area and polar bears encountered by the Noticed Activities would likely be swimming in open water. Polar bears swim with their heads above water, making them less susceptible to impacts from seismic airguns and other survey equipment. Previous monitoring efforts for similar projects have shown that ships traversing open water encounter few polar bears. Disturbances created by the presence and noise of seismic survey ships are brief and would have negligible effects on polar bears.

Mitigation, monitoring and operational procedures identified in the USFWS 2012 BO (USDOI, FWS, 2012) and USFWS 2013 LOA (USDOI, FWS, 2013) would reduce adverse impacts, including disturbance from vessel presence, vessel noise, airgun noise, multibeam echosounders, sidescan sonar, subbottom profilers, or collisions to a negligible level of effect on polar bears.

Pacific Walrus.

Vessel traffic could disturb walruses at sea and may alter walrus movements or foraging activity by briefly displacing animals if vessels pass through an area. Repeated disturbances from vessels could incur energetic costs for walruses and might separate walrus calves from cows. Pacific walruses are scarce in the Beaufort Sea and few walruses could be affected. Disturbance effects would amount to brief deflections from vessels and ancillary activities.

Mitigation, monitoring and operational procedures identified in the USFWS 2013 LOA would reduce adverse impacts, including disturbance from vessel presence, vessel noise, airgun noise, multibeam echosounders, sidescan sonar, subbottom profilers, or collisions to a negligible level of effect on walruses.

3.3.6.3. Cumulative Effects

Appendix B identifies other activities that could overlap in space and time with the Noticed Activities. The vessel associated with the Noticed Activities would not measurably add to the existing impacts of vessel traffic on marine mammals in the Beaufort Sea.

A few activities may occur concurrently with the Noticed Activities in the Beaufort Sea. A TGS survey is being contemplated for deeper waters north of Barrow Canyon, far to the west of the Noticed Activities, while SAE and BPXA are conducting smaller seismic surveys in the vicinity of the Noticed Activities and in Harrison Bay to the west of the Noticed Activities. Collectively, airgun operations from the Noticed Activities would not appreciably raise the overall level of effects to marine mammals from seismic noise beyond negligible because the effects remain centered on the moving vessel, and would only last for a few weeks. Likewise, the other components of the Noticed Activities involve noise-producing equipment that has an extremely low likelihood of affecting marine mammals, and only for brief periods of time. Consequently noise effects would remain localized and would not persist beyond the period of BPXA ancillary operations. Likewise vessel traffic and noise levels have produced negligible cumulative effects on marine mammals in the Beaufort Sea, and no records of vessel -marine mammal collisions exist.

Effects of climate change in the Beaufort Sea include loss of sea ice habitat for resting and foraging for polar bears, walrus, and ice seals. However, the Noticed Activities has no clear causal link to climate change.

The Noticed Activities are not expected to appreciably add to the cumulative effects of climate change, airgun noise, multibeam echosounder noise, sidescan sonar noise, subbottom profiler noise, vessel noise, vessel traffic, or collision risk to marine mammals in the Beaufort Sea.

3.3.7. Subsistence, Environmental Justice, Public Health, and Economic Resources

3.3.7.1. Affected Environment

Subsistence Activities

Subsistence activities are of high cultural and social value to Iñupiat of the North Slope. Subsistence activities provide a sense of identity and are an important economic pursuit. Subsistence is viewed by Alaska Natives not just as an activity that is embedded in the culture; it is viewed as the very culture itself (Wheeler and Thornton, 2005). Because subsistence has such an important role in culture and society, a reduction (or even a perceived reduction) in the availability of subsistence foods impacts food security and contributes to social pathologies such as crime, mental health issues, and increasing social disorganization. (Wernham, 2007). Harvesting practice studies have indicated that NSB communities have an annual harvest of between 153.2 to 665.3 pounds (69.6 to 301.8 kg) per person (Einarsson et al., 2004). Bowhead whales are a subsistence resource paramount the social and cultural organization of North Slope Communities. This cultural relevance of subsistence hunting and resources dominates subsistence discourse in North Slope Iñupiat Eskimo communities (USDOI, BOEMRE, 2011a). Subsistence harvests provide dietary variety and nutrition along with providing long-term, sustainable nutritional needs to when few or no bowhead whales are taken during the hunting season (USDOI, BOEMRE, 2011a).

Nuiqsut and Kaktovik subsistence resources and harvest periods followed by descriptions of each affected resource upon which the community depends will be described in upcoming sections of this report.

Subsistence Communities and Resources: Nuiqsut and Kaktovik

Communities

Nuiqsut. Nuiqsut is a coastal community 17 miles inland from the Beaufort Sea coast along the western shore of the Colville River along the Nigliq Channel. Thetis Island and Cross Island, from which Nuiqsut hunters base their seal, eider, and bowhead whaling activities, respectively, are located to the northeast. The Noticed Activities Area is located 73 miles west of Nuiqsut and will occur from July through October, 2014. Nuiqsut's subsistence harvest areas are depicted in detail in MMS OCS Study 2009-003, Subsistence Mapping of Nuiqsut, Kaktovik, and Barrow (SRB&A, 2010: Maps 131-136). Subsistence resources taken throughout the year are relied on to provide a substantial portion of the Nuiqsut subsistence diet (SRB&A, 2010).

Nuiqsut residents utilize marine and terrestrial environments for harvesting subsistence resources. Subsistence resources extend over a large area between Barrow and Atqasuk to the west, Kaktovik to the east, and have occurred offshore over 50 miles (SRB&A, 2010). Summer subsistence hunts begin in July, with some hunts as early as May, increasing in June, and continuing through September (SRB&A, 2010).

Camps and cabins are located along the Colville River Delta. Use of these camps and cabins are important in allowing residents access to resource areas when conducting subsistence activities. There are many camps or cabins located on Cross Island and used in the harvesting of resources (SRB&A, 2010).

Kaktovik. Kaktovik is located on Barter Island just off the Beaufort Sea coast approximately 120 miles east of Prudhoe Bay and 90 miles west of the Canadian border just north of the Arctic National Wildlife Refuge (ANWR). Kaktovik residents utilize both marine and terrestrial subsistence resources throughout the year and these resources comprise a major portion of the Kaktovik subsistence diet (SRB&A, 2010). The Noticed Activities Area is more than 90 miles west of Kaktovik. Kaktovik's subsistence harvest areas are depicted in detail in MMS OCS Study 2009-003, Subsistence Mapping of Nuiqsut, Kaktovik, and Barrow (SRB&A, 2010: Maps 131-136).

Subsistence Resources: Nuiqsut and Kaktovik

Bowhead Whale (*aġviq*)

Nuiqsut. Bowhead whaling in Nuiqsut occurs around late August through mid-October. In 2008 Cross Island bowhead whale hunting began earlier in the season with the first crew arriving on August 29 and since this time the season has continued to begin earlier. Monitoring of bowhead whales and related harvesting activities from 2001-2008 indicates the majority of bowhead whales harvested by Nuiqsut have been in the northeast quadrant off Cross Island (Applied Sociocultural Research, 2012; USDOI, BOEMRE, 2011a; SRB&A, 2010: Maps 113 and 114).

Kaktovik. Kaktovik bowhead whale hunters travel between Camden Bay to the west, Nuvagapak Lagoon to the east, and up to approximately 50 miles from Kaktovik in search of bowhead whales July through October. Primary harvest is during September, when the ocean is ice-free (SRB&A, 2010). Bowhead whale hunting occurs up to approximately 25 miles from shore, between Arey Island and Tapkaurak Lagoon. Hunters generally stay within 15 and 30 miles from shore traveling only farther when bowhead whales are not available closer to shore or when ice conditions or supply or drilling ships force hunters farther from shore (SRB&A, 2010).

Ringed Seal (*natchiq*) and Bearded Seal (*ugruk*)

Nuiqsut. Nuiqsut residents use bearded seal meat and oil for its nutritional value and hunters harvest ringed and bearded seal in the Beaufort Sea during summer months. Subsistence use areas for ringed seal are located from Cape Halkett to the west, Camden Bay to the east, and up to approximately 20-25 miles from shore with some hunters traveling up to 40 miles offshore near Thetis Island (SRB&A,

2010: 284). Hunting of ringed seal occurs in open water as seals follow the ice pack between June and September. However, hunting has been reported in May and October with hunting peaks in July and August.

Kaktovik. Kaktovik residents hunt for ringed seal while hunting for bearded seal with hunts occurring offshore between Prudhoe Bay to the west, Demarcation Bay to the east, and up to approximately 30 miles from shore with periodic harvesting of ringed seal occurring inside lagoons close to Barter Island.

Nuiqsut. Nuiqsut bearded seal hunting occurs between Harrison Bay and Flaxman Island with a high number of hunts occurring between the mouth of Fish Creek and Thetis Island. Hunting occurs offshore up to 20 miles extending as far west as Cape Halkett, as far east as Camden Bay, and offshore up to 40 miles.

Kaktovik. Bearded seal hunting for Kaktovik residents is more common than ringed seal hunting in recent years since bearded seal remains an important source of food to many Kaktovik residents. Bearded seal hunting occurs along the coast as far west as Prudhoe Bay and as far east as the United States/Canada border approximately 30 miles from shore. Many hunters will generally hunt closer to shore, up to five miles (SBR&A, 2010). Hunting activities for Kaktovik begin in March, peaking in July and August, concluding in September.

Fish: Arctic Cisco (*Qaaktaq*), Arctic Char/Dolly Varden (*paikłuk/iqalukpik*), Broad Whitefish (*Aanaagæiq*), and Burbot (*Tittaaliq*)

Nuiqsut and Kaktovik, closest to the Noticed Activities, harvest fish primarily on inland waterways. The Noticed Activities do not involve inland waterways during the temporal (July-September) and spatial (Foggy Island Bay of the Beaufort Sea) location of the project.

Geese, Swans, and Eider

Nuiqsut and Kaktovik, closest to the Noticed Activities, harvest birds primarily onshore and on inland waterways. Some geese, swans, and eiders may be hunted offshore and on barrier islands. The Noticed Activities are in shallow water offshore and do not extend to these areas during the temporal (July-September) and spatial (Foggy Island Bay of the Beaufort Sea) location of the Noticed Activities.

Caribou (*Tuttu*)

Nuiqsut and Kaktovik, closest to the Noticed Activities, area harvest caribou on land. The Noticed Activities are in shallow water and do not include onshore work during the temporal (July-September) or spatial (Foggy Island Bay of the Beaufort Sea) location of the project.

Environmental Justice

Executive Order 12898 (EO), "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," requires each Federal agency:

- Consider environmental justice to be part of its mission; and,
- Provide an evaluation in an EIS or EA as to whether the Noticed Activities would have "disproportionately high adverse human health and environmental effects on minority populations and low income populations."

The intent of EO 12898 is to promote the fair treatment of people of all races and income brackets, so no person or group of people bears a disproportionate share of the negative effects from Federal agency decisions.

Demographics of the Nuiqsut and Kaktovik communities, according to the 2010 indicate they meet the 50% population threshold of an affected area.

- Nuiqsut - 88.2% of the population (402 residents) are Alaska Native (specifically Iñupiat) American Indian
- Kaktovik - 88.7% of the population (239 residents) of Kaktovik are Alaska Native or American Indian

For centuries, survival in the Arctic has centered on of subsistence foods and materials and knowledge needed to harvest these resources. Iñupiat culture has depended upon passing on traditional knowledge and beliefs about subsistence resources including:

- Observations of game behavior to successfully locate and harvest game
- Hunter and family behaviors to ensure successful harvests in the future (Spencer, 1976)

Although there have been substantial social, economic, and technological changes in the Iñupiat way of life, subsistence continues to be the central organizing value of Iñupiat sociocultural systems. Iñupiat continue to be socially, economically, and ideologically loyal to their subsistence heritage with substantial amounts of subsistence food sharing within and between communities comprising important kin ties (Heinrich, 1963).

Disruption of subsistence harvest patterns could alter these cultural values, affect community social structure and, consequently, resulting in disproportionately high adverse effects on this minority population.

Public Health

Good health is essential to cultural sustainability and socio-economic development and is a prerequisite to human productivity and development (Basavanthappa, 2008). Communities develop their own healthy or unhealthy patterns of interaction resulting from the interrelationships between many systems (social and organizational) within each community. Individual status, roles, and positions function together in an attempt to achieve goals of these systems. This is demonstrated by the relationships between subsistence hunting of bowhead whales and whaling crew structures in Iñupiat society. Subsistence food gathering is not only central to Iñupiat culture, but also to survival and good health (GAO, 2003).

Good health comes from socio-cultural identities incorporating their traditions, values, and norms that are accepted and reinforced, placing priorities on prevailing attitudes and values about health and illness, and about utilizing traditional medicines such as food to maintain a community's health.

Fuel and shipping costs to get food and supplies to Villages varies across Alaska and is dictated by region. These high costs create higher food prices, directly impacting community health. Any real or perceived decrease in subsistence harvests coupled with higher food prices results in the availability of less nutritious foods and resulting "food deserts." Further, lack of accessibility to a variety of reasonably priced nutritious and fresh foods or subsistence harvest foods can be an obstacle to achieving the recommended daily diet (Block and Kouba, 2005). Research shows that people in low income communities pay proportionately more for food that people living in higher income communities and in the NSB this issue, along with others plays a role in environmental justice, public health, and economic sustainability. Research shows there is an association between under-nutrition, malnutrition, high obesity rates, and (ii) decreased economic and social resources (Black and Macinko, 2008).

Economy

The NSB is a mixed economy, characterized by a traditional cash economy and subsistence economy and is characterized by high unemployment and underemployment. Training programs and workforce development continue to be important in the future to increase the number of NSB residents that

receive employment and personal income in the oil industry. Increasing local hire is needed to benefit residents by employment and to increase personal income benefits from oil and gas activities.

Outer Continental Shelf oil and gas activities generate economic benefits for the NSB in the form of direct and indirect employment, increasing personal income, and various types of revenues to the local government. NSB receives revenues primarily from property taxes from high value onshore oil and gas infrastructure. For a more detailed description of the structure and composition of the NSB economy, see the MMS study on the "North Slope Economy, 1965 to 2005" (USDOI, MMS, 2006c).

3.3.7.2. Direct and Indirect Effects

Subsistence Activities

Vessel mobilization will occur at West Dock or Endicott and 20 individuals will be involved in the operation. Individuals will be housed at BPXAs existing camps and on the survey vessel.

The Noticed Activities have the potential to affect marine and terrestrial subsistence harvests due to the location and time of the project. The Noticed Activities will take place between July and September with seismic data acquisition occurring in July and August in the Foggy Island Bay area of

The Beaufort Sea. Mobilization is scheduled to begin prior to July 1st from existing facilities in Deadhorse.

BPXA's plan of operation (BPXA, 2014b) commits to mitigation measures described in their Environmental Impact Assessment (BPXA, 2014d). BPXA is currently negotiating a Conflict Avoidance Agreement (CAA) and Plan of Cooperation (POC) with the Alaska Eskimot Whaling Commission (AEWC), and also plans to hold meetings in the village of Nuiqsut and with the AEWC.

The Noticed Activities will have negligible to minor effects on subsistence resources due to the timing and location of the project. Marine and terrestrial subsistence hunts undertaken by Nuiqsut and Kaktovik hunters will be able to continue. The largest source of conflict will be from noise associated with the number of vessels working in the area and use of airguns in the Noticed Activities Area.

Based on the timing (July-October) and spatial location (Foggy Island Bay area of the Beaufort Sea) of the Noticed Activities, subsistence hunting for marine mammals, birds, fish and terrestrial animals falls within the noticed schedule. Subsistence hunting which overlaps the Noticed Activities Area will be for Bowhead whales, ringed and bearded seal, fish, geese, eider and caribou.

Cross Island, located approximately 14 miles (22 km) from the Noticed Activities Area, is the primary location for bowhead whaling hunting by Nuiqsut hunters and occurs north of the Noticed Activities in water depths of 50ft. The Noticed Activities are located inside the barrier islands and have potential effects to marine and terrestrial subsistence hunts of Nuiqsut and Kaktovik due to increased human activity, vessel traffic, and airguns. Mitigation described in the IHA application, if issued, would protect subsistence harvests. Effects from the project in the Beaufort Sea should not be long-term, but limited to the season in which the seismic work is conducted: July-October 2014. There will be negligible to minor effects on subsistence activities from the Noticed Activities.

Environmental Justice

BPXA's plan of operation has identified mitigation measures regarding potential impacts on subsistence activities as stated in the previous section. There may be slight disruption to subsistence based hunting during the Noticed Activities period but no long-term impacts to health and well-being of Nuiqsut and Kaktovik will result. Environmental justice impacts from these Noticed Activities will be negligible to minor.

Public Health

There will be continued subsistence harvests sufficient to maintain nutritional status, BPXA crews will be accommodated on ships and in existing camps, and since BPXA is cooperating with NSB Communities, negligible effects will occur to public health.

Economy

The Noticed Activities are short term, temporary, involve low levels of new employment and associated income, and no generation of property tax revenues will be realized by the NSB or State of Alaska. The Noticed Activities are expected to have a negligible effect on employment, income, and revenue levels of the NSB.

3.3.7.3. Cumulative Effects

Subsistence

The level of effects of the Noticed Activities on subsistence resources is negligible to minor. When considered in combination with other past, present, and reasonably foreseeable actions, effects on subsistence resources remain negligible to minor. Past projects include seismic surveys and exploration drilling, but the effects of these projects were temporary and no longer impact subsistence resources. One current project is a 3D ocean bottom node seismic survey which will be ongoing in the same sea as the Noticed Activities. While seismic and exploration projects do have potential effects on subsistence resources, the additive impact of the BPXA seismic survey are likely to be negligible because the duration of the project is limited and since BPXA has committed to follow mitigation measure requirements described in the USFWS 2013 LOA and described in BPXA's IHA application (BPXA, 2014c). Therefore, projects occurring concurrently in the Beaufort Sea may have negligible to minor additive effects on subsistence resources.

Environmental Justice

The Noticed Activities are short-term and will have no measurable effects on human health and the environment. Therefore, the contribution of BPXA's activities to cumulative impacts on human health and the environment would be negligible.

Public Health

The Noticed Activities are short-term and will have no measurable effects on NSB routines or community functions related to health. There will be no long-term consequences for health and well-being from this action. Cumulative impacts to public health will be negligible.

Economy

The Noticed Activities are temporary, involving low levels of new employment and no generation of property tax revenues to the NSB or State of Alaska. Cumulative impacts on employment, income, and revenue levels of the NSB will be negligible.

4.0 CONSULTATION AND COORDINATION

4.1. Endangered Species Act Consultation

Section 7(a)(2) of the ESA requires Federal agencies to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in the adverse modification of designated critical habitat. BOEM fulfilled ESA obligations for the Noticed Activities and no further consultation is required for ESA- listed species. Consultations and conferences required by ESA between BOEM, USFWS and NMFS for ESA-protected species have been accomplished through Biological Opinions on the Noticed Activities. BOEM previously consulted on the effects of high-resolution surveys and the effects were addressed in current programmatic Biological Opinions. Leasing and exploration activities are addressed in the programmatic Biological Opinions. The effects of certain pre-developmental activities were considered and accounted for in the consultations addressed in the programmatic Biological Opinions as Other Types of Surveys including Shallow Hazard Surveys and High-Resolution Surveys.

4.1.1. USFWS Administered ESA-Listed Species

BOEM has determined BPXA's Noticed Activities are within the scope of activities analyzed in the USFWS programmatic Biological Opinion (USFWS 2012 BO) issued to BOEM for oil and gas leasing and exploration activities in the U.S. Beaufort and Chukchi Seas on May 8, 2012 (USDOI, FWS, 2012). To ensure compliance with performance standards, BOEM shall require BPXA to conduct the Noticed Activities in accordance with appropriate Reasonable and Prudent Measures/Terms and Conditions of the USFWS 2012 BO (USDOI, FWS, 2012) and discussed in the Measures to Reduce Impacts to Marine and Coastal Birds, specific Mitigation Measures in Section 2.3. A small number of ESA-listed polar bears may be present in the area of the Noticed Activities. On July 3, 2013, BPXA received a Letter of Authorization (LOA) from USFWS (USDOI, FWS, 2013) for incidental take of small numbers of polar bear under the Marine Mammal Protection Act (MMPA). The USFWS 2013 LOA also constitutes incidental take authorization for BOEM under the ESA.

Pacific walrus, a candidate species, was not included in the USFWS 2012 BO (USDOI, FWS, 2012) and consultation is not required by law. ESA only requires Federal agencies to conference on actions likely to jeopardize the continued existence of a proposed species. The USFWS LOA of July 3, 2013, to BPXA is also authorization for incidental take of small numbers of Pacific walrus under MMPA, because a small number of Pacific walrus may be present in the area of the Noticed Activities.

4.1.2. NMFS Administered ESA-Listed Species

BOEM determined BPXA's proposal is within the scope of activities analyzed in the 2013 BO (NMFS, 2013). The NMFS issued a programmatic Biological Opinion (NMFS 2013 BO) to BOEM for oil and gas leasing and exploration activities for ESA-listed whales and seals (Section 3.3.6.1) on April 2, 2013 (USDOC, NOAA, NMFS, 2013). Whales and seals may be present in area of the Noticed Activities. BPXA requested an Incidental Harassment Authorization (IHA) on February 5, 2014, from NMFS for non-lethal harassment under the Marine Mammal Protection Act (MMPA) (BPXA, 2014c). Once the IHA is issued, it will also constitute incidental take authorization for BOEM under the ESA.

4.2. Essential Fish Habitat Consultation

The Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801-1884) mandated the identification of Essential Fish Habitat (EFH) for managed species and requires that Federal agencies consult with NMFS on actions and activities that may adversely affect EFH. BOEM has

prepared an EFH assessment in a separate document for the Noticed Activities and is currently in consultation with NMFS.

4.3. Public Involvement

BOEM notified the public of its receipt of the BPXA Noticed Activities on February 14, 2014, and later issued a public notice that BOEM would prepare an EA. On March 7, 2014, BOEM posted a request for public input on preparation of an Environmental Assessment for the BP Exploration (Alaska) Inc. 2014 Ancillary Activities to take place during the open water season on the Alaska OCS. Comments were accepted at http://www.regulations.gov through midnight March 19, 2014. The request, which closed on March 19, 2014 without receiving any public comment, is available to view at: http://www.regulations.gov/#!docketDetail;D=BOEM-2014-0025.

4.4. Reviewers and Preparers

The persons responsible for the review of BPXA's Noticed Activities, supporting information and analyses, and preparation of this EA are listed below:

Name	Title	Contribution
Gene Augustine	Biologist	ESA consultation
Frances Mann	Supervisory Environmental Protection Specialist	Project Manager
Christopher Crews	Wildlife Biologist	Marine Mammals
Nancy Deschu	Fishery Biologist	Water Quality, Fish and Essential Fish Habitat, EFH consultation
Dan Holiday	Wildlife Biologist	Lower Trophic Levels, Cumulative Effects
Melanie Hunter	NEPA Coordinator	Project Coordinator
Virginia Raps	Meteorologist	Air Quality, Climate Change, and Meteorology
Mark Schroeder	Wildlife Biologist	Marine and Coastal Birds
Caryn Smith	Oceanographer	Oil / Fuel Spills, Sea Ice and Sea State
William Swears	Technical Writer / Editor	Technical Editor
Jennifer Youngblood	Socioeconomic Specialist	Sociocultural/Subsistence

Glossary

Airgun: An airgun is a device that releases compressed air into the water column, creating an acoustical energy pulse with the purpose of penetrating the seafloor.

Exclusion Zone: Also synonymously referred to as a safety zone within the BPXA source material, the exclusion zone is an area around the seismic-survey-sound source within a designated sound-level isopleth wherein marine mammals may be exposed to sounds that are considered a Level A take by NMFS. The exclusion zones are based on sound levels of 180 dB (for cetaceans and walrus) and 190 dB (for ice seals and polar bears). The exclusion zones must be clear of marine mammals prior to survey commencement, and must remain free of marine mammals during survey operations.

Harrassment: The MMPA defines "harassment" as "any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment]."

Isopleth: A line on a map connecting points at which a given variable has a specified constant value. For seismic surveying, isopleths connect points of equal sound level (e.g. 160 dB, 180 dB, 190 dB).

Power-down Procedure: Reduction of the sound output of the airgun array to a level that would avoid exposing any marine mammal to the 180 or 190 dB (depending upon the species) exclusion zone.

Protected Species Observer (PSO): Formerly Marine Mammal Observer (MMO). PSOs are trained observers whose responsibilities are to observe, record, and inform the vessel crew of any sighted protected species. PSOs sole vessel duties include watching for and identifying marine mammals; recording their numbers, distances, and reactions to the survey operations; and documenting "take by harassment" as defined by NMFS and/or USFWS.

Ramp-up Procedure: Ramp-up of an airgun array consists of a gradual increase in sound level and a step-wise increase in the number and total volume of airguns firing until the full volume is achieved. The intent of ramp-up is to "warn" marine mammals in the vicinity of the airguns and to allow sufficient time for those animals to leave the area and avoid any potential injury or impairment of their hearing. Under normal conditions, animals sensitive to these activities are expected to move out of the area. Seismic surveys, including airgun testing or tuning, use the ramp-up procedures described below to allow whales and other marine mammals to depart the exclusion zone before seismic surveying begins.

Ramp-up procedures during seismic survey operations are as follows.

- Visually monitor the entire full array exclusion zone and adjacent waters for the absence of marine mammals for at least 30 min before initiating ramp-up procedures. If no marine mammals are detected, (15 min for ice seals and polar bears or 30 min for baleen whales and Pacific walrus), ramp-up procedures may be initiated.
- Initiate ramp-up by firing a single airgun, preferably the smallest in terms of energy output (dB) and volume.
- Continue ramp-up by gradually activating additional airguns over a period of at least 20 min, but no longer than 40 min, until the desired operating level of the airgun array is obtained.

Safety Zone: see Exclusion Zone.

Shut-down Procedure: Airgun operations may not be conducted when marine mammals are present within the exclusion zone. If a marine mammal is seen swimming toward the exclusion zone, the

airguns may first be powered down to avoid exposing the marine mammal to the 180/190 dB level, depending on species. If the animal reaches the single airgun exclusion zone, the array must be shut down. Likewise, if a marine mammal surfaces within single airgun exclusion zone, the seismic survey must be shut down. If the airgun array is shut-down for any reason during darkness or poor weather, it may not be re-energized until conditions allow for the exclusion zone to be effectively monitored.

Start-up Procedure: Start-up is the initiation of airgun activity preparatory to ramp-up (either initial operation in the survey area, or subsequent to a shut-down). Start-up of airgun operations may not commence unless the 180 dB exclusion zone has been visible for at least 30 min prior to start-up, and no marine mammals are observed within the exclusion zone for 15 min (ice seals and polar bears) or 30 min (baleen whales and Pacific walrus). If the array is shut-down pursuant to observation of a marine mammal, airgun operations may resume after the mammal has been observed to clear the exclusion zone for single airgun actuation or no marine mammals are observed within the exclusion zone for 15 min (ice seals and polar bears) or 30 min (baleen whales and Pacific walrus).

Take/Taking: The term “take” under the MMPA means “to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal” (MMPA, Section 3(13). Take, as defined by the ESA, means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. (ESA Section 3(19)."

Under the MMPA, the ‘taking’ of marine mammals, incidental or otherwise, without a permit or exemption is prohibited, with a few exceptions. One such exception (as stated in Sections 101(a)(5)(A) and (D)) is for the incidental, but not intentional, “taking,” by U.S. citizens, while engaging in an activity (other than commercial fishing) of small numbers of marine mammals of a species or population stock provided that the taking will have a negligible impact on such species or stock, will not have an unmitigable adverse impact on the availability of such species or stock for taking for subsistence uses, and the permissible methods of taking and requirements pertaining to the mitigation, monitoring, and reporting are set forth. Additionally, pursuant to Section 101(a)(5)(D) of the MMPA monitoring plans are required to be independently peer reviewed where the proposed activity may affect the availability of a species or stock for taking for subsistence uses.

In the 1982 amendments to the ESA, the "incidental take permit" process was established under section 10(a)(1)(B) of the ESA to allow for the "incidental take" of endangered and threatened species of wildlife by non-Federal entities. Incidental take is defined by the ESA as take that is "incidental to, and not the purpose of, the carrying out of an otherwise lawful activity."

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APPENDIX A – BPXA 2014 ANCILLARY ACTIVITIES

LEVEL OF EFFECTS DEFINITIONS

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Appendix A - Table of Contents

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A-1. Introduction

This appendix defines and explains the levels of effect used in the BPXA Ancillary Activities notice AA005 EA to evaluate potential environmental impacts. Impacts are described in terms of frequency, duration, general scope, and/or size and intensity. Each level considers such factors as the nature of the impact, the spatial extent, recovery times, and the effects of mitigation. The terms negligible, minor, moderate, and major are used to describe the relative degree or anticipated level of effect of an action on a specific resource. Following each term listed below for a specified resource are the general characteristics used to determine the anticipated level of effect. For each term, best professional judgment was used to evaluate the best available data concerning the affected resource.

For each resource, a "significance threshold" is also provided. Adverse impacts that do not meet the significance threshold are considered "not significant." Required mitigation measures may reduce otherwise "significant" impacts to a level of "not significant."

The absence of a significant effect does not equate to "no effect." As shown in the four-category scale, and in the numerous environmental analyses that BOEM has undertaken, effects from activities can be adverse and noticeable before they reach the significance threshold. Furthermore, in the cumulative effects analysis, BOEM analyzes the combined effects of projected activities with other actions, because BOEM recognizes that effects that individually do not reach this significance threshold may exceed that significance threshold when considered collectively.

A-2. Levels of Effect

2.1 Air Quality

The levels of effect applied to the air quality analysis are based on the results of two levels of analyses, the emission inventory, and if required, the more rigorous ambient air analysis based on computer dispersion modeling.

2.1.1 Significance Threshold

A significant effect on air quality is determined when:

1. Project-related emissions cause an increase in pollutant concentrations over the nearest onshore area of at least 20 square kilometers that
    a. exceeds half of any of the National Ambient Air Quality Standards (NAAQS) (except for ozone); or
    b. exceeds half of the maximum allowable increase for any pollutant for the Prevention of Significant Deterioration (PSD) for a Class II area under 40 CFR 52.21(c) or 18 AAC 50.020(b); or
    c. is expected to exceed half the ozone NAAQS based on an analysis of the potential increase in the ozone precursor emissions of volatile organic compounds (VOC) and nitrogen oxides (NOX); or
2. Design concentrations violate the NAAQS or if applicable, the Alaska Ambient Air Quality Standards (AAQS).

2.1.2 Level of Effects

Negligible

- Emission rates would be less than 100 tons per year for VOCs and all pollutants regulated under the NAAQS, and, if applicable, the Alaska AAQS.

Minor

- Emission rates would be equal to or greater than 100 tons per year for VOCs and all pollutants regulated under the NAAQS, and, if applicable, the Alaska AAQS.

Moderate

- Project-related emissions cause pollutant concentrations of at least one pollutant to exceed one-half of the PSD maximum allowable increases; or
- Project-related emissions cause pollutant concentrations of at least one pollutant to exceed one-half of the NAAQS, and, if applicable, the Alaska AAQS; or
- Increases in emissions of NO_X and VOC would result in the formation of ozone to a level that would be expected to exceed one-half the ozone NAAQS.

Major

- Design concentrations of at least one pollutant would equal or exceed one-half the NAAQS, and, if applicable, one-half the Alaska AAQS; or
- Increases in emissions of NO_X and VOC would result in the formation of ozone to a level that would be expected to equal or exceed the ozone NAAQS.

2.2 Water Quality

The levels of effect applied to water quality analysis consider the context and intensity of impacts, EPA's NPDES permitting program, and criteria under 40 CFR 125.122:

1. The quantities, composition and potential for bioaccumulation or persistence of the pollutants to be discharged;
2. The potential transport of such pollutants by biological, physical or chemical processes;
3. The composition and vulnerability of the biological communities which may be exposed to such pollutants, including the presence of unique species or communities of species, the presence of species identified as endangered or threatened pursuant to the Endangered Species Act, or the presence of those species critical to the structure or function of the ecosystem, such as those important for the food chain;
4. The importance of the receiving water area to the surrounding biological community, including the presence of spawning sites, nursery/forage areas, migratory pathways, or areas necessary for other functions or critical stages in the life cycle of an organism.
5. The existence of special aquatic sites including, but not limited to marine sanctuaries and refuges, parks, national and historic monuments, national seashores, wilderness areas and coral reefs;
6. The potential impacts on human health through direct and indirect pathways;
7. Existing or potential recreational and commercial fishing, including finfishing and shellfishing;
8. Any applicable requirements of an approved Coastal Zone Management plan;
9. Such other factors relating to the effects of the discharge as may be appropriate;
10. Marine water quality criteria developed pursuant to section 304(a)(1).

2.2.1 Significance Threshold

Significant effect on water quality is determined by any of the following: (1) the action is likely to violate its National Pollution Discharge Elimination System permit; (2) in the event of an accidental spill of crude oil or refined oil, total aromatic hydrocarbon or total aqueous hydrocarbon criteria for the Alaska marine or fresh-water quality standards are exceeded; or (3) the action is otherwise likely to introduce changes in the physical, chemical, or biological characteristics of a waterbody which

case an unreasonable degradation of the marine environment as defined at 40 CFR 125.121 and determined in accordance with 40 CFR 125.122.

2.2.2 Level of Effects

Negligible:

- Temporary and localized impacts to water quality that do not cause an unreasonable degradation under 40 CFR 125.122.

Minor:

- Long-term and/or widespread impacts to water quality that do not cause an "unreasonable degradation" under 40 CFR 125.122.

Moderate:

- Impacts to water quality that exceed NPDES permit criteria or cause a temporary or localized "unreasonable degradation" under 40 CFR 125.122.

Major:

- Impacts to water quality that cause long-term and widespread "unreasonable degradation" under 40 CFR 125.122.

2.3 Lower Trophic Organisms

2.3.1 Significance Threshold

An adverse impact that results in a decline in abundance and/or change in distribution requiring three or more generations for the indicated population to recover to its former status.

2.3.2 Level of Effects

Negligible:

- No measurable impacts. Population-level effects are not detectable.
- Localized, short-term disturbance or habitat effect experienced during one season that is not anticipated to accumulate across multiple seasons.
- No population level impacts to reproductive success or recruitment are anticipated.
- Mitigation measures are implemented fully and effectively or are not necessary.

Minor:

- Population-level effects are not detectable.
- Widespread annual or chronic disturbances or habitat effects not anticipated to accumulate across 1 year, or localized effects that are anticipated to persist for more than 1 year.
- Mitigation measures may be implemented on some, but not all, impacting activities, indicating that some adverse effects are avoidable.
- Unmitigatable or unavoidable adverse effects are short term and localized.

Moderate:

- Disturbances could occur, but not on a scale resulting in population-level effects.
- Widespread annual or chronic disturbances or habitat effects could persist for more than one year and up to a decade.

- Widespread implementation of mitigation measures for similar activities may be effective in reducing the level of avoidable adverse effects.
- Unmitigatable or unavoidable adverse effects are short term and widespread, or long term and localized.

Major

- Disturbances occur that result in measurable population-level effects.
- Widespread seasonal, chronic, or effects from subsequent seasons are cumulative and are likely to persist for more than 1 decade.
- Mitigation measures are implemented only for a small portion of similar impacting activities, but more widespread implementation for similar activities could be more effective in reducing the level of avoidable adverse effects.
- Unmitigatable or unavoidable adverse effects are widespread and long lasting.

2.4 Fish

2.4.1 Significance Threshold

An adverse impact that results in a decline in abundance and/or change in distribution requiring three or more generations for the indicated population to recover to its former status.

2.4.2 Level of Effects

Negligible:

- No measurable impacts. Population-level effects are not detectable.
- Localized, short-term disturbance or habitat effect experienced during one season that is not anticipated to accumulate across multiple seasons.
- No mortality or impacts to reproductive success or recruitment are anticipated.
- Mitigation measures are implemented fully and effectively or are not necessary.

Minor:

- Population-level effects are not detectable. Temporary, nonlethal adverse effects to some individuals.
- Widespread annual or chronic disturbances or habitat effects not anticipated to accumulate across 1 year, or localized effects that are anticipated to persist for more than 1 year.
- Low mortality levels may occur, measurable in terms of individuals or <1% of the local post-breeding fish populations.
- Mitigation measures may be implemented on some, but not all, impacting activities, indicating that some adverse effects are avoidable.
- Unmitigatable or unavoidable adverse effects are short term and localized.

Moderate:

- Mortalities or disturbances could occur, but not on a scale resulting in population-level effects.
- Widespread annual or chronic disturbances or habitat effects could persist for more than 1 year and up to a decade.
- Some mortality could occur but remains limited to a number of individuals insufficient to produce population-level effects.

- Widespread implementation of mitigation measures for similar activities may be effective in reducing the level of avoidable adverse effects.
- Unmitigatable or unavoidable adverse effects are short term and widespread, or long term and localized.

Major

- Mortalities or disturbances occur that have measureable and thus significant population-level effects.
- The action may adversely affect an endangered or threatened species or its habitat in a way that has been deemed to be critical under the Endangered Species Act of 1973.
- For fishes, the anticipated mortality is estimated or measured in terms of tens of thousands of individuals or >20% of a local breeding population and/or >5% of a regional population, which may produce short-term, localized, population-level effects.
- Widespread seasonal, chronic, or effects from subsequent seasons are cumulative and are likely to persist for more than 1 decade.
- Mitigation measures are implemented only for a small portion of similar impacting activities, but more widespread implementation for similar activities could be more effective in reducing the level of avoidable adverse effects.
- Unmitigatable or unavoidable adverse effects are widespread and long lasting.

2.5 Marine and Coastal Birds

2.5.1 Significance Threshold

Threatened and Endangered Species: An adverse impact that results in a decline in abundance and/or change in distribution requiring one or more generation for the indicated population to recover to its former status.

All Other Marine and Coastal Birds: An adverse impact that results in a decline in abundance and/or change in distribution requiring three or more generations for the indicated population to recover to its former status.

2.5.2 Level of Effects

Negligible

- Localized short-term disturbance or habitat effect experienced during one season that is not anticipated to accumulate across one year.
- No mortality is anticipated.
- Mitigation measures implemented fully and effectively or are not necessary.

Minor

- Widespread annual or chronic disturbances or habitat effects not anticipated to accumulate across one year, or localized effects that are anticipated to persist for more than 1 year.
- Anticipated or potential mortality is estimated or measured in terms of individuals or <1% of the local post-breeding population.
- Mitigation measures are implemented on some, but not all, impacting activities, indicating that some adverse effects are avoidable.
- Unmitigatable or unavoidable adverse effects are short-term and localized.

Moderate

- Widespread annual or chronic disturbances or habitat effects anticipated to persist for more than one year, but less than a decade.
- Anticipated or potential mortality is estimated or measured in terms of tens or low hundreds of individuals or <5% of the local post-breeding population, which may produce a short-term population-level effect.
- Mitigation measures are implemented for a small proportion of similar impacting activities, but more widespread implementation for similar activities likely would be effective in reducing the level of avoidable adverse effects.
- Unmitigatable or unavoidable adverse effects are short-term but more widespread.

Major

- Widespread annual or chronic disturbance or habitat effect experienced during one season that would be anticipated to persist for a decade or longer.
- Anticipated or potential mortality is estimated or measured in terms of hundreds or thousands of individuals or <10% of the local post-breeding population, which could produce a long-term population-level effect.
- Mitigation measures are implemented for limited activities, but more widespread implementation for similar activities would be effective in reducing the level of avoidable adverse effects.
- Unmitigatable or unavoidable adverse effects are widespread and long lasting.

2.6 Marine Mammals

2.6.1 Significance Threshold

Threatened and Endangered Species: An adverse impact that results in a decline in abundance and/or change in distribution requiring one or more generation for the indicated population to recover to its former status.

All Other Marine Mammals: An adverse impact that results in a decline in abundance and/or change in distribution requiring three or more generations for the indicated population to recover to its former status.

2.6.2 Level of Effects

Negligible:

- No measurable impacts and no population-level effects.
- May cause brief behavioral reactions such as temporary avoidances of or deflections around an area.
- Localized, short-term disturbance or habitat effects experienced during one season are not anticipated to accumulate across multiple seasons.
- No mortality or detectable impacts to reproductive success or recruitment are anticipated.
- Mitigation measures are fully implemented or are not necessary.

Minor:

- Low but measurable impacts with no population-level effects.
- A small number of mortalities are unlikely but possible.
- May cause behavioral reactions such as avoidances of or deflections around an area.

- Localized, disturbance or habitat effects experienced during one season may accumulate across subsequent seasons, but not over one year.
- Mitigation measures are fully implemented or are not necessary.

Moderate:

- Mortalities or disturbances could occur, but no detectable population-level effects.
- A small number of mortalities are likely, but not to an extent resulting in detectable population level effects.
- Adverse impacts to ESA-listed species could occur.
- Widespread annual or chronic disturbances or habitat effects could persist for more than one year and up to a decade.
- Widespread implementation of mitigation measures for similar activities may be effective in reducing the level of avoidable adverse effects.
- Unmitigated or unavoidable adverse effects may be short term and widespread, or are long term and localized.

Major:

- Mortalities or disturbances occur that have detectable population-level effects.
- For marine mammals, mortality might occur at or above the estimated Potential Biological Removal[1] (PBR) as a result of the Noticed Activities.
- For fish and benthic invertebrates, the anticipated mortality is estimated or measured in terms of tens of thousands of individuals or >20% of a local breeding population and/or >5% of a regional population, which may produce population-level effects.
- Widespread seasonal or chronic effects are cumulative and are likely to persist for more than one decade.
- Mitigation measures are implemented only for a small portion of similar impacting activities, but more widespread implementation for similar activities could be more effective in reducing the level of avoidable adverse effects.
- Unmitigatable or unavoidable adverse effects are widespread and long lasting.

2.7 Sociocultural Systems

Sociocultural systems include social organization, cultural values, and institutional arrangements.

2.7.1 Significance Threshold

A disruption of social organization, cultural values, and/or institutional arrangements with a tendency towards displacement of existing social patterns.

2.7.2 Level of Effects

Negligible:

- Periodic disruption of social organization, cultural values, and/or institutional arrangements occurs without displacement of existing social patterns.

Minor:

- Disruption of social organization, cultural values, and/or institutional arrangement occurs for a period of less than one year, without a tendency toward displacement of existing social patterns.

Moderate:

- Chronic disruption of social organization, cultural values, and/or institutional arrangements occurs for a period of more than one year, without a tendency toward displacement of existing social patterns.

Major:

- Disruption of social organization, cultural values, and/or institutional arrangements with a tendency towards displacement of existing social patterns.

2.8 Subsistence

2.8.1 Significance Threshold

Adverse impacts which disrupt subsistence activities, or make subsistence resources unavailable, undesirable for use, or only available in greatly reduced numbers, for a substantial portion of a subsistence season for any community.

2.8.2 Level of Effects

Negligible: Subsistence resources could be periodically affected with no apparent effect on subsistence harvests.

Minor: Adverse impacts to subsistence activities are of an accidental and/or incidental nature and limited to a short-term (within one season or the duration of the project).

Moderate: Adverse impacts which disrupt subsistence activities, or make subsistence resources unavailable, undesirable for use, or only available in greatly reduced numbers, for a substantial portion of a subsistence season for any community.

Major: Adverse impacts resulting in one or more important subsistence resources becoming unavailable, undesirable for use, or available only in greatly reduced numbers for any community.

2.9 Economy

The effects levels used for this analysis focus on the impacts associated with the Noticed Activities on socioeconomic systems, including employment, personal income, and revenues accruing to the local, state, and federal government.

2.9.1 Significance Threshold

Economic effects that would cause important and sweeping changes in the economic well-being of the residents or the area or region. Local employment is increased by 20% or more for at least 5 years.

2.9.2 Level of Effects

Negligible

- No measurable effects beyond short term, periodic impacts.

Minor

- Adverse impacts to the affected activity or community are avoidable with proper mitigation.
- Impacts would not disrupt the normal or routine functions of the affected activity or community. Economic systems would be impacted for a period of up to 1 year.

- Once the impacting agent is eliminated, the affected activity or community will return to a condition with no measurable effects from the Noticed Activities without any mitigation.

Moderate

- Impacts to the affected activity or community are unavoidable. Proper mitigation would reduce impacts substantially during the life of the project.
- Effects on economic systems would be unavoidable for a period longer than 1 year.
- The affected activity or community would have to adjust somewhat to account for disruptions due to impacts of the project.
- Once the impacting agent is eliminated, the affected activity or community will return to a condition with no measurable effects from the Noticed Activities if proper remedial action is taken.

Major

- Impacts to affected community are unavoidable.
- Proper mitigation would reduce impacts somewhat during the life of the project.
- The affected activity or community would experience unavoidable disruptions to a degree beyond what is normal.
- Once the effect producing agent is eliminated, the affected activity or community may retain measurable effects of the Noticed Activities indefinitely, even if remedial action is taken.

2.10 Public Health

2.10.1 Level of Effects

Negligible

- Infrequent minor acute health problems, not requiring medical attention.
- No measurable effects on normal or routine community functions.
- No long-term consequences for Public Health or well being.

Minor

- Public Health affected, but the effects would not disrupt normal or routine community functions for more than one week.
- Effects would not occur frequently.
- Effects would not affect large numbers of individuals.
- Effects could be avoided with proper mitigation.

Moderate

- Adverse effects on Public Health occurring for brief periods of time that do not result in or incrementally contribute to deaths or long-term disabilities.
- Effects can be prevented, minimized, or reversed with proper mitigation.
- Effects could occur more frequently than minor events, but would not be frequent.

Major

- Effects on Public Health would be unavoidable and would contribute to the development of disabilities, chronic health problems, or deaths.

- Alternatively, occurrence of minor health problems with epidemic frequency.
- Effective mitigation might minimize the adverse health outcomes but would not be expected to reverse or eliminate the problem.

2.11 Environmental Justice

Executive Order 12898 requires Federal Agencies to evaluate whether proposed projects would have "disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low income populations."

2.11.1 Significance Threshold

The significance threshold for Environmental Justice is when minority or low-income populations experience disproportionate, high adverse human health or environmental effects from the Noticed Activities. Disproportionately high adverse impacts are those impacts which exceed the significance thresholds for subsistence or sociocultural effects for minority populations or low income populations.

2.11.2 Level of Effects

The levels of effect for Environmental Justice correspond to the levels of effects for subsistence, sociocultural, or public health effects as experienced by minority populations or low income populations.

2.12 Archaeology

2.12.1 Level of Effects

Negligible

- This category equates to No Historic Properties Affected as defined by 36 CFR 800.4(d)(1), the Code of Federal Regulations that promulgates Section 106 of the National Historic Preservation Act of 1966 as amended.

Minor

- This category equates to a finding of No Historic Properties Affected when the Agency identifies a potential conflict within an Area of Potential Effect due to the presence of a geomorphological feature and revises the plan to avoid it prior to consultation with the State Historic Preservation Officer.

Moderate

- This category equates to a finding of No Adverse Effect as defined by 36 CFR 800.5(b) when the SHPO identifies a conflict that requires a change in plan to avoid effects on an Historic Property as defined by 36 CFR 800.16(l)(1&2).

Major

- This category equates to a finding of Adverse Effect as defined by 36 CFR 800.5(C) requiring mitigation and a Memorandum of Agreement.

[1] Marine mammal stock management is often based on a theoretical concept called Potential Biological Removal (PBR). The PBR is defined as the maximum number of animals, not including natural mortalities, which may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustained population. An optimum sustained population is defined as the number of animals which will result in the maximum productivity of the population or the species, keeping in mind the carrying capacity of the habitat and the health of the ecosystem. For example, as the bowhead whale population continues to grow, it continues to approach its carrying capacity. Contemporary population ecology suggests that at carrying capacity, a stable population is achieved when mortality equals productivity.

The PBR is calculated as the product of the minimum population estimate, one-half the theoretical productivity rate, and a "recovery factor". For example, the current estimate for the rate of increase for the bowhead whale stock (3.3%) should not be used as an estimate of maximum productivity because the population is currently being harvested and because the population has recovered to population levels where the growth is expected to be significantly less than maximum productivity. For the Western Arctic bowhead whale stock, the population size is estimated to be 9,472 (estimated in 2001), the theoretical productivity rate is 0.2, and the recovery factor is 0.5. The PBR is generally only used by the NMFS to guide decisions regarding the allowable removal of individual animals from a stock.

The conceptual PBR is used in the level of effects to identify a threshold whereby maximum population growth is sustained or not. If an anticipated effect could result in a loss of whales that exceeded the PBR, this would be inferred to be a population-level effect. In reality, given the conservative values used to derive the PBR, the loss of marine mammals that exceeded calculated PBR could be entirely consistent with a stable population.

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APPENDIX B

CUMULATIVE EFFECTS SCENARIO

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B-1. PAST, PRESENT AND REASONABLY FORESEEABLE FUTURE ACTIONS

The Council on Environmental Quality (CEQ) Regulations define cumulative effects at 40 CFR 1508.7:

> *Cumulative impact* is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. (40 CFR 1508.7)

This appendix provides a description of past, present and reasonably foreseeable future actions in the Chukchi and Beaufort Seas, which may contribute to cumulative impacts of oil and gas activities in these areas.

B-2. IMPACT SOURCES

The main sources of impacts which could have a cumulative impact with the 2014 BOEM analyzed activities affecting the U.S. Arctic OCS are:

1. Marine vessel traffic
2. Aircraft traffic
3. Subsistence and other community activities
4. Scientific research activities
5. Oil and gas-related activities

2.1. Marine Vessel Traffic

Past marine vessel traffic has been associated with subsistence hunting, oil exploration, research, and military activities. Weather and ice have traditionally limited marine vessel traffic in the Noticed Activities Area to July through September.

The number of marine vessels in both the Beaufort and Chukchi Seas has increased in recent years due to advances in the technology of ice strengthening and ice breaking capacities of marine vessels, changes in ice cover and classifications of ice, increases in use of both the Northeast Passage over Russia and the Northwest Passage through Canada for commercial and tourist voyages, and increased interest in scientific and economic pursuits in the area. Reasonably foreseeable traffic in the region includes small craft involved in the fall whaling hunt at Barrow and Wainwright; USCG vessels; cargo vessels; other supply ships, tugs, and barges; cruise ships; and vessels associated with scientific endeavors. The USCG estimates that from 2008 to 2010 the number of vessels in the Arctic increased from around 100 to more than 130, and the number of transits through the Bering Strait increased from around 245 to more than 325 (USCG, 2011). The estimated number of miles of non-seismic vessel traffic in the Chukchi Sea for July through October increased from approximately 2,000 miles in 2006 to more than 11,500 miles in 2010 (Marine Exchange of Alaska, 2011). Vessel tracks from 2009 indicate vessel transits in the vicinity of Barrow and Wainwright are traditionally concentrated along the coast (Marine Exchange of Alaska, 2011).

Marine vessels are the greatest contributors of anthropogenic sound introduced to the Beaufort Sea. Sound levels and frequency characteristics of vessel sound generally are related to vessel size and speed. Larger vessels generally emit more sound than do smaller vessels. Same size class vessels travelling at higher rates of speed generally emit more sound than the same vessels travelling at lesser speeds. Vessels underway with a full load, or vessels pushing or towing loaded non-powered vessels, generate more sound than unladen vessels in a similar size class. The most common sources of marine vessel mechanical components that generate sound waves are propulsion engines, generators, bearings, pumps, and other

similar components. Operations and navigation equipment, including fathometers and sonar equipment, are also inclusive of onboard mechanical components that cumulatively create and propagate sound into the marine environment through the vessel hull. The most intense level of sound pressure introduced into the water from an underway marine vessel originates from cavitation associated with the energy of spinning propellers. Moored vessels can generate sound from the operation of engines and pumps. Cranes or other similar operational equipment performing construction activities or other work functions may transmit sound directly to the marine environment through the air-water interface or indirectly through propagation of sound waves through hulls or other support structures.

2.2. Aircraft Traffic

Air traffic has increased in recent years, mostly from increases in academic and commercial ventures, and increases in military operations. Aircraft traffic in the Arctic includes fixed wing and helicopter flights for research programs and marine mammal monitoring operations; cargo flights for supplies to villages and for commercial ventures including oil and gas related activities (such as crew changes and supply flights); flights for regional and inter-village transport of passengers; air-ambulance and search and rescue emergency flights; general aviation for the purpose of sport hunting and fishing or flightseeing activities; and multi-governmental military flights. An average of 306 commercial flights per month occurred from Wainwright airport between July and October, 2000 to 2008 (Bureau of Transportation Statistics, 2009).

2.3. Subsistence Activities and Other Community Activities

Subsistence hunting and other community activities associated with regional native villages such as Wainwright and Point Lay have persisted for millennia, and are expected to continue during the period of Noticed Activities. Marine traffic associated with subsistence hunting consists of small craft used during fishing, seal hunting, and whale hunts. Vessel traffic associated with other community activities consists primarily of supply barges traveling close to shore, within state waters. Overall, vessel traffic associated with native village activities within the Noticed Activities Area is expected to be very low.

2.4. Scientific Research Activities

A considerable scientific research effort by governmental, non-governmental, and academic organizations operating from marine vessels and aircraft occurs annually in the Beaufort Sea and Chukchi Sea. The programs conducted by these organizations are generally expected to have ended for the season, or end for the season during October, but may produce cumulative impacts on resources analyzed for the Noticed Activities. Marine environmental baseline studies involve deployment of oceanographic equipment for collecting water and sediment samples, and use of nets and trawls for fish sampling and collection of phytoplankton, zooplankton, benthic invertebrates, and pelagic invertebrates. Also continuing will be observations of marine and coastal birds and marine mammals using standardized survey transect methods and passive acoustic monitoring. Metocean buoys and acoustic wave and current meters will continue to be deployed for studies of physical oceanography and climate. Previous environmental assessments, such as the environmental assessment for Shell's Beaufort Sea marine research program, describe the techniques used and the effects of these programs in detail (USDOI, BOEMRE, 2011).

2014 BOEM ANIMIDA III (AK-11-14b). The Arctic Nearshore Impact Monitoring in Development Area (ANIMIDA) and continuation of ANIMIDA (cANIMIDA) started in 1999 and has provided baseline data and monitoring results for chemical contamination, turbidity, Boulder Patch productivity, and subsistence whaling in the vicinity of oil industry development in the Beaufort Sea OCS. Northstar and Liberty prospects were monitored prior to development and Northstar into development and production. Activities include both nearshore and offshore components, both concentrating in the region north and west of Camden Bay. Nearshore components are achieved by small vessel support in the open water season. Larger vessel support will be needed in offshore Camden Bay collections along the Beaufort Sea shelf break. Primary biological/contaminant field surveys should occur in the open-water period, with some effort during breakup with high river flow, and at least once during the ice-covered

season. Sediment and biota sampling will be scheduled such that stations sampled in eastern, central, and western Beaufort in ANIMIDA and cANIMIDA will be resampled at least once and the new deeper eastern Beaufort Region stations around Sivulliq and Torpedo would be sampled at least twice. Focus will be on oil and gas development potential contaminants in sediments and benthic biota, and distribution and abundance of benthic biota.

2014 BOEM ANIMIDA III: Boulder Patch and Other Kelp Communities in the Development Area (AK-11-14a). The Boulder Patch kelp bed surveys and monitoring will be conducted using small vessel support in the open water season in the Stefansson Sound region to the north and west of Camden Bay. Kelp production will be measured using established or comparable techniques. Oceanographic measurements shall include ambient light intensity and total suspended solids using established or comparable techniques. Data will be combined with the existing long-term dataset. The extent of kelp in Camden Bay will be surveyed and GIS maps constructed of kelp and implied (boulder and or hard bottom) kelp beds in the study area.

2014 BOEM Distribution and Abundance of Select Trace Metals in Chukchi and Beaufort Sea Ice (AK-13-03-04). The concentrations of certain trace metals are significantly elevated in sea ice relative toseawater, as indicated by results of previous studies in Antarctica and the Bering Sea. Consequently, sea ice melt has been shown to increase concentrations of some elements in surface waters, but the processes controlling the retention and subsequent release of trace metals in sea ice are not well understood. Offshore surface seawater and aerosols samples will be collected on board the R/V Mirai in collaboration with the Japanese Agency for Marine-Earth Science and Technology (JAMSTEC). Snow will be collected onboard the ship opportunistically during snow events. A total of ~80-100 ice core samples will be collected from 10 stations during the sea ice sampling effort in Camden Bay. This sampling will involve travel by snow machine from Kaktovik/Barter Island to Camden Bay during April-May, 2014.

2014 BOEM Satellite Tracking of Bowhead Whales: Habitat Use, Passive Acoustic and Environmental Monitoring (AK-12-02) This ongoing study will track the movements and document the behavior of bowhead and gray whales using satellite telemetry. Tagging operations will focus on locations nearby St.Lawrence Island during the months of April and May; Barrow during the months of May and September/October; and in Canada during July and August. Only smaller vessels used by tagging crews will be involved. Bowhead whale vocalization rates and ambient noise levels will be documented using an acoustic tag to develop analysis of call rates relative to behavior and disturbance. Tags equipped with environmental sensors will be deployed to monitor, summarize, and transmit ambient oceanographic conditions as bowheads migrate.

2014 BOEM Aerial Surveys of Arctic Marine Mammals Project (AK-11-06). ASAMM aerial surveys are conducted in the western Beaufort and northeastern Chukchi Seas (68°N-72°N latitude and 140°W-169°W longitude), extending from the coast to a maximum of approximately 315 km offshore, encompassing 230,000 km^2. Two teams are required to cover the study area: one team, based out of Barrow, Alaska, surveys the northeastern Chukchi Sea and the other team, based out of Deadhorse, Alaska, surveys the western Beaufort Sea. Fixed-wing, twin-turbine Aero Commander aircraft were used for all surveys in 2012. These aircraft have a 5.5-hour flight endurance and are outfitted with bubble windows for downward visibility. Line-transect surveys are flown every day, weather and logistics permitting, at an altitude of 1,200 ft in the Chukchi Sea and 1,500 ft in the Beaufort Sea. The ASAMM project is conducted by the National Marine Mammal Laboratory (NMML), funded by the Bureau of Ocean Energy Management (BOEM), and permitted through the National Marine Fisheries Service (NFMS) and the U.S. Fish and Wildlife Service. Daily reports from the 2013 field season as well as previous years' reports are available on the NMML website at http://www.afsc.noaa.gov/NMML/cetacean/bwasp/index.php.

2014 BOEM Characterization of the Circulation on the Continental Shelf Areas of the Northeast Chukchi and Western Beaufort Seas (AK-12-03a). This project will coordinate and collaborate with

other research projects in the area (BOEM, WHOI, industry, etc.) to synthesize and integrate all available physical oceanographic data collected at the junction of the Beaufort and Chukchi Seas north of Barrow, AK. Various vessels will be used to deploy and retrieve buoys and slocum gliders during the open-water season of 2013, most likely in September. This study will involve using a suite of instrumentation including: ADCPs, CTDs, Ice Profiling Sonar (IPS5), gliders, surface drifters and HF radars. Long Range HF radar systems presently deployed along the Chukchi coast at Point Lay, Wainwright and Pt. Barrow will be modified to increase the maximum observable range to approximately 250 km to capture the summer surface current flow over a larger area of the Chukchi shelf and around Hanna Shoal. A planned HF radar deployment at Cape Simpson (CIAP funds) will capture surface current flow along the western Beaufort shelf and slope and within Barrow Canyon. Gliders, surface drifters, moored ADCPs and towed CTDs will collect data on depth and time dependent current, temperature and salinity structure. Ice Profiling Sonar and moored ADCPs will be used to calculate ice drift and velocity. Sea ice extent will be obtained from satellite information, while drifting buoys will be crucial for computing flow trajectories and diffusivities. Data from the ADCPs, CTDs, glider deployments, HF radars, planned drifter measurements and available industry data will be synthesized to acquire a comprehensive characterization of the circulation in the study area.

2014 BOEM U.S.-Canada Transboundary Fish and Lower Trophic Communities (AK-12-04). The survey will sample fish, invertebrates, and related biological and oceanographic habitat characteristics between longitudes 141° and 147° in the U.S. and into Canadian waters to ~138° (across the Canadian border to Herschel Island and the Mackenzie canyon) during the 2013 open water season. This survey will expand the scope and reach of a Beaufort Sea Pilot Fish Survey conducted in 2008. Methodologies will follow those from the 2008 survey and the ongoing BOEM Central Beaufort Sea Fish Survey, modified in consideration of lessons learned from the earlier work. Sampling will deploy gear types such as beam trawl (10m wide), otter trawl, Isaacs-Kidd, and bongo nets. This study will include additional field surveys in both the under-ice and open water seasons to provide a better understanding of variability and collect additional habitat characteristics; collect invertebrates in both the water column and benthos; collect CTD data to document hydrographic structure; and collect and analyze ecological (e.g. energetics, isotope, genetic and otolith) samples for a foodweb model.

2.5. Oil and Gas Related Activities

Past oil and gas related activities in the Beaufort Sea and Chukchi Sea OCS include exploration wells, exploration seismic surveys, shallow geologic hazards surveys, geotechnical sampling programs, baseline biological studies and surveys, biological, chemical and physical oceanography monitoring programs, and other environmental studies and sampling programs including ongoing work funded by industry for the purpose of understanding the environment within and outside the project areas.

Current reasonably foreseeable oil and gas related activities in the Arctic OCS during 2014 include:

- SAExploration Holdings Inc. (SAE) three dimensional (3D) on-ice seismic survey in the Colville River Delta area of the Alaskan Beaufort Sea during the winter of 2014. (G&G Seismic Survey Application #14-01): February 15 – May 31, 2014. Project would not overlap temporally or geographically with the Noticed Activities Area.
- Chukchi Sea Environmental Studies Program (CSESP) research efforts in the region encompassing the Conoco Phillips leased areas in the Chukchi Sea. The CSESP projects would not occur geographically with the Noticed Activities.
- SAE 3D ocean bottom seismic survey in the Colville River Delta area of the Alaskan Beaufort Sea during the 2014 Beaufort Sea open water season (G&G Seismic Survey Application #14-02): July 1 2014 – October 15, 2014. Project would not occur geographically with the Noticed Activities.

- TGS NOPEC Geophysical Company. 2014 Chukchi Sea 2D Seismic Survey (G&G Seismic Survey Application #14-05): August 1, 2014 – October 31, 2014. Project would not occur temporally with the Noticed Activities.
- BPXA 2014 Winter Geotechnical and Seabottom Investigation: March 2014 through early May 2014. Categorical Exclusion granted February 6, 2014. Project will not occur temporally with the Noticed Activities.

2.6. Climate Change and Ocean Acidification

Climate change is an ongoing consideration in evaluating cumulative effects on environmental resources of the Arctic region (NOAA, 2011). It has been implicated in changing weather patterns, changes in the classification and seasonality of ice cover, ocean surface temperature regimes, and the timing and duration of phytoplankton blooms in the Chukchi Sea. These changes have been attributed to rising carbon dioxide ($CO_{2)}$ levels in the atmosphere and corresponding increases in the CO_2 levels of the waters of the world's oceans. These changes have also led to the phenomena of ocean acidification (IPCC, 2007; Royal Society, 2005). This phenomenon is often called a sister problem to climate change, because they are both attributed to human activities that are leading to increased CO_2 levels in the atmosphere. The capacity of the Arctic Ocean to uptake CO_2 is expected to increase in response to climate change (Bates and Mathis, 2009). Further, ocean acidification in high latitude seas is happening at a more advanced rate than other areas of the ocean. This is due to the loss of sea ice that increases the surface area of the Arctic seas. The resultant exposure of surface water lowers the solubility of calcium carbonate, resulting in lower saturation levels of calcium carbonate within the water that in turn leads to lower available levels of the minerals needed by shell-producing organisms, such as pteropods, foraminifers, sea urchins, and molluscs (Fabry et al., 2009; Mathis, Cross, and Bates, 2011).

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APPENDIX C
AIR QUALITY

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Air Quality

The BP Shallow Geohazard Survey proposes to operate a survey vessel on the OCS requiring the operation of large marine diesel propulsion and auxiliary engines that will contribute to the budget of emissions already existing within the project area. During the OCS portions of the Noticed Activities emissions from the vessel will be transported to land areas by the wind resulting in adverse air quality effects, depending on the level of emissions from the ship. Thus, it is appropriate to assess the quantity of emissions expected from the survey ship and determine the degree of air quality effects.

The purpose of the air quality evaluation is to assess whether emissions from the Noticed Activities have the potential to adversely impact air quality on the North Slope adjacent to the Beaufort Sea OCS. The Noticed Activities include plans to use an ocean-going vessel that will be continually traversing a planned geographic area for research.

The vessel will not be temporarily or permanently anchored or secured to the seabed in a fashion similar to drillship operations during oil and gas exploration. As such, the ship is assumed to be a mobile source throughout the survey period and the engines categorized as marine diesel engines.

C-1. Existing Air Quality Classification on the Alaska North Slope

Impacts from pollutants emitted over the open sea are influenced predominately by wind, which is the mechanism that disperses and dilutes air pollutants, and is also the means to transport pollutants across large geographical areas. The impacts are further influenced by the route and speed of the ship. The existing air quality conditions near an onshore area are influenced primarily by the number and type of emissions sources located onshore. Winds are fairly persistent over the coastline adjacent to the Beaufort Sea where the area is flat and open to the winds of the Arctic Ocean. The mean wind speed during the Noticed Activities time-frame is 12.4 miles per hour (mph), defined on the Beaufort scale as a moderate breeze, which is sufficient to cause dispersion and diffusion of air pollutants (Wang, Wu, Cheung, and Lam, 2000; NOAA, 2010). The Arctic is characterized by episodes of strong winds and the vast open area on the North Slope provides little to slow them down (Spall, Pickart, Fratantoni, et al., 2007).

The existing air quality conditions are determined by the Environmental Protection Agency (EPA) based on data obtained from emission monitoring equipment located near communities on the North Slope coastline. The National Ambient Air Quality Standards (NAAQS) are compared to the monitored data to determine how often and to what extent federal standards are exceeded over a specific geographical area. The air quality is classified within the geographical area by the EPA based on this data and the number of violations each year. These geographical areas are referred to as air quality control regions (AQCR) and are defined by authority of the EPA.

There are four such areas defined in Alaska. The North Slope land area adjacent to the Beaufort Sea OCS is included in the Northern Alaska Intrastate AQCR (40 CFR Part 81). The northern Alaska area is defined by the EPA as a clean air resource, meaning the monitors are not detecting pollutant concentrations high enough to consistently violate federal standards. Also, the area is classified as an attainment/unclassifiable area, meaning all federal requirements for healthful air quality are being maintained over the long-term.

C-2. Regulatory Review

Outside air, referred to in a regulatory context as ambient air, becomes a concern when potential exists for harmful gases, particles, and other contaminants to build up in the lower atmosphere sufficient to cause measurable damage to human health, wildlife, or property (Monks, Granier, & Stohl, et al., 2009). Thus, the EPA established the NAAQS to serve as the benchmark for determining

when the potential for harm exists. The NAAQS represent the numerical limits (criteria) above which concentrations of the most common air pollutants may be harmful to human health; pollutant concentrations are expressed in terms of mass per volume, or micrograms per cubic meter of air ($\mu g/m^3$). The NAAQS are updated periodically by the EPA and are provided at http://www.epa.gov/air/criteria.html. The six common air pollutants for which EPA regulates through the NAAQS are:

- Carbon monoxide (CO);
- Nitrogen dioxide (NO_2);
- Sulfur dioxide (SO_2);
- Fine particulate matter ($PM_{2.5}$);
- Coarse particulate matter (PM_{10});
- Ozone; and
- Lead.

The EPA requires the NAAQS to be attained and maintained, which is accomplished through local, state, and federal regulations. Within those regulations are the procedures for controlling stationary emission sources, which are distinctly different from regulations applicable to mobile sources. Emissions from a single stationary source tend to affect the same downwind area on a consistent basis over a period of time due to the prevailing wind, whereas emissions from a mobile source are dispersed over a much larger area as the continuously moving source approaches and then moves farther away from a sensitive location (daycare, park, etc.). While a single mobile source is not likely to cause a buildup of pollutants in a single area sufficient to exceed the NAAQS, where scores of mobile sources are concentrated in a relatively small area, such as a highway corridor during rush hour, Federal standards are, on occasion, exceeded. Thus, the EPA requires that engines on vehicles be controlled at the point of manufacture, which reduces emissions not only on the highway corridor during rush hour, but on all the roadways wherever the vehicle is operated, thus reducing emissions on a local and regional scale, over the long term. In a similar way, the EPA has a coordinated strategy to focus efforts to reduce emissions from large marine diesel engines, on ships flagged in both the United States and in other countries.

Marine diesel engines emit primarily particulate matter and nitrogen oxides (NO_X), which includes NO_2. The pollution from marine vessels is the result of operating main propulsion engines, power generation engines, and auxiliary engines. The main propulsion and power generation engines on very large ships are designated as “Category 3” marine diesel engines. Category 3 engines may be more than three stories high and as long as two school buses, as shown in Figure C-1 *Photograph of the Finnish Wärtsilä-Sulzer RTA96-C two-stroke marine diesel engine*. Auxiliary engines aboard a vessel might range in size from small portable generators to locomotive-size engines and are designated as “Category 1” and “Category 2” engines.

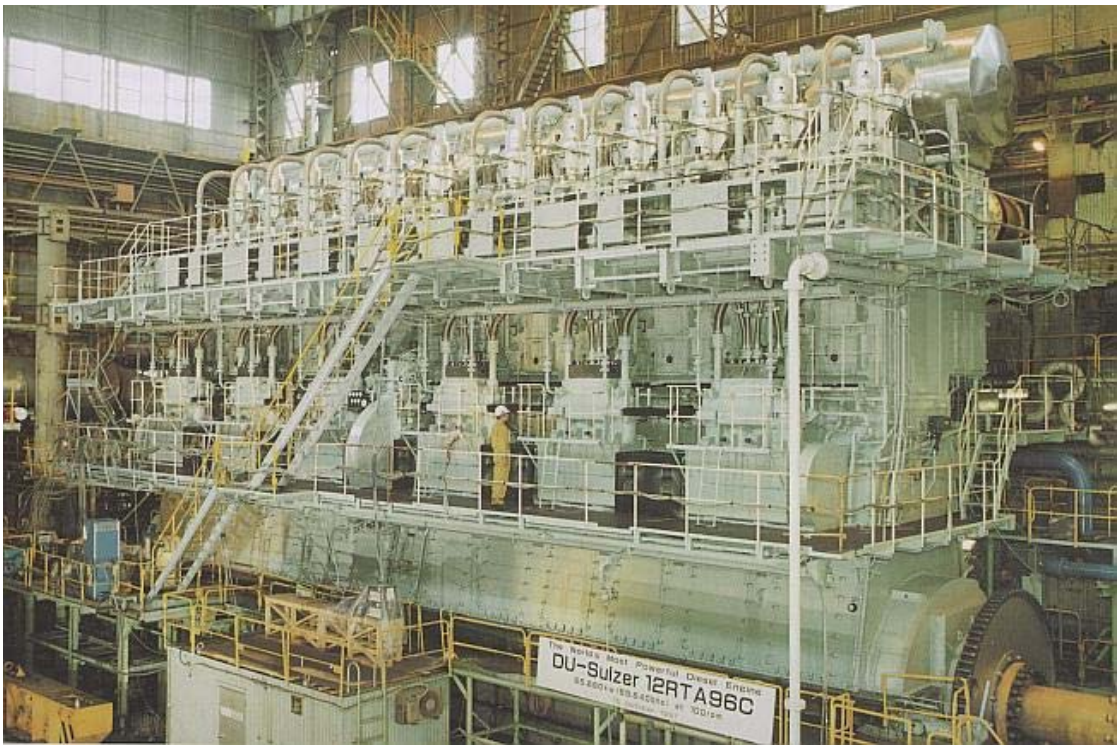

Figure C-1. Photograph of Category 3 marine engine, the Wärtsilä-Sulzer RTA96-C, two-stroke marine diesel engine for the Emma Maersk (Denmark).

Source: http://www.gizmag.com/go/3263/picture/6197/

2.1 BOEM Air Quality Regulatory Program and Clean Air Act

The BOEM Air Quality Regulatory Program (AQRP) (30 CFR Part 550 subpart C) does not apply to the BPXA survey vessel or any other emission sources or emissions resulting from operation of the Noticed Activities. The BOEM AQRP applies only to a facility, as defined under 30 CFR 550.105, which requires the facility to be permanently or temporarily attached to the seabed for the purpose of drilling during oil and gas exploration, development, and production. The authority and jurisdiction allowed BOEM under the AQRP is further limited to compliance of facility emissions with national standards to the extent that activities authorized by OCS Lands Act (OCSLA) significantly affect the air quality of any State; anything different is beyond the limited authority of BOEM (42 USC 1334(a)(5)). The EPA rule for the Prevention of Significant Deterioration (PSD) and the requirement for a Title V permit under the Clean Air Act as given under 40 CFR Part 55, also are not applicable.

2.2 International Control of Pollution from Ships

The EPA and U.S. Congressional reports agree that large ships similar in size to container ships, tankers, and cruise ships are not trivial contributors to regional and global air pollution (EPA, 2013; Copeland, 2008). According to the EPA, pollution from large marine diesel engines is expected to contribute more than 2.1 million tons of NO_x emissions each year by 2030, and increase $PM_{2.5}$ emissions to 170,000 tons per year (EPA, 2013).

Emissions from the main propulsion and auxiliary engines onboard ocean-going vessels, including those operating on the OCS, are controlled at the point and time of manufacturer (OEM, Original Equipment Manufacturer) and must meet emission standards imposed by the International Maritime Organization (IMO). The IMO is the United Nations specialized agency with responsibility for maritime safety and security, and is concerned with the prevention of marine pollution from ships. Established in 1959, the IMO includes the United States as a signatory country and the U.S. EPA is a

participant on the U.S. delegation to the IMO. In 1973, IMO adopted the MARPOL (short for marine pollution) Convention to minimize specific types of pollution of the seas.

2.2.1 MARPOL, International Convention of the Prevention of Pollution from Ships

MARPOL refers to the International Convention on the Prevention of Pollution from Ships, which established a set of agreed-upon standards and criteria (conventions) intended to minimize and prevent pollution from ships. MARPOL consists of six annexes (documents), where each describes regulations for pollution prevention at sea, where each annex is specifically dedicated to rules and regulations of a particular harmful contaminant, substance, or material. The annexes include the prevention by:

- Oil from ships (Annex I in 1983);
- Noxious liquid substances in bulk (Annex II in1983);
- Harmful substances carried by sea in packaged form (Annex III in1992);
- Sewage pollution by ships (Annex IV in 2003);
- Garbage pollution from ships (Annex V, revised for 2013), and the
- Prevention of air pollution from ships (Annex VI revised in 2010) (IMO, 2013).

The provisions of each annex are legally binding and enforceable only when ratified by member countries (signatories) whose combined gross tonnage reflects at least half (50 percent) of the world's gross tonnage. MARPOL applies to all vessels operating in U.S. waters as well as ships operating within 200 nautical miles of the coast of North America.

2.2.2 MARPOL Revised ANNEX VI

MARPOL Revised Annex VI (Annex VI) has been ratified by 59 countries, including the U.S., representing approximately 84 percent of the world's gross tonnage. As such, the provisions of Annex VI became legally binding and enforceable beginning July 1, 2010 (IMO, 2010). Hence, U.S. OEMs of specific marine diesel engines are required to meet the Annex VI emission standards for NO_x, and the fuel used in the engines must reduce emissions of SO_x. Engines not subject to the emission standards of the 2010 Annex VI may be subject to standards set forth in the previous versions of the annex. Large ships of a foreign flag are obliged to meet the standards imposed by the U.S. when navigating within U.S. jurisdictional waters. In addition to emission standards at the manufacturer, Annex VI includes requirements for the certification and operation of vessels and engines, as well as fuel quality used in vessels in the waters of the U.S. Annex VI establishes limits on NO_x emissions for the purpose of protecting public health and the environment.

Ships of signatory countries constructed on or after January 1, 1990 but prior to January 1, 2000, or when a major rebuild was completed during this time, must comply with the Tier 1 NO_x emission limits given in Table C-1. The emission standard in Table C-1 is limited to engines with a power rating of more than 5000 kW (6705.11 hp).

Table C-1. MARPOL Annex VI NO_X Emissions Limits

Tier	Date Enforced	NO_X Limit g/kW-hr, where n=rpm		
		n < 130	130 ≤ n < 2000	n ≥ 2000
I	2000	17	$45 \cdot n^{-0.2}$	9.8
II	2011	14.4	$44 \cdot n^{-0.23}$	7.7
III	2016*	3.4	$9 \cdot n^{-0.2}$	1.96

Source: Det Norske Veritas (DNV). 2005. Marpol 73/78 Annex VI: Regulations for the prevention of Air Pollution from Ships – Technical and Operational Implications. Regulation 13 Tier I: Current Limits.

The standards presented in Table C-1 apply to both main propulsion and auxiliary engines and require the engines to be operated with sulfur-limited marine fuels.

2.3 U.S. 1980 Act to Prevent Pollution from Ships to Implement MARPOL

The international nature of maritime shipping makes implementation and enforcement of marine engine emission standards challenging. Following ratification of a MARPOL annex, each nation that is a signatory to the annex must enact domestic laws to implement the standards and ensure certification and compliance to the laws of the other signatory nations related to ships' emissions. Certification of ships' engines to the pollution prevention standards is the responsibility of the country where the ship is registered, referred to as the flag state. In response, the U.S. enacted the 1980 Act to Prevent Pollution from Ships (1980 APPS). The 1980 APPS is a U.S. federal law enacted to implement the provisions of MARPOL and the ratified annexes. The Act "gives the U.S. Coast Guard the authority to develop regulations and enforce MARPOL . . ." (Council on Foreign Relations, 2013). The 1980 APPS applies to all U.S. flagged ships operating anywhere in the world and, "…to all foreign flagged vessels operating in navigable waters of the U.S. or while at port under U.S. jurisdiction;" the 1980 APPS is codified at 33 U.S. Code §1901 (USLegal, 2013). The regulatory mechanism established in the 1980APPS to implement MARPOL and its annexes is separate and distinct from the Clean Air Act and other federal environmental laws. The provisions of the 1980 APPS do not apply to any warship, naval auxiliary, ships of the Department of the Navy, or ships operating during a time of war or a declared national emergency.

2.3.1 EPA and U.S. Coast Guard Enforcement of MARPOL

The EPA issued guidance to establish terms under which the USCG and the EPA will mutually cooperate in the implementation and enforcement of Annex VI to MARPOL as implemented by the 1980 APPS. The EPA and USCG entered into a Memorandum of Understanding (MOU) on June 27, 2011, that includes inspections, investigations, and enforcement actions if a violation is detected. Efforts to ensure compliance include oversight of marine fuelling facilities, onboard compliance inspections, and reviews of records. The USCG or EPA may bring an enforcement action for a violation, which may result in criminal and/or civil liability. The memorandum is available at http://www.epa.gov/enforcement/air/documents/policies/mobile/annexvi-mou062711.pdf (EPA, 2012b). The EPA and USGC also issued a Joint Letter to ship owners, ship operators, shipbuilders, marine diesel engine manufacturers, and marine fuel suppliers to inform them of the regulations for prevention of air pollution from ships and the requirements of Annex VI (EPA, 2012a).

2.3.2 U.S. Required Certifications and Examinations

Each diesel engine regulated under MARPOL aboard U.S. flagged vessels must have an Engine International Air Pollution Prevention (EIAPP) certificate issued by the EPA to document the engine meets the MARPOL NO_X standard. Some vessels are also required to have an International Air Pollution Prevention Certificate (IAPP) issued by the USCG. Ship operators must also maintain records onboard documenting compliance with the emission standards and fuel requirements. Non-U.S. flagged ships are subject to examination under Port State Control while operating in U.S. waters.

C-3. Emission Sources Onshore

A comprehensive statewide inventory of existing emission sources was prepared by the Alaska Department of Environmental Conservation (ADEC) to support the development of the State's program to control regional haze (ADEC, 2010a). The inventory accounted for all known emission sources of air pollutants across the entire state. Emission sources on the North Slope included in the inventory are:

- Area sources, such as fireplaces, asphalt paving, and gasoline distribution,
- Non-road mobile sources, such as construction equipment and snow vehicles,
- On-road mobile sources, such as passenger cars, trucks, and buses,
- Point sources, such as commercial and residential heating facilities, and
- Aviation sources, ranging from small planes to large commercial aircraft.

An inventory of projected 2018 emissions was included in the ADEC report to account for expected changes in pollutant source activity, such as population, and changes in technology, such as emission controls. The inventory shows there were relatively few emission sources located on the coastline of the North Slope during the period of the ADEC emissions study, and there was no indication that the number of sources would be expected to increase in the foreseeable future.

C-4. Projected Emissions from BPXA Survey Sources

An inventory of projected emissions was prepared that reflects the operation of the *R/V Thunder* research vessel. As there would be no baseline of emissions associated with the no-action alternative, the projected emissions should be considered the total net emission increase caused by the Proposed Action.

The projected emission inventory was prepared using the BOEM Form 0138. The form provides emission factors established by the EPA using EPA-approved methodologies to calculate projected emissions. The projected emission inventory includes an evaluation of the following pollutants:

- CO;
- NO_X, where emissions of NO_X are assumed to be made up entirely of NO_2;
- SO_X, where emissions of SO_X are assumed to be made up entirely of SO_2;
- Particulate matter (where emissions of PM are assumed to be made up entirely of PM_{10});
- Volatile organic compounds (VOC); and
- Carbon dioxide (CO_2).

Although a criteria pollutant, an assessment of ozone emissions was not included in the analysis. This is because ozone is not emitted directly by a source; rather ozone is formed through the secondary photochemical reaction between emissions of the precursor pollutants, NO_x and volatile organic compounds (VOC), and sunlight. As such, an inventory of NO_x and VOC emissions is provided and serves as an indicator of potential ozone development in the Noticed Activities area. While not a criteria pollutant, CO_2 is considered a greenhouse gas that contributes to global climate change, and is included in the inventory. Diesel fuel contains no lead, a criteria pollutant; thus, the analysis did not include an inventory of lead emissions.

Emissions from diesel engines were calculated using the standard EPA method of applying the output power (horsepower) to the emission factors, which are expressed as pounds per horsepower-hour (lb/hp-hr), and applying the number of total operating hours. The emission factors are summarized in Table C-2. The emission rates allow the quantity of each pollutant to be calculated based on the operating power of each engines. The BPXA Plan of Operations identify the survey vessel will by the R/V *Thunder* or a similar vessel. An image of the R/V *Thunder* is show in Figure C-2.

Figure C-2. Research Vessel R/V Thunder.

Source: Northern Telecommunications Consultants, Inc. The image is available on the Internet at http://ntcalaska.com/RESEARCH_VESSEL_THUNDER.php

The specifications of the *R/V Thunder* indicate two onboard main engines, Caterpillar C-181, 1,001 horsepower (hp) each, two Hamilton 461 jets 900 hp each, and two 20 kilowatt (kW) generators. The analysis assumed use of all six engines for the full 20 days of operation, 24 hours per day.

The emission factors in Table C-2 were applied to the vessel specifications. No emission reduction controls were assumed. The data from Table C-2 was used to calculate total projected emissions, which are summarized in Table C-3 *Projected Emissions*.

Table C- 2. Diesel Engine Emission Factors

Pollutant	Emission Factors (pollutant per power unit)[1/] g/hp-hr	
	> 600 hp	< 600 hp
CO	2.4	3.03
NO_X [2/]	11	14
PM [3/]	0.32	1
SO_X [4/]	1.468	1.468
VOC [5/]	0.33	1.12

1/ Based on engines without any pollution control devices or technologies.
2/ Assumes all NO_X are comprised of NO_2.
3/ Assumes all particulate matter is defined as PM_{10}.
4/ Assumes all SO_X in the fuel is converted to SO_2.
5/ Defined as total organic compounds.
6/ CO2 emission factor, based on 40 CFR 600.113, and published by EPA at http://www.epa.gov/otaq/climate/documents/420f11041.pdf

Table C- 3. Projected Emissions

Emission Sources	Projected Emissions (in tons for the total project)				
	CO	NO_x	PM_{10}	SO_x	VOC
Main Engines	2.54	11.64	0.34	1.55	0.35
Propulsion Engines	2.28	10.47	0.30	1.40	0.31
Generator Sets	0.09	0.40	0.03	0.04	0.03

Total	**4.91**	**22.51**	**0.67**	**2.99**	**0.70**

Note: Total may not sum exactly due to rounding.
Source: Form BOEM-0138.

The primary criteria pollutants caused by engines operated on the *R/V Thunder* are NO_2, CO, and SO. Emissions of NO_2 emissions are caused by the high pressures and temperatures during the combustion process, whereas emissions of CO, PM, and VOC are due to incomplete combustion. Ash and metallic additives in the fuel contribute to the content of PM_{10} in the exhaust. Projected emissions of SO_2 are mainly linked to the sulfur content of the fuel rather than any combustion variable. Emissions from the combined operation of the equipment would not have the potential to exceed 100 tons per year for any regulatory pollutant.

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