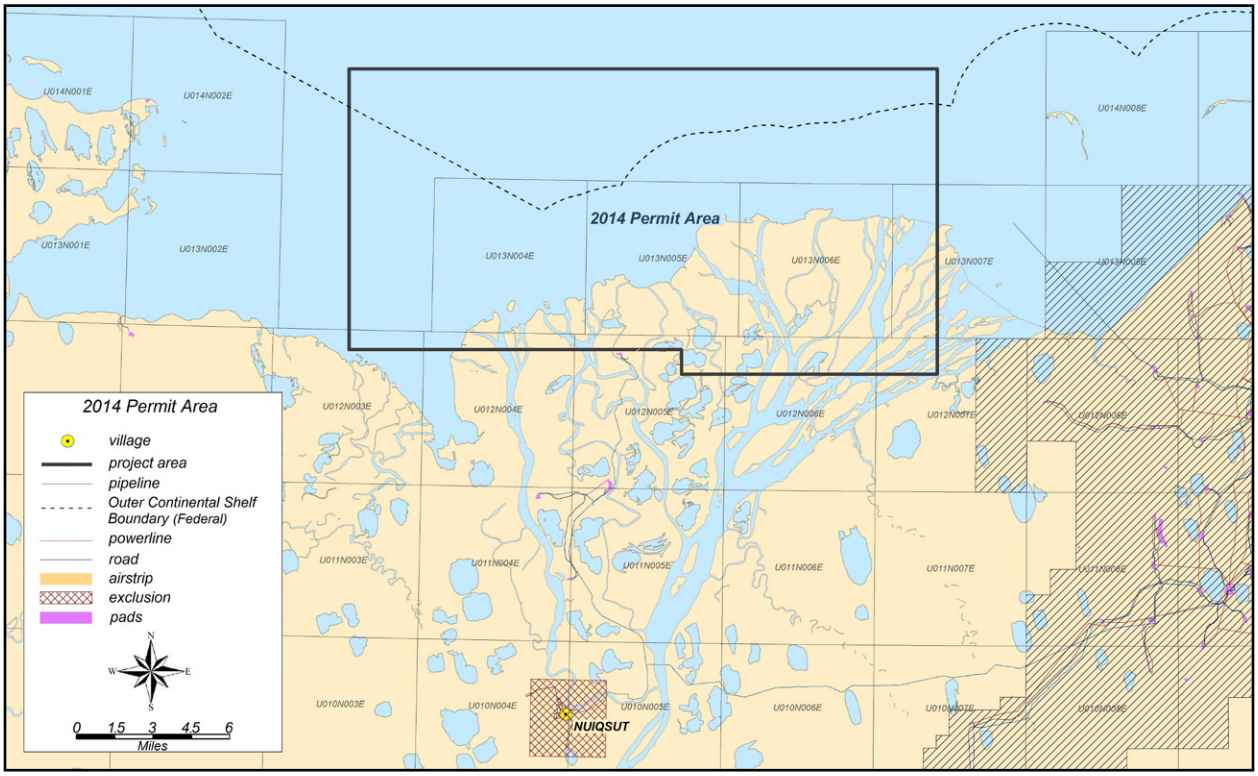
Alaska Outer Continental Shelf

OCS EIS/EA
BOEM 2014-007

SAExploration 2014 Geophysical Seismic Survey Beaufort Sea, Alaska

ENVIRONMENTAL ASSESSMENT

Prepared By:
Office of Environment
Alaska OCS Region



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

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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 .....Clean Air Act
CEQ .....Council on Environmental Quality
CFR .....Code of Federal Regulations
CO .....carbon monoxide
CSESP .....Chukchi Sea Environmental Studies Program
CWA.....Clean Water Act
EA.....Environmental Assessment
EFH .....Essential Fish Habitat
EIS.....Environmental Impact Statement
EJ.....Environmental Justice
EP .....Exploration Plan
EPA .....U.S. Environmental Protection Agency
ESA .....Endangered Species Act
FR.....Federal Register
FWS.....U.S. Fish and Wildlife Service
G&G .....Geological and Geophysical
IPCC .....Intergovernmental Panel on Climate Change
km/h.....Kilometers per Hour
LOA.....Letter of Authorization
mi/h.....Miles per Hour
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
NO_x.....Nitrogen Oxides
NSB .....North Slope Borough
OCSLA.....Outer Continental Shelf Lands Act
OCS .....Outer Continental Shelf
PEA .....Programmatic Environmental Assessment
PSD.....Prevention of Significant Deterioration
PSO.....Protected Species Observer
SAE .....SAExploration Holdings Inc.
SO_2 .....Sulfur Dioxide
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 PURPOSE AND NEED

SAExploration Holdings, Inc. (SAE) submitted a Geological and Geophysical (G&G) permit application (hereafter "SAE G&G Seismic Survey Application #14-01") to the Bureau of Ocean Energy Management (BOEM) on November 4, 2013 to conduct a three-dimensional (3D) on-ice seismic survey in the U. S. Beaufort Sea (SAE, 2013a). As part of its survey, SAE also intends to conduct operations on State of Alaska lands. In this environmental assessment (EA), the term Proposed Action refers to the entire survey area. The survey would be conducted between February 15, 2014 and May 31, 2014.

The Proposed Action would occur north of the Colville River Delta area on land and primarily on bottom-founded ice of the U.S. Beaufort Sea in both Federal and State jurisdictional waters (see Figure 1). BOEM has jurisdiction to permit G&G surveys (30 CFR Part 551) occurring in and limited to the Federal Action area seaward of the Federal-State Boundary (see Figure 1).

To inform its decision-making, BOEM decided to prepare an environmental assessment pursuant to 46 DM 43.000. Further, BOEM assumes that the survey activities in the area under State jurisdiction are an interdependent part of the larger action, and depend on the larger action for their justification. Accordingly, the portion of the Proposed Action under State jurisdiction is treated as a connected action for purposes of NEPA analysis. However, any permits and associated restrictions issued by BOEM subsequent and pursuant to this analysis apply only to activities in the U.S. waters seaward of the Federal-State Boundary (see Figure 1).

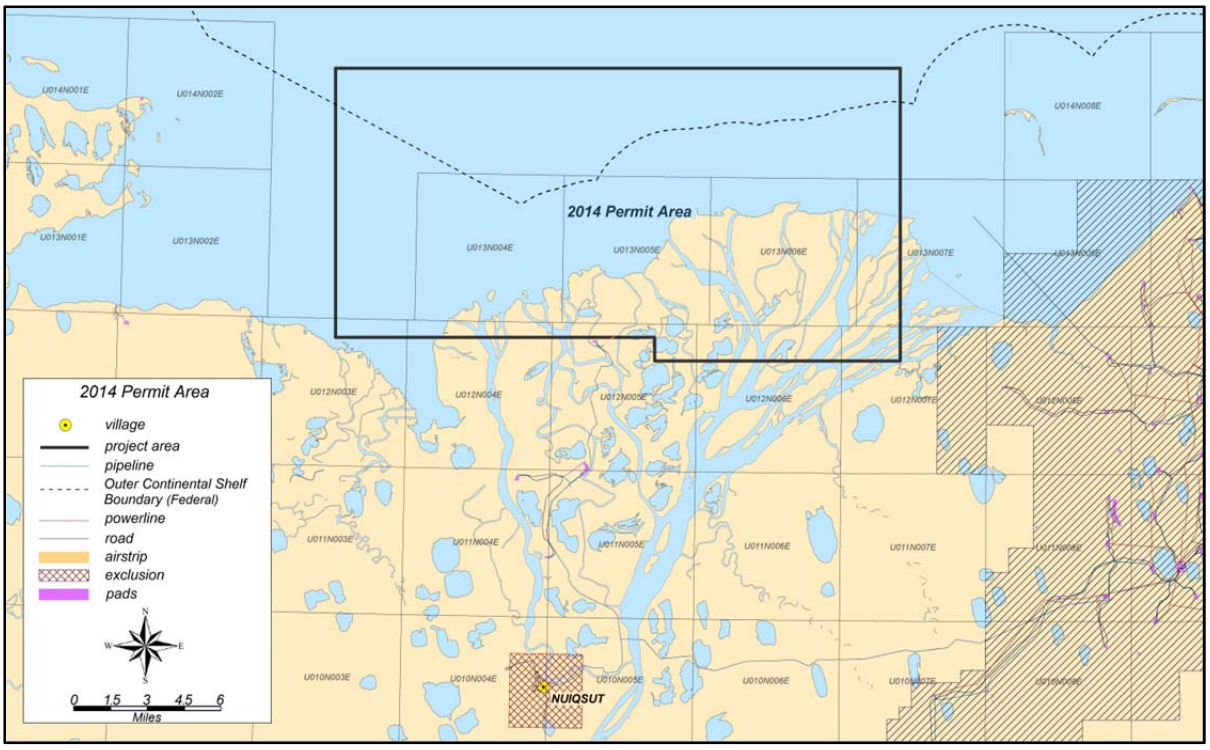

Figure 1. Proposed Action Area

Source: SAExploration (SAE, 2013b: Appendix A)

1.1. Purpose of the Proposed Action

The Outer Continental Shelf Lands Act (OCSLA)(43 USC §1332) requires the Outer Continental Shelf (OCS) to 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. The purpose of the proposed seismic program is to gather geophysical data that will be used to identify and map potential hydrocarbon-bearing formations and the geologic structures that surround them. This information will provide critical insight into the geologic evolution, basin architecture, and depositional and structural history of the petroleum system.

BOEM has prepared this EA to determine whether the Proposed Action would result in significant effects to the environment, and to assist the agency in making an informed decision on the Proposed Action in accordance with the following:

- National Environmental Policy Act (NEPA) (42 USC 4231 *et seq*).
- Council on Environmental Quality (CEQ) regulations at 40 CFR Part 1500 (specifically 1501.3(b) and 1508.27).
- Department of the Interior (DOI) regulations at 43 CFR Part 46.
- DOI policy in Section 516, Chapter 15 of the Department of the Interior Manual (DM) (516 DM 15).

Permit applications to conduct such seismic survey activities in areas under Federal jurisdiction are submitted pursuant to Federal regulations for Geological and Geophysical (G&G) Explorations of the Outer Continental Shelf (OCS) at 30 CFR Part 551.

1.2. Previous Applicable Analyses

NEPA requires Federal agencies to use a systematic, interdisciplinary approach to protecting the human environment, which is broadly construed to include the natural and physical environment, and the relationship of people with that environment. This approach ensures the integrated use of the natural and social sciences in any planning and decision-making that may have an impact on the environment. The level of NEPA review for a particular proposed project depends on the OCSLA stage (516 DM 15), the scope of the Proposed Action, and the agency's findings on the potential effects of the Proposed Action.

BOEM has completed previous NEPA reviews of Beaufort Sea OCS activities. Documents relevant to the current analysis include:

- 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").
- Environmental Assessment – Shell Offshore, Inc., 2012 Revised Outer Continental Shelf Lease Exploration Plan, Camden Bay, Beaufort Sea, Alaska. (OCS EIS/EA BOEMRE 2011-039) (USDOI, BOEMRE, 2011) (hereafter "2012 Shell Camden Bay Revised EP EA").
- Environmental Assessment – Proposed OCS Lease Sale 202, Beaufort Sea Planning Area. (OCS EIS/EA MMS 2006-001) (USDOI, MMS, 2006b).
- Environmental Assessment – Proposed OCS Lease Sale 195, Beaufort Sea Planning Area. (OCS EIS/EA MMS 2004-028) (USDOI, MMS, 2004).
- 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, Beaufort Sea and Chukchi Sea, Alaska, ION Geophysical, 2012 Seismic Survey, (OCS EIS/EA BOEM 2012-817), October 2012 (USDOI, BOEM, 2012) (hereafter "2012 ION Seismic Survey EA").

- Environmental Assessment, Beaufort Sea and Chukchi Sea Planning Areas, ION Geophysical, Inc. Geological and Geophysical Seismic Surveys, (OCS EIS/EA BOEMRE 2010-027) September 2010 (USDOI, BOEMRE, 2010a) (hereafter "2010 ION Seismic Survey EA").

The EA and EIS documents above, and others, are available on the BOEM Alaska Region website at: http://www.boem.gov/ak-eis-ea/. Relevant sections of some of these documents are summarized and incorporated by reference in this EA. This EA builds upon these previous analyses by analyzing site- and project-specific information, and by incorporating new information from recent scientific studies.

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2.0 PROPOSED ACTION AND ALTERNATIVES

2.1. Summary of Alternatives

2.1.1. Alternative 1 – No Action

Under this alternative, BOEM would not approve the 2014 SAE G&G Seismic Survey Application #14-01 and the proposed seismic survey would not occur in areas under jurisdiction of the United States.

2.1.2. Alternative 2 – Proposed Action

Under this alternative, BOEM would approve SAE G&G Seismic Survey Application #14-01 and the 3D seismic survey would occur on land and on bottom-founded ice of the U.S. Beaufort Sea in both Federal and State jurisdictional waters, beginning February 15 and concluding May 31, 2014.

2.2. Description of the Alternatives

2.2.1. Alternative 1 – No Action

Under this alternative, BOEM would not approve the SAE G&G Seismic Survey Application #14-01 and the proposed seismic survey would not occur in areas under jurisdiction of the United States. SAE would not be able to identify and map potential hydrocarbon-bearing formations and the geologic structures that surround them, which could slow or prevent future development of these formations.

2.2.2. Alternative 2 – Proposed Action

BOEM would approve SAE G&G Seismic Survey Application #14-01 for activities in the area under Federal jurisdiction, and SAE's proposed 3D seismic survey would occur on land and on bottom-founded ice of the U.S. Beaufort Sea during the open tundra season of winter 2014, beginning February 15, 2014 and concluding no later than May 31, 2014.

2.2.2.1. Overview

The survey area encompasses approximately 221 square miles (572 km^2), including approximately 149 square miles (386km^2) of State of Alaska lands and waters and approximately 72 square miles (186 km^2) of federal waters of the U.S. Beaufort Sea (SAE, 2013b).

2.2.2.2. Schedule

Preliminary scouting activities and camp setup may begin as early as February 15, 2014. On ice vibroseis activity is anticipated to start approximately March 1, 2014, depending on conditions.

2.2.2.3. Seismic Survey

Seismic operations would be conducted using 12 rubber-tracked vibroseis vehicles (seismic source), operating in groups of four. Receiver (geophone) lines would be placed perpendicular to source lines, a minimum of 660 feet (201 m) apart. Geophones would typically be located every 110 feet (33 m) along the lines, laid out by crews using rubber tracked vehicles or operating on foot.

2.2.2.4. Monitoring and Mitigation

Ringed seals are listed as threatened under the Endangered Species Act. As a condition of this permit, BOEM will require SAE to implement mitigation measures to avoid damaging seal lairs or harassing or injuring ringed seals. These mitigation measures include surveying all on-ice travel routes and operation areas where ringed seals may occur using a 150 m (492 ft) buffer around each travel route

and seismic source. Protected species observers (PSO) would be present to detect any ringed seal activity. Operations must cease immediately if any damage to a seal lair occurs and SAE would contact BOEM before it could restart operations.

3.0 AFFECTED ENVIRONMENT

This section describes the environmental conditions and resources in areas potentially affected by the Proposed Action.

3.1. Expected Operating Conditions

3.1.1. Climate Change

The Council on Environmental Quality (CEQ), which oversees the implementation of the NEPA, recognizes that there may be potential health and environmental effects associated with emissions of greenhouse gases (GHG) and climate change that may be relevant to proposed Federal actions. Therefore, the CEQ issued draft guidance in 2010 advising Federal agencies to consider opportunities to reduce GHG caused by proposed Federal actions, and evaluate the relativity of the actions with respect to the effects of climate change (CEQ, 2010). This guidance asks Federal agencies to consider, in the context of the NEPA process, how Federal actions contribute to the emissions of GHG and how climate change could potentially influence the natural resources affected by Federal actions.

Because the Proposed Action is located in the Beaufort Sea OCS of the Arctic region, which is of particular importance to global climate and especially sensitive to climate change, this section describes climate and climate change in the Arctic and how changes in Arctic climate may affect the natural resources evaluated in this environmental review.

The Intergovernmental Panel on Climate Change (IPCC) held the Twelfth Session of Working Group I in Stockholm, Sweden, from September 23-26, 2013, wherein the underlying scientific and technical assessment of the IPCC Fifth Assessment Report (AR5) was approved (IPCC, 2013). The AR5 provides a "comprehensive assessment of the physical science basis of climate change, drawing on the scientific literature accepted for publication" up to March 15, 2013. The report indicates that while the annual mean sea ice extent is increasing in the Antarctic, the extent of sea ice over the Arctic Ocean continues to decrease. The decrease in Arctic sea ice extent is most rapid in the summer and would not be expected to affect permafrost or influence the construction or operation of proposed onshore base camps associated with the Proposed Action in February through May, 2014. Changes to habitat over the North Slope are already evident as the shrub-line and the tree line are moving farther north and species from other biomes and ecosystems are moving into Alaskan systems, which indicates a change in distribution and abundance of particular species. Coastal erosion could occur that further alters habitat, and storm surges may produce changes in the dynamics of rivers and deltas affecting fish populations. These and other effects of climate change are considered in the discussion of existing conditions, and effects by and on the Proposed Action for the several environmental resources are included in this environmental review.

3.1.2. Meteorology

The Proposed Action would occur from February 15, 2014 through May 31, 2014. Seismic vibroseis activities are expected from approximately March 1 through May 31. The seismic operations are proposed during open tundra travel winter season on the Proposed Action area on the Beaufort Sea OCS. Based on 1961-1990 historical records for Barrow, Alaska (WRCC, 2012), temperatures in February and March in the project area are expected to remain below zero degrees Fahrenheit (°F) (-17.8°C), with average daily high temperatures of minus 10°F (–12.2°C) and average daily low temperatures of minus 22°F (-30°C). Warmer temperatures will prevail during April and May with average daily high temperatures of 14°F (-10) and average daily low temperatures of 3°F above zero (-16.1°C). The record low temperatures during the period of proposed operations range from minus 56°F (-48.8°C) in February to minus 19°F (-28.3°C) in May. Most of the annual water equivalent

precipitation occurs in the summer; therefore, less than one inch would be expected throughout the period from February through May, all of which would occur as snowfall or other frozen precipitation. The average wind speed can be expected to be 11-12 miles per hour (mi/h) (17.7-19.3 km/h) generally from the east.

A multiyear meteorological study that includes data from stations along the Beaufort Sea coastline at Barter Island, Kaktovik, Deadhorse, and Nuiqsut suggests the trend for wind patterns on the North Slope is 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 (48.2 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. When considering the average wind speeds and temperatures common to the North Slope, daily wind chills will likely be minus 35°F (-37.2°C) in the months of February and March, increasing to zero to minus 5°F (-17.8°C to -20.6°C) by late May. Occasional sudden storms can occur and the lack of natural wind barriers results in unrestricted winds across the shoreline of the North Slope. The combined effect of cold temperatures and strong winds during storms makes the North Slope a wind-chill risk to persons exposed to outside conditions for even brief periods of time (5 to 10 minutes). In extreme cases, the wind chill could drop as low as minus 45°F to minus 55°F (-42.7 to -48.3°C) in February and early March.

3.2. Resources

3.2.1. Air Quality

The existing condition of air quality in the vicinity of the Proposed Action is largely a function of the few emission sources existing on the coastline of the North Slope adjacent to the Beaufort Sea and meteorological conditions, mainly wind, over the open water. The offshore waters of the Beaufort Sea typically experience steady east winds averaging 11-12 mi/h (17.7-19.3 km/h) 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. Pollutants are diluted during transport, which decreases pollutant concentrations and reduces the environmental impact of emissions caused by the Proposed Action (Ahrens, 2009). Thus, the wind conditions over the area proposed for seismic operations together with the relatively few pollutant sources either onshore or offshore causes the quality of the air over the affected area to be consistently better than required by federal standards (ADEC, 2011).

3.2.2. Water Quality

Water quality describes the chemical and physical characteristics of water, usually in respect to its suitability for a particular purpose such as for conserving the capacity of fish and wildlife to carry on biological cycles of life.

Beaufort Sea water quality is described in more detail in the Beaufort Sea Multiple-Sale EIS (USDOI, MMS, 2003, Section III.A.5, pages III-23 through III-27), incorporated here by reference. Beaufort Sea waters are influenced by wind and storms, spring river runoff, and sea ice formation and melt. Water quality in the Beaufort Sea naturally varies throughout the year related to seasonal biological activity and naturally occurring processes, such as formation of surface ice, seasonal plankton blooms, naturally occurring hydrocarbon seeps, seasonal changes in turbidity due to terrestrial runoff, and localized upwelling of cold water from the Barrow Canyon. The rivers and streams that flow directly into the nearshore environments of the Beaufort Sea, such as the Colville River, contribute

sediments and minerals to the marine system, affecting salinity, temperature and other aspects of water.

Several scientific studies have also contributed to the knowledge of water quality in the Beaufort Sea (Dunton et al., 2005; Naidu et al., 2012) and indicate the water quality of the Beaufort Sea is within the criteria for the protection of marine life according to Clean Water Act (CWA), Section 403. No waterbodies are identified as impaired (CWA, Section 303) within the Arctic Region by the State of Alaska.

3.2.3. Lower Trophic Levels

Complete descriptions of the lower trophic landfast ice biota (collectively known as epontic organisms, or those living on and in the ice) present in the affected environment are found in the Beaufort Sea Multiple-Sale EIS (USDOI, MMS, 2003), Section III.B.1 (Pages III 29-30). Further information is in the 2012 Shell Camden Bay Revised EP EA, (USDOI, BOEMRE, 2011), Section 3.2.3 (Pages 45-46). During the operating time of the Proposed Action, epontic organisms from landfast ice will be the only lower trophic resources affected by the Proposed Action and the only lower trophic organisms considered in this analysis. Therefore, following is a brief summary of the above references and new information regarding the landfast ice environment.

Landfast ice is known to provide habitat for a diverse and abundant flora and fauna, collectively known as epontic organisms (Gradinger, Kaufman, and Bluhm, 2009). These organisms include amphipods, nematodes, single cell protozoans, larvae of many species including crabs, bivalves, and worms, with the extreme seaward edges of the ice harboring early developmental stages of fish species such as Arctic cod (Hopcroft et al., 2008). Ice algae is commonly the primary contributor to the biomass found within landfast ice (Arrigo, Mock, and Lizotte, 2010). Ice algae are dominated by diatoms (Melnikov et al., 2002). More than 250 species were identified in just two ice cores taken by von Quillfeldt, Ambrose, Jr. and Clough (2003) during work done in the Chukchi Sea. In a study of landfast ice near Barrow, Alaska, it was shown that ice algae may contribute as much as 74% of the benthic productivity in the winter months before spring breakup and the onset of pelagic, open water algae blooms (Lee, Whitledge, and Kang, 2008). That makeup of the flora and fauna associated with the ice is dependent upon conditions at formation (Pickart et al., 2013). The formation of the ice and its resultant flora and fauna is highly influenced by upwelling of nutrients from the outer shelf and through freshwater input such as that from the nearby Colville and Ublutoch Rivers.

3.2.4. Fish

Descriptions of fish resources of the Beaufort Sea are detailed in the Beaufort Sea Multiple-Sale EIS (USDOI, MMS, 2003: Section III.B.2, pages III-31 through III-36) and the 2012 Shell Camden Bay Revised EP EA (USDOI, BOEMRE, 2011, Section 3.2.4, pages 46-47). Those documents are summarized here to describe a seasonally abundant and diverse fish population in the Harrison Bay area of the Beaufort Sea.

There are 36 known species of fish that occur in the Beaufort Sea (Mecklenburg et al., 2007; Logerwell and Rand, 2008). Fish species that are widespread in the Beaufort Sea include Arctic cod, saffron cod, sculpins, sand lance, capelin, flounders, poachers, eelpouts, snailfishes, pink salmon, chum salmon and herring (Schmidt, McMillan, and Gallaway, 1989; Thorsteinson, Jarvela, and Hale, 1991). Small demersal fish are abundant in the Beaufort Sea and their distribution is characterized by sediment type, bottom salinity and bottom temperature (Logerwell and Rand, 2008; Norcross et al., 2010). Several species, such as saffron cod and capelin, move on and offshore seasonally for spawning using shallower waters for spawning and rearing in autumn and winter. Some of the rivers entering the Beaufort Sea provide estuarine and freshwater habitat for several anadromous species including salmon, Dolly Varden, whitefish, cisco and smelt. Saffron cod, Arctic flounder, and

snailfish use the nearshore area; however, their occurrences are sporadic and variable and in much lower numbers than those for most other species.

Sea water temperature and salinity affect the distribution and behavior of fish in the Beaufort Sea. During the summer months, some species move shorewards and feed nearshore on the abundant epibenthic fauna (Craig, 1984). As summer progresses, the nearshore zone becomes more saline due to decreased freshwater input from coastal rivers and streams. In fall, when diadromous fishes move into freshwater systems to spawn and overwinter, some of these marine fish species remain in the nearshore area to feed (Craig et al., 1985).

As nearshore ice thickens in winter, marine fishes probably continue to feed under the ice but eventually depart the area and move further offshore as ice freezes to the bottom at approximately 2 m (6 ft) thick. Seaward of the bottomfast ice, marine fishes continue to feed and reproduce in nearshore waters during winter (Craig, 1984).

Saffron cod occur primarily in nearshore waters. Unlike Arctic cod, they do not specifically associate with ice. Arctic cod are more concentrated along the interface between the warmer nearshore water and colder marine water.

Arctic cod and Pacific salmon that occur in the Beaufort Sea are discussed further below.

Arctic Cod. The Arctic cod is widely distributed throughout the U.S. Beaufort Sea, depending on season and life history stage. Arctic cod inhabit offshore and nearshore areas without ice during warmer times of year (Bradstreet and Cross, 1982; Bradstreet, 1982; Cross, 1982; Crawford and Jorgenson, 1993; Gradinger and Bluhm, 2004). Frost and Lowry (1983) found smaller Arctic cod more often in water less than 100 m (327 ft) deep. Craig et al. (1982) found adult and juvenile Arctic cod in shallow nearshore waters (1-12 m (3.2 – 39.4 m) in the Beaufort Sea in summer. Copepods and amphipods are common prey for Arctic cod in open water (Lowry and Frost, 1981; Benoit et al., 2010).

Arctic cod are associated with sea ice, using it at various life stages and seasons for shelter and as a forage habitat. Amphipods on the underside of ice are an important food source for Arctic cod (Lonne and Gulliksen, 1989; Gradinger and Bluhm, 2004). Arctic cod spawn under the offshore ice between November and February in the U.S. Beaufort Sea (Craig et al., 1982) and the larvae then drift into pelagic waters during the summer months.

Pacific Salmon. Pacific salmon occur in the Beaufort Sea (Craig and Haldorson, 1986; Babaluk et al., 2000); pink and chum salmon are the most common of the five species. Craig and Haldorson (1986) summarized the distribution of Pacific salmon in Arctic Alaska:

> All five North American Pacific salmon species occur in small numbers in Arctic waters, but only pink and chum salmon appear to have viable populations north of Point Hope, Alaska. Pink salmon are the most common species and constitute 85% of salmon caught in biological surveys. Pink salmon apparently have small runs in eight Arctic drainages, while chum salmon may have small runs in six. Arctic pink salmon are smaller in size than individuals to the south but have similar meristic characteristics. It is likely that minimal use of freshwater habitats by pink and chum salmon has allowed them to colonize characteristically cold Arctic rivers.

Populations of salmon may have a difficult time establishing and persisting in the Arctic, most likely because of the limitation of freshwater spawning habitats which freeze over in winter and are not suitable for overwintering eggs and young (Craig, 1989; Fechhelm and Griffiths, 2001). Craig and Haldorson (1986) identified seventeen water bodies that apparently support small populations of pink and chum salmon, including an isolated spawning stock of chum and pink salmon occurring in the Colville River.

3.2.5. Marine and Coastal Birds

Full descriptions of the most important marine and coastal bird species in the Beaufort Sea are provided in the Beaufort Sea Multiple-Sale EIS (USDOI, MMS, 2003; sections III.B.4.a(2) (page III-49) and III.B.5 (page III-50)). Those descriptions document that marine and coastal birds that occur in the Beaufort Sea OCS are there during the open-water season. Some marine and coastal birds may breed outside the project area, but spend time in the Beaufort Sea after breeding or during their non-breeding seasons. Arrival times usually coincide with the formation of leads during spring migration to coastal breeding areas. Spring migration for birds arriving in the Beaufort Sea takes place during late May.

3.2.6. Marine Mammals

Full descriptions of marine mammals in the Beaufort Sea are provided in the Beaufort Sea Multiple-Sale EIS (USDOI, MMS, 2003: sections III.B.6 (pages III-54 through 58) and III.B.4 (pages III-39 through 49)).

The effects of Alternative 2 are described in the effects analyses in section 4. Only polar bears and ringed seals, known to appear in the project area during the Proposed Action timeframe, will be analyzed further. Polar bears and ringed seals are the only mammals likely to overlap spatially or temporally with the planned activities. Cetaceans, terrestrial mammals, Pacific walruses, and seal species other than ringed seals would not be subject to disturbances produced by the proposed action and will not be analyzed further.

Polar Bear. Polar bears occur throughout the Beaufort Sea. Polar bears spend most of the year on ice hunting, often moving great distances in search of prey, primarily ringed and bearded seals. Pregnant female polar bears den in snow banks found on ice near pressure ridges and on shore near cut banks and other features. Polar bears typically enter dens in the fall, give birth, and remain in or near their dens until they leave with their cubs in March or April. When disturbance events cause females with cubs to abandon their den sites early, cub survival rates can be impacted. Cubs will remain with the mother for two to three years. For most of the year, polar bears appear to be relatively insensitive to noise or other human disturbances (Amstrup, 1993). Polar bears may avoid human activities or may be drawn to investigate. Reactions vary between individual bears, with females accompanied by cubs being most cautious. Polar bears were listed as a threatened species under the Endangered Species Act (ESA) in 2008 (73 *FR* 28212, May 15, 2008).

Ringed Seal. During winter and spring ringed seals construct subnivian lairs where they can rest and whelp while accessing flaws and lead systems. These dens are crucial to the survival of adult and newborn ringed seals due to the protection they provide from predators and the elements. Ringed seals whelp from mid-March through mid-May, producing a single pup that typically remains in its birth den for its first weeks of life. Ringed seals prefer water depths >20 m (66 ft)., however they can occur in waters as shallow as 3 m (9.8 ft) (Williams et al., 2006; Moulton et al., 2002). In 2012 ringed seals were listed as threatened under the ESA (77 *FR* 76705, December 28, 2012).

3.2.7. Subsistence Activities, Environmental Justice, Public Health and Archaeological Resources

Subsistence activities are a critical element of North Slope Borough (NSB) social systems. Communities dependent on subsistence consider it a collective and cultural right (and duty) rather than an individual right since limited numbers of individuals provide for the larger community (Ristroph, 2010). This EA will address specific components of resources most relevant to subsistence, environmental justice, public health, and economy impacting Nuiqsut, the community closest to the Proposed Action.

3.2.7.1. Subsistence Activities

Subsistence Communities

Subsistence activities are of high cultural 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. This contributes to social pathology, as a subset of cultural change, as highlighted by public testimony (Wernham, 2007).

Use of traditional food provides important benefits to communities and subsistence foods are often preferable as they are rich in many nutrients, lower in fat, and healthier than purchased foods. The Alaska State Division of Subsistence states about 38.3 million pounds (lbs) of wild foods are taken annually by residents of rural Alaska, or about 316 lbs per person per year. (ADF&G, 2010). Previous harvesting practice studies indicated that NSB communities alone have had an annual harvest of between 153.2 to 665.3 lbs (69.6 to 301.8 kg) per person (Einarsson et al., 2004). Subsistence activities underscore central values and cultural activities for communities of the North Slope, strengthen families and communities, and allow for retention of traditional culture and ways of life. Subsistence harvesting provides strength, purpose, and unity in the face of rapid change for NSB communities (EDAW/AECOM, 2007) and is unquestionably important even with the use of resources other than whales. Nuiqsut subsistence resources and harvest periods in the project area are described below. Table 1 identifies resources and months of harvest, along with transportation modes utilized to reach harvest locations, and harvest locations identified by local residents (SRB&A, 2010).

Table 1. Subsistence resources and approximate harvest periods, methods, and locations.

Subsistence Resource	Harvest Month(s)	Harvest Transportation	Harvest Locations
Ringed Seal	March – December	Boat, snowmachine	Cape Halkett west and Camden Bay east; Offshore from the Colville river delta between Atigaru Point and Thetis Island up to approximately 20 to 25 miles from shore, with some travel up to 40 miles from shore
Bearded Seal	May – October	Boat, snowmachine	West to Cape Halkett, east to Camden Bay, offshore up to 40 miles, offshore up to 20 miles between the mouth of Fish Creek and Thetis Island.
Caribou	June – September	Boat, snowmachine	Colville, Itkillik, Chandler, Anaktuvuk, and Kikiakrorak rivers; along the coast between Atigaru Point and Oliktok Point; in an overland area surrounding Fish Creek, Judy Creek, and Colville River west, Colville River and Itkillik River east
Broad Whitefish	January – November (Primary month: July)	Boat, snowmachine	Colville River between the mouth and Sentinel Hill area, Fish Creek, Itkillik River, Chipp River, in some area lakes; Nigliq Channel in the easternmost channel of the Colville River delta
Burbot & Grayling	October and April	Snowmachines, trucks	Colville River just past the mouth of Itkillik River, along Nigliq Channel, at several locations on Fish Creek, and at the mouths of Chandler and Anaktuvuk rivers.
Geese	April and June (noted that travel conditions deteriorate as May progresses into June, and that hunters must move closer to the coast as the season wears on.	Snowmachine, boat	Colville River, Itkillik River, Fish Creek, and Judy Creek. Along the Colville River at various locations south of the community (including areas north and south of Itkillik River, near Ocean Point, and near the mouths of Kikiakrorak and Kogosugruk rivers), and north of the community along Nigliq Channel.

Subsistence Resource	Harvest Month(s)	Harvest Transportation	Harvest Locations
Eider	April and September (Primary month: July)	Boat, snowmachine	Beaufort Sea between Atigaru Point and the mouth of Kuparuk River and farther east in the community's bowhead whale hunting area; along the Colville River delta, along Fish Creek, and near Ocean Point in the Colville River
Camps and Cabins (Thetis Island and Mainland)	Summer and fall months residents harvest fish, caribou, moose, and marine mammals		Colville River (especially along Nigliq Channel and the east channel, and near Itkillik River, Ocean Point, Sentinel Hill, and the mouths of Chandler and Anaktuvuk rivers) and along Fish Creek and Judy Creek. In addition to these locations, residents reported staying in camps and cabins along Chipp River, near Teshekpuk Lake, near Kuparuk River, and at a number of island and coastal locations, including Thetis Island, Cross Island, and Oliktok Point.

Subsistence Community

Nuiqsut

Nuiqsut is a coastal community 17 miles inland from the Beaufort Sea along the western shore of the Colville River along the Nigliq Channel. Thetis Island and Cross Island, from which Nuiqsut hunters' base seal, eider, and whaling activities, respectively, are located to the northeast. Table 1 and the following discussion identify subsistence resources, harvest areas, and related activities overlapping with the Proposed Action area. 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).

Nuiqsut residents rely on a variety of marine and terrestrial subsistence resources throughout the year. Migratory animals such as bowhead and beluga whales, seals, numerous fish species, birds, and terrestrial based animals comprise a substantial portion of the Nuiqsut subsistence diet. (SRB&A, 2010).

Nuiqsut residents harvest all year around gathering as many resources as necessary to provide nutritional needs for the year. Most subsistence activity occurs distant from the village, up to 40 miles north from the mouth of the Nigliq Channel with summer being the busiest time for harvesting. (SRB&A, 2010). Hunters use ice and marine environments for harvesting whales, seals, ducks, and caribou.

Camps or Cabins on Thetis Island and the Mainland Coast

Nuiqsut residents report traveling to camps and cabin locations throughout the year when conducting subsistence activities. The majority of these camps or cabins are located along the Colville River (especially along Nigliq Channel and the east channel, and near Itkillik River, Ocean Point, Sentinel Hill, and the mouths of Chandler and Anaktuvuk rivers) and along Fish Creek and Judy Creek (SRB&A, 2010). During winter months, residents have reported staying at many of the same cabins and camps used during the summer and fall along Colville River. Residents report camping in farther removed locations as near Teshekpuk Lake, west of Nuiqsut, while hunting caribou (SRB&A, 2010).

Use of camps and cabins are important, allowing residents to take extended trips during subsistence activities. Hunts may start in May, increase in June, and continue through September. Residents report harvesting marine mammals, fish, and caribou from these camps. Many camps and cabins are located in the southeastern most part of the project on the Colville River Delta.

Subsistence Resources

Bowhead Whale (*aġviq*)

Bowhead whaling takes precedence over any other subsistence activity, and occurs around late August through October. This resource will not be part of the affected environment during this project period from February – May.

Spotted Seal (*Qasigiaq*)

Nuiqsut residents travel to hunt seal March through December. Spotted seal, unlike ringed and bearded seal, is not a primary subsistence resource.

Ringed Seal (*natchiq*)

Nuiqsut hunters harvest ringed seal in the Beaufort Sea March through December, with the highest levels of subsistence activity in April and again in June–September. Hunters who are searching for bearded seal may simultaneously look for ringed seal and cite equal preference for the two species (SRB&A, 2012). Braund Map 133 (SRB&A, 2012) identifies ringed seal use areas and a high number of these areas extend east to Thetis Island and west through Harrison Bay. Hunters report traveling as far off shore as 30 miles in search of ringed seals (SRB&A, 2010). Hunting distance depends primarily on the location of ice pack, as seals migrate with the ice pack, rest on the ice floes and feed near the ice. A number of Nuiqsut hunters have reported traveling farther than Thetis Island, to Spy or Pingok Islands, or farther out toward Flaxman Island while others stay closer to the mouth of the Colville River "Close to three miles out. Not too far from Nigliq about two miles, sometimes we go north and sometimes southeast" (SRB&A, 2010: p. 284)

One hunter provided the following detailed description of seal hunting:

> *"At the mouth* [of Colville River] *straight out, six to 10 miles depending on the ice conditions and the time of year. All the way over to Thetis Island. Sometimes we get out about five miles, all the way across, and come over here to Atigaru, keeping about a mile off [from shore]. We can go into the ice. Sometimes it will be broken up enough if you don't see any seals on the open edge you can go in and scout, and I don't try to go in more than half a mile, and if the wind changes the ice will close up on you. You have to pay attention…. Look for bearded and spotted seal, natchiq and ugruk. Spotted seal. No walrus, I look when I am out, but I never see them; they tend to be out here [farther offshore]. Most of the [seals] we catch are in the water. The only time [they are] on the ice floes is on a sunny day, June and July, August, whenever there is time. The ice, it lingers here [just outside delta] until the second week of July, and then it breaks up and moves out. It is all shallow water, and seals won't go to shallow water. They have breathing holes to stay out there, and we have fish coming through here through Colville, Fish Creek and Nigliq Channel; that is where the seals feed year around."* (SRB&A, 2010: Nuiqsut Interview December 2006, p. 290)

Ringed seal use areas are located primarily in the southeast corner of the Proposed Action area but are also located in the southwest and northeast portions of the Proposed Action area.

Bearded Seal (*ugruk*)

Bearded seals are hunted May through October in the ocean by boat, often near Thetis Island. Bearded seal hunting usually occurs near the ice pack. Hunters also look for seals feeding near the mouths of rivers later in summer. Bearded seal hunts usually begin in May and conclude in October. Bearded seal use areas extend as far west as Cape Halkett, as far east as Camden Bay, and offshore up

to 40 miles. The highest numbers of overlapping bearded seal use areas are located offshore up to 20 miles between the mouth of Fish Creek and Thetis Island (SRB&A, 2010). As with the ringed seal, subsistence use areas overlap with the Proposed Action through the southwest, southeast and northwest portions of the Proposed Action.

Caribou (*Tuttu*)

The Teshekpuk Caribou Heard (TCH) has core winter areas to the west of the Coleville River Delta near Teshekpuk Lake. The TCH is unique when compared to other caribou herds that calve along the North Slope, in that it is the only herd in which over 50% of the population typically overwinters on the coastal plain. The villages of Atqasuk, Barrow, and Nuiqsut rely heavily on this herd for a source of protein in winter (Brower and Opie, 1997). Nuiqsut residents harvest caribou throughout the entire year with June-September being predominant hunting months. Most harvests occur along the Colville River between its delta, the Chandler and Anaktuvuk rivers, in an area west of Nuiqsut as far as Fish Creek, and in locations east of the Itkillik and Colville rivers. Braund Map 112 shows Nuiqsut caribou use areas which overlap the southeastern area of the Proposed Action (SRB&A, 2010).

Arctic Cisco (*Qaaktaq*)

The majority of Arctic Cisco originate in the Mackenzie River and each spring a large number of young Arctic Cisco travel to the Beaufort Sea. Many of these fish end up in the Colville River over-wintering in the river (SRB&A, 2010). Arctic Cisco are harvested with nets under the ice. This is a regular seasonal activity in which the majority of Nuiqsut households participate. Designated fish camps where nets are set for Arctic Cisco and other species of fish are near Nanuk Lake and close to the mouth of the Colville River. Residents generally reported targeting Arctic Cisco from October through December. Based on the months when harvests occur this resource will not be part of the affected environment during this project scheduled for February through May.

Arctic Char/Dolly Varden (*paikłuk/iqalukpik*)

Arctic char/Dolly Varden harvesting is a common activity among Nuiqsut residents and generally occurs May through November. This resource will not be part of the affected environment during this project.

Broad Whitefish (*Aanaagæiq*)

Broad whitefish are harvest occurs from January through November. Broad whitefish use areas are shown on Braund Maps 123,124, and 125 (SRB&A, 2010) along the Colville River in Nigliq Channel and in the easternmost channel of the Colville River delta. In addition to harvesting broad whitefish at the Colville River, a number of individuals reported setting nets for broad whitefish in Fish Creek, Itkillik River, Chipp River, and in some area lakes. Nuiqsut residents reported accessing broad whitefish use areas between May and November with the peak fishing season for broad whitefish June through August with the highest number of use areas accessed in July. Based on the months of use by Nuiqsut residents, this will not be part of the affected environment during the project period February to May.

Burbot and Grayling (*Tittaaliq* and *Sulukpaugaq*)

The majority of burbot fishing occurs along the main channel of the Colville River just past the mouth of Itkillik River, along Nigliq Channel, and south of the project area (SRB&A, 2010). Harvesting occurs between October and April. Based on the location of harvest being south of the Proposed Action and the months when harvests occur, this resource will not be part of the affected environment during this project scheduled for February through May.

Geese

Nuiqsut residents harvest several species of geese during the months of April through June: Greater white-fronted goose (kigiyuk niålivailuk), Canada goose (iqsraġutilik), Brant (Niålinåaq) and snow goose (Kaÿuq). A majority of goose harvests are reported in May with hunting occurring in April and June. Hunters have observed that travel conditions deteriorate as May progresses into June and move closer to the coast as the season progresses (SRB&A, 2010). Locations of most recent harvests are depicted on Braund Map 130 around the Colville River near Ocean Point and the mouth of Itkillik River; along Nigliq Channel to the mouth, and in a large area around Fish and Judy creeks. (SRB&A, 2010). Many of subsistence use areas are west of the Colville River Delta but may be found in the southwest portion of the Proposed Action area.

Eider

Nuiqsut residents hunt king eiders (Qiÿalik) and common eiders (Qaugak) May through September. Hunters generally target eiders closer to shore, but will hunt them farther offshore seal hunting areas if they are available and the timing is right. Nuiqsut residents report hunting eider ducks in the Beaufort Sea between Atigaru Point and the mouth of the Kuparuk River and along the Colville River Delta and eastward to within the vicinity of fall whaling areas. Highest numbers of overlapping use eider use areas were reported offshore from the Colville River delta east to Thetis Island (SRB&A, 2010). Hunters commented that Thetis Island is a nesting ground for eiders and a few hunters reported using it as a base for their hunting activities:

> *"Once in a while we go out here on the ice pack, by Thetis Island.* [We hunt eiders] *above* [Thetis] *Island, and sometimes we go over here duck hunting at Atigaru Point. During seal hunting, we're out there duck hunting. We use Thetis Island for base camp.* [There is] *a lot of nesting on Thetis Island; lots of eiders. We see eiders while we are hunting whales. They are nesting on Thetis Island, eider ducks."* (SRB&A, 2010: Nuiqsut Interview November 2005, pp. 276)

3.2.7.2. Environmental Justice (EJ)

Executive Order 12898, February 16, 1994 (EO), "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," requires that each Federal agency consider environmental justice to be part of its mission and that the agency provide an EJ evaluation in an EIS or EA identifying if a Proposed Action would have "disproportionately high adverse human health and environmental effects on minority populations and low income populations." The intent of this EO is to promote fair treatment for 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. According to the 2010 Census, 88.2% of the population (402 residents) of Nuiqsut are Alaska Native (specifically Iñupiat) or American Indian, an identified minority group. This number meets the 50% population threshold for an affected area.

3.2.7.3. Public Health

Good health is essential to cultural sustainability and socio-economic development and is a prerequisite to human productivity and development. A healthy community is the infrastructure upon which is built an economically viable society (Basavanthappa, 2008). Diet and exercise have long been known to play an important role in health. Subsistence harvesting promotes both more healthful diets and exercise while hunting. In rural arctic regions diets consist of both traditional or subsistence foods, and non-traditional or market foods. Subsistence foods have been associated with lower rates of impaired glucose tolerance (a risk factor for diabetes), lower blood pressure, and favorable cholesterol profiles. Moreover, traditional subsistence foods are believed by many to be the very foundation of community health and well-being.

Information on the composition and nutritional content of the diet of NSB residents is limited, but research conducted locally in the NSB has confirmed the high nutritional value of a number of major subsistence foods utilized. The variety of species used for subsistence in the North Slope encompasses marine mammals such as whale, walrus, and seal; caribou and other land mammals; and a wide variety of birds, fish, plants and berries. Moreover, the variety and balance of subsistence foods harvested varies considerably across the eight North Slope villages. An analysis of seal and sheefish in prepared forms traditionally consumed in the NSB found them to be rich in omega-3 fatty acids and other essential nutrients.

The oils and blubber of arctic marine mammals and fish have also been found to contain Vitamins A and D. Vitamin D is of particular importance to people living at high latitudes with low exposure to sunlight. Populations with increased skin pigment and low intake of vitamin-D-fortified dairy products are at particularly high risk of vitamin D deficiency. The role of vitamin D has been suggested to support immune function, cancer prevention, and rheumatoid arthritis in addition to its known role in prevention of skeletal disorders such as childhood rickets. Because nutritional content of the large variety of subsistence foods used has not been completely analyzed, the nutritional value of the NSB subsistence diet may yet be underestimated.

Table 2. Subsistence Food Use among NSB Iñupiat Households (see note)

	Anaktuvuk Pass	Atqasuk	Barrow	Kaktovik	Nuiqsut	Point Hope	Point Lay	Wainwright	NSB
2010 NSB Census	77%	67%	60%	76%	79%	72%	67%	75%	67%
2003 NSB Census	79%	67%	66%	76%	67%	75%	79%	82%	

Note: Percent of households for which at least half the diet came from subsistence foods in the previous year
Source: 2003 NSB Economic Profile and Census and 2010 NSB Census (NSB, 2012).

With increasing modernization, many arctic communities have come to rely more on store-bought foods (Table 2), replacing healthy, nutrient-rich traditional subsistence foods with foods that are often high in sugar, calories, and unhealthy types of fat. Highly-processed foods available in Alaskan village stores are typically low in nutrients. A number of dietary surveys have been conducted in rural Alaska and findings from other regions of Alaska suggest a higher reliance on non-traditional, or "store" foods by younger residents. Considerable dietary variation exists among different regions of Alaska and findings from a sample of regions should not be generalized to all of rural Alaska or to North Slope communities.

Having reliable access to enough food is important to nutritional behavior and overall health. "Food security" refers to the ability to procure enough food at all times and to produce an active healthy life for all household members. Although food security is not an individual health-related behavior but rather a social, political, and economic phenomenon, a discussion of food security is included in this section because of its close association with subsistence harvest foods and impacts on community diets and nutrition. In the NSB, above average transportation costs create higher food prices of store-bought foods, directly impacting community health. If transportation of food to this region were to fail and/or a real or perceived decrease in subsistence harvests occurs, that, coupled with higher food prices and a lack of non-subsistence foods, can result in the availability of less nutritious foods and reduced food security.

The lack of accessibility to a variety of reasonably priced nutritious and fresh foods or subsistence harvest foods can be an obstacle to achieving recommended nutrition from diets (Block and Kouba, 2005). Research shows that people in low income communities pay proportionately more for food that people living in higher income communities. This food security issue in the NSB plays a role not only in public health but also in economic sustainability and environmental justice. In some

communities research has shown that there is an association between under-nutrition, malnutrition, high obesity rates, and decreased economic and social resources (Black and Macinko, 2008).

3.2.7.4. Archaeological Resources

SAE will conduct operations during the winter, over ice and snow with seismic work that will consist of setting up a grid of wireless nodes on the snow or on sea ice. Terrestrial cultural resources will have pre-established buffers as non-activity zones as an added precaution to ensure that no historic properties will be affected.

4.0 ENVIRONMENTAL CONSEQUENCES

Two alternatives for the Proposed Action exist, Alternative 1–No Action, and Alternative 2–Proposed Action.

A cumulative impact is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonable foreseeable actions regardless of what agency or person undertakes such other actions. Appendix B gives a summary of key projects.

The potential for an accidental oil spill was examined. An accidental small spill during refueling has a reasonably foreseeable chance of occurring during any project. A high percentage (50-99.8%) of spills is less than 10 gallons (ADEC, 2007; Anderson, Mayes and LaBelle, 2012; Etkin, 2009). On-ice refueling of the vibroseis buggies and other support vehicles associated with the proposed action has the potential to result in a small spill. None of the proposed action takes place over or near open water. Should a small fuel spill occur, pollution prevention, mitigation and response measures in place would reduce impacts of any fuel spill to a negligible level.

In order to address the potential for a small fuel spill and eliminate or reduce impacts, SAE has adopted the following pollution prevention, mitigation and response practices:

- Fueling procedures include spill management practices such as drip pan placement under any parked vehicle, and placement of vinyl liners with foam dikes under all valves or connections to diesel fuel tanks.
- All fuel tanks are double-wall tank construction.
- Fuel dye is added to all fuel to aid in spill detection.
- All spills, no matter what size, are tracked and cleaned up by SAE, and used to update spill prevention operations.
- SAE holds a Spill Prevention Countermeasure Control (SPCC) plan for their fueling and fuel storage operations associated with their seismic operations. This SPCC plan is site specific.
- Pollution prevention measures are in place to prevent fuel spills from reaching the environment. A small fuel spill would be cleaned up immediately on the frozen ground, sea ice, or snow and disposed of properly.
- Setbacks of 100 feet make it unlikely fuel would reach rivers, streams or lakes.

On this basis, the overall environmental significance of the impact of a small accidental fuel spill to sea ice, snow, frozen ground, water quality, fish species, marine mammals, and lower trophic organisms is considered negligible and is not further considered in this document.

4.1.1. Air Quality

4.1.1.1. Direct and Indirect Effects

Alternative 1 – No Action

Selection of the No Action Alternative would not result in any adverse direct or indirect effects to air quality.

Alternative 2 – Proposed Action

SAE proposes a winter geophysical seismic survey that would require operation of various types of equipment designed to travel across tundra, frozen sea-ice, and fresh-water ice (lakes, rivers, streams, etc.). Additional equipment and vehicles would be required to transport a sled camp along the sea ice and tundra every three to five days, setting up and dismantling base stations and camp facilities for

150 people, establish river crossings, create snow ramps, and operate up to 12 vibroseis vehicles for seismic recordings. Other proposed equipment includes long-haul fuel tractors, remote fuelers, water makers, incinerators, resupply and survival sleighs, tractors, loaders, truckers and various types of construction equipment. Several modes and phases of operation are proposed requiring the use of tracked and wheeled tundra vehicles. In addition, a 150-person sleigh-camp facility will be mobilized along the coastline and camp trails will be scouted to measure snow depth. The sleigh-camp would be moved up to two miles every few days. SAE proposes all the equipment would be powered by ultra-low sulfur diesel (ULSD) fuel that, during combustion, produces emissions of pollutants that are regulated under the Clean Air Act (CAA). As such, an inventory of projected emissions was prepared to assess the direct and indirect effects to outdoor air quality in the vicinity of the Proposed Action.

Emissions from the types of diesel-powered equipment and vehicles described in the Proposed Action are typically calculated based on the number of hours each unit is operated, the maximum power rating of each engine expressed in horsepower or kilowatts, and the application of an emission factor in units of grams of pollutant per horsepower, per hour of operation of the engine. However, the expected uncertainty of ground and weather conditions that would cause inconsistent use of the equipment, and the many different types of vehicles and engines, all with varying engine power, makes calculating emissions based on fuel-use a much more efficient and accurate approach to calculating the total projected emissions inventory. The isolated location of the Proposed Action allows the volume of fuel consumed to be accurately recorded, and data reflecting the exact characteristics of each engine powered by the fuel would be unnecessary. As the fuel would be transported to the project staging area and stored until used, there would be no other access to diesel fuel available.

Direct and Indirect Emissions

SAE estimates consumption of 4,500 gallons (gal) of ULSD fuel each day of operation. Thus, the total fuel consumption for approximately 106 days of operation would require 477,000 gal, or 1805.64 kiloliters (kl) of ULSD fuel. The equation to project emissions is shown in Equation (1).

(1) $$E_p = (EF_p \times F_t) / 2000$$

where, E_p is the total projected emissions of each pollutant emitted throughout the operation of the Proposed Action, EF_p is the emission factor for each pollutant in units of pounds (lbs) per gallon of ULSD fuel, F_t is the total fuel consumed in units of gallons (477,000 gal), and the value is divided by the conversion of pounds to short tons, where 2,000 lbs is equal to one short ton.

Emission factors applied for the calculation of total emissions were obtained from the U.S. Environmental Protection Agency (EPA) Internet Web Emission Factor Information Retrieval (WebFire) database, which replaces the previous FIRE v. 6.25 software (EPA, 2012). The emission factors obtained through WebFire correspond to the EPA Source Classification Code (SCC) 20300101 for internal combustion, reciprocating diesel engines. The factor for emissions of sulfur dioxide (SO_2) allows for the reduction of emissions due to the use of ULSD fuel. The emission factors applied to Equation (1) are summarized in Table 3. Total projected emissions from combustion of the proposed total volume of fuel (477,000 gal) expected to power all the vehicles and equipment necessary to complete the survey are also summarized in Table 3, and represent direct effects to air quality from the Proposed Action.

Table 3. Emission Factors and Project Emissions for the Proposed Action.

POLLUTANTS	EMISSION FACTORS (lbs/gal)	PROJECTED EMISSIONS (short tons)
Carbon monoxide (CO)	0.13	31.01
Nitrogen oxides (NO_x)	0.604	144.05
Coarse particulate matter (PM_{10})	0.0425 [1/]	10.14

POLLUTANTS	EMISSION FACTORS (lbs/gal)	PROJECTED EMISSIONS (short tons)
Fine particulate matter ($PM_{2.5}$)	0.0425 [1/]	10.14
Sulfur dioxide (SO_2)	0.0397	9.47
Volatile organic compounds (VOC) [2/]	0.0493	11.76
Ammonia (NH_3) [3/]	0.0029	0.69
Greenhouse gases (CO_2e) [4/]	22.60	5,390

Note: Emission factors are in units of pounds of pollutant gases per gallon of burned diesel fuel. Projected emissions are in short tons where one short ton is equal to 2,000 lbs.

1/ Emission factors for PM_{10} and $PM_{2.5}$ are the same in the EPA WebFIRE database for SCC 20300101 sources. This is due to the accepted conservative practice to assess emissions of $PM_{2.5}$ as being equal to emissions of PM_{10}, even though when the emission factors were developed for PM_{10}, when no emission factors existed for $PM_{2.5}$, PM_{10} included all particles with a diameter of less than10 micrometers, which includes $PM_{2.5}$, particles, defined by EPA as particles with a diameter of 2.5 micrometers or less.

2/ Emissions of volatile organic compounds (VOC) contribute to the formation of ozone, when present in the lower atmosphere together with emissions of nitrogen oxides (NO_X), and in the presence of sunlight. As such, VOC is considered a "precursor pollutant" and should be considered in any inventory of emissions projected for a Federal action.

3/ Emissions of ammonia (NH_3) are included in this inventory because the Proposed Action includes the use of land-vehicles across tundra, which are state lands of Alaska. Alaska Department of Environmental Conservation regulates the emissions of NH_3 under the Alaska Administrative Code. As such, emissions of NH_3 are appropriately included in the inventory.

4/ Emissions of greenhouse gases are considered based on the projected carbon dioxide (CO_2) equivalent emissions, and are reported as CO_2e. Because CO_2e emissions can, under certain circumstances, require permitting by the EPA, the emissions of CO_2e are appropriately included in the inventory.

Source: U.S. Environmental Protection Agency (EPA). 2012. Clearing house for Inventories & Emissions Factors – WebFIRE. Available on the EPA Technology Transfer Network Website at http://epa.gov/ttn/chief/webfire/index.html

An evaluation of the emission inventory shows the predominant pollutant is nitrogen oxide (NO_x), which is to be expected from the exhaust of diesel-powered engines. Less prominent are emissions of carbon monoxide (CO) and particulate matter (PM_{10} and $PM_{2.5}$). Sulfur dioxide (SO_2) emissions would be higher except for the use of low sulfur content of ULSD fuel. Also calculated and presented in Table 3 is information relating to greenhouse gas emissions in the form of carbon dioxide equivalent emissions (CO_2e). Emissions of CO_2e, which may affect the total budget of global greenhouse gases contributing to climate change, would be considered an indirect effect of the Proposed Action, and is appropriately included in the inventory of projected emissions.

Nearly all the emissions reflected in the projected emissions inventory would occur due to the operation of mobile sources, characterized as including both onroad and off-road vehicles and equipment, where the vehicles and equipment would be operating at least partly on state land, and over the submerged land of the OCS. As such, the applicability of the Proposed Action was evaluated against regulatory requirements to limit emissions and/or control emission sources under the CAA and EPA greenhouse permitting regulations.

Direct and Indirect Air Quality Effects

Persistent moderate winds over the coastline and occasional episodes of strong winds, which are typically found over the open waters of the Beaufort Sea, would transport, disperse, and mix the air pollutants caused by the Proposed Action within the surrounding clean air. Even moderate winds cause turbulence in the air that dilutes pollutant concentrations and reduce the environmental impact (Ahrens, 2009). Thus, when considering the wind conditions over the project area, the relative lack of onshore sources, together with the temporary nature of the emissions caused by the Proposed Action, the quality of the air over the affected area would remain better than required by Federal standards

(ADEC, 2011). As such, the potential direct and indirect effects to air quality conditions caused by the Proposed Action would be negligible.

4.1.1.2. Cumulative Effects

Alternative 1 – No Action

Selection of the No Action Alternative would add no incremental effects on air quality to those produced by ongoing or reasonably foreseeable activities in the Proposed Action area.

Alternative 2 – Proposed Action

The incremental impact of an action on air quality is assessed by examining the effects an action, whether proposed for onshore or offshore, may have on the onshore air quality of a state. The level of effects for the Proposed Action with respect to air quality is negligible. When considered in combination with other past, present, and reasonably foreseeable actions, effects on the onshore air quality of the Alaska North Slope adjacent to the Beaufort Sea OCS would remain negligible.

Past projects include seismic surveys and exploration drilling, but the effects of these projects were temporary and no longer have an air quality impact. Current and future offshore seismic exploration projects and other marine vessel traffic, including subsistence hunting, would likely contribute only negligible effects to onshore air quality because the transient nature of boat and ship traffic on the OCS prevents the transport of emissions over the same onshore area for an extended period of time. Therefore, the emissions would not have an additive effect with the Proposed Action.

Although the operations of aircraft have increased in recent years, the emissions from aircraft engines would be greatest in the general vicinity of the airport, and transport of those emissions would be minimal over the area where the Proposed Action would occur. Therefore, the emissions would not have an additive effect with the Proposed Action.

Emissions resulting from current and future community activities associated with regional native villages located in Wainwright and Point Lay would be negligible, as those activities are located far enough away from where the Proposed Action would occur that transport of the emissions would dissipate and reduce the pollutant concentrations on the onshore areas. Therefore, the emissions would not have an additive effect with the Proposed Action.

Current and future operations on the Chukchi Sea and Beaufort Sea OCS would have negligible air quality effects because the transient nature of the ships on the OCS prevent the transport of emissions over the same onshore area for an extended period of time. Therefore, the emissions would not have an additive effect with the Proposed Action.

4.1.2. Water Quality

4.1.2.1. Direct and Indirect Effects

Alternative 1 – No Action

Selection of the No Action Alternative would not result in any adverse direct or indirect effects to water quality.

Alternative 2 – Proposed Action

As described in section 4.0 on p. 21 of this document, fueling operations would not take place in the marine environment, so there is no reasonably foreseeable risk of a fuel spill during refueling operations to affect water quality in the Proposed Action area. There would be a negligible level of effect attributable to the Proposed Action on water quality in the Federal Action Area if BOEM authorized the Proposed Action.

4.1.2.2. Cumulative Effects

Alternative 1 – No Action

Selection of the No Action Alternative would add no incremental effects on water quality to those produced by ongoing or reasonably foreseeable activities in the Proposed Action area.

Alternative 2 – Proposed Action

The level of effect for the proposed action with respect to water quality is negligible. When considered in combination with other past, present, and reasonably foreseeable actions, effects on water quality would remain negligible. Past projects include seismic surveys and exploration drilling, but the effects of these projects were temporary and no longer impact water quality. BP Exploration (Alaska) Inc. (BPXA) plans to conduct on-ice ancillary activities near the Liberty prospect, but, as with the proposed action, these activities would not affect water quality. There are no other activities described in Appendix B that overlap both temporally and spatially with the proposed action.

4.1.3. Lower Trophic Levels.

4.1.3.1. Direct and Indirect Effects

Alternative 1 – No Action

Selection of the No Action Alternative would not result in any adverse direct or indirect effects to lower trophic organisms in landfast ice.

Alternative 2 – Proposed Action

No adverse effects from the Proposed Action on lower trophic epontic organisms are anticipated.

4.1.3.2. Cumulative Effects

Alternative 1 – No Action

Selection of the No Action Alternative would add no incremental effects on lower trophic organisms to those produced by ongoing or reasonably foreseeable activities in the Proposed Action area.

Alternative 2: Proposed Action

The level of effects for the Proposed Action with respect to lower trophic resources is negligible. When considered in combination with other past, present, and reasonable foreseeable actions, effects on lower trophic resources remain negligible. Past projects include seismic surveys and exploratory drilling, but the effects of these projects were temporary and no longer impact lower trophic resources.

4.1.4. Fish

4.1.4.1. Direct and Indirect Effects

Alternative 1 – No Action

Selection of the No Action Alternative would not result in any adverse direct or indirect effects to fish.

Alternative 2 – Proposed Action

Because few, if any, fish would be concentrated in the area of the on-ice surveys, there are no other sources of potential impacts from the Proposed Action to affect fish resources. There would be a negligible level of effect attributable to the Proposed Action on fish resources if BOEM authorized the Proposed Action.

4.1.4.2. Cumulative Effects

Alternative 1 – No Action

Selection of the No Action Alternative would add no incremental effects on fishes to those produced by ongoing or reasonably foreseeable activities in the Proposed Action area.

Alternative 2 – Proposed Action

The level of effects for the proposed action with respect to fish resources is negligible. When considered in combination with other past, present, and reasonably foreseeable actions, effects on fish would remain negligible. Past projects include seismic surveys and exploration drilling, but the effects of these projects were temporary and no longer impact fish resources. BPXA plans to conduct on-ice ancillary activities near the Liberty prospect, but, as with the proposed action, these activities would not affect fish resources because these activities would be conducted when few fish are present. There are no other activities described in Appendix B that overlap both temporally and spatially with the proposed action.

4.1.5. Marine and Coastal Birds

4.1.5.1. Direct and Indirect Effects

Alternative 1 – No Action

Selection of the No Action Alternative would not result in any adverse direct or indirect effects to marine and coastal birds.

Alternative 2 – Proposed Action

Birds would not likely be in the Proposed Action area during the timeframe of the Proposed Action because conditions suitable for birds to migrate into the area would not exist until late May, when the Proposed Action will be concluding. Therefore, no adverse effects from the Proposed Action on coastal and marine birds are anticipated.

4.1.5.2. Cumulative Effects

Alternative 1 – No Action

Selection of the No Action Alternative would add no incremental effects on marine and coastal birds to those produced by ongoing or reasonably foreseeable activities in the Proposed Action area.

Alternative 2 – Proposed Action

The level of effects for the proposed action with respect to marine and coastal birds is negligible. When considered in combination with other past, present, and reasonably foreseeable actions, effects on marine and coastal birds would remain negligible. 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 on-ice ancillary activities near the Liberty prospect, but, as with the proposed action, these activities would not affect marine and coastal birds because these activities would be conducted when the marine and coastal birds are not present. There are no other activities described in Appendix B that overlap both temporally and spatially with the proposed action.

4.1.6. Marine Mammals

4.1.6.1. Direct and Indirect Effects

Alternative 1 – No Action

Selection of the No Action Alternative would not result in any adverse direct or indirect effects to marine mammals.

Alternative 2 – Proposed Action

The only two marine mammal species that could be in the action area during mid-February through May are the polar bear and ringed seal.

Polar Bear. SAE is proposing on-ice seismic operations in state and federal waters in the Colville River area and on land from the adjacent shoreline inland. Operations would begin in mid-February and continue through the end of May. During the proposed February through May timeframe polar bears use the sea ice and adjacent coastline and nearshore barrier islands as corridors for movement and as resting habitat. Polar bears may also be denning within the Proposed Action area.

SAE has received USFWS Letter of Authorization (LOA) 13-18, dated December 6, 2013. SAE will avoid areas which have been identified as possible denning sites by the USFWS. All known dens will be avoided by a minimum distance of one mile (1.6 km). The lead survey crews will be trained in polar bear awareness and will also identify /avoid possible den sites during operations. On sea ice, bear dens are typically found near pressure ridges, while SAE's operations require relatively flat ice for the tracked vehicles to move forward. Given the conditions required by the LOA, it is unlikely that the Proposed Action would disturb denning polar bears.

Some non-denning polar bears may approach or move through SAE's area of operations. SAE personnel will maintain a minimum distance of one half mile (800 m) from any known bear. When polar bears are sighted in the area, crews will cease operations, avoid approaching the bear, and will return to their vehicles to stand by while the bear moves through the area. SAE will incinerate all food wastes and other garbage twice per day to reduce the potential for the scent of food or garbage to attract bears to the camp.

Implementation of measures identified in the LOA will avoid/minimize impacts to polar bears from disturbance or displacement. While some polar bears may be displaced from the immediate areas of activity, this displacement will be short term and localized.

The Proposed Action is anticipated to result in a negligible level of effect on polar bears.

Ringed Seal. Equipment used to support the Proposed Action has the potential to damage ringed seal lairs and harass or injure seals (71 *FR* 26336, May 4, 2006; 78 *FR* 75488, December 12, 2013). Noise produced by vehicles and seismic survey equipment could temporarily displace ringed seals from lairs if operations occur within 150 m (492 ft) of lairs (Kelly, Burns, and Quakenbush, 1988) or may separate female ringed seals from their pups if the survey occurs from mid-March to mid-May. If a mother and pup were to be separated, the pup could potentially die from exposure, abandonment, predation, or the inability to access breathing holes and lairs.

As a condition of their permit approval, SAE would be required to implement mitigation measures to avoid damaging seal lairs or harassing or injuring ringed seals. These mitigation measures include surveying all on-ice travel routes and operation areas where ringed seals may occur using a 150 m (492 ft) buffer around each travel route and seismic source. PSOs must be present to detect any ringed seal activity. Operations must cease immediately if any damage to a seal lair occurs and SAE must contact BOEM before restarting operations.

The Proposed Action, including the implementation of required mitigation measures, is anticipated to result in a negligible level of effect to ringed seals.

4.1.6.2. Cumulative Effects

Alternative 1 – No Action

Selection of the No Action Alternative would add no incremental effects on marine mammals to those produced by ongoing or reasonably foreseeable activities in the Proposed Action area.

Alternative 2 – Proposed Action

The level of effect for the proposed action with respect to marine mammals (polar bears and ringed seals) is negligible. When considered in combination with other past, present, and reasonably foreseeable actions, effects on marine mammals would remain negligible. Past projects include seismic surveys and exploration drilling, but the effects of these projects were temporary and no longer impact marine mammals. BPXA plans to conduct on-ice ancillary activities near the Liberty prospect, but, as with the proposed action, these activities would be required to follow operational procedures that would avoid harm or injury to polar bears or ringed seals There are no other activities described in Appendix B that overlap both temporally and spatially with the proposed action.

4.1.7. Subsistence Activities, Environmental Justice, Public Health and Archaeological Resources

4.1.7.1. Direct and Indirect Effects

Alternative 1 – No Action

Selection of the No Action Alternative would not result in any adverse direct or indirect effects to Subsistence Activities, Environmental Justice, Public Health or Archaeological Resources.

Alternative 2: Proposed Action

Potential effects of seismic activities on sociocultural and subsistence resources are of concern for Inupiat coastal communities. This Proposed Action will have negligible effects on sociocultural systems and has potential for negligible to minor effects on subsistence harvests for the community of Nuiqsut. Potential impacts may come from aircraft, on-ice vehicles, equipment, and personnel operating in the project area. SAE has committed to minimizing potential impacts through the use of local subsistence resource representatives and a commitment to communicate with key entities in the community. Concerns about potential effects of seismic activities on subsistence resources are not new and have been expressed in public hearings, public comments, and government-to-government meetings in the past.

SAE would conduct the Proposed Action in a joint partnership agreement with Kuukpik Corporation (an Alaska Native Claims Settlement Act (ANCSA) village corporation) to mitigate impacts on sociocultural systems, subsistence, environmental justice, and public health during the winter 2014 season. SAE will hire local subsistence representatives and hold meetings in the villages, including Barrow, to plan community interaction and communication during the project period. Direct impacts may occur when residents from Nuiqsut hunt ringed and bearded seal, ice fish and hunt caribou. Hunts are primarily conducted on sea ice and occur during the time frame of the Proposed Action period. Further, hunts for common and king eider along with on-ice fishing are also active at this time.

Subsistence Activities

The Proposed Action has potential for negligible to minor effects on subsistence hunts. The largest sources of impacts to subsistence resources will be from vehicles, equipment, camp movement and

human presence on the ice along with potential impacts of low-level aircraft over the Teshekpuk Lake caribou wintering grounds between Barrow and the project area. Noise associated with crews working in the area, the use of seismic equipment, air transport of crews and ice-road movement of equipment and the camp, crew exchanges, human movement, and human voices are all direct effects of the Proposed Action.

Based on the timing and spatial location, the Proposed Action will cause no impacts to bowhead whale migration. On-ice seismic survey activities can conflict with the harvest season, though impacts to bearded and ringed seal, an important subsistence resource for Nuiqsut, harvested March through December on sea ice, will be negligible to minor. Harvesting of fish species and land based animals also occurs during this time. With appropriate and timely communication and working in areas prior to or after residents plan to harvest, impacts will be limited. Therefore, negligible to minor effects are expected.

Environmental Justice

This Proposed Action does not have disproportionately high adverse human health and environmental impacts to residents of the NSB, and although there are periodic disruptions to subsistence based on the Proposed Action period, no long-term impacts to health and well-being of Nuiqsut will result. Therefore, environmental justice impacts from this Proposed Action are negligible.

Public Health

The Proposed Action is short-term and temporary and will have no measurable effects on NSB routines or community functions. There will be no measurable effect on normal day to day community routines, and no long-term consequences for health and well-being from this action. Therefore, cumulative impacts to public health will be negligible.

Archaeological Resources

The SAE seismic survey plan of operations will have no effect on archaeological resources. Section 106 of the National Historic Preservation Act, as implemented by the regulations at 36 CFR 800 *et seq.*, does not apply to this action. SAE will conduct operations during the winter, over ice and snow with seismic work consisting of setting up a grid of wireless nodes on the snow or on sea ice. Terrestrial cultural resources will have pre-established buffers as non-activity zones as an added precaution to ensure that no historic properties will be affected.

4.1.7.2. Cumulative Effects

Alternative 1 – No Action

Selection of the No Action Alternative would add no incremental effects on Subsistence Activities, Environmental Justice, Public Health or Archaeological Resources to those produced by ongoing or reasonably foreseeable activities in the Proposed Action area.

Alternative 2 – Proposed Action

The level of effects for the proposed action with respect to subsistence resources, public health, and environmental justice is negligible. Selection of the Proposed Action alternative would add no measurable incremental effects on archaeological resources to those produced by ongoing or reasonably foreseeable activities in the Proposed Action area. However, when considered in combination with other past, present, and reasonably foreseeable actions, effects on subsistence resources, public health, and environmental justice could be minor.

Past projects include seismic surveys and exploration drilling, but the effects of these projects were temporary and no longer impact subsistence resources, public health, and environmental justice. BPXA plans to conduct ancillary activities near Prudhoe Bay, which is near the proposed action.

While these activities have potential effects on subsistence resources, public health, and environmental justice, the impacts are likely to be negligible because of timing of the project, use of protected species observers, and communication with villages near the proposed project area; therefore, they will not have an additive effect with the proposed action. There are no other activities described in Appendix B that overlap both temporally and spatially with the proposed action.

5.0 CONSULTATION AND COORDINATION

5.1. 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 has engaged with USFWS and NMFS in conferences and consultations regarding ESA-protected species.

BOEM consulted with USFWS and received a programmatic Biological Opinion and Conference Opinion for Oil and Gas Activities in the Beaufort and Chukchi Sea Planning Areas on Polar Bears (*Ursus maritimus*), Polar Bear Critical Habitat, Spectacled Eiders (*Somateria fischeri*), Spectacled Eider Critical Habitat, Steller's Eiders (*Polysticta stelleri*), Kittlitz's Murrelets (*Brachyramphus brevirostris*), and Yellow-billed Loons (*Gavia adamsii*) on May 8, 2012 (USDOI, FWS, 2012). BOEM determined that the Proposed Action was within the scope of the programmatic consultation. SAE will follow the conditions of an LOA and no further consultation is necessary for species under USFWS jurisdiction.

BOEM consulted with NMFS and received a programmatic Biological Opinion: Oil and Gas Leasing and Exploration Activities in the U.S. Beaufort and Chukchi Seas, Alaska on April 2, 2013 (NMFS, 2013). BOEM determined that the Proposed Action, with required mitigation measures, was within the scope of the programmatic consultation and no further consultation is necessary for marine mammals under NMFS jurisdiction.

5.2. Essential Fish Habitat Consultation

In accordance with the Magnuson-Stevens Fishery Conservation and Management Act of 1976, as amended, Federal agencies are required to consult with the National Marine Fisheries Service on any Proposed Action that may adversely affect designated Essential Fish Habitat (EFH). BOEM determined that the Proposed Action would not adversely affect any designated EFH.

5.3. Public Involvement

BOEM notified the public of its receipt of the SAE G&G Seismic Survey Application #14-01 and later issued a public notice that BOEM would prepare an EA. On December 19, 2013, BOEM posted a request for public input on preparation of an Environmental Assessment for the SAExploration Inc. 2014 Geophysical 3D Ocean Bottom Seismic Survey in the Beaufort Sea. Comments were accepted at http://www.regulations.gov through midnight January 10, 2014. The request, which closed on January 10, 2014 without receiving any public comment, is available to view at: http://www.regulations.gov/#!documentDetail;D=BOEM-2013-0089.

5.4. Reviewers and Preparers

The persons responsible for the review of SAE G&G Seismic Survey Application #14-01 and supporting information and analysis, and preparation of this EA are listed below:

Name	Title	Contribution
Gene Augustine	Biologist	ESA consultation
Mary Cody	Wildlife Biologist	Marine Mammals-Polar Bear and Walrus
Christopher Crews	Wildlife Biologist	Marine Mammals
Dan Holiday	Wildlife Biologist	Lower Trophic Levels, Cumulative Effects
Melanie Hunter	NEPA Coordinator	Project Coordinator

Name	Title	Contribution
Virginia Raps	Meteorologist	Air Quality, Climate Change, and Meteorology, Emissions Inventory
Mark Schroeder	Wildlife Biologist	Marine and Coastal Birds, Fish and Essential Fish Habitat, Water Quality, and EFH consultation
Caryn Smith	Oceanographer	Oil / Fuel Spills, Sea Conditions Determination
William Swears,	Technical Writer / Editor	Technical Editor
Jennifer Youngblood	Socioeconomic Specialist	Sociocultural/Subsistence

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APPENDIX A

LEVEL OF EFFECTS DEFINITIONS AND ABBREVIATIONS

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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 SAE G&G Seismic Survey Application #14-01 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 proposed action.
- 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 Proposed Action 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 proposed action 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 proposed action 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 proposed action 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 proposed action. 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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APPENDIX B: CUMULATIVE EFFECTS

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 proposed action on the resources in the Arctic OCS are: (1) marine vessel traffic, (2) aircraft traffic, (3) subsistence and other community activities, (4) scientific research activities, and (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 proposed exploration 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 Chukchi 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 Proposed Action. 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 Proposed Action 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 Proposed Action. 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 to seawater, 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.

2014 Pacific Arctic Group (PAG). Ongoing activities in the general Beaufort Sea and Chukchi Sea regions include multinational efforts carried out by the Pacific Arctic Group (PAG). Organized under the International Arctic Science Committee (IASC), the PAG mission is to serve as a Pacific Arctic regional partnership to plan, coordinate, and collaborate on science activities of mutual interest to the Arctic region. Some of these activities could coincide in time and space with Shell's proposed exploration plan activities. The Diversified Biological Observatory is a multi-national cooperative effort coordinated by the PAG, with the USA, Canada, Russia, Japan, China, and Korea contributing cruise data from past, ongoing, and planned research programs. The programmatic sampling includes continuation of collections from prior and existing research stations, including BOEM-funded projects. Focus is on five geographical research areas within the Bering Sea, Bering Strait, Chukchi Sea, and Beaufort Sea. This work includes the synthesis of studies in fields including physical oceanography, marine chemistry, biological oceanography and marine biology (primary productivity, zooplankton, phytoplankton, ice algae, epontic, pelagic, and benthic collections), and marine mammal and marine bird ecology (PAG, 2011).

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:

- SAE G&G Seismic Survey Application #14-01 (This Project)
- Chukchi Sea Environmental Studies Program (CSESP) research efforts in the region encompassing the Conoco Phillips lease areas in the Chukchi Sea. The CSESP projects would not occur temporally or geographically with the Proposed Action.
- SAE three dimensional (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 temporally with the Proposed Action.
- BP Exploration (Alaska) Inc. (BPXA) North Prudhoe Bay 2014 OBS Seismic (G&G Seismic Survey Application #14-03): June 1, 2014 – September 30, 2014. Project would not occur temporally with the Proposed Action.
- 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 Proposed Action.
- BPXA 2014 Winter Geotechnical and Seabottom Investigation: March 2014 through early May 2014. Categorical Exclusion granted February 6, 2014. Project will not occur spatially within the Proposed Action Area.

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).

B-3. REFERENCES

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