Environmental Assessment/ Overseas Environmental Assessment for Ice Exercise

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Lead Agency
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Action Proponent
Commander, U.S. Fleet Forces Command

ENVIRONMENTAL ASSESSMENT/OVERSEAS ENVIRONMENTAL ASSESSMENT FOR ICE EXERCISE

Lead Agency:	Department of the Navy
Cooperating Agency:	None
Title of the Proposed Action:	Ice Exercise
Designation:	FINAL

ABSTRACT

The United States Department of the Navy prepared this Environmental Assessment (EA)/Overseas Environmental Assessment (OEA) in compliance with the National Environmental Policy Act (NEPA) and Executive Order (EO) 12114, Department of Defense regulations found at 32 Code of Federal Regulations Part 187, Department of Defense Directive 6050.7, and the Chief of Naval Operations Instruction 5090.1D and its accompanying manual (M-5090).

This EA/OEA evaluates the potential impact to the environment from an Ice Exercise (ICEX). The need for the Proposed Action is to prepare forces capable of extended operations and warfighting in the Arctic in accordance with Title 10 U.S.C. § 5062, and to support the aims of the Arctic Research and Policy Act (15 United States Code §§ 4101 *et seq.*). The purpose of the Proposed Action is to conduct realistic training and testing in an Arctic environment, and if resources are available, to gather data on environmental conditions and technology suitability in an Arctic environment. This EA/OEA evaluates the following alternatives: the No Action Alternative, Alternative 1 (Submarine-Only Activities), and Alternative 2 (Research Activity Addition).

In this EA/OEA, the Navy analyzed potential impact to the environment that could result from the No Action Alternative and two Action Alternatives. The resources evaluated include marine habitats, marine invertebrates, marine birds, fish, Essential Fish Habitat, and mammals (marine and terrestrial).

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Executive Summary

PROPOSED ACTION

The Proposed Action is to conduct submarine training and testing activities, which includes the establishment of a tracking range and temporary ice camp, and if resources are available, conduct research in an Arctic environment. The purpose of the Proposed Action is to evaluate the employment and tactics of submarine operability in Arctic conditions. The Proposed Action would also evaluate emerging technologies and assess capabilities in the Arctic environment, and gather data on Arctic environmental conditions. Ice Exercises (ICEX) would occur every two to three years, and involve submarine forces conducting training and testing activities. For the purposes of this Environmental Assessment (EA)/Overseas Environmental Assessment (OEA), an ICEX involves the construction of a camp on an ice floe to support the submarine training and testing; however some submarine training and testing may occur throughout the deep Arctic Ocean basin near the North Pole, within the Study Area (Figure 2-1). United States (U.S.) submarines must continue to train in the Arctic to refine and validate procedures and required equipment, as the Arctic Ocean serves as a route for submarines to transit between the Atlantic and Pacific Oceans. In addition to the primary objective of submarine training and testing, military and academic institutions collaterally benefit from the use of the ice camp to test new systems and conduct data collection and research in and about the Arctic environment.

ALTERNATIVES

For this EA/OEA, three alternatives were analyzed: the No Action Alternative and two Action Alternatives. Under the No Action Alternative, ICEX would not be conducted. Alternative 1, Submarine-Only Action, would allow for the establishment of an ice camp and the conduct of submarine training and testing. Alternative 2, Research Activity Addition, would allow for the execution of research activities in addition to submarine activities.

ENVIRONMENTAL CONSEQUENCES

Potential environmental stressors include acoustic (acoustic transmissions, aircraft noise, and on-ice vehicle noise), physical (aircraft, on-ice, and in-water vessel/vehicle strike, and human presence), and expended material (bottom disturbance, combustive byproducts, entanglement, and ingestion). The potential environmental consequences of these stressors have been analyzed in this EA/OEA for resources associated with the natural, physical, and socioeconomic environments. Quantitative analysis was performed on those resources, namely marine mammals, for which numerical impact thresholds have been established. For those resources for which no thresholds have been established or appropriate information was not available, a qualitative approach was used.

In terms of greenhouse gases (GHG), implementing the Proposed Action would contribute directly to emissions of GHGs from the combustion of fossil fuels. However, due to the minor increase in overall average flights around Prudhoe Bay/ Deadhorse Airport, the emissions are very limited. Emissions of GHGs from the Proposed Action are similar among the two action alternatives and do not conflict with Department of Defense (DoD), Navy, state, or local GHG goals and programs.

Climate change has important implications for Navy operations. Factors driving this include the potential impact of sea level rise on installations, operations, and plans; changing storm patterns and severity; and water resources and challenges. The potential effects of the GHG emissions from the Proposed Action are by nature global and cumulative, as individual sources of GHG emissions are not large enough to have an appreciable effect on climate change. Neither of the action alternatives would introduce significant emissions to affect climate change. The DoD is planning to meet GHG reduction targets by developing energy efficiency in facilities, identifying new strategies to minimize GHG emissions, and using innovative approaches and renewable energy. As climate science advances, DoD and the Navy will regularly evaluate risks and opportunities in order to develop plans and policies to manage its effects on the DoD operating environment, missions, and facilities.

The results of the analysis indicate that, with the implementation of standard operating procedures and mitigation measures, neither of the two Action Alternatives would significantly impact the natural and physical environments.

Under section 7 of the Endangered Species Act (ESA), the Navy initiated an informal consultation with the U.S. Fish and Wildlife Service (USFWS) on 16 October 2017 for the polar bear. USFWS concurred on 16 November 2017, with the Navy's finding that the Proposed Action may affect, but is not likely to adversely affect, polar bears (Ursus maritimus). An informal consultation was initiated with National Marine Fisheries Service (NMFS) for the bearded seal on 12 June 2017 and NMFS issued a letter of concurrence that the Proposed Action may affect but is not likely to adversely affect the bearded seal on 27 September 2017. In accordance with the Marine Mammal Protection Act, an incidental harassment authorization (IHA) was prepared for the incidental take of ringed seals and submitted to NMFS on 28 February 2017. The Draft IHA was provided to the Navy on 5 January 2018. In addition, an intentional take permit (for the active deterrence of polar bears) under the Marine Mammal Protection Act was obtained from the USFWS on 27 December 2017.

The Navy completed consultation with NMFS, in accordance with the Magnuson-Stevens Fishery Conservation and Management Act for Essential Fish Habitat (EFH) for ICEX 16; NMFS determined that the Proposed Action would not likely reduce the quantity or quality of Essential Fish Habitat and no conservation recommendations were provided. NMFS also stated they would like to be informed if the proposed action significantly changed. Navy sent a letter to NMFS on 15 December 2017 stating that the proposed action had not significantly changed for ICEX 18. Finally, the Navy modified the National Pollutant Discharge Elimination System permit it obtained for ICEX 16 from the Environmental Protection Agency for the discharge of graywater and reverse osmosis reject water from the ice camp into the Beaufort Sea. The modification was for the increase in the size of the Study Area (where the camp could be located) and the addition of a handwashing station.

According to CEQ regulations (40 CFR section 1506.6), agencies are directed to make diligent efforts to involve the public in preparing and implementing their NEPA procedures. Through the public involvement process, the Navy coordinates with relevant federal, state, and local agencies and notifies them and the public of the Proposed Action. Input from public responses is incorporated into the analysis of potential environmental impacts, as appropriate.

To announce the availability of the Draft EA/OEA for public review, a Notice of Availability (NOA) for the Draft EA was published in the Arctic Sounder (print and online version). The published NOA solicited comments on the Draft EA/OEA and intended to involve the local community in the decision making process. The Draft EA/ OEA was made available at http://www.aftteis.com/ICEX, and comments could be submitted on-line during the public commenting period, which started on September 29, 2017 and ended on October 16, 2017. Additionally, prior to the public release of the draft EA/OEA, the Navy informed the Village of Nuiqsut, the Village of Kaktovic, and the Inupiat Community of the Arctic Slope and mailed a CD containing the draft EA/OEA directly to them. No comments were received on the draft EA/OEA.

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Acronyms and Abbreviations

ºC	degrees Celsius
°F	degrees Fahrenheit
BOEM	Bureau of Ocean Energy Management
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cm	centimeter(s)
cm/s	centimeters per second
dB re 1 µPa	decibel(s) referenced to 1 micropascal
dB re 20 µPa	decibel(s) referenced to 20 micropascal
dBA	A-weighted sound levels
DoD	Department of Defense
EA	Environmental Assessment
EMATT	Expendable Mobile Anti-Submarine Warfare Training Targets
EO	Executive Order
ESA	Endangered Species Act
GHG	Greenhouse gases
Hz	Hertz
ICEX	Ice Exercise
IHA	Incidental Harassment Authorization
km	kilometer(s)
km^2	kilometers squared
kHz	kilohertz
lb	pound(s)
m	meter(s)
Magnuson-Stevens Act	Magnuson Stevens Fishery Conservation and Management Act
mg/gallon	Milligram(s) per gallon
MMPA	Marine Mammal Protection Act
NAAQS	National Ambient Air Quality Standards
NAEMO	Navy Acoustic Effects Model
Navy	United States Department of the Navy
NEPA	National Environmental Policy Act
nm	nautical miles
NMFS	National Marine Fisheries Service
OAML	Oceanographic and Atmospheric Master Library
OEA	Overseas Environmental Assessment
psu	practical salinity units
PTS	Permanent Threshold Shift
SAS	Synthetic aperture source
SEL	Sound Exposure Level
SPL	Sound Pressure Level
TTS	Temporary Threshold Shift
U.S.	United States
U.S.C.	United States Code
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service

CHAPTER 1 PURPOSE AND NEED

1.1 INTRODUCTION

The United States (U.S.) Department of the Navy (Navy) has maintained a presence in the Arctic region for decades. Navy experience spans Admiral Byrd's historic overflight of the North Pole in 1926, various campaigns in World War II, consistent activity during the Cold War, and combined exercises with surface, subsurface, aviation, and expeditionary forces today. While the Arctic is not unfamiliar for the Navy, expanded capabilities and capacity are needed for the Navy to increase its engagement in this region.

In 2012, Arctic sea ice reached its smallest yearly extent in recorded history, breaking the previous record set in 2007. This type of physical change in the Arctic is unprecedented in both the rate and scope of change. As a result, commercial shipping, resource development, research, tourism, environmental interests, and military focus in the region are projected to reach new levels of activity. Because of these changes, the Navy Arctic Roadmap (a document that provides direction to the Navy to enhance the Navy's ability to operate in the Arctic region) has indicated that "[b]y 2020, the Navy will increase the number of personnel trained in Arctic operations. The Navy will grow expertise in all domains by continuing to participate in exercises, scientific missions, and personnel exchanges in Arctic-like conditions" (Chief of Naval Operations 2014).

Ice Exercises (ICEXs) are typically conducted every two to three years in the waters north of Alaska. ICEXs are conducted to allow for the continued training of submarine forces in the Arctic and to refine and validate procedures and required equipment. In addition to Navy submarine training and test and evaluation (hereafter referred to as "training and testing"), military and academic institutions coordinate and collaborate with the Navy during each ICEX to further their research objectives of better understanding the Arctic environment, and the suitability and survivability of particular technologies in the environment.

The Navy prepared this Environmental Assessment (EA)/Overseas Environmental Assessment (OEA) to analyze the potential effects from a proposed ICEX on the environment in compliance with the National Environmental Policy Act (NEPA), Executive Order (EO) 12114, Department of Defense regulations found at 32 Code of Federal Regulations (CFR) Part 187, and the Chief of Naval Operations Instruction 5090.1D and its accompanying manual (M-5090.1).

1.2 PURPOSE AND NEED

The primary purpose of the Proposed Action is to evaluate the employment and tactics of submarine operability in Arctic conditions. Secondarily, the Proposed Action would also test emerging technologies and assess capabilities in the Arctic and gather data on Arctic environmental conditions. The need for the Proposed Action is to prepare forces capable of extended operations and warfighting in the Arctic in accordance with Title 10 United States Code (U.S.C.) § 5062 and the U.S. Navy Arctic Roadmap 2014-2030 Strategic Objectives.

1.3 APPLICABLE LAWS AND DIRECTIVES

The Navy has prepared this EA/ OEA based upon federal and state laws, statutes, regulations, and policies that are pertinent to the implementation of the Proposed Action, including the following:

- NEPA (42 U.S.C. sections 4321-4370h), which requires an environmental analysis for major federal actions that have the potential to significantly impact the quality of the human environment
- CEQ Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations [CFR] parts 1500-1508)
- Navy regulations for implementing NEPA (32 CFR part 775), which provides Navy policy for implementing CEQ regulations and NEPA
- Executive Order (EO)12114, Environmental Effects Abroad of Major Federal Actions
- Clean Air Act (CAA) (42 U.S.C. section 7401 et seq.)
- Clean Water Act (CWA) (33 U.S.C. 1251 et seq.)
- Arctic Research and Policy Act of 1984 (15 U.S.C. §§ 4101-4111)
- Endangered Species Act (ESA) (16 U.S.C. section 1531 et seq.)
- Marine Mammal Protection Act (16 U.S.C. §§ 1361-1407)
- Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. §§ 1801-1822)
- Migratory Bird Treaty Act (MBTA) (16 U.S.C. sections 703-712)
- Executive Order (EO) 12088, Federal Compliance with Pollution Control Standards
- EO 13175, Consultation and Coordination with Indian Tribal Governments

A more detailed discussion surround consultations and coordination with regulatory agencies is below:

1.3.1 National Environmental Policy Act

NEPA (42 U.S.C. §§ 4321 *et seq.*) was enacted to provide for the consideration of environmental factors in federal agency planning and decision making, including a series. NEPA requires federal agencies to analyze the potential impacts of a Proposed Action on the human environment, which includes the physical, biological, and socioeconomic environments and the relationship of people with that environment. The Navy undertakes environmental planning for major Navy actions occurring throughout the world in accordance with applicable laws, regulations, and executive orders. Presidential Proclamation 5928, issued December 27, 1988, extended the exercise of U.S. sovereignty and jurisdiction under international law to 12 nautical miles (nm).

This EA/OEA was prepared pursuant to the requirements of NEPA and subsequent implementing regulations issued by the Council on Environmental Quality (40 CFR §§ 1500 *et seq.*). This document also is in conformance with the provisions of the Navy's Environmental Readiness Program Manual, (OPNAVINST 5090.1D CH-1).

1.3.2 Executive Order 12114

EO 12114 (44 FR 1957), Environmental Effects Abroad of Major Federal Actions, directs federal agencies to be informed of and take account of environmental considerations when making decisions regarding major federal actions outside the United States, its territories, and possessions. The EO requires environmental consideration of actions with the potential to significantly harm the global commons, which are the geographic areas outside the jurisdiction of any nation, including the oceans beyond the territorial sea, which the United States defines as 12 nautical miles (nm). The purpose of EO 12114 is for agency decision makers to be informed of pertinent environmental considerations and to take environmental considerations into account, with other pertinent considerations of national policy, in making decisions.

In accordance with EO 12114 and the Department of Defense's implementing regulations in 32 CFR Part 187, this EA/OEA evaluates the potential for significant environmental harm from the Proposed Action in ocean waters beyond the territorial limits of the United States.

1.3.3 Arctic Research and Policy Act

The Arctic Research and Policy Act of 1984, as amended in 1990 (15 U.S.C. §§ 4101-4111), reaffirms that the Arctic is critical to national defense (15 U.S.C. §§ 4101). Conducting Ice Exercises is consistent with the goals of the Arctic Research and Policy Act, by helping to ensure the continued naval capability in the Arctic furthering national defense. Additionally, research activities conducted as a collateral benefit during submarine training and testing supports the Arctic Research and Policy Act goal for basic and applied scientific research in the Arctic. This act also established the U.S. Arctic Research Commission. The purpose of the commission is (1) to establish the national policy, priorities, and goals for a basic and applied scientific research program, (2) to promote Arctic research, to recommend Arctic research policy, and to communicate policy recommendations to the President and Congress, (3) to work with the National Science Foundation to implement the Arctic research policy and to support cooperation and collaboration throughout the federal government, (4) to give guidance to the Interagency Arctic Research Policy Committee to develop Arctic research projects, and (5) to interact with Arctic residents, international Arctic research programs and organizations to assess Arctic research needs (United States Arctic Research Commission (USARC) 2010). The Arctic Research and Policy Act also established an Interagency Arctic Research Policy Committee, on which the Department of Defense is represented (15 U.S.C. § 4107(b)).

1.3.4 Clean Water Act

The Clean Water Act (33 U.S.C. §§ 1251-1376) is the cornerstone of surface water quality protection in the United States. Section 403 of the Clean Water Act (33 U.S.C. § 1343) and implementing EPA regulations (40 CFR Part 125 Subpart M) set forth criteria for assessing impacts from discharges of pollutants from point sources into ocean waters. No permit can be issued if the Environmental Protection Agency finds that the discharge would result in an unreasonable degradation of the marine environment (40 CFR § 125.123).

In accordance with Section 403, the Navy applied for and received a National Pollution Discharge Elimination System permit from the U.S. Environmental Protection Agency on 21 December 2017, with an effective date of 1 February 2018, for the discharge of graywater from the ice camp (Appendix A). This was a modification of the prior NPDES permit received on December 14, 2015 with an effective date of January 1, 2016.

1.3.5 Endangered Species Act

The Endangered Species Act (ESA) (16 U.S.C. §§ 1531-1544) applies to federal actions in two respects. First, the ESA requires that federal agencies, in consultation with the responsible wildlife agency, ensure that proposed actions are not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat (16 U.S.C. § 1536 (a)(2)). Regulations implementing the ESA include a requirement for consultation on those actions that "may affect" a listed species or adversely modify critical habitat.

Second, if an agency's proposed action would "take" a listed species, then the agency must obtain an incidental take authorization from the responsible wildlife agency. The ESA defines the term “take” to mean “harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt any such conduct” (16 U.S.C. §1532(19)). The regulatory definitions of “harm” and “harass” are relevant to the Navy’s determination as to whether the Proposed Action would result in adverse effects on listed species.

- Harm is defined by regulation as “an act which actually kills or injures” fish or wildlife (50 CFR § 222.102, 50 CFR § 17.3; 64 FR 60727, Nov 8 1999).
- Harass is defined by the U.S. Fish and Wildlife Service (USFWS) regulation to mean an “intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering” (50 CFR § 17.3). The National Marine Fisheries Service (NMFS) has interim guidance out regarding the definition of harassment (NMFSPD 02-110-19 December 21, 2016).

In accordance with the ESA, informal consultation with NMFS for the bearded seal, and informal consultation for the polar bear with USFWS were initiated based on the determination that the Proposed Action may affect, not likely to adversely affect bearded seals and polar bears (*Ursus maritimus*). Concurrence was received from NMFS regarding bearded seals on 27 September 2017, and from USFWS regarding polar bears on 16 November 2017 (Appendix B).

1.3.6 Marine Mammal Protection Act

The MMPA (16 U.S.C. §§ 1361-1407) established, with limited exceptions, a moratorium on the “taking” of marine mammals in waters or on lands under U.S. jurisdiction. The act further regulates “takes” of marine mammals in U.S. waters and by U.S. citizens on the high seas. The term “take,” as defined in Section 3 (16 U.S.C. § 1362) of the MMPA, means “to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal.”

The MMPA defines harassment as applied to military readiness activities. The Proposed Action constitutes a military readiness activity as defined in Public Law 107-314 (16 U.S.C. § 703) because these activities constitute “[t]raining operations of the Armed Forces that relate to combat, as well as adequate and realistic testing of military equipment, vehicles, weapons, and sensors for proper operation and suitability for combat use.” For military readiness activities, such as the Proposed Action, the relevant definition of harassment is any act that:

- Injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild (“Level A harassment”), or
- Disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering to a point where such behavioral patterns are abandoned or significantly altered (“Level B harassment”) (16 U.S.C. § 1362 (18)(B)).

In addition to incidental taking of marine mammals, section 101(a)(4)(B) provides an exception to otherwise prohibited acts, allowing the use of measures that may deter a marine mammal from, among other things, damaging private property or endangering personal safety (16 U.S.C. 1371(a)(4)(A)(ii) and (iii), respectively. These measures may not result in the death or serious injury of a marine mammal. Section 101(a)(4)(A) of the MMPA specifically identifies the circumstances when the deterrence of a marine mammal may be undertaken and by whom. For polar bears, the USFWS has provided deterrence guidelines in 50 CFR § 18.34. These guidelines, if followed by a person otherwise subject to the provisions of the MMPA, provide an exception to the take prohibition under the MMPA; therefore, a permit under the MMPA is not required. Outside of the 50 CFR § 18.34 guidelines, use of deterrents against a polar bear requires an "intentional take permit" from the USFWS. Additionally, section 101(c) of the MMPA specifically states that, "it shall not be a violation of this chapter to take a marine mammal if such taking is imminently necessary in self-defense or to save the life of a person in immediate danger, and such taking is reported to the Secretary within 48 hours."

Based on the analysis contained herein, the Navy applied for an incidental harassment authorization for the taking of ringed seals on (28 February, 2017). Additionally, a request for the intentional take (deterrence) of polar bears was requested for personnel and polar bear safety. A letter of authorization was received by USFWS on 27 December 2017) (Appendix C).

1.3.7 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) (16 U.S.C. §§ 1801-1822), enacted to conserve and restore the nation's fisheries, includes a requirement for NMFS and regional fishery councils to describe and identify Essential Fish Habitat for all species that are federally managed. Essential Fish Habitat is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. Under the Magnuson-Stevens Act, federal agencies must consult with the Secretary of Commerce regarding any activity or proposed activity that is authorized, funded, or undertaken by the agency that may adversely affect Essential Fish Habitat. An adverse effect is any effect that may reduce the quantity or quality of Essential Fish Habitat. Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of Essential Fish Habitat.

In accordance with the Magnuson-Stevens Act, consultation with NMFS was initiated based on the determination of potential adverse effects to Essential Fish Habitat for the Arctic cod for ICEX 16. NMFS provided a written response on 9 November 2015, with a determination that the Proposed Action would not likely reduce quantity or quality of Essential Fish Habitat, and therefore no conservation recommendations were provided. NMFS stated "Should activities significantly change, NMFS wishes to be informed of any changes in order to reassess this determination." ICEX 18 activities are not significantly different and therefore consultation was not required. NMFS' ICEX 16 finding is included herein (Appendix D).

1.3.8 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (16 U.S.C. §§ 703-712) was enacted to ensure the protection of shared migratory bird resources. The Migratory Bird Treaty Act prohibits the take, possession, import, export, transport, selling, purchase, barter, or offering for sale, purchase or barter, of any migratory bird, their eggs, parts, and nests, except as authorized under a valid permit. The Migratory Bird Treaty Act protects a total of 1,026 bird species; the list of species protected by the Migratory Bird Treaty Act appears in 50 CFR § 10.13.

USFWS regulations at 50 CFR § 21.15 authorize takes of migratory birds resulting from otherwise lawful military readiness activities. The definition of military readiness activities applies to the Migratory Bird Treaty Act in the same way that it applies to the MMPA, and ICEX is considered a military readiness activity for the purposes of this act. Under this regulation, the Navy must consider the potential environmental effects of its actions and assess the adverse effects of military readiness activities on migratory birds. If a Proposed Action may result in a significant adverse effect on a population of migratory bird species, the Navy shall consult with the USFWS to develop and implement appropriate conservation measures to minimize or mitigate these effects. A significant adverse effect on a population is defined as an effect that could, within a reasonable period of time, diminish the capacity of a population of a migratory bird species to sustain itself at a biologically viable level (50 CFR § 21.3).

Based on the analysis herein, the Proposed Action would not result in a significant adverse effect on a population of migratory bird species. As such, consultation with the USFWS was not warranted.

CHAPTER 2 PROPOSED ACTION AND ALTERNATIVES

2.1 PROPOSED ACTION

The Proposed Action is to conduct submarine training and testing activities, which includes the establishment of a tracking range and temporary ice camp, and if resources are available, conduct research in an Arctic environment. The purpose of the Proposed Action is to evaluate the employment and tactics of submarine operability in Arctic conditions. The Proposed Action would also evaluate emerging technologies and assess capabilities in the Arctic environment, and gather data on Arctic environmental conditions. The vast majority of submarine training and testing would occur near the ice camp, however, some submarine training and testing may occur throughout the deep Arctic Ocean basin near the North Pole, within the Study Area (Figure 2-1). Though the Study Area is large, the area where the proposed ice camp would be located is a much smaller area (see 2018 ice camp proposed action area). The Proposed Action, as well as the construction and demobilization of the ice camp, would occur over approximately six-week period from February through April (considered winter through early spring). The submarine training and testing and the research activities would occur over approximately four weeks during the six-week period. Graywater and reverse osmosis reject water discharges would occur over five and four weeks, respectively. Neither graywater nor reverse osmosis reject water would be discharged during the construction of the ice camp. Additionally, the reverse osmosis unit is not expected to be the primary means of generating freshwater, and therefore its use would be delayed until the camp is fully functional. The camp should be fully functional within five days after initial flights to drop-off equipment have been made.

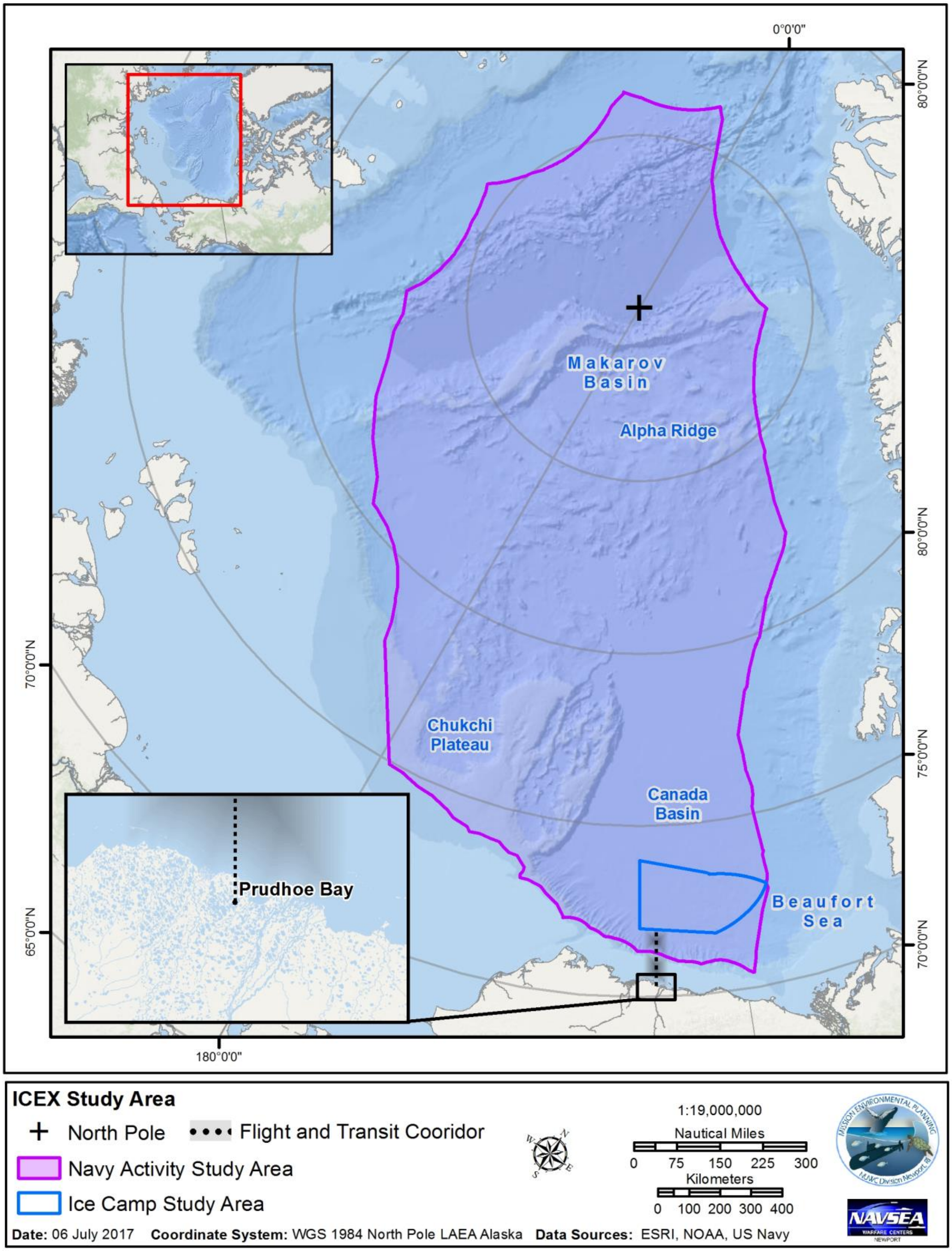

Figure 2-1. ICEX Study Area

2.1.1 Ice Camp

The ice camp would consist of a command hut, dining tent, sleeping quarters, tents to house temporary visitors, a powerhouse, runway, and helipad (Figure 2-2). The number of structures/tents ranges from 10 to 20, and are typically 2 to 6 meters (m) by 6 to 10 m in size. Some tents may be octagon shaped that are approximately 6 m in diameter. Berthing tents would contain bunk beds, a heating unit, and a circulation fan. The completed ice camp, including runway, is approximately 1.6 kilometers (km) in diameter. Support equipment for the ice camp includes snowmobiles, gas powered augers and saws (for boring holes through the ice), and diesel generators.

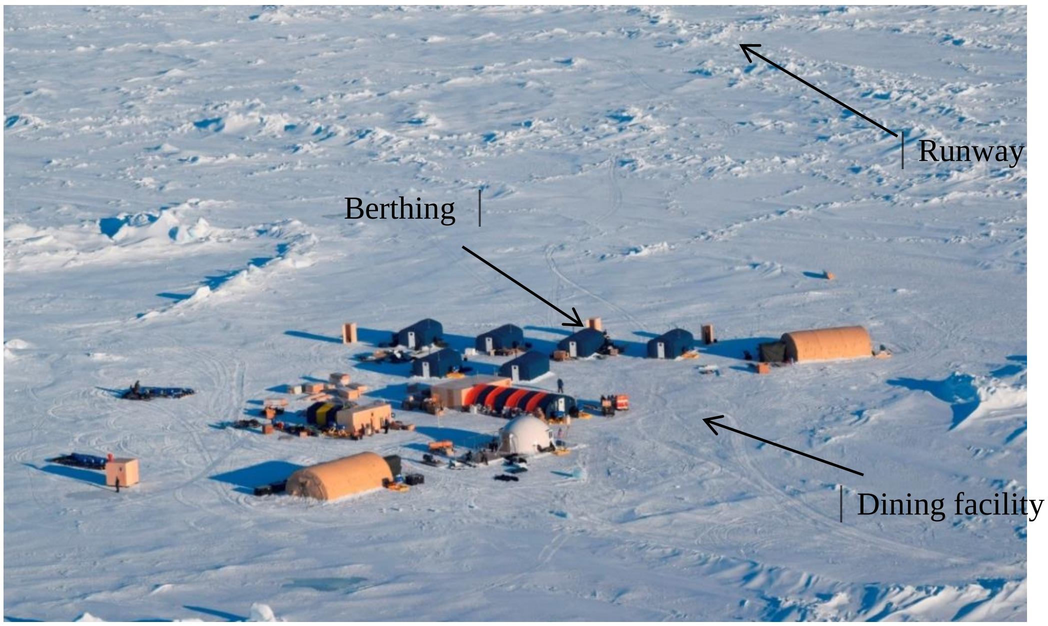

Figure 2-2. Example Ice Camp

All ice camp materials, fuel, and food would be transported from Prudhoe Bay, Alaska, and delivered by air-drop from military transport aircraft (e.g., C-17 and C-130), or by landing at the ice camp runway (e.g., small twin-engine aircraft and military and commercial helicopters). Aircraft would be used to transport personnel and equipment from the ice camp to Prudhoe Bay; up to nine round trips could occur daily. At the completion of ICEX, the ice camp would be demobilized and all personnel and materials would be removed from the ice floe. All shelters, solid waste, hazardous waste, and sanitary waste would be removed upon completion of ICEX and disposed of in accordance with applicable laws and regulations.

A portable tracking range for submarine training and testing would be installed in the vicinity of the ice camp; eight hydrophones, located on the ice and extending to 30 m below the ice, would be deployed. Hydrophones are approximately 11.8 centimeters (cm) in length and have 610 m in associated cables. The associated cable is Kevlar reinforced and has a long-life polyurethane jacket for durability. The hydrophones would be deployed by drilling holes in the ice and lowering the cable down into the water column. Hydrophones would be linked remotely to the command hut. Additionally, tracking pingers would be configured aboard each submarine to continuously monitor the location of the submarines. Acoustic communications with the submarines would be used to coordinate the training and research schedule with the submarines; an underwater telephone would be used as a backup to the acoustic communications. Recovery of the hydrophones is planned, however if emergency demobilization is required or the hydrophones are frozen in place and are unrecoverable, they would be left in place.

Freshwater would be primarily generated at the camp via ice mining, which entails collecting and melting of multi-year ice. A reverse osmosis unit would be tested to determine if desalination of ocean water is a viable alternative, but the majority of the camp's water would come from mined ice, not the reverse osmosis unit. Freshwater would only be made available in the camp's dining facility. This water would be available for limited food preparation, dishwashing, and human consumption. Additionally, a hygiene station would be available at the ice camp for hand washing. The hygiene station would be located in the dining facility and consist of a gravity fed container which would provide water for hand sanitizing and/or face washing if needed. The hygiene station would utilize the same drain as the kitchen sink for grey water discharge. No shower facilities would be available at the camp.

Dishwashing and a hygiene station would use biodegradable, chlorine-, and phosphate-free detergent that meets the Environmental Protection Agency's Safer Choice standards (U.S. Environmental Protection Agency 2015). Prior to use, dishwashing water would be heated using an on-demand propane water heater. Wastewater generated during food preparation and dishwashing would be discharged to the Beaufort Sea via a single drain in the camp's dining facility. The drain would consist of a corrugated pipe, wrapped in electric heat tape to prevent the pipe from freezing, which would be placed through a hole drilled/melted into the ice. The drain would utilize a removable metal screen to capture solid debris (i.e., food particles) in the wastewater prior to discharge. The metal screen would have a mesh size of no greater than 0.16 centimeters (cm). Solids captured in the screen would be disposed of via the camp's solid waste containers and brought back to Prudhoe Bay, Alaska, for disposal. A tray ration heater would be used for the majority of food preparation. The tray ration heater utilizes approximately 20 gallons of heated potable water per meal to heat trays of individual rations, and the water would be able to be reused since the food would never come in direct contact. The use of the tray ration heater would largely eliminate the need to wash utensils and food preparation serving dishes, since the ration packaging and utensils will be disposed of in the ice camp's solid waste containers. The camp would have an average discharge rate of 100 gallons per day, with a maximum discharge rate of 155 gallons per day during the two weeks of peak camp operations. The estimated total discharge from the ice camp's dining facility is 2,925 gallons.

Although most freshwater for drinking and cooking will be produced by the mining and melting of multi-year ice, the camp may also utilize one reverse osmosis unit to produce some freshwater through desalination. The operation of a reverse osmosis system results in "reject water," or water that is of higher salinity (approximately three times the salinity) than the initial seawater input. This reject water would also be discharged at the camp via a single drain (corrugated pipe placed through a hole in the ice) co-located with the portable system. The average reject water production is expected to be 144 gallons per day. This amount is based on the unit not being operated continuously due to downtime associated with system maintenance and adjustments for flow rate. The maximum reject water production would be approximately 288 gallons per day. The extreme conditions of the ice camp would influence both the system's efficiency and ability to operate, which is why the system is being used primarily to test its viability in this environment. Assuming continuous operation (24 hours per day) for the 4 weeks of camp operations (excluding a week each for construction and demobilization), a maximum total discharge of reject water from the ice camp would be 8,064 gallons.

Sanitary/human waste generated at the camp would be collected in zero-discharge sanitary facilities (e.g., barrels lined with a plastic bag), would be collected and containerized, then flown back to Prudhoe Bay, Alaska, for disposal at appropriate facilities.

In addition to the main ice camp, two smaller, adjacent berthing areas are proposed for ICEX. These areas (used for expeditionary forces) would leverage the facilities provided by the main camp (e.g., sanitary facilities) while verifying these groups could function independently if necessary. All materials from these adjacent areas would be removed from the ice upon completion of the activities.

2.1.2 Prudhoe Bay

During the Proposed Action, flights to and from Prudhoe Bay would utilize Deadhorse Airport, a public airport. Up to nine round trips could occur daily in addition to the usual flight traffic that occurs at the airport (average of 90 flights per day). All flights would leave from Deadhorse Airport and fly directly to the ice camp. The flight and transit corridor, shown in Figure 2 1. is approximately 25 miles wide and is the most direct route to the camp. Additionally, exercise torpedoes (i.e., non-explosive) that are retrieved from the water column following submarine training and testing would then be transported to and processed at Prudhoe Bay. Exercise torpedoes would then be prepared for transport in accordance with existing Navy policies.

An average of 6-12 personnel would stay at the local lodging facilities during the duration of the ICEX. Since the personnel would be staying in commercial lodging facilities, they would easily be absorbed into the communities' infrastructure and would not require any additional resources. Prudhoe Bay is a transient community and able to handle influxes of groups such as oil and gas employees. The additional personnel would not impact any other resources because of the minimal amount of time spent in the area.

2.1.3 Submarine Training and Testing

Submarine activities associated with ICEX are classified, but generally entail safety maneuvers, active sonar use, and exercise torpedo use (Appendix E). These maneuvers and sonar use are similar to submarine activities conducted in other undersea environments; they are being conducted in the Arctic to test their performance in a cold environment. Classified descriptions of submarine training and testing activities planned for ICEX can be provided to authorized individuals upon request.

One unclassified activity conducted by submarines is surfacing through the ice. It is critical that submarines are able to surface through ice cover in case they ever need to in the event of an emergency. Each U.S. submarine will conduct up to five surfacing events during ICEX. Surfacings are conducted in either open leads or areas of thin ice (generally first year ice) to reduce the risk of damaging the submarine, and will sometimes use the same area for subsequent surfacing.

2.1.4 Research Activities

Personnel and equipment proficiency testing and multiple research and development activities would be conducted (Table 2-1). Each type of activity scheduled for ICEX has been reviewed and placed into one of seven general categories of actions (Table 2-1); these categories of actions are analyzed herein. All researcher personnel traveling to the ice camp would be berthed at the established ice camp facilities.

Table 2-1. Summary of Training and Testing and Research Activities

Activity Type	Category of Action	Project	Description
Submarine Training and Testing	Logistics	Ice Camp Operations	A camp is constructed and an associated underwater tracking range is deployed to support submarine training and testing.
	Submarine Training and Testing	Submarine Training and Testing	Submarines conduct various training and testing events.
Research Activities	Aerial Data Collection	Aircraft	Use of manned aircraft and sensors to collect ice and snow thickness data and to validate/calibrate satellite measurements.
		Balloon	Launch of balloons to collect atmospheric data, primarily for weather forecasting.
	In-water Device Data Collection	Buoy	Deployment of surface buoys through the ice to collect measurements of conductivity, temperature, and ocean/ice fluxes.
		Array	Use of acoustic arrays to collect data on ambient noise, as well as determine signal propagation through Arctic environments.
	Personnel/ Equipment Proficiency	Diving Evolutions	Diver personnel conduct cold water diving evolutions under the ice using various equipment.
		Personnel/ Equipment Air-Drop	Fixed-wing and rotary-wing aircraft deliver paratroopers and equipment to the ice camp. Equipment is dropped by parachute to support camp operations (e.g., food, fuel, building materials) as well as to test search and rescue equipment delivery capability.
		Aircraft Landing Evaluation	Military aircraft are flown to the ice camp to evaluate the use of landing skis on an ice flow runway in the Arctic environment.
	Unmanned Aerial System Testing	Fixed-Wing	Fixed-wing unmanned aerial systems are launched by hand or pneumatic catapult. Fixed-wing systems may have up to a 3 m wingspan and fly at speeds up to 80 knots.
		Rotary-Wing	Rotary-wing unmanned aerial systems (“quadcopters”) used individually or simultaneously. Rotary-wing systems are approximately 51 cm square and fly at speeds up to 30 knots.
	Unmanned Underwater Vehicle Testing	Vehicle Testing	Autonomous and tethered unmanned underwater vehicles deployed to test navigation, control, and communications in the polar environment, as well as to gather data on existing oceanographic conditions.

2.2 PLATFORM DESCRIPTIONS

Typical platforms used for ice camp logistics and those necessary to support proposed research activities include on-ice vehicles (e.g., snowmobiles), aircraft, unmanned vehicles (both aerial and underwater), and passive devices. Although details on some specific systems are provided as examples, the general categories of platforms are analyzed for their potential effect to the environment.

2.2.1 On-Ice Vehicles

Snowmobiles would be used to transport personnel and equipment on the ice. Additionally, snowmobiles would support research activities that require data collection from multiple locations, with some at a distance from the camp. Four to six snowmobiles would be used during an ICEX (Figure 2-3). Two types of snowmobiles are typically used at the ice camp. Heavyweight snowmobiles have a single steering track and a very large drive track; these machines are slow with limited maneuverability, and are used to pull sleds and sledges to move equipment around camp. Light weight snowmobiles have dual steering tracks and a single drive track, are faster and maneuverable, and are used to transport personnel.

Figure 2-3. Typical On-Ice Vehicles (e.g. snowmobiles) used during ICEX

In addition to the typical snowmobiles, small unit support vehicles and all-terrain vehicles equipped with either six or eight wheels that can be used in open water (referenced herein as all-terrain tracked vehicle) (Figure 2-4) may be air-dropped to support runway construction and expeditionary forces, respectively. The small unit support vehicle is a full-tracked, articulated vehicle designed to transport personnel and equipment in all terrains. The all-terrain tracked vehicle is an 8x8 due to the amount of tires. It has a low ground pressure of 1.6 pounds per square inch and is used in sensitive habitats. The all-terrain tracked vehicle is capable of traversing in all terrains (Ontario Drive and Gear Ltd. 2017).

Expeditionary forces may use an all-terrain tracked vehicle. The all-terrain tracked vehicles have a load capacity of up to 1,200 pounds, depending on the model. They are capable of floating in open water if necessary. All-terrain tracked vehicles typically have either gas or diesel engines. Both engines are approximately 30 horsepower (Ontario Drive and Gear Ltd. 2017). The all-terrain tracked vehicle would be used to transport expeditionary forces to and from the main camp.

Figure 2-4. All-Terrain Tracked Vehicle

2.2.2 Aircraft

Aircraft that may be used during ICEX: small, single or twin-engine fixed-wing aircraft and rotary-wing aircraft (helicopters) (Figure 2-5). Shelters, personnel, and equipment would be transported to and from the ice camp via these aircraft. Up to nine round trips may be conducted each day. These aircraft also support many of the research activities.

Figure 2-5. Typical Aircraft used during ICEX

In addition to the typical commercial aircraft, military aircraft may also be used depending on their availability. Examples of military aircraft that may be used include C-130, V-22, and C-17 transport aircraft (as well as the LC-130, which is a modified C-130 suited to land on the ice) and CH-47 Chinook heavy-lift helicopters (Figure 2-6). These aircraft are much larger than the small, fixed-wing aircraft typically used (up to 53 m in length for the C-17 compared to 8 and 24 m in length for a Cessna 185 and Casa, respectively) and would allow for more efficient (i.e., fewer trips) transport of supplies. Equipment and material may be dropped by parachute from these military aircraft. The LC-130 would conduct up to four round trip flights to the ice camp over the course of the Proposed Action; these are included within the maximum number of daily flights to the ice camp. The V-22 would only land and take off from the ice camp one time during the Proposed Action. The V-22 Osprey has several modes of operation associated with it, which include a vertical take-off, similar to a helicopter as well as a traditional take off similar to other fixed-wing aircraft. The V-22 generates a large amount of heat from its engines. However, due to the low ambient temperature of the Arctic, ice thickness required supporting aircraft and re-freezing of the ice, temporary melting of the runway may occur and re-freezing of the ice would occur after the aircraft has departed the ice. The aircraft would not be allowed to alter the runway enough to make it inoperable for the remainder of the aircraft operations which would need to occur.

Figure 2-6. Rotary-Wing Aircraft (left panel; CH-47), Military Fixed-Wing Aircraft (right panel; LC-130), and V-22 (lower left and right)

2.2.3 Unmanned Underwater Vehicles and Systems

Unmanned underwater vehicles would either maneuver autonomously, or may be tethered to a command center (Figure 2-7). Unmanned underwater vehicles are typically slow moving (less than 5 knots), and range in size from approximately 52 cm in length and width to 493 cm in length and 53 cm in diameter. Some unmanned underwater vehicles would use active acoustic sources. Details for the active sources described above can be found in Table 2-2. Additionally, some unmanned underwater vehicles would have *de minimis* sources used and deployed throughout ICEX which are not discussed further in this document. *De minimis* sources have the following parameters: low source levels, narrow beams, downward directed transmission, short pulse lengths, frequencies above (outside) known marine mammal hearing ranges, or some combination of these factors (Department of the Navy 2013b).

Figure 2-7. Example Unmanned Underwater Vehicles
(Top panel is a Remote Environmental Monitoring Unit System 100; bottom left is a 21" Bluefin; bottom center is a LBV300; bottom right is the tether associated with the LBV300, resulting in a Tethered, Hovering Autonomous Underwater System)

In addition to unmanned underwater vehicles, various unmanned aerial systems are proposed for testing. Systems used may be either fixed-wing (Figure 2-8) or rotary-wing (Figure 2-9). Fixed-wing systems vary in their wingspans, up to approximately 305 cm, and fly at speeds of about 80 knots. Rotary-wing systems are typically smaller, approximately 51 cm in length and width, and fly at speeds of about 30 knots.

Figure 2-8. Example Fixed-wing Unmanned Aerial System
(Left panel is launch; center panel is in flight; right panel is recovery)

Figure 2-9. Example Rotary-wing Unmanned Aerial Systems

2.2.4 Scientific Devices

Various passive and active acoustic devices would be used for data collection, including weather balloons, a vertical array, and buoys.

2.2.4.1 Passive Devices

Accurate weather forecasting is essential for a successful ICEX. To support weather observations, up to two Kevlar or latex balloons (Figure 2-10) would be launched per day for 20 days at the ice camp (40 balloons total). These balloons and associated radiosondes (a sensor package that is suspended below the balloon) are similar to those that have been deployed by the National Weather Service since the late 1930s. When released, the balloon is approximately 1.5–1.8 m in diameter and gradually expands as it rises owing to the decrease in air pressure. When the balloon reaches a diameter of 4–7 m, it bursts and a parachute is deployed to slow the descent of the associated radiosonde. Weather balloons are not recovered.

A vertical line array would be deployed through the ice to measure ambient underwater noise and sound propagation through Arctic waters. This array would contain a series of acoustic recorders located at depths from the surface to 730 m. The array would be retrieved from the ice after approximately one week at the completion of data gathering.

Various scientific buoys (typically less than 1 m in diameter) would be deployed. An estimated five geographic positioning system buoys would be dropped from an aircraft on various ice floes in order for smaller aircraft capable of landing on the ice to re-locate the floes to determine suitability for the establishment of the ice camp; none of these buoys would be retrieved. To support submarine self-tracking, an acoustic buoy would be deployed and would emit a homing signal so that the submarines can determine their location relative to the ice camp. This buoy would be retrieved at the completion of the exercise. The remaining buoys would be deployed as part of the research activities and would collect data on the under-ice topography and environmental conditions (Figure 2-11). These buoys have sensors that can extend as much as 800 m below the ice; sensor packages may either remain stationary below the ice or may move vertically to gather data at various depths within the water column. These buoys would be left in place for up to two years to gather data, after which time they are expected to eventually sink to the seafloor. Finally, two radiofrequency

Figure 2-10. Typical Upper Air Sounding Balloon

identification tags would be deployed on the ice surface to determine their effectiveness in the Arctic environment for tracking ice movements. Radiofrequency tags would not be recovered.

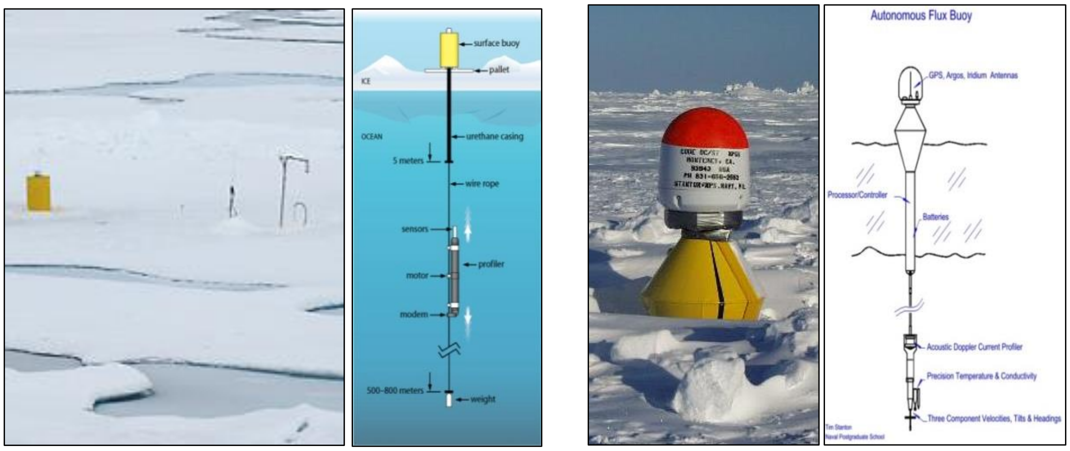

Figure 2-11. Example Passive Devices (Buoys)
(left panels are Ice Tethered Profiler; right panels are Ocean Flux Buoy)

2.2.4.2 Active Acoustic Devices

Active buoys and moored sources would be used during ICEX. One active buoy would be the Autonomous Reverberation Measurement System, which would be attached to the bottom of the ice and may be active for up to 30 days of ICEX. The device would transmit up to four hours per day. Additionally, a Massachusetts Institute of Technology/Lincoln Lab vertical line array would be deployed a through a hole in the ice to a source depth of 150 m. This array would have a continuous wave and chirp transmission capability. The continuous wave and chirp transmissions would both be active four hours per day for no more than 8 days during ICEX. Acoustic parameters for all active sources described above can be found in Table 2-2.

Table 2-2. Parameters of Scientific Devices with Active Acoustics

Research Institution	Source Name	Frequency Range (kHz)	Source Level (dB)	Pulse Length (milli-seconds)	Duty Cycle (Percent)	Associated Bin[1]	Source Type
Office of Naval Research	Autonomous Reverberation Measurement System	3 to 6	200	1,000	1.67	MF9	Moored
Naval Research Laboratory	SAS	Classified					Unmanned Underwater Vehicle
Massachusetts Institute of Technology/ Lincoln Labs	Continuous Wave[2]	0.20 to 1.2	190	continuous	100	LF4	Moored
	Chirp[2]	0.25 to 1.2	190	15,000	25	LF4	Moored

[1]General bin names are included (for each source) though modeling was conducted at the specified source parameters provided, for research activities.

[2]Both sources are located on the Massachusetts Institute of Technology/Lincoln Labs deployed vertical line array

2.3 ALTERNATIVES

Screening criteria were used in the development and selection of alternatives. These criteria were developed based upon training and testing requirements, as well as geographic and temporal limitations associated with the Arctic. Screening criteria for the selection of alternatives include:

(1) ICEX must be conducted during a time of year when there are sufficient hours of daylight to support several hours of training and testing each day.

(2) The training location must be on a large area of stable ice that does not have (and is not likely to develop) open leads or "gaps" and can sustain a runway and a camp for several weeks.

(3) The location must have sufficient water depth to accommodate safe submarine activities.

(4) The location must be in sufficient proximity to shore logistics centers to allow for transfers of personnel and equipment to and from the ice camp.

Based on these screening criteria, a No Action Alternative and two Action Alternatives will be addressed herein.

2.3.1 No Action Alternative

Under the No Action Alternative, ICEX would not occur. The Navy would not establish an ice camp and would not conduct submarine training and testing activities or research in the Arctic. This alternative requires no subsequent analysis of potential consequences to environmental resources as no action would occur.

2.3.2 Alternative 1: Submarine-Only Activities

Under Alternative 1, to support submarine training and testing, the Navy would establish an ice camp. The ice camp would be established approximately 100–200 nautical miles north of Prudhoe Bay, Alaska, and the exact location cannot be identified ahead of time as required conditions (e.g. ice cover) cannot be forecasted until exercises are expected to commence. The vast majority of submarine training and testing would occur near the ice camp; however, some submarine training and testing may occur throughout the deep Arctic Ocean basin near the North Pole, within the Study Area (Figure 2-1). Though the Study Area is large, the area where the proposed ice camp would be located is a much smaller area (See 2018 ice camp proposed action area on Figure 2-1). Prior to the set-up of the ice camp, reconnaissance flights would be conducted to locate suitable ice conditions required for the location of the ice camp. The reconnaissance flights would occur over an area of approximately 70,374 square kilometers (km^2); the actual ice camp is no more than 1.6 km in diameter (approximately 2 km^2 in area).

The Proposed Action would occur over an approximately six week period from February to early April, including construction and demobilization of the ice camp. The submarine training and testing would occur over approximately four weeks during the six-week period.

2.3.3 Alternative 2: Submarine Activities plus Research Activities (Preferred Alternative)

Under Alternative 2, the Navy would conduct the submarine training and testing activities under Alternative 1, as well as research activities (Table 2-1). The research activities would involve gathering data on environmental conditions and evaluating various technologies in Arctic conditions. Research activities are conducted for acoustic data collection to assess the effects of the changing arctic environment on acoustic propagation which, among other things, is critical to provide a better understanding of how military equipment, sensors and training and operations events may be affected by the changing arctic environment effects to acoustic propagation.

2.3.4 Alternatives Eliminated from Further Consideration

Other action alternatives considered but not carried forward for detailed analysis include geographic, seasonal, and operational variations. As discussed in the screening criteria (Section 2.3), holding ICEX in a different location (i.e. Study Area), or at a different time of year, would not satisfy the purpose and need. For example, holding ICEX closer to shore would not afford sufficiently thick ice to support an ice camp as well as the submarine tracking range to conduct the required submarine training and testing. Additionally, submarines need a relatively deep depth in which to operate. Positioning the camp further from shore would put the camp beyond the reach of logistics support required to sustain the activity. Seasonal alternatives are likewise not feasible because the combination of ice conditions and sufficient daylight required to support the ice camp are only available in the timeframe identified for the Proposed Action.

Finally, altering how submarine training and testing is conducted (e.g., reducing source level or limiting duration) is not feasible because the training and test plans are designed to specifically meet or test certain objectives. Conducting the training and testing differently would not meet the purpose and need of these requirements. Therefore, the Study Area identified in Figure 2-1 is the only suitable location, February through April is the only suitable timeframe, and the Proposed Action must be conducted as proposed to meet training and testing objectives.

2.4 RESOURCE ANALYSIS

As part of the process to determine the potential impact from the Proposed Action, the Navy identified potential resources and issues to be analyzed (Table 2-3). Table 2-4 lists the resources eliminated from further analysis and provides an explanation for their dismissal.

Table 2-3. Relevant Resources and Potential Effects of the Proposed Action

Resource	Potential Stressors
Physical Environment	
Air Quality	The Proposed Action would generate air emissions from mobile generators, aircraft, and on-ice vehicles. The ice camp location is located outside of the jurisdictional limit of the Clean Air Act. Therefore the conformity rule does not apply, and the Proposed Action is not subject to a conformity analysis. Prudhoe Bay falls within in the North Slope attainment area, therefore, Prudhoe Bay is not subject to a conformity analysis.
Bottom Substrate	Expended materials have the potential to impact bottom substrate in the Study Area.
Water Quality	Human presence (e.g., graywater discharge) and combustive byproducts (from exercise torpedoes) have the potential to impact water quality.
Biological Environment	
Marine Vegetation	Human presence (e.g., graywater discharge) has the potential to impact marine vegetation.
Invertebrates	Acoustic transmissions, in-water vessel and vehicle strike, bottom disturbance, combustive byproducts (from exercise torpedoes), entanglement, and ingestion have the potential to impact invertebrates.
Marine birds	Aircraft noise, on-ice vehicle noise, aircraft strike, and ingestion have the potential to impact marine birds.
Fish	Acoustic transmissions, in-water vessel and vehicle strike, bottom disturbance, combustive byproducts (from exercise torpedoes), entanglement, and ingestion have the potential to impact fish.
Essential Fish Habitat	Human presence (e.g. graywater discharge) and combustive byproducts (from exercise torpedoes) have the potential to affect Essential Fish Habitat.
Mammals	Acoustic transmissions, aircraft noise, on-ice vehicle noise, on-ice vehicle strike, in-water vessel and vehicle strike, human presence, combustive byproducts (from exercise torpedoes), entanglement, and ingestion have the potential to impact marine mammals. Aircraft noise, on-ice vehicle noise, on-ice vehicle strike, human presence, entanglement and ingestion have the potential to impact the Arctic fox.
Socioeconomic Environment	
Subsistence Hunting	The Proposed Action has the potential to temporarily impact species which are used in subsistence hunting. Subsistence hunting itself would not be stopped or interrupted as part of the Proposed Action due to the distance from shore that the majority of actions would occur.

Table 2-4. Resources Eliminated from Analysis

Resource	Reason for Elimination
Physical Environment	
Airspace	The majority of Proposed Action would occur in the water or on the ice surface. Aircraft would depart from Deadhorse Airport, but with a maximum of nine flights per day at the height of the exercise, would not have an impact to airspace use. All flights would be coordinated with the airport and would not create undue congestion of airspace. Low flying aircraft may be used for a portion of the training and testing but would not interfere with regular public airspace usage given that the offshore location is not a frequently used flight corridor. Therefore, the Proposed Action would not impact use of airspace.
Floodplains and Wetlands	The Proposed Action would occur in open water and would not impact the physical attributes of floodplains or wetlands. Therefore, the Proposed Action would not impact floodplains or wetlands.
Geology	No construction or dredging is planned as part of the Proposed Action. Therefore, the Proposed Action would not impact geological resources.
Land Use	The Proposed Action would occur in offshore of Prudhoe Bay, Alaska on ice-covered water and not on land. Therefore, the Proposed Action would not impact land use.
Terrestrial Environment	The Proposed Action would occur offshore, except for aircraft flights from Deadhorse Airport, in Prudhoe Bay. Because the Proposed Action would take place during the winter and early spring no biological resources would be present within the Deadhorse Airport, in Prudhoe Bay, so further analysis of these terrestrial resources are not included. Therefore, the Proposed Action would not impact the terrestrial environment including parks, forests, and prime and unique farmland.
Wild and Scenic Rivers	The Proposed Action would occur on or in ocean waters. Therefore, the Proposed Action would not impact wild and scenic rivers.
Biological Environment	
Terrestrial Wildlife	With the exception of the Arctic fox, no other terrestrial wildlife is anticipated to occur at the ice camp. Therefore, no impact would occur to these species.
Deep Sea Corals and Coral Reefs	No deep sea corals or coral reefs are present in the Study Area. Therefore, no impact would occur to these species.
Sea Turtles	No sea turtles would be present in the Study Area. Therefore, no impact would occur to these species.
Socioeconomic Environment	
Aesthetics	Aircraft movements out of the Deadhorse Airport, in Prudhoe Bay would be consistent with the typical flights coming in and out of the airport. Vessel movements would be at least 100-150 nautical miles (nm) from shore and would be under the ice in the Study Area. Therefore, the Proposed Action would not impact aesthetics.
Archaeological and Historical Resources	No known archaeological or historical resources are located within the Study Area. Therefore, the Proposed Action would not impact archaeological and historical resources.
Commercial and Recreational Fisheries	There are no commercial or recreational fisheries near or in the Study Area. Therefore, the Proposed Action would not impact commercial and recreational fisheries.
Commercial Shipping and Transportation	Although, there is a shipping lane in the Study Area (i.e. Northwest Passage) it is only used during late July through mid-October (depending on the route and year). Since this is outside of the timeframe of the Proposed Action there would be no impact to commercial shipping and transportation.
Cultural Resources	The Study Area is offshore of known cultural resources. There are no cultural resources in Prudhoe Bay, AK.
Environmental Justice	The Proposed Action would occur on the water and there would be no disproportionately high or adverse human health or environmental impacts on minority or low-income populations. Additionally, Prudhoe Bay does not have a minority of low income population. Therefore, the Proposed Action would not impact environmental justice.

Resource	Reason for Elimination
Infrastructure	No modification of infrastructure would occur as a result of the Proposed Action. Therefore, the Proposed Action would not impact infrastructure.
Recreational Boating and Tourism	During the timeframe of the Proposed Action there would be no recreational boating and tourism in the Study Area. Therefore, the Proposed Action would not impact recreational boating and tourism.
Utilities	The Proposed Action would not occur near any utilities. Therefore, the Proposed Action would not impact utilities.

CHAPTER 3 EXISTING ENVIRONMENT

3.1 PHYSICAL ENVIRONMENT

The Study Area for the Proposed Action is primarily located within the Beaufort Sea, where the ice camp proposed action area is located, but extends northward and encompasses the North Pole where submarine activities would occur. Additionally, the Proposed Action includes flights to and from Deadhorse Airport, and the use of the Deadhorse Aviation Center Hangar and other facilities in Prudhoe Bay, Alaska.

Prudhoe Bay, Alaska falls within the North Slope Borough, encompassing approximately 1425 square kilometers (km^2). The area that would be utilized for ICEX falls directly between Nuiqsut and Kaktovik along the Beaufort Sea. Based on the 2010 U.S. Census, the population is roughly 2,200, though at any given time there are several thousand transient workers supporting the Prudhoe Bay oil field, the largest in the United States (North Slope Borough 2016).

3.1.1 Bathymetry

The Arctic Ocean region is divided into two major basins: the Amerasian Basin and the Eurasian Basin, with their division marked by the Lomonosov Ridge, which runs from the northern coast of Greenland to the Laptev Sea. The Amerasian Basin contains the Siberian Sea, Bering Sea, Chukchi Sea, and the Beaufort Sea. Within the Amerasian Basin, some geographical features of importance for ICEX include the deep Canada Basin and the Alpha Ridge. The portion of the Study Area around the North Pole also includes portions of the Eurasian Basin, including the deeper Makarov and Amundsen (or Fram) Basins, which are separated by the Lomonosov Ridge.

The primary bathymetric feature of the Beaufort Sea is the Canada Basin, a deep ocean basin with depths up to 4,000 m (International Bathymetric Chart of the Arctic Ocean (IBCAO) 2015). This basin extends north into the Arctic Ocean and is bordered to the west by the Mendeleev (also referred to as Mendeleyev) Ridge, which ranges from 740 to 2,000 m below sea level (Stein 2008). The ice camp proposed action area is centrally located within this basin, in water depths ranging from 3,000 to 4,000 m (International Bathymetric Chart of the Arctic Ocean (IBCAO) 2015). Based on visual evaluation by Bluhm et al (2005), the seafloor within the Canada Basin is composed of very fine, silty sediment over a thick clay layer. North of the Canada Basin lies the Alpha Ridge, reaching 1,402 m at its peak, which rises up between the Canada and Makarov Basins, running parallel to the Lomonosov Ridge. At the pole sits the deeper Makarov and Amundsen (or Fram) Basins, which reach up to 4,289 m in depth, separated by the Lomonosov Ridge which, at its highest is 954 m below sea level (King 2014).

3.1.2 Currents, Circulation, and Water Masses

The processes governing water currents and circulation into and out of the Beaufort Sea are complex. Water enters the Arctic from the Pacific via the Bering Strait, a narrow, shallow passageway at only 46 nautical miles (nm) wide and 50 m deep (Woodgate 2012). Due to the narrow width of this passage, it is only an inflow point. On the Atlantic side, both an inflow and outflow movement of water occurs (Woodgate 2012). Cold water, with salinity levels averaging about 32.5 practical salinity units (psu), enters the Bering Strait from the Pacific Ocean (Woodgate et al. 2005). During winter, winds from interior Alaska blow over the shallow Chukchi Sea, freezing the water into ice and moving the ice away from land. This process is constantly creating and moving ice as well as leaving behind salt; this cold, salty water becomes denser and will sink into the western Arctic. The cold, salty water lies atop warmer, even saltier water (about 35 psu) from the Atlantic Ocean, creating the Arctic halocline (Woodgate 2012). This halocline prevents the warm, dense bottom water from melting the polar ice from below (Woods Hole Oceanographic Institution (WHOI) 2006). Meanwhile, the waters from both the Atlantic and Pacific inflows get swept into the Beaufort Gyre, an anticyclonic (clockwise) system north of Alaska where Canadian rivers deposit fresh water. When winds shift, the Beaufort Gyre weakens and fresh water is dispersed throughout the Arctic via the Transpolar Current (Woods Hole Oceanographic Institution (WHOI) 2006). The water exiting the Arctic for global circulation is colder and less saline than the incoming water (Woodgate 2012). Water exits the Arctic through several areas: the Canadian Archipelago via Hudson Strait, Baffin Bay via Davis Strait, or through the Fram Strait between Greenland and Svalbard into the Atlantic Ocean. The circulation patterns through the Arctic are shown in Figure 3-1, demonstrating the means by which water distributes from the Beaufort Gyre throughout the Arctic and beyond.

Currents within the Beaufort Gyre are variable, and depend on multiple factors including: wind speed, presence of eddies, and the value of the Arctic Oscillation, a representation of the state of atmospheric circulation over the Arctic. These factors come together to affect the overall velocity of the waters as they move throughout the Arctic Ocean, and can make predicting the velocity of the currents difficult. While subsurface velocities have been measured from ice camps historically, the most comprehensive studies are often of short duration (Plueddemann et al. 1998). Plueddemann et al (1998) used an Ice-Ocean Environmental Buoy frozen into Arctic pack ice approximately 130 nautical miles (nm) north of Prudhoe Bay, Alaska, to take long-term measurements of meteorological and oceanographic variables in the Arctic. This buoy travelled within the vicinity of the Study Area for the first few months of its expenditure before travelling into the Chukchi Sea. This study concluded that the ice drift within the Beaufort Gyre ranged from approximately 1 to 5 centimeters per second (cm/s) (Plueddemann et al. 1998). Ice Ocean Environmental Buoy deployment within the Beaufort Gyre has also been used to study various physical properties of Arctic eddies. A recent study by O'Brien et al (2013) used moorings with sequential sediment traps to study downward sediment flux in the Canada Basin. These sediment traps measured water current speed at multiple depths, finding that from the surface to 83 m, velocities were typically between 0 and 10 cm/s, though could jump up to 40 cm/s in the event of encounter with an eddy. The Beaufort Gyre expands and contracts based on the state of Arctic Oscillation; under high Arctic Oscillation conditions, the Beaufort Gyre will contract (Woodgate 2012).

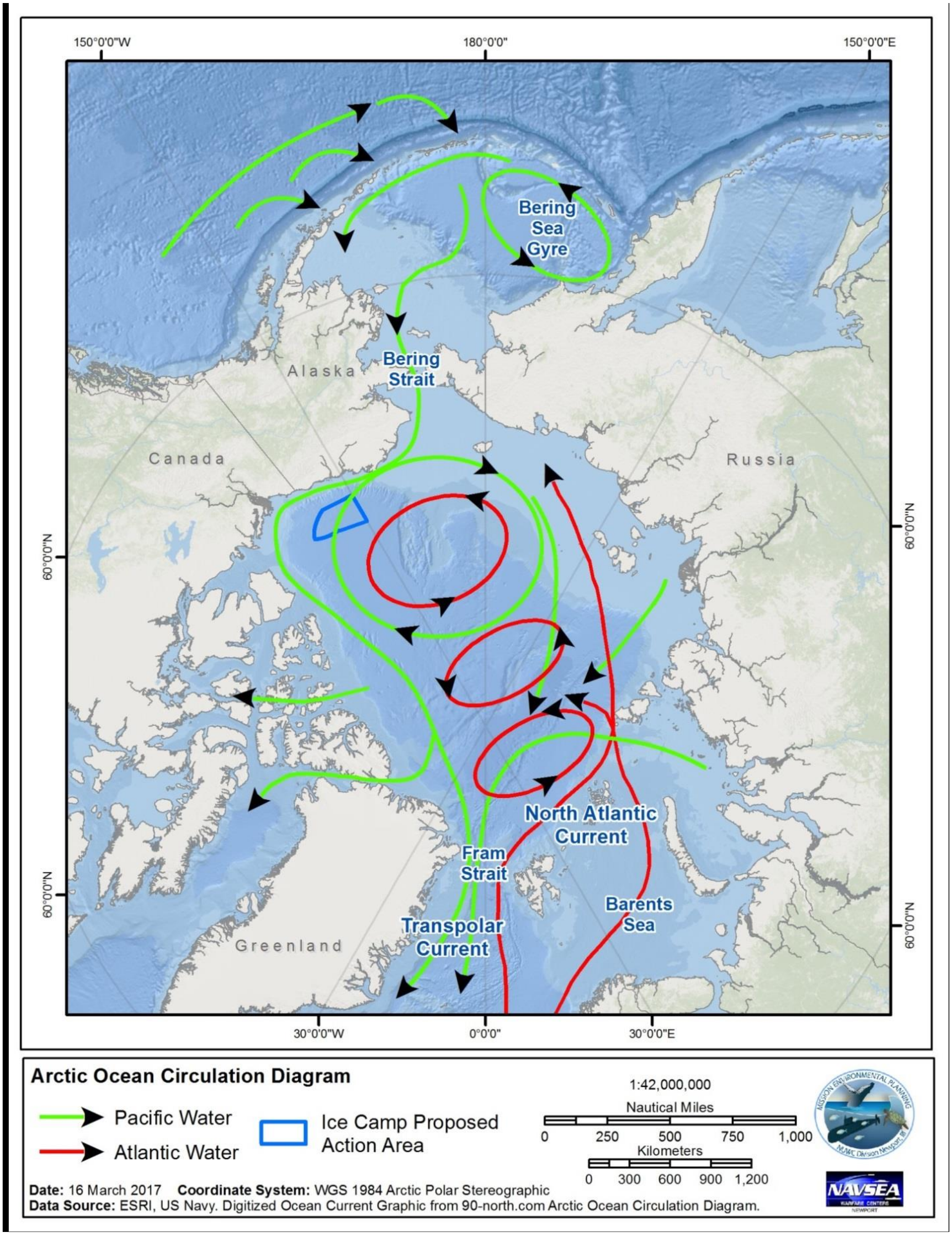

Figure 3-1. Arctic Ocean Circulation

In the Arctic, areas of ice-cover usually have a surface mixed layer 5–10 m deep. In ice-free regions, which have increased over time, this mixed layer, driven by winds, can be more than twice as deep (Rainville et al. 2011). In most of the western Arctic (also referred to as the Canada Basin), Pacific Waters are found below this mixed layer. Pacific Winter Waters are indicated by a deep minimum temperature around freezing at depths of about 100–150 m (Woodgate 2012). Shallower temperature maxima, probably formed locally by solar heating, are observed in some regions (Jackson et al. 2010; Shimada et al. 2001). Below the Pacific Water, Atlantic Water forms a temperature maximum (up to 33.8 degrees Fahrenheit [°F; 1 degrees Celsius; ºC]) at depths of around 200–400 m. These are called Fram Strait Branch Waters since they come mainly from the Fram Strait inflow (Rudels et al. 1994), although some influence is likely from the Barents Sea (Rudels et al. 2000; Woodgate et al. 2001). Below the Fram Strait Branch Waters, temperatures decrease and an inflexion point in temperature-salinity marks waters of mainly Barents Sea (Rudels et al. 1994; Smith et al. 1999). Throughout the Arctic, a cold halocline layer provides a density barrier, trapping Atlantic Water heat at depth away from the ice. Arctic Bottom Water occurs at depths greater than 900 m, and ranges in temperature from 30.6 to 30.4 °F (-0.8 to -0.9 °C) and salinities of 34 to 35 psu (Woodgate 2012). Upwelling and eddies allow for increased mixing of water both by currents, and by mixing of water layers containing different temperatures and salinities (Weingartner et al. 2008).

In the Beaufort Sea, the Alaska Shelf-Slope Front stretches along the north coast of Alaska from Point Barrow to the Mackenzie Delta by the Canadian Border. This front is a "hot spot" of activity where marine life, including mammals and sea birds, gather. Additionally, this is the site of the Cape Bathurst Polynya (an area of open sea surrounded by pack ice) (Belkin et al. 2009). In the Arctic Ocean, the observation of fronts is hampered by perennial ice cover that prevents satellite remote sensing in the Arctic Basin. Data collected from drifting stations and submarines has revealed a major front separating Atlantic waters from Pacific waters. Until the mid-1990s this front was located over the Lomonosov Ridge, but is now along the Mendeleyev-Alpha Ridge (Belkin et al. 2009).

3.1.3 Water Quality

The high Arctic waters (a term used to describe barren polar areas) have water of relatively low nutrient loads. At the end of the winter, a burst of primary productivity occurs under the ice when light levels become sufficiently high and nutrients are released from the ice. This surge of nutrients includes nitrogen (as ammonium, nitrite, and nitrate), phosphorus (as phosphate), iron, and other elements, which would then be either grazed upon and move through the food chain, or sink to the bottom and incorporate into bottom sediments (Vancoppenolle et al. 2013). In polar waters, nutrient concentrations undergo seasonal depletion in surface waters due to photosynthesis during spring/summer and renewal during winter when photosynthesis stops (Whitledge et al. 2008).

3.1.4 Atmospheric Temperature

The Earth's climate has warmed approximately 1.1 °F (0.6 °C) over the past 100 years with two main periods of warming occurring between 1910 and 1945 and from 1976 to present day (Overland et al. 2014; Walther et al. 2002). Temperature trends in the Arctic exhibit regional and annual variability (Maxwell 1997; Symon et al. 2005); however, a general warming trend has been observed since the late 1970s. Warming air temperatures have played a major role in the observed increase in permafrost temperatures around the Arctic rim, earlier spring snowmelt, reduced sea ice, widespread glacial retreat, increases in river discharge into the Arctic Ocean, and an increase in greenness of Arctic vegetation (Overland et al. 2014). Arctic atmospheric circulation is a complicated system, though air moves west to east across the Study Area and into the Canadian Archipelago and mainland (Hudson et al. 2001). Based on approximately nine months of data (including those months during which the Proposed Action would occur) from a 2014 model, the wind speed measured at a point in the Beaufort Sea, approximately 90 nm south of the Study Area, averaged 14.6 miles per hour (6.83 meters per second) (Naval Oceanographic Office 2014). The climatologic, hydrologic, and biological subsystems of the Arctic are highly interconnected, and thus cannot be easily isolated for discussion (Hinzman et al. 2005).

3.1.5 Air Quality and Greenhouse Gases

Air quality is defined by ambient concentrations of specific air pollutants – pollutants the U.S. Environmental Protection Agency (USEPA) determined may affect the health or welfare of the public. The six major pollutants of concern are called "criteria pollutants" and include carbon monoxide, sulfur dioxide, nitrogen dioxide, ozone, suspended particulate matter (dust particles less than or equal to 10 microns in diameter particulate matter [PM_{10}] and fine particulate matter less than or equal to 2.5 microns in diameter [$PM_{2.5}$]), and lead. The USEPA established National Ambient Air Quality Standards (NAAQS) for these criteria pollutants.

Air pollutants are classified as either primary or secondary pollutants based on how they originate in the atmosphere. Primary air pollutants are emitted directly into the atmosphere from the source of the pollutant and retain their chemical form. Examples of primary pollutants are the ash produced by burning solid waste and volatile organic compounds emitted from a dry cleaner (U.S. Environmental Protection Agency 2010). Secondary air pollutants are those formed through atmospheric chemical reactions – reactions that usually involve primary air pollutants (or pollutant precursors) and normal constituents of the atmosphere (U.S. Environmental Protection Agency 2010). Ozone, a major component of photochemical smog, is a secondary air pollutant. Ozone precursors fall into two broad groups of chemicals: nitrogen oxides and organic compounds. Nitrogen oxides consist of nitric oxide and nitrogen dioxide. Organic compound precursors of ozone are routinely described by various terms, including volatile organic compounds, reactive organic compounds, and reactive organic gases. Finally, some air pollutants are a combination of primary and secondary pollutants. PM_{10} and $PM_{2.5}$ are generated both as primary pollutants by various mechanical processes (e.g., abrasion, erosion, mixing, or atomization) or combustion processes. They are generated as secondary pollutants through chemical reactions or through the condensation of gaseous pollutants into fine aerosols.

NAAQS are set for criteria pollutants. Areas that exceed a standard are designated as "nonattainment" for that pollutant, while areas in compliance with a standard are in "attainment" for that pollutant. An area may be nonattainment for some pollutants and attainment for others simultaneously. States, through their air quality management agencies, are required to prepare and implement State Implementation Plans for nonattainment areas, which demonstrate how the area will meet the NAAQS. Areas that achieved attainment may be designated as "maintenance areas," subject to maintenance plans showing how the area will continue to meet federal air quality standards. Nonattainment areas for some criteria pollutants are further classified, depending on the severity of their air quality problem, to facilitate their management:

- Ozone – marginal, moderate, serious, severe, and extreme
- Carbon monoxide – moderate and serious

- Particulate matter – moderate and serious

The USEPA delegates the regulation of air quality to the state once the state has an approved State Implementation Plan. The Clean Air Act of 1970 also allows states to establish air quality standards more stringent than the NAAQS.

3.1.5.1 Greenhouse Gases

Greenhouse gases (GHGs) are gas emissions that trap heat within the atmosphere. These emissions occur from both natural processes and human activities. Scientific evidence indicates a trend of increasing global temperature over the past century due to an increase in GHG emissions from human activities. The climate change associated with this global warming is predicted to produce negative economic and social consequences across the globe.

The USEPA has identified greenhouse gases as carbon dioxide, methane, nitrogen oxide, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and other fluorinated gases including nitrogen trifluoride and hydrofluorinated ethers. Each GHG is assigned a global warming potential. The global warming potential is the ability of a gas or aerosol to trap heat in the atmosphere; this rating system is standardized to carbon dioxide, which has a value of one. The equivalent carbon dioxide rate is calculated by multiplying the emissions of each GHG by its global warming potential and adding the results together to produce a single, combined emissions rate representing all GHGs.

Climate Change and Department of Defense Policies

The DoD and the Department of the Navy have established various directives pertaining to climate change, including DoD Directive 4715.21, from January 2016, which integrates climate change considerations into all aspects of the department (Department of Defense, 2016a). DoD components are charged with assessing and managing risks, and mitigating the effects of climate change on natural and cultural resource management, force structure, basing, and training and testing activities in the field environment.

Additionally, the DoD 2016 Operational Energy Strategy (Department of Defense, 2016b) sets forth plans to reduce the demand for energy and secure energy supplies. This policy also directs DoD components to reduce GHG emissions from operational forces. Other recent policies, updates, and/or directives include the Fiscal Year (FY) 15 DoD Sustainability Performance Plan (Department of Defense, 2015) and the 2014 Climate Change Adaptation Roadmap (Department of Defense, 2014), which focus on various actions DoD is taking to increase its resilience to the impacts of climate change. The Secretary of the Navy set goals to improve energy security, increase energy independence, and reduce the reliance on petroleum by increasing the use of alternative energy (Department of the Navy, 2010a).

The Navy has established FY 2020 GHG emission reduction targets of 34 percent from a FY 2008 baseline for direct GHG emissions and 13.5 percent for indirect emissions. Examples of Navy-wide GHG reduction projects include energy efficient construction, thermal and photovoltaic solar systems, geothermal power plants, and the generation of electricity from wind energy. The Navy continues to implement a number of renewable energy projects in an effort to reduce energy consumption, reduce GHGs, and reduce dependence on petroleum.

3.1.5.2 Affected Environment

The Study Area spans from the northern coastline of Alaska to the area surrounding the North Pole. The majority of the Study Area, including the ice camp proposed action area, is substantially offshore and beyond state boundaries; outside of 12 nm, attainment status is not applicable and the Clean Air Act NAAQS do not apply. However, given fluctuations in wind direction, air quality in adjacent onshore areas may be affected by releases of air pollutants from Study Area sources. Therefore, NAAQS attainment status of adjacent onshore areas is considered in determining whether appropriate controls on air pollution sources in the adjacent offshore state waters is warranted. All coastal Alaska boroughs and counties are classified as attainment areas of the eight-hour standard for ozone (40 CFR § 81.322). As previously mentioned, attainment areas are areas that meet the NAAQS for specific pollutants. Under the Clean Air Act, only nonattainment areas are required to limit and act to decrease emissions below the NAAQS. Since the Study Area is not adjacent to nonattainment areas, there are not limitations placed on emissions.

The primary concern with regards to GHGs for ICEX comes from flights to and from the ice camp. These flights would be small aircraft departing from an existing airfield, and therefore would not lead to emissions levels of concern. Increases in daily flights operating out of the Deadhorse Airport, in Prudhoe Bay, due to the ICEX activity are not expected to significantly contribute to greenhouse gas emissions in the area during the temporary timeframe of the Proposed Action. The remainder of ICEX activities, including the use of generators, would occur more than 12 nm from shore, where NAAQS do not apply.

3.1.6 Sea Ice

3.1.6.1 Arctic Sea Ice Regime

Sea ice is frozen seawater that floats on the surface of the ocean, covering millions of square miles. Sea ice that persists year after year, surviving at least one summer melt season, is known as multiyear ice. Sea ice forms and melts with polar seasons and affects both human activity and biological habitat (Jeffries et al. 2014). Arctic sea ice plays a crucial role in Northern Hemisphere climate and ocean circulation, and is thought to play an even more crucial role in regulating climate than Antarctic sea ice (National Snow and Ice Data Center 2007; Serreze et al. 2003).

Sea ice directly impacts coastal areas and broadly affects surface reflectivity, ocean currents, water cloudiness, humidity, and the exchange of heat and moisture at the ocean's surface. Since sea ice reflects the sun's heat, when ice retreat is greater and there is more open ocean, more of the sun's heat is absorbed, increasing the warming of the water (Timmermans and Proshutinsky 2014).

3.1.6.2 Sea Ice Extent

Though the record of sea ice extent dates as far back as 1900 in the Northern Hemisphere, the most complete record of sea ice is provided by microwave satellites, which have routinely and accurately monitored sea ice extent since 1979 (Jeffries et al. 2014; Timmermans and Proshutinsky 2014). Annually, sea ice extent is at its maximum in March, representing the end of winter, and is at its minimum in September (Jeffries et al. 2014). During the Proposed Action, the southerly extent of sea ice is located within the Bering Sea (Figure 3-2); the entire Study Area would be covered by sea ice during the Proposed Action.

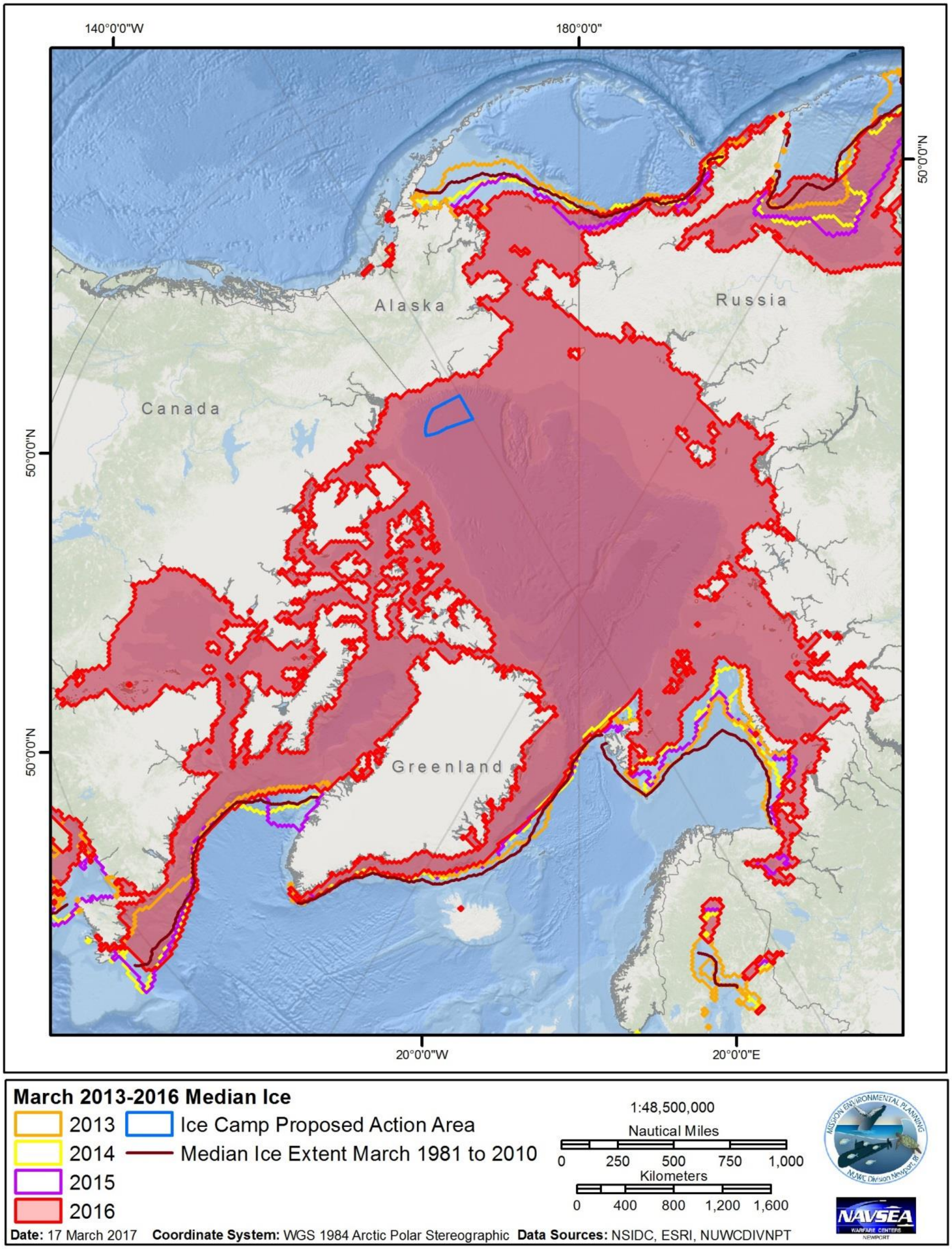

Figure 3-2. Average Arctic Sea Ice Extent in March

Data from 2016 reveals a minimum extent of 4.14 million km^2. This extent is tied with September of 2007 for the second lowest minimum ice extent on record. September 2012 remains the record low minimum ice extent of 3.4 million km^2 (National Snow and Ice Data Center 2017). In September of 2007, the sea ice recession was so vast that the Northwest Passage completely opened up for the first time in human memory (National Snow and Ice Data Center 2007).

The age of the sea ice is another key descriptor of the state of the sea ice cover, as it is an indicator for its physical properties including surface roughness, melt pond coverage, and ice thickness. Older ice tends to be thicker and thus more resilient to changes in atmospheric and oceanic forcing than younger ice. The age of the ice can be determined using satellite observations and drifting buoy records to track ice parcels over several years (Tschudi et al. 2010). The distribution of ice of different ages illustrates the extensive loss in recent years of the older ice types (Maslanik et al. 2011). In 2014, the distribution of ice age favored first-year ice, or ice that has not survived a melt season. This is the thinnest type of ice. The month of March has shown a decreasing trend in the oldest ice, which is 4 years old or older. In 1988, 26 percent of ice cover was the oldest ice. The oldest ice cover decreased to 19 percent in 2005 and to 10.1 percent in 2014, which has increased slightly from 2013 (Perovich et al. 2013). Sea ice has also been experiencing later freeze-up than usual and earlier ice melt over the past few years, leading to a decline in multiyear ice, although there was an increase in multi-year ice seen from 2013 to 2014 (Overland and Wang 2013). In March of 2014, the coverage of multi-year ice increased to 31 percent of ice cover. In March of 2013, the coverage was only 22 percent. The mean thickness of this ice, measured northwest of Greenland, also increased: 2.35 m in March of 2014 compared to 1.97 m in March of 2013.

Sea ice extent fluctuates annually and is influenced by natural variations in atmospheric pressure and wind patterns, but clear linkages have also been made to decreased Arctic sea ice extent and rising greenhouse gas concentrations dating back to the early 1990s (Timmermans and Proshutinsky 2014). A general downward trend in Arctic sea ice has occurred during the last few decades (Serreze et al. 2003). The maximum ice extent from March 2016 tied with March 2014 for the lowest maximum ice extent in the 37 year satellite record (14.76 million km^2). This maximum extent is 5 percent below the 1981 through 2010 average, though fairly typical of measurements taken in the last decade (Perovich et al. 2013). The March 2015 maximum extent measured 4.52 million km^2 (National Snow and Ice Data Center 2017). The ice is declining faster than computer models had projected, and this downward trend is predicted to continue (National Snow and Ice Data Center 2007; Timmermans and Proshutinsky 2014). The decrease in sea ice extent can be seen in Figure 3-3 below, illustrating the decline in sea ice during the month of March between 1979 and 2016, estimated to be approximately a 3.2 percent decrease per decade (National Snow and Ice Data Center 2017).

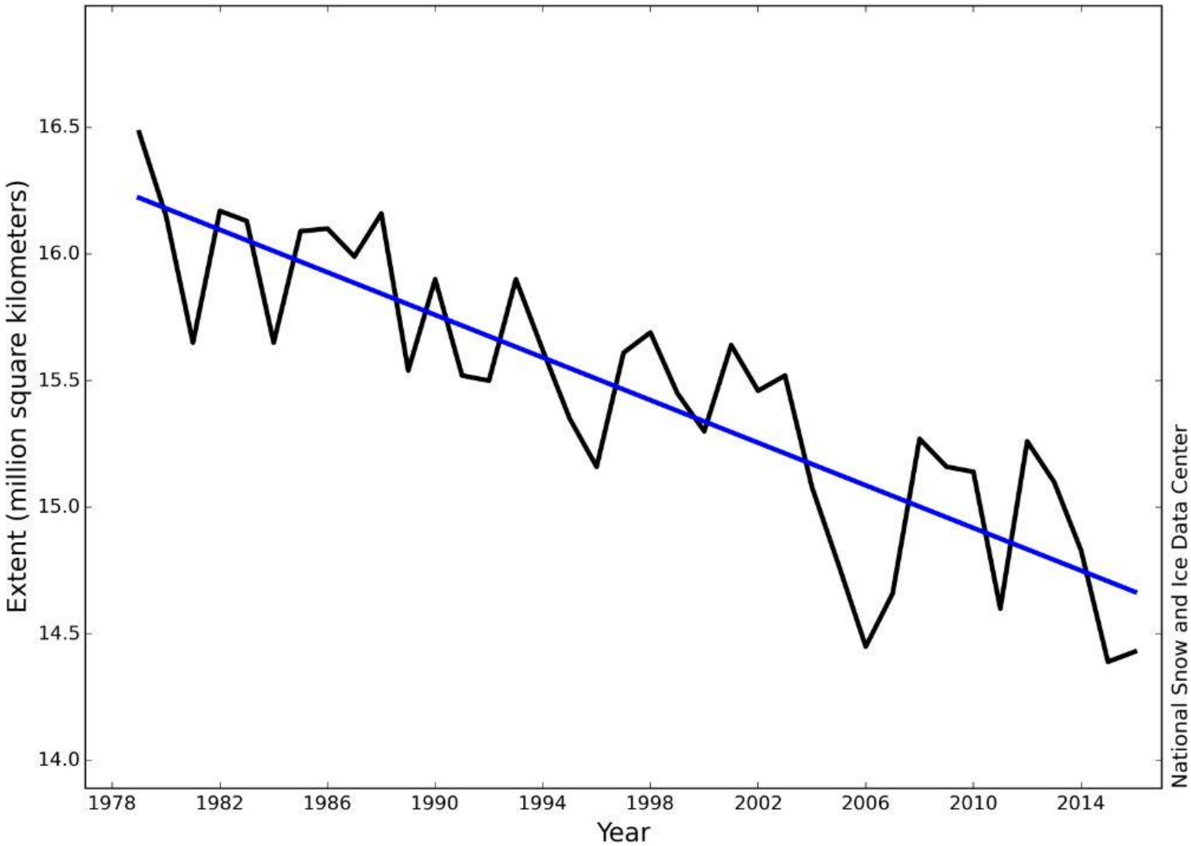

Figure 3-3. Average Arctic Sea Ice Extent for March (1979-2016)

3.2 BIOLOGICAL ENVIRONMENT

3.2.1 Marine Vegetation

Two groups of marine algae represent all marine vegetation within the Study Area: dinoflagellates (Section 3.2.1.1) and diatoms (Section 3.2.1.2). Table 3-1 provides an overview of these taxonomic groups, basic descriptions of each group and their ecosystem roles, and their vertical distribution in the Study Area. No species of marine vegetation within the Study Area are protected by the Endangered Species Act. As there are no stressors that would impact land-based marine vegetation, only those that would be present in the waters of the ice camp proposed action area are included.

Table 3-1. Major Taxonomic Groups of Marine Vegetation in the Study Area*

Marine Vegetation		Vertical Distribution
Common Name (Taxonomic Group)	**Description**	**Open Ocean**
Dinoflagellates (phylum Dinophyta)	Most are photosynthetic single-celled algae that have two flagella; some live inside other organisms such as zooxanthellae. Some produce toxins that can result in red tide or ciguatera poisoning.	Photic zone
Diatoms (phylum Heterokontophyta)	Unicellular or colonial algae that have a silica shell called a frustule and form the base of the marine food web.	Photic zone

*Based on Lindeberg and Lindstrom (2017)

Phytoplankton not only flourish under thick layers of ice, but are about four times higher in abundance under the ice than in the open water (Arrigo et al. 2012). The reason that phytoplankton can flourish under the ice is because the Arctic ice pack has thinned in recent decades, covering the ice with meltwater ponds at its surface. Meltwater ponds absorb more sunlight than ice and accelerate the melting rate of ice into the sea. As such, more light can penetrate through the ice into the water below. Phytoplankton begins to grow beneath the Arctic ice as soon as ample light is available for photosynthesis. After a couple of weeks, the ice disappears and what is left is a remnant population of phytoplankton from that earlier under-ice bloom (Arrigo et al. 2012). The clear water and high light conditions prevail until a bloom of phytoplankton occurs or turbid melt-water flows into the sea (Drew and Hastings 1992). Ice algae contributes to the total primary production in the Arctic Ocean with higher production values in first-year ice compared to the multi-year ice zone, and ice algae can contribute up to 60 percent of total primary productivity in these areas (Horner and Schrader 1982). Dunton et al. (2005) collected chlorophyll-a concentrations during the ice-free period from late May to September between 1974 and 1995, noting levels between 10 and 15 milligrams per square meter within the Study Area. In regards to sea ice algal production, the central Arctic Ocean is one of the least productive marine regions on Earth due to its multiyear ice cover. The rate of productivity in the central Arctic Ocean has been measured at about 14 grams of Carbon per meter per year. Annual estimates of the contributions of sea ice algal production to total productivity is less than 10 percent in the shelf seas and greater than 50 percent in the central Arctic Ocean.

3.2.1.1 Dinoflagellates

No ESA-listed or federally managed species of dinoflagellates are located in the Study Area. Dinoflagellates are eukaryotic, single-celled, and predominantly marine algae (Bisby et al. 2010). They occur throughout the Study Area, and over 70 species have been identified in Arctic sea ice (Bluhm and Gradinger 2008). Organisms such as zooplankton feed on dinoflagellates. Dinoflagellates are responsible for some types of harmful algal blooms caused by sudden increases of nutrients (e.g., fertilizers) from land into the ocean or changes in temperature and sunlight (Levinton 2009b). Common genera of dinoflagellates that occur in the Study Area are *Ceratium* and *Noctiluca* (Marret and Zonneveld 2003). Most dinoflagellates are photosynthetic, and many can also ingest small food particles.

3.2.1.2 Diatoms

No ESA-listed or federally managed species of diatoms are located in the Study Area. Diatoms are primarily planktonic, single-celled organisms with cell walls made of silica (Castro and Huber 2000). Most species are found in the lighted areas, the upper 200 m of the water column and under ice in the open ocean areas of the Study Area. Zooplankton feed on diatoms; Arctic diatom blooms are typically dominated by species in the genera *Chaetoceros*, *Thalassiosira*, and *Fragilariopsis* (Arrigo et al. 2012; Lovejoy et al. 2006).

3.2.2 Invertebrates

Marine invertebrates occur in the world's oceans, from warm shallow waters to cold deep waters, and are the dominant animals in all habitats of the Study Area. Excluding microbes, approximately 5,000 known marine invertebrates have been documented in the Arctic; the number of species is likely higher, though, since this area is not well studied (Josefson et al. 2013). Although most species are found within the benthic zone, marine invertebrates can be found in all zones (sympagic [within the sea ice], pelagic [open ocean], or benthic [bottom dwelling]) of the Beaufort Sea (Josefson et al. 2013). Marine invertebrate distribution in the Beaufort Sea is influenced by habitat and oceanographic conditions (e.g., depth, temperature, salinity, nutrient concentrations, and ocean currents) (Levinton 2009a). The cold water of the Arctic generally results in slow growth and high longevity among invertebrates and food sources which are only seasonally abundant. Major taxonomic groups found within the Beaufort Sea are listed and described in Table 3-2, since no studies of invertebrates have been completed within the Study Area. No ESA-listed species of invertebrates exist within the Study Area. Additionally, Essential Fish Habitat has not been designated for any federally managed invertebrate species within the Study Area. Because of the large number of species, a general discussion of each ecologic zone (sympagic, pelagic, and benthic) is provided below.

3.2.2.1 Sympagic Zone

Sea ice provides a habitat for algae and a nursery ground for invertebrates during times when the water column does not support phytoplankton growth (Michel et al. 2002). Sympagic zone invertebrates live within the pores and brine channels of the ice (small spaces within the sea ice which are filled with a salty solution called brine) or at the ice-water interface. Biodiversity of species is low within the sympagic zone due to the extreme conditions of the sea ice (Nuttall 2005). Species abundance within the ice has been found to be highly variable with most species occurring within the bottom 10 cm of ice core samples. Species are also found in greater densities in coastal fast ice compared to offshore pack ice. Additionally, abundance is 1 to 4 orders of magnitude greater in spring and early summer (compared to winter) in coastal fast ice (Bluhm et al. 2010). The most dominant sympagic species are nematodes, harpacticoid copepods, and rotifers (Josefson et al. 2013). At the ice-water interface, *Apherusa glacialis, Onisimus glacialis, O. nanseni,* and *Gammarus wilkitzkii* are common amphipods (Gradinger et al. 2010).

Table 3-2. Taxonomic Groups of Marine Invertebrates in the Beaufort Sea

Invertebrate Group		Presence in Beaufort Sea		
Common Name (Taxonomic Group)	**Description**	**Sympagic**	**Pelagic**	**Benthic**
Flatworms (Phylum Platyhelminthes)[1]	Simplest form of marine worm with a flattened body.	✓		✓
Ribbon worms (Phylum Nemertea)[1]	Worms with a long extension from the mouth (proboscis) that helps capture food.		✓	✓
Roundworms (Phylum Nematoda)[1]	Small worms; many live in close association with other animals (typically as parasites).	✓	✓	✓
Sponges (Phylum Porifera)[2]	Large species have calcium carbonate or silica structures embedded in cells to provide structural support.			✓
Segmented worms (Phylum Annelida)[2]	Highly mobile marine worms; many tube-dwelling species.	✓	✓	✓
Bryozoans (Phylum Bryozoa)[3]	Lace-like animals that exist as filter feeding colonies. Form either encrusting or bushy-tuftlike lacy colonies.			✓
Hydroids and jellyfish (Phylum Cnidaria)[2]	Animals with stinging cells.	✓	✓	✓
Cephalopods, bivalves, sea snails, chitons (Phylum Mollusca)[2]	Mollusks are a diverse group of soft-bodied invertebrates with a specialized layer of tissue called a mantle. Mollusks such as squid are active swimmers and predators, while others such as sea snails are predators or grazers and clams are filter feeders.		✓	✓
Shrimp, crab, barnacles, copepods (Phylum Arthropoda – Crustacea)[2]	Diverse group of animals, some of which are immobile. Most have an external skeleton. All feeding modes from predator to filter feeder.	✓	✓	✓
Sea stars, sea urchins, sea cucumbers (Phylum Echinodermata)[2]	Predators and filter feeders with tube feet.			✓

[1]Based on Arctic Ocean biodiversity (Bluhm 2008), and due to lack of information on phyla species added for analysis (presence within the Study Area is unknown).
[2]Invertebrate phyla are based on the World Register of Marine Species (Appeltans et al. 2010) and Catalogue of Life (Bisby et al. 2014).
[3]Phyla not extracted when searched the distribution of the Beaufort Sea on the World Register of Marine Species. Individual species found on Arctic Ocean biodiversity, and verified via the distribution maps on the World Register of Marine Species (Appeltans et al. 2010)

3.2.2.2 Pelagic Zone

Pelagic habitats include downwelling and upwelling areas and frontal zones. Dominant species groups within the pelagic zone are highly stratified by depth. In a zooplankton survey from the Arctic Canadian Basin (east of the Study Area) within the pelagic zone, 50 percent of the biomass was concentrated in the upper layer from 0 to 100 m in depth (Hopcroft et al. 2005). The pelagic zone invertebrate fauna is dominated by large copepods such as *Calanus glacialis* and *C. hyperboreus*. Copepods in the pelagic zone of the Beaufort Sea have longer life cycles (2–4 years) and are larger than copepod species living in warmer water (Hopcroft et al. 2008). Sirenko (2001) and Sirenko et al. (2010) found that cnidarians are second to copepods in both diversity and numbers. Jellyfish are likely important invertebrate predators within this zone (Josefson et al. 2013).

3.2.2.3 Benthic Zone

The benthic zone is the most diverse and species-rich habitat, where the majority of the species within the Study Area can be found. Benthic marine invertebrates play an important role in the food web as scavengers, recyclers of nutrients, and habitat-forming organisms or can serve as food themselves to predators such as fish and whales.

Within the Arctic region, major species groups within the benthic zone that have the highest diversity and abundance are Arthropoda (e.g., crabs and barnacles), Bryozoa (moss animals), Mollusca (e.g., snails and clams), and Nematoda (e.g. roundworms) (Josefson et al. 2013). In a recent Beaufort Sea trawl, the invertebrates with the highest densities in descending order of abundance were the notched brittle star (*Ophiura sarsi*), snow crab (*Chionoecetes opilio*), mussels (*Musculus* spp.), and the mud star (*Ctenodiscus crispatus*) (Rand and Logerwell 2010). Within the sediment, roundworms are one of the most widespread marine invertebrates with population densities of one million organisms per 1 square meter (m^2) of mud (Levinton 2009a). The principal habitat-forming invertebrates of the benthos are Porifera (e.g., sponges), Annelida (e.g., tube worms), and Mollusca (e.g., sea snails).

3.2.2.4 Invertebrate Hearing

Hearing capabilities of invertebrates are largely unknown (Lovell et al. 2005; Popper and Schilt 2008). Outside of studies conducted to test the sensitivity of invertebrates to vibrations, very little is known on the effects of anthropogenic underwater noise on invertebrates (Edmonds et al. 2016). While data are limited, research suggests that some of the major cephalopods and decapods may have limited hearing capabilities (Hanlon 1987; Offutt 1970), and may hear only low-frequency (less than 1 kHz) sources (Offutt 1970; Packard et al. 1990), which is most likely within the frequency band of biological signals (Hill 2009). In a review of crustacean sensitivity of high amplitude underwater noise by Edmonds et al. (2016), crustaceans may be able to hear the frequencies at which they produce sound, but it remains unclear which noises are incidentally produced and if there are any negative effects from masking them. Acoustic signals produced by crustaceans range from low frequency rumbles (20-60 Hz) to high frequency signals (20-55 kHz) (Henninger and Watson 2005; Patek and Caldwell 2006; Staaterman et al. 2016).

Aquatic invertebrates that can sense local water movements with ciliated cells include cnidarians, flatworms, segmented worms, urochordates (tunicates), mollusks, and arthropods (Budelmann 1992a, 1992b; Popper et al. 2001). Some aquatic invertebrates have specialized organs called statocysts for determination of equilibrium and, in some cases, linear or angular acceleration. Statocysts allow an animal to sense movement and may enable some species, such as cephalopods and crustaceans, to be sensitive to water particle movements associated with sound (Hu et al. 2009; Kaifu et al. 2008; Montgomery et al. 2006; Popper et al. 2001). Because any acoustic sensory capabilities, if present at all, are limited to detecting water motion, and water particle motion near a sound source falls off rapidly with distance, aquatic invertebrates are probably limited to detecting nearby sound sources rather than sound caused by pressure waves from distant sources.

Both behavioral and auditory brainstem response studies suggest that crustaceans may sense frequencies up to three kilohertz (kHz), but best sensitivity is likely below 200 hertz (Hz) (Goodall et al. 1990; Lovell et al. 2005; Lovell et al. 2006). Most cephalopods likely sense low-frequency sound below 1,000 Hz, with best sensitivities at lower frequencies (Budelmann 2010;

Mooney et al. 2010; Offutt 1970; Packard et al. 1990). A few cephalopods may sense higher frequencies up to 1,500 Hz (Hu et al. 2009).

3.2.3 Marine Birds

For the purpose of this document, "marine birds" refers to shoreline, coastal, bay, and pelagic bird species. A description is provided below for each of the major taxonomic group of marine birds that occur in the Study Area and include species protected under the Migratory Bird Treaty Act. No ESA-listed bird species exist within the Study Area. A combination of short-distance migrants, long-distance migrants, and year-round resident marine bird species occur within the Study Area, although during the timeframe of the Proposed Action only year-round residents would be present. Typical behaviors that would be encountered within the Study Area predominantly include on-ice foraging and migrating.

3.2.3.1 Major Bird Groups

Five species of birds may occur within the Study Area during the Proposed Action. All species listed in Table 3-3 have a year-round seasonality in the Beaufort Sea and surrounding region. All other Beaufort Sea bird species are only encountered in the summer season when they migrate from their southern wintering grounds to their northern breeding grounds in the Arctic.

Table 3-3. Marine Bird Species that May Occur in the Study Area during the Proposed Action

Common Name	Scientific Name	Seasonal Presence within the Study Area*
Order Charadriiformes		
Family Laridae		
Ivory gull	*Pagophila eburnea*	Year-round
Ross's gull	*Rhodostethia rosea*	Year-round
Order Procellariiformes		
Family Phasianidae		
Rock Ptarmagan	*Lagopus muta*	Year-round
Family Procellariidae		
Northern fulmar	*Fulmarus glacialis*	Year-round
Short-tailed shearwater	*Puffinus tenuirostris*	Year-round

*All seasonality information was obtained from International Union for the Conservation of Nature (2016) and Cornell Lab of Ornithology (2016).

3.2.3.1.a Order Charadriiformes

The order Charadriiformes within the Study Area is comprised of species within the family Laridae. No species in this group are listed under the ESA.

Within the Study Area, two species from the family Laridae (ivory gull [*Pagophila eburnean*] and Ross's gull [*Rhodostethia rosea*]) may be present during the timeframe of the Proposed Action. These species winter in the Arctic Ocean, and will spend time at edges of pack ice. Therefore, ivory gulls would be more likely to be encountered near Prudhoe Bay, and Ross's gulls would be more likely to be encountered both near Prudhoe Bay and further out towards the ice camp proposed action area. Outside of the breeding season, ivory gulls occur singly or in flocks of up to 20 individuals (BirdLife International 2016; International Union for the Conservation of Nature 2016). These species consume fish, surface-dwelling marine invertebrates, and algae, though ivory gulls also will scavenge on marine mammal remains on the sea ice (International Union for the Conservation of Nature 2016; Kaufman 1996). Ross's gull will forage solitarily or in small, loose flocks.

3.2.3.1.b Order Galliformes

Within the Order Galliformes, the species that may be present within the Study Area is the rock ptarmigan (*Lagopus muta*). This species is not listed under the ESA.

Rock ptarmigans winter within their breeding habitat, which consists of shrubby areas; some may spend up to several weeks in complete darkness. They are a land based species, living within arctic tundras and hummocky areas (Montgomerie and Holder 2008), and therefore would be most likely to be present near the Prudhoe Bay portion of the Study Area. The diet of rock ptarmigans is comprised of over 99 percent plant material, and like other birds in the family Phasianidae, do not dive.

3.2.3.1.c Order Procellariiformes

Procellariiformes is a large order of pelagic marine birds. Two species in this order occur within the Study Area during the timeframe of the Proposed Action: the northern fulmar (*Fulmarus glacialis*) and short-tailed shearwater (*Puffinus tenuirostris*), both of the family Procellariidae. Neither of these species are ESA-listed within the Study Area.

Fulmars are medium to large birds, and are typically scavengers. They are more likely to be found near Prudhoe Bay. Shearwaters obtain their food at or close to the water's surface (Brooke 2001). Typically only non-breeding short-tailed shearwaters would be found either in Prudhoe Bay or within the ice camp proposed action area during the winter, though most of this species migrates south and will return to the Arctic in May (U.S. Fish and Wildlife Service 2006). This order includes species that are generally long lived, breed once per year, and lay only one egg; thus, they have a low reproductive output.

3.2.3.2 Hearing

Although hearing range and sensitivity has been measured for many terrestrial birds, little research has been conducted on the hearing capabilities of marine birds. The majority of published literature on bird hearing focuses on terrestrial birds, particularly songbirds, and their ability to hear in the air. A review of 32 terrestrial and marine species reveals that birds generally have greatest hearing sensitivity between 1 and 4 kHz (Beason 2004; Dooling 2002). Research shows that very few birds can hear below 20 Hz, most have an upper frequency hearing limit of 10 kHz, and none exhibit the ability to hear frequencies higher than 15 kHz (Dooling 2002; Dooling et al. 2000). Hearing capabilities have been studied for only a few marine birds (Beason 2004; Beuter et al. 1986; Thiessen 1958; Wever et al. 1969); these studies show that marine birds have hearing ranges and sensitivities that are consistent with what is currently known about general bird hearing capabilities.

3.2.4 Fish

The fish species located in the Study Area include those that are closely associated with the deep ocean habitat of the Beaufort Sea. Nearly 250 marine fish species have been described in the Arctic, excluding the larger parts of the sub-Arctic Bering, Barents, and Norwegian Seas (Mecklenburg et al. 2011). However, only about 30 are known to occur in the Arctic waters of the Beaufort Sea (Christiansen and Reist 2013). Largely because of the difficulty of sampling in remote, ice-covered seas, many high-Arctic fish species are known only from rare or geographically patchy records (Mecklenburg et al. 2013). Aquatic systems of the Arctic undergo extended seasonal periods of ice cover and other harsh environmental conditions. Fish inhabiting such systems must be biologically and ecologically adapted to surviving such conditions. Important environmental factors that Arctic fish must contend with include reduced light, seasonal darkness, ice cover, low biodiversity, and low seasonal productivity. No ESA-listed fish species occur within the Study Area. Fish present on the continental shelf are not analyzed herein, as they would not be impacted by aircraft flyovers.

3.2.4.1 Major Fish Groups

Marine fish can be broadly categorized into horizontal and vertical distributions within the water column. The primary distributions of fish that occur in the marine environment of the Study Area are within the water column near the surface. While there are multiple major fish groups inhabiting the deep waters of the Beaufort Sea (Table 3-4), the only federally managed species within the Study Area is the Arctic cod (*Arctogadus glacialis*) (Section 3.2.4.1.a).

Table 3-4. Major Groups of Marine Fish in the Study Area during the Proposed Action*

Common Name	Scientific Name	Vertical Distribution Within the Study Area
Cod	Order Gadiformes	Water column
Scorpionfish	Order Scorpaeniformes	Seafloor, water column
Eelpouts, Eelblennys, and Wolffishes	Order Perciformes	Seafloor

* All distribution information was obtained from Food and Agriculture Organization of the United Nations (Cohen et al. 1990), Kaschner et al. (2013), and Arctic Ocean Diversity (Mecklenburg and Mecklenburg 2009).

3.2.4.1.a Cods (Order Gadiformes)

The two major species of cod within the Study Area are Arctic cod and polar cod (*Boreogadus saida*). Cod are an important component in the food web of the Beaufort Sea environment, preying on primary producers such as plankton, and being preyed upon by ringed seal (*Phoca hispida*), bearded seal (*Erignathus barbatus*), beluga whale (*Delphinapterus leucas*), narwhal (*Monodon monoceros*), and many marine birds (including gulls and guillemots) (Bluhm and Gradinger 2008; Cohen et al. 1990; Welch et al. 1993). Cods predominantly inhabit the water column of oceanic waters seaward of the 200-m isobath, exhibiting some preference of bathymetric stratification.

Arctic cod is the northernmost-occurring fish species and is widespread throughout Arctic seas (Mecklenburg et al. 2013). Arctic cod are both cryopelagic (live in cold, deep water) and epontic (live on the underside of ice). They use sea ice for shelter, to capture prey, and to avoid predators. Arctic cod often occur in ice holes, cracks, hollows, and cavities in the lower surface of the ice and are most common near the ice edge or among broken ice. As the ice thaws at these margins, plankton grow and provide a food source. They occur in the open-ocean waters of the Study Area from the surface to depths of 400 m. Onshore-offshore movements are associated with spawning and movements of ice. Cod are generally found near the bottom in the continental shelf areas, feeding on benthic organisms (Paxton and Eshmeyer 1998). The primary offshore food source of Arctic cod is plankton (Mecklenburg et al. 2011). Specifically, they feed predominantly on epibenthic mysids, amphipods, copepods, and fish (Cohen et al. 1990). It is possible that they also feed on the amphipod-diatom ice community inhabiting the lower ice layer. This species moves and feeds in different groupings, dispersed in small and very large schools throughout the water column (Welch et al. 1993).

3.2.4.1.b Scorpionfish (Order Scorpaeniformes)

Scorpionfish, of the order Scorpaeniformes, are distinguishable by the well-developed spines on their cheeks, and the distinct ridges or spines on top of the head. Adults of most Arctic species live on the seafloor, but some are both benthic and pelagic. These fish typically consume small crustaceans, worms, clams, and fish eggs. One example of a scorpionfish that inhabits the Study Area is the gelatinous seasnail (*Liparis fabricii*), which is both benthic and pelagic, living at depths up 2,500 m (Mecklenburg et al. 2011). Scorpionfish are prey species for other fishes and marine birds.

3.2.4.1.c Eelpouts, Eelblennys, and Wolffishes (Order Perciformes)

Though most species of the order Perciformes are found in the benthic habitats of shallower shelf waters, some species are associated with deep-water marine environments. One such species is the glacial eelpout (*Lycodes frigidus*), which is endemic to the Arctic basins. This species is benthic in water depths up to 3,000 m (Mecklenburg et al. 2011). To feed themselves, these species move along the seafloor and use the cartilaginous keels on their lower jaws to stir up prey, such as crustaceans, worms, and fishes (Mecklenburg et al. 2011).

3.2.4.2 Hearing

All fish have two sensory systems to detect sound in the water: the inner ear, which functions very much like the inner ear in other vertebrates, and the lateral line, which consists of a series of receptors along the fish's body (Popper and Fay 2010a; Popper et al. 2014). The inner ear generally detects relatively higher-frequency sounds, while the lateral line detects water motion at low frequencies (below a few hundred Hz) (Hastings and Popper 2005). Lateral line receptors respond to the relative motion between the body surface and surrounding water; this relative motion, however, only takes place very close to sound sources and most fish are unable to detect this motion at more than one to two body lengths distance away (Popper et al. 2014). Although hearing capability data only exist for fewer than 100 of the 32,000 fish species, current data suggest that most species of fish detect sounds from 50 to 1,000 Hz, with a few fish hearing sounds above 4 kHz (Popper 2008). It is believed that most fish have their best hearing sensitivity from 100 to 400 Hz (Popper 2003b). Permanent hearing loss has not been documented in fish. A study by Halvorsen et al. (2012) found that for temporary hearing loss or similar negative impacts to occur, the noise needed to be within the fish's individual hearing frequency range; external factors, such as developmental history of the fish or environmental factors, may result in differing impacts to sound exposure in fish of the same species. The sensory hair cells of the inner ear in fish can regenerate after they are damaged, unlike in mammals where sensory hair cells loss is permanent (Lombarte et al. 1993a; Smith et al. 2006b). As a consequence, any hearing loss in fish may be as temporary as the timeframe required to repair or replace the sensory cells that were damaged or destroyed (Smith et al. 2006b), and no permanent loss of hearing in fish would result from exposure to sound.

The inner ears of fish are directly sensitive to acoustic particle motion rather than acoustic pressure. Although a propagating sound wave contains pressure and particle motion components, particle motion is most significant at low frequencies (less than a few hundred Hz) and closer to the sound source (Popper and Fay 2010a). A fish's gas-filled swim bladder can enhance sound detection by converting acoustic pressure into localized particle motion, which may then be detected by the inner ear. Fish with swim bladders generally have better sensitivity and better high-frequency hearing than fish without swim bladders (Popper and Fay 2010b). Some fish also have specialized structures such as small gas bubbles or gas-filled projections that terminate near the inner ear. In reality, many fish species possess a continuum of anatomical specializations that may enhance their sensitivity to pressure (versus particle motion), and thus higher frequencies and lower intensities (Popper and Fay 2010b).

Past studies indicated that hearing specializations in marine fish were quite rare (Amoser and Ladich 2005; Popper 2003b). However, more recent studies show there are more fish species than originally investigated by researchers, such as deep sea fish, that may have evolved structural adaptations to enhance hearing capabilities (Deng et al. 2011). Marine fish families holocentridae (squirrelfish and soldierfish), pomacentridae (damselfish), gadidae (cod, hakes, and grenadiers), and sciaenidae (drums, weakfish, and croakers) have some members that can potentially hear sound up to a few kHz. The only marine fish family in the Study Area thought to possibly have hearing sensitivities in the range of the frequencies of the Proposed Action is the Gadidae (though research is inconclusive; details below). Additional evidence exists, based on the structure of the ear and the relationship between the ear and the swim bladder, that at least some deep sea species, including myctophids, may have hearing specializations and thus be able to hear higher frequencies (Popper 1977, 1980), although it has not been possible to do actual measures of hearing on these fish.

While no auditory studies have been completed on Arctic cod specifically, and anatomical differences may result in different hearing abilities, other Gadidae have the potential to be surrogate species for Arctic cod. Gadidae have been shown to detect sounds up to about 500 Hz (Popper 2008; Sand and Karlsen 1986). Atlantic cod (*Gadus morhua*) may also detect high-frequency sounds (Astrup and Mohl 1993). Astrup and Møhl (1993) indicated that conditioned Atlantic cod have high frequency thresholds of up to 38 kHz at 185 to 200 decibels referenced to 1 micropascal (dB re 1 µPa), which likely only allows for detection of predators at distances no greater than 10–30 m (Astrup 1999). A more recent study by Schack et al (2008) revisited the conclusions from Astrup and Mohl's study, arguing that hearing and behavioral responses in Atlantic cod would be different with unconditioned fish. They found that ultrasound exposures mimicking those of echosounders and odontocetes would not induce acute stress responses in Atlantic cod, and that frequent encounters with ultrasound sources would therefore most likely not induce a chronic state of stress (Schack et al. 2008). The discrepancies between the two studies remain unresolved, but it has been suggested the cod in Astrup and Mohl's (1993) study were conditioned to artifacts rather than to the ultrasonic component of the exposure (Astrup 1999; Ladich and Popper 2004; Schack et al. 2008). Additionally, Jørgensen et al (2005) found that juvenile Atlantic cod did not show any clear behavioral response when exposed to either 1.5 or 4 kHz simulated sonar sound. Therefore, accepted research on cod hearing indicates sensitivities limited to low-frequency sounds.

3.2.5 Essential Fish Habitat

The fisheries of the United States are managed within a framework of overlapping international, federal, state, interstate, and tribal authorities. Individual states and territories generally have jurisdiction over fisheries in marine waters within 3 nm of their coast. Federal jurisdiction includes fisheries in marine waters inside the U.S. Exclusive Economic Zone (EEZ), which encompasses the area from the outer boundary of state waters out to 200 nm offshore of any U.S. coastline, except where intersected closer than 200 nm by bordering countries (61 FR 19390-19429, May 1, 1996). The Study Area resides within the U.S. EEZ, but outside of state jurisdiction.

The Study Area is within the jurisdiction of the North Pacific Fishery Management Council, which is responsible for designating Essential Fish Habitat and habitat areas of particular concern for all federally managed species occurring off the coast of Alaska. This council has prepared and implemented a Fishery Management Plan for the Arctic Management Area, which encompasses all marine waters in the U.S. exclusive economic zone from 3 nm offshore of the Alaskan coast to 200 nm offshore north of the Bering Strait. This Fishery Management Plan identifies Essential Fish Habitat for Arctic cod, saffron cod (*Eleginus gracilis*), and snow crab (*Chionoecetes opilio*). Only Essential Fish Habitat for Arctic cod overlaps the Study Area (Figure 3-4). No habitat areas of particular concern have been designated for any species within the Arctic Management Area Fisheries Management Plan (North Pacific Fishery Management Council 2009).

The North Pacific council has not delineated Essential Fish Habitat for eggs, larvae, and early juveniles of Arctic cod due to insufficient information. Essential Fish Habitat for late juvenile and adult Arctic cod within the Arctic Management Area occurs in waters from the nearshore to offshore areas along the continental shelf (0-200 m) and upper slope (200-500 m) throughout Arctic waters and often associated with ice floes which may occur in deeper waters (North Pacific Fishery Management Council 2009).

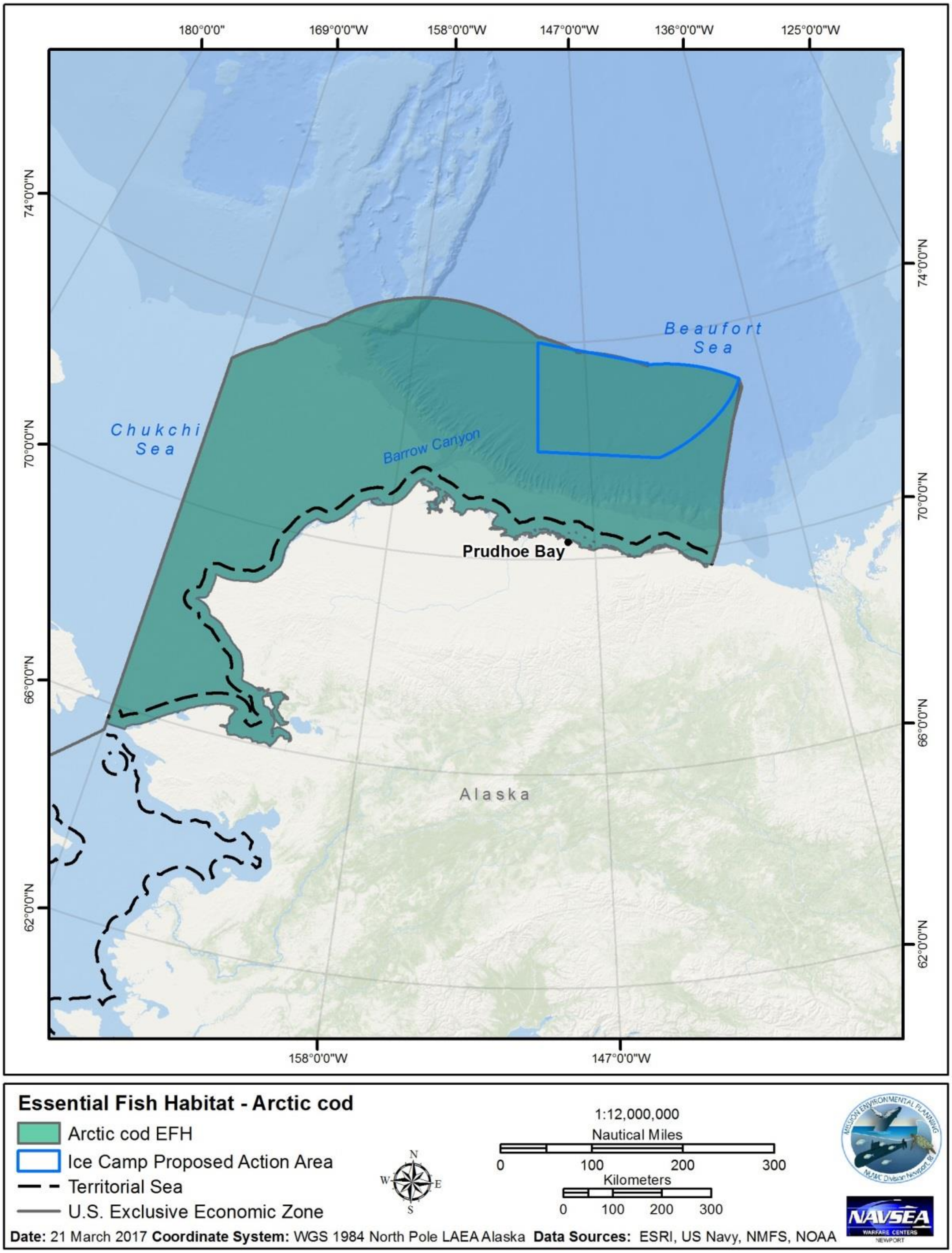

Figure 3-4. Essential Fish Habitat for Arctic Cod

3.2.6 Mammals

Both marine and terrestrial mammals may be present in the Study Area during the Proposed Action. Marine mammals are found throughout the Study Area including on the sea ice and within the water column. All marine mammals are protected under the MMPA, and some mammals, because they are threatened or endangered, are further protected by the ESA. Table 3-5 lists the mammals, and stock designation, if applicable, that may be within the Study Area during the Proposed Action. Other species, such as bowhead and beluga whales (*Balaena mysticetus* and *Delphinapterus leucas*, respectively), and narwhals (*Monodon monoceros*), may inhabit the Study Area during other times of the year (Burns et al. 1981; Garland et al. 2015; Heide-Jørgensen 2009; Jefferson et al. 2008; Muto et al. 2016) but are not expected in the area during the Proposed Action. Details about the geographic range, habitat and distribution, hearing, and predator/prey interactions of each species expected to be present in the Study Area during the Proposed Action are provided below.

Table 3-5. Mammals Found in the Study Area during the Proposed Action

Common Name	Scientific Name	Stock(s) within the Study Area
Marine Mammals		
Bearded seal[1]	*Erignathus barbatus nauticus*[2]	Alaska[3]
Ringed seal	*Phoca hispida*	Alaska[3]
Polar bear[1]	*Ursus maritimus*	Southern Beaufort Sea, Chukchi/Bering Sea
Terrestrial Mammals		
Arctic Fox	*Vulpes lagopus*	n/a

[1] Species currently listed as threatened under the ESA.
[2] Scientific name of subspecies within the Study Area
[3] Stock is designated by the MMPA.

3.2.6.1.a Bearded Seal

The bearded seal (*Erignathus barbatus*) is listed as threatened under the ESA, and listed as depleted under the MMPA. The bearded seal has been separated into two subspecies: *E. b. barbatus* and *E. b. nauticus*. Only the *E. b. nauticus* subspecies is located within the Study Area. Based on evidence, the *E. b. nauticus* subspecies was further divided into an Okhotsk Distinct Population Segment (DPS) and a Beringia DPS, which are both located in the Study Area. The Beringia DPS is the only DPS of bearded seal that is located within the Study Area (Muto et al. 2016). The Beringia DPS is considered the Alaska Stock of the bearded seal. NMFS published a final rule (on December 28, 2012) listing the Beringia and Okhotsk DPSs as threatened. No critical habitat is currently designated for the bearded seal.

Bearded seals are found in the Northern Hemisphere with a circumpolar distribution that does not extend farther north than 85° N (Muto et al. 2016; Reeves et al. 2002). Beringia bearded seals are widely distributed throughout the northern Bering, Chukchi, and Beaufort Seas and are most abundant north of the ice edge zone (MacIntyre et al. 2013). Telemetry data from Boveng and Cameron (2013) showed that large numbers of bearded seals move south in fall/winter as sea ice forms and move north as the seasonal sea ice melts in the spring. The highest densities of bearded seals are found in the central and northern Bering Sea shelf during winter (Braham et al. 1981; Burns 1981; Burns and Frost 1979; Fay 1974; Heptner et al. 1976; Nelson et al. 1984). In late winter and early spring bearded seals are widely (not uniformly) ranging from the Chukchi Sea south to the ice front in the Bering Sea usually on drifting pack ice (Muto et al. 2016). In a shallow water study by MacIntyre et al. (2013), bearded seal calls were recorded throughout the year (11 to 12 months) in the Beaufort Sea, with the peak of calls detected from January to July. Bearded seals inhabit the seasonally ice-covered seas of the Northern Hemisphere, where they whelp and rear their pups, and molt their coats on the ice in the spring and early summer.

Bearded seals along the Alaskan coast tend to prefer areas where sea ice covers 70 to 90 percent of the surface, and are most abundant 20 to 100 nm offshore during the spring season (Bengston et al. 2000; Bengtson et al. 2005; Simpkins et al. 2003). In spring, bearded seals may also concentrate in nearshore pack ice habitats, where females give birth on the most stable areas of ice (Reeves et al. 2002). Bearded seals haul out on spring pack ice (Simpkins et al. 2003) and generally prefer to be near polynyas (areas of open water surrounded by sea ice) and other natural openings in the sea ice for breathing, hauling out, and prey access (Nelson et al. 1984; Stirling 1997). While molting between April and August, bearded seals spend substantially more time hauled out then at other times of the year (Reeves et al. 2002).

In their explorations of the Canada Basin, Harwood et al. (2005) observed bearded seals in waters of less than 200 m during the months from August to September. These sightings were east of 140° W. The Bureau of Ocean Energy Management (BOEM) conducted an aerial survey from June through October which also covered the shallow Beaufort and Chukchi Sea shelf waters, and observed bearded seals from Point Barrow to the border of Canada (Clarke et al. 2014). The farthest from shore that bearded seals were observed was the waters of the continental slope (within 50 nm from Prudhoe Bay).

Bearded seals feed on the seafloor, commonly occupying shallow waters (Fedoseev 2000; Kovacs 2002). The preferred depth range is often described as less than 200 m (Allen and Angliss 2014; Fedoseev 2000; Jefferson et al. 2008; Kovacs 2002), although adults have been known to dive to around 300 m (Cameron and Boveng 2009; Kovacs 2002). At these depths, they feed on demersal fish (e.g. Arctic and saffron cod, flatfish, and sculpins and a variety of small invertebrates that live in the substrate or on its surface (Fedoseev 2000; Kovacs 2002)). They may also opportunistically supplement their diet with crab, shrimp, mollusks, and octopus (Reeves et al. 2002).

Bearded seals may be present near Prudhoe Bay, Alaska, during the Proposed Action.

3.2.6.1.b Ringed Seal

The ringed seal, specifically the Arctic/Bering Sea subspecies *Phoca hispida hispida*, occurs within the U.S. EEZ of the Beaufort, Chukchi, and Bering Seas and overlaps with the Study Area (Kelly et al. 2009; Palo 2003; Palo et al. 2001). Currently, the ringed seal is not listed under the ESA. In March 2016, the U.S. District Court for the District of Alaska in the case of Alaska Oil & Gas Association v. National Marine Fisheries Service vacated the NMFS' ESA listing of the Arctic/Bering Sea subspecies of ringed seals (*P. h. hispida*) as threatened under the ESA (No. 4:14-cv-00029-RRB, 2016 U.S. Dist. LEXIS 34848 [D. Alaska Mar. 17, 2016]). The case is still being litigated. Additionally, no decision has been rendered to date. No critical habitat is currently designated. Critical habitat for the ringed seal that was proposed by NMFS in 2014 (79 FR 71714; December 3, 2014) would fall within the Study Area and includes all the contiguous marine waters from the coast line of Alaska to an offshore limit of the U.S. exclusive economic zone north of Alaska (Figure 3-5). The Arctic/Bering Sea subspecies is listed as depleted and

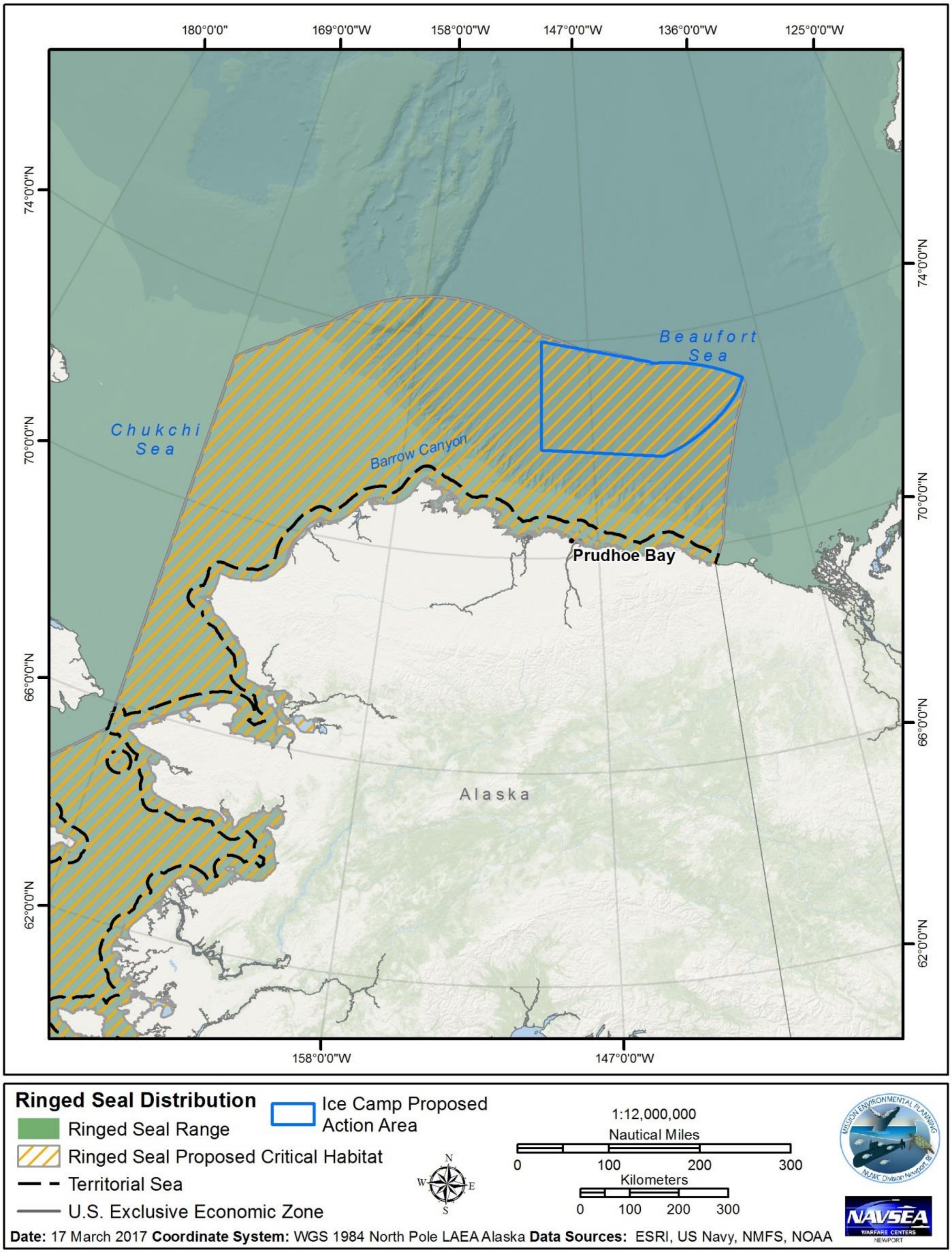

Figure 3-5. Ringed Seal Distribution in Study Area

strategic under the MMPA. For the purposes of this analysis, the Alaska stock of ringed seals, as designated under the MMPA, is considered to be the portion of the subspecies P. h. hispida that occurs within the U.S. EEZ of the Beaufort, Chukchi, and Bering Seas.

NMFS regulations (50 CFR § 424.12(b)) state that, in determining what areas qualify as critical habitat, the agencies "shall consider those physical and biological features that are essential to the conservation of a given species and that may require special management considerations or protection." These essential features "may include, but are not limited to, the following: spawning sites, feeding sites, seasonal wetland or dryland, water quality or quantity, geological formation, vegetation type, tide, and specific soil types." In a proposed rule on December 3, 2014, NMFS identified areas used by ringed seals along with a description of those features essential to conservation. These three features are as follows:

1) Sea ice habitat suitable for the formation and maintenance of subnivean birth lairs used for sheltering pups during whelping and nursing.

2) Sea ice habitat suitable as a platform for basking and molting, which is defined as sea ice of 15 percent or more concentration, except for bottom-fast ice extending seaward from the coastline in waters less than 2 m deep.

3) Primary prey resources to support Arctic ringed seals, which are defined to be Arctic cod, saffron cod, shrimps, and amphipods.

NMFS determined that the essential features of the habitat of the Arctic ringed seal may require special management considerations or protection in the future to minimize the risks posed to these features by potential shipping and transportation activities. The reason for this was because: (1) both the physical disturbance and noise associated with these activities could displace seals from favored habitat that contains the essential features, thus altering the quantity and/or quality of these features; and (2) in the event of an oil spill, sea ice essential for birth lairs and for molting could become oiled, and the quantity and/or quality of the primary prey resources could be adversely affected.

Ringed seals are the most common pinniped in the Study Area and have wide distribution in seasonally and permanently ice-covered waters of the Northern Hemisphere (North Atlantic Marine Mammal Commission 2004). Throughout their range, ringed seals have an affinity for ice-covered waters and are well adapted to occupying both shore-fast and pack ice (Kelly 1988b). Ringed seals can be found further offshore than other pinnipeds since they can maintain breathing holes in ice thickness greater than 2 m (Smith and Stirling 1975). Breathing holes are maintained by ringed seals' sharp teeth and claws on their fore flippers. They remain in contact with ice most of the year and use it as a platform for molting in late spring to early summer, for pupping and nursing in late winter to early spring, and for resting at other times of the year.

Ringed seals have at least two distinct types of subnivean lairs: haulout lairs and birthing lairs (Smith and Stirling 1975). Haulout lairs are typically single-chambered and offer protection from predators and cold weather. Birthing lairs are larger, multi-chambered areas that are used for pupping in addition to protection from predators. Ringed seals pup on both land-fast ice as well as stable pack ice. Lentfer (1972) found that ringed seals north of Barrow, Alaska (west of the ice camp proposed action area depicted in Figure 2-1), build their subnivean lairs on the pack ice near pressure ridges. Since subnivean lairs were found north of Barrow, Alaska, in pack ice, they are also assumed to be found within the sea ice in the ice camp proposed action area. Ringed seals excavate subnivean lairs in drifts over their breathing holes in the ice, in which they rest, give birth, and nurse their pups for 5–9 weeks during late winter and spring (Chapskii 1940; McLaren 1958; Smith and Stirling 1975). Snow depths of at least 50–65 cm are required for functional birth lairs (Kelly 1988a; Lydersen 1998; Lydersen and Gjertz 1986; Smith and Stirling 1975), and such depths typically are found only where 20–30 cm or more of snow has accumulated on flat ice and then drifted along pressure ridges or ice hummocks (Hammill 2008; Lydersen et al. 1990; Lydersen and Ryg 1991; Smith and Lydersen 1991). Ringed seals are born beginning in March, but the majority of births occur in early April. About a month after parturition, mating begins in late April and early May.

In Alaskan waters, during winter and early spring when sea ice is at its maximal extent, ringed seals are abundant in the northern Bering Sea, Norton and Kotzebue Sounds, and throughout the Chukchi and Beaufort seas (Frost 1985; Kelly 1988b). Passive acoustic monitoring of ringed seals from a high frequency recording package deployed at a depth of 240 m in the Chukchi Sea 120 km north-northwest of Barrow, Alaska, detected ringed seals in the area between mid-December and late May over the four year study (Jones et al. 2014). With the onset of the fall freeze, ringed seal movements become increasingly restricted and seals will either move west and south with the advancing ice pack with many seals dispersing throughout the Chukchi and Bering Seas, or remain in the Beaufort Sea (Crawford et al. 2012; Frost and Lowry 1984; Harwood et al. 2012). Kelly et al (2010a) tracked home ranges for ringed seals in the subnivean period (using shorefast ice); the size of the home ranges varied from less than 1 up to 27.9 km^2; (median is 0.62 km^2 for adult males and 0.65 km^2 for adult females). Most (94 percent) of the home ranges were less than 3 km^2 during the subnivean period (Kelly et al. 2010a). Near large polynyas, ringed seals maintain ranges up to 7,000 km^2 during winter and 2,100 km^2 during spring (Born et al. 2004). Some adult ringed seals return to the same small home ranges they occupied during the previous winter (Kelly et al. 2010a). The size of winter home ranges can, however, vary by up to a factor of 10 depending on the amount of fast ice; seal movements were more restricted during winters with extensive fast ice, and were much less restricted where fast ice did not form at high levels (Harwood et al. 2015).

Ringed seal population surveys in Alaska have used various methods and assumptions, had incomplete coverage of their habitats and range, and were conducted more than a decade ago; therefore, current, comprehensive, and reliable abundance estimates or trends for the Alaska stock are not available (Muto et al. 2016). Frost *et al*. (2004) conducted surveys within 40 km of shore in the Alaska Beaufort Sea during May-June 1996-1999, and observed ringed seal densities ranging from 0.81 seal/km^2 in 1996 to 1.17 seals/km^2 in 1999. Moulton *et al*. (2002) conducted similar, concurrent surveys in the Alaska Beaufort Sea during 1997-1999 but reported substantially lower ringed seal densities (0.43, 0.39, and 0.63 seals/km^2 in 1997-1999, respectively) than Frost *et al*. (2004). Using the most recent estimates from surveys by Bengtson *et al*. (2005) and Frost *et al*. (2004) in the late 1990s and 2000, Kelly *et al*. (2010b) estimated the total population in the Alaska Chukchi and Beaufort seas to be at least 300,000 ringed seals, which Kelly *et al*. (2010b) states is likely an underestimate since the Beaufort surveys were limited to within 40 km of shore.

In general, ringed seals prey upon fish and crustaceans. Ringed seals are known to consume up to 72 different species in their diet; their preferred prey species is the polar cod (Jefferson et al. 2008). Ringed seals also prey upon a variety of other members of the cod family, including Arctic cod (Holst et al. 2001), and saffron cod, with the latter being particularly important during the summer months in Alaskan waters (Lowry et al. 1980). Invertebrate prey seems to become prevalent in the ringed seals diet during the open-water season and often dominates the diet of young animals (Holst et al. 2001; Lowry et al. 1980). Large amphipods (e.g., *Themisto libellula*), krill (e.g., *Thysanoessa inermis*), mysids (e.g., *Mysis oculata*), shrimps (e.g., *Pandalus* spp., *Eualus* spp., *Lebbeus polaris*, and *Crangon septemspinosa*), and cephalopods (e.g., *Gonatus* spp.) are also consumed by ringed seals.

3.2.6.1.c Polar Bear

Two polar bear stocks occur within the Study Area: (1) the Southern Beaufort Sea stock and (2) the Chukchi/Bering Seas stock. Both of these stocks are listed as threatened under the ESA (73 FR 28212, May 15, 2009). The determination of polar bears as threatened under the ESA was made based on an extinction risk assessment. This assessment found that the main concern regarding the conservation of polar bears stems from the loss of habitat, particularly sea ice. Polar bears were determined to likely become endangered within the foreseeable future (defined as 45 years) throughout its range, based on expected continued decline of sea ice. Additionally, both stocks are currently listed as depleted and classified as strategic under the MMPA. In 2010, USFWS designated 484,734 km^2 of on-shore and off-shore critical habitat for polar bears. Polar bear critical habitat extends out from the shoreline into the Study Area, however is not present within the ice camp proposed action area.

The Chukchi/Bering Seas stock is widely distributed on the pack ice in the Chukchi Sea and northern Bering Sea and adjacent coastal areas in Alaska and Russia. An extensive area of overlap between the Southern Beaufort Sea stock and the Chukchi/Bering Seas stock occurs between Point Barrow and Point Hope, centered near Point Lay (Amstrup 2000; Garner et al. 1994; Garner et al. 1990).

The Southern Beaufort Sea population spends the summer on pack ice and moves toward the coast during fall, winter, and spring (Durner et al. 2004). Polar bears in the Southern Beaufort Sea concentrate in waters less than 300 m deep over the continental shelf and in areas with greater than 50 percent ice cover in all seasons except summer to access prey such as ringed and bearded seals (Durner et al. 2004; Durner et al. 2006; Durner et al. 2009; Stirling et al. 1999). The eastern boundary of the Southern Beaufort Sea stock occurs south of Banks Island and east of the Baillie Islands, Canada (Amstrup et al. 2000). The western boundary of the Southern Beaufort Sea stock is near Point Hope, Alaska. Polar bears from this population have historically denned on both the sea ice and land. Therefore, the southern boundary of the Southern Beaufort Sea stock is defined by the limits of terrestrial denning sites inland of the coast, which follows the shoreline along the North Slope in Alaska and Canadian Arctic (Bethke et al. 1996). Polar bears could be within the Study Area at any time during the Proposed Action. General year-round distribution of polar bears within the Study Area is depicted in Figure 3-6. The size of a polar bear’s range depends on a number of factors, including habitat quality and the amount of available food (Polar Bears International 2015). In the Beaufort Sea, annual polar bear activity areas for individually monitored female bears averaged 149,000 km^2, ranging from 13,000 km^2 to 597,000 km^2 (Amstrup et al. 2000).

Mating occurs in late March through early May, which overlaps with the timeframe of the Proposed Action. In November and December, females dig maternity dens in pressure ridges in fast ice, drifting pack ice, or on land (up to 161 km inland). Females give birth to their cubs from December to January and stay within their dens until spring (Reeves et al. 2002).

Each year, only 25 percent of reproductively active females produce a litter. Studies conducted between 1981 and 1994 of radio-collared bears found over half of the dens on sea ice (53 percent on pack ice and 4 percent on land fast ice) with the remainder of dens on land. Polar bears do not show fidelity to specific den sites but certain bears do show fidelity to denning on either land or sea ice. The U.S. Geological Survey mapped polar bear dens between 1910 and 2010 using satellite telemetry, very high frequency telemetry, forward-looking infrared, polar bear captures, and reports from coastal Alaskans, hunters, and industry personnel (Durner et al. 2010). Denning sites in the Beaufort Sea and neighboring regions of Alaska are depicted in Figure 3-6.

Little comprehensive information exists that allows for reliable population estimates of the Chukchi/Bering Seas and Southern Beaufort Sea stocks. Polar bears typically occur at low densities throughout their range and it is difficult to assess population sizes given their wide distribution and the challenges involved in conducting surveys in these areas (DeMaster and Stirling 1981).

Surveys of portions of the Southern Beaufort Sea stock range, from Pt. Barrow, Alaska, in the west to Baillie Islands, Canada, in the east, have been conducted and provide a minimum population estimate of 1,526 animals (Regehr et al. 2006). The most recent stock assessment for polar bears indicates that the Southern Beaufort Sea stock is declining (Allen and Angliss 2011).

Polar bears' main prey are ringed and bearded seals (Durner et al. 2004; Durner et al. 2006; Durner et al. 2009; Stirling et al. 1999). Occasionally, polar bears are known to prey upon walruses or beluga whales trapped by ice, and may also consume carrion when prey is scarce (U.S. Fish and Wildlife Service 2014).

1 *3.2.6.1.d* Arctic Fox

The Arctic fox is not listed as threatened or endangered under the ESA. The Arctic fox has a circumpolar distribution in all Arctic tundra habitats. Their preferred habitat is tundra, near rocky shores. In general, the Arctic fox inhabits Eurasia, North America, Greenland, and the Canadian archipelago. More specifically, their distribution includes most Arctic islands and many islands in the Bering Sea. Off the coast of Alaska, Arctic foxes can be found in both the Beaufort and Chukchi Seas.

Eberhardt and Hansson (1978) discovered that Arctic foxes are capable of long migrations (greater than 1,000 km) over the polar pack ice. In a study by Pamperin (2008), collared Arctic foxes travelled between 904 and 2,757 km during the winter season averaging 8 to 18 km per day with the longest travel distance of 38 mi (61 km) in one day. Migrations seaward occur in the fall and early winter seasons and migrations back to shore occur in the late winter and early spring. They have been observed ranging far out into the pack ice during the winter with observations as far north as the North Pole. The Arctic fox could be found in the Study Area at any time during the Proposed Action.

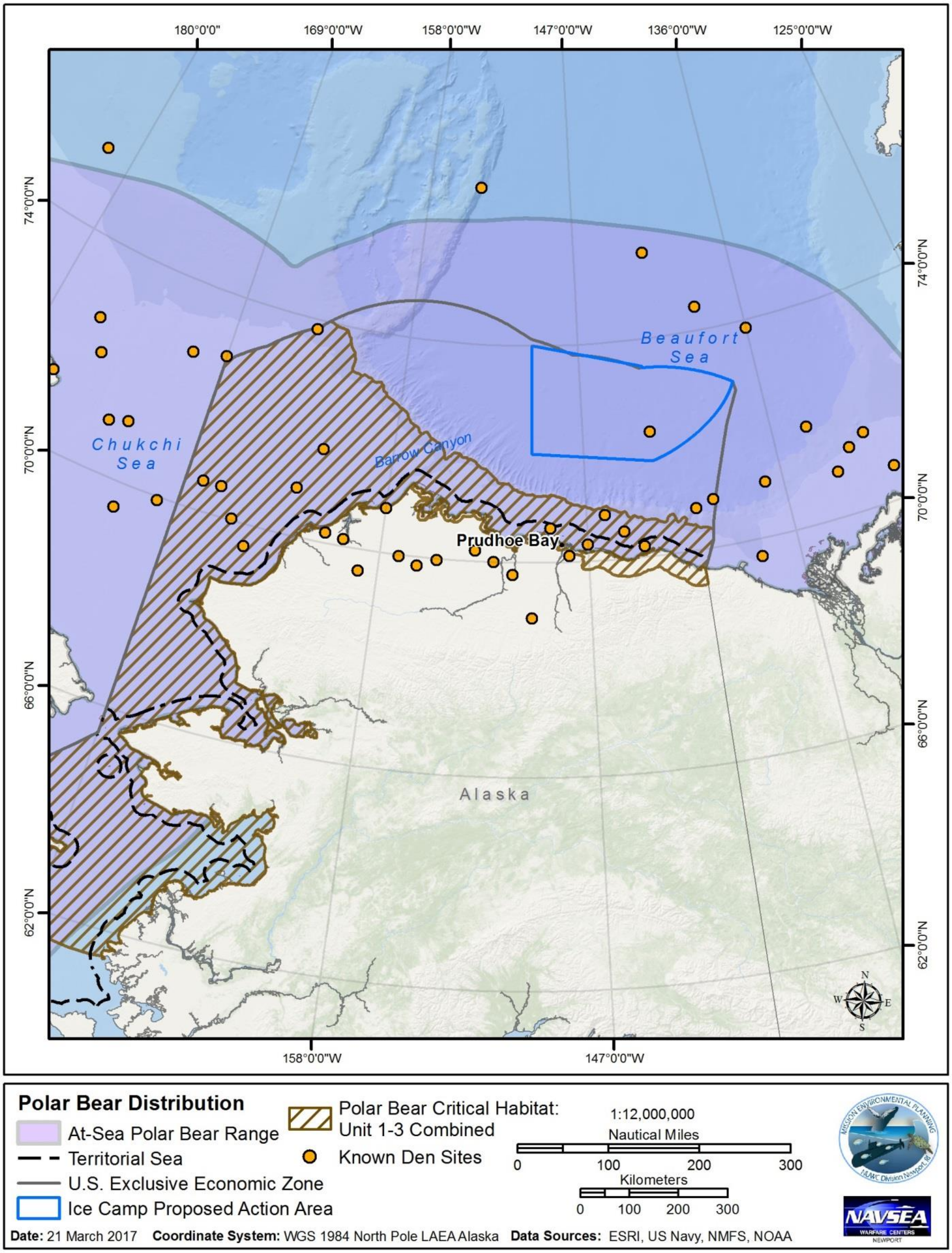

Figure 3-6. Polar Bear At-Sea Distribution in Study Area

Breeding occurs north of and above the tree line on the Arctic tundra in North America and Eurasia and on the alpine tundra in Fennoscandia, ranging from northern Greenland at 88° N to the southern tip of Hudson Bay, Canada, at 53° N. Mating for Arctic foxes occurs in March and early April with a gestation period of 52 days. Mothers give birth to litters averaging between seven and 15 pups. The worldwide population of Arctic foxes is several thousand animals.

Generally two ecotypes of Arctic foxes are recognized: (1) lemming foxes and (2) coastal foxes. Lemming foxes prey mainly on lemmings (*Lemmus* spp. and *Dicrostonyx* spp.) (Dalén 2005), while the coastal foxes' diet consists of eggs, birds, and scavenged remains of other animals (Braestrup 1941). Some populations of foxes will switch between lemmings, migratory birds, fish, and marine invertebrates depending on prey availability (Angerbjörn and Tannerfeldt 2014).

When Arctic foxes are roaming the sea ice in winter, they scavenge on seals killed by polar bears (Andriashek et al. 1985; Roth 2002; Tarroux et al. 2010). During spring, Arctic foxes also invade the subnivean lairs of ringed seals to prey on their pups (Lydersen and Hammill 1993; Smith 1976; Smith and Lydersen 1991). When travelling, Arctic foxes are usually found in breeding pairs, though the species typically hunts alone (Angerbjörn and Tannerfeldt 2014).

3.2.6.1.e Hearing

All marine mammals that have been studied can use sound to forage, orient, socially interact with others, and detect and respond to predators. Measurements of marine mammal sound production and hearing capabilities provide some basis for assessment of whether exposure to a particular sound source may affect a marine mammal behaviorally or physiologically.

Ringed and bearded seals fall into the phocid seal hearing group. Functional hearing limits for this hearing group are estimated to be 75 Hz–30 kHz in air and 75 Hz–75 kHz in water (Kastak and Schusterman 1999; Kastelein et al. 2009a; Kastelein et al. 2009b; Møhl 1968a, 1968b; Reichmuth 2008; Terhune and Ronald 1971, 1972). No studies have directly measured bearded seal hearing. Cleator et al (1989) recorded bearded seal calls at six sites in the Arctic. Calls ranged in frequency from 130 Hz to 10.5 kHz. Although, hearing sensitivities for bearded seals have not been directly measured it is assumed best sensitivities would be at the same frequencies as their calls. Phocids can make calls between 90 Hz and 16 kHz (Richardson et al. 1995). The generalized hearing for phocids (underwater) (National Marine Fisheries Service 2016) ranges from 50 Hz to 86 kHz, which includes the suggested auditory bandwidth for pinnipeds in water proposed by Southall et al. (2007), ranging between 75Hz to 75 kHz. Based on a study by Sills *et al.* (2015), the best frequencies for ringed seal hearing were 12.8 and 25.6 kHz at 49 and 50 decibels referenced to 1 microPascal at 1 meter (dB re 1µPa) respectively. The best hearing range for ringed seals combined was 0.4 to 52 kHz (Sills et al. 2015). Data on ringed seal hearing indicates an upper frequency limit to be 60 kHz (Terhune and Ronald 1976), which falls within the phocid hearing group.

Airborne hearing threshold measurements of polar bears have shown best hearing sensitivity between 8 and 14 kHz, with a rapid decline in sensitivity below 125 Hz and above 20 kHz (Bowles et al. 2008; Nachtigall et al. 2007; Owen and Bowles 2011). Like the pinnipeds, polar bears are amphibious mammals in the order Carnivora. Additionally, the polar bear ear is very similar to the otariid ear and therefore the polar bear is placed within the same hearing group as otariids (Nummela 2008a; Nummela 2008b). Hearing limits for this group are 50 Hz–35 kHz in air and 50 Hz–50 kHz in water (Southall et al. 2007).

Little research has been conducted into the hearing thresholds of Arctic foxes. Stansbury et al (2014) studied the behavioral responses of two captive Arctic foxes exposed to sound signals; the foxes had a functional hearing range of 125 Hz to 16 kHz (sensitivity up to 60 dB re 20 µPa), and an average peak sensitivity of 24 dB re 20 µPa at 4 kHz. This study concluded that Arctic foxes may have a lower frequency range than other domestic dogs and carnivores, though differences could be due to testing constraints (Stansbury et al. 2014). Malkemper et al (2015) were able to create an audiogram of the red fox (within the same family as the arctic fox). In this study it was found that red foxes have a low frequency hearing limit at 51 Hz and a high frequency hearing limit at 48 kHz, with maximum sensitivity at 4 kHz. Best sensitivity for the red fox is the same as the arctic fox (Malkemper et al. 2015; Stansbury et al. 2014). The high frequency cut-off for the red fox is comparable to the domestic dog while the low frequency cut-off is comparable to the domestic cat.

3.3 SOCIOECONOMIC ENVIRONMENT

3.3.1 Subsistence Hunting

Subsistence hunting is defined as the customary and traditional uses of wild resources for food, clothing, fuel, transportation, construction, art, crafts, sharing, and customary trade. Subsistence hunting and fishing is important for many of the Alaska Native communities. Subsistence uses are central to the traditions and customs of many cultural groups in Alaska. The subsistence food harvest by Alaska residents represents only 0.9 percent of the fish and game harvested annually in Alaska. Since Prudhoe Bay is considered an urban area (under federal rules) residents only harvested 35 pounds of wild food per person, compared to the rural arctic area where the residents harvested 370 pounds of wild food per person. (Alaska Department of Fish and Game 2014) Subsistence hunting is year-round in Alaska. During the timeframe of the Proposed Action subsistence hunting is limited to furbearers and caribou, with some harvests of fish, especially burbot. Spring hunting consists mainly of geese, but also includes bowhead whales in Barrow. Bowhead whale hunting does not start until April. Although there may be some potential overlap in the timeframe (April) of the Proposed Action; bowhead whale hunting would occur in open leads in the Chukchi Sea during the month of April, which is outside of the Study Area (Stephen R. Braund & Associates 2010).

The North Slope villages of Nuiqsut, Kaktovik, and Barrow identifies the primary resources used for subsistence and the locations for harvest (Stephen R. Braund & Associates 2010), including terrestrial mammals (caribou, moose, wolf, and wolverine), birds (geese and eider), fish (Arctic cisco, Arctic char/Dolly Varden trout, and broad whitefish), and marine mammals (bowhead whale, ringed seal, bearded seal, and walrus). The geographic extent of the harvest for all species identified in Stephen R. Braund & Associates (2010) is provided in Figure **3-7**. Of the species reported, ringed seals could be located within the 2018 ice camp proposed action area during the Proposed Action. Bearded seals may be near Prudhoe Bay during the Proposed Action.

Bearded seals are an important subsistence resource for residents in the north slope of Alaska. They are the primary marine mammal (other than bowhead whales) hunted in the area. Bearded seal hunting in Kaktovik is more common than ringed seal hunting. Bearded seal meat and oil are used for consumption, and is also used in building skin boats which are used during the spring whaling season (Ice Seal Committee 2014; Stephen R. Braund & Associates 2010). Peak hunting season for bearded seal starts in June and goes into September. Bearded seal hunts follow the ice pack although hunters tend to stay closer to shore due to safety concerns, but some hunters will travel up to 40 miles from shore in pursuit of the bearded seals (Stephen R. Braund & Associates 2010).

Ringed seals are of lesser importance to many North Slope communities, and have historically been used as a primary source of food for dog teams; this need has lessened with the introduction of snow machines. Ringed seal hunting typically coincides with the bearded seal hunt during the summer months, though hunting has occurred year-round. Harvest locations for ringed seals extends up to 129 km from shore, particularly in summer; the winter harvest of ringed seals typically occurs closer to shore (Stephen R. Braund & Associates 2010). From 1985 through 2003, for years in which data were available, an average of 419 ringed seals were harvested per year for the villages of Barrow, Nuiqsut, and Kaktovik (Stephen R. Braund & Associates 2010). With the addition of the North Slope villages of Wainright, Point Lay, and Point Hope, an average of 1,099 ringed seals were harvested per year (data from 1985-2003) (Ice Seal Committee 2014). The number of seals harvested in a given year can vary considerably, depending upon environmental (e.g., ice) conditions.

In addition to ringed and bearded seals, polar bears and Arctic foxes are also hunted for subsistence. Polar bears have historically been killed for subsistence, handicrafts, and recreation (sport hunting was banned in 1972 with the passing of the MMPA). From 2003 to 2007, the average annual harvest of polar bears was 70 (33 from the Southern Beaufort Stock and 37 from the Chukchi/Bering Seas Stock) (Allen and Angliss 2011). Bacon et al. (2011) identify that polar bears are harvested year-round, though many communities do not typically harvest this species.

Arctic foxes are harvested as one of many furbearers used by Alaska Natives. Hunting of Arctic fox generally occurs from October through April, based on subsistence data collected from seven North Slope villages (Anaktuvuk Pass, Atqasuk, Barrow, Kaktovik, Nuiqsut, Point Hope, Point Lay, and Wainwright) from 1994 through 2003 (Bacon et al. 2011). For some villages, only a single year of survey data was collected; other villages had multiple years of survey data. After averaging data for each village (where multiple years were provided) and combining each average, an estimated 164 Arctic foxes are harvested per year. However, data between years can vary greatly. For example, the estimated total harvest (based on the reported number plus a statistical estimate for houses not surveyed) for Arctic fox in Barrow during calendar year 2000 was 90.8 foxes, whereas the calendar year 2001 harvest was only 1.7 (Bacon et al. 2011). Arctic foxes are under no direct management, and are open to trapping and sport hunting.

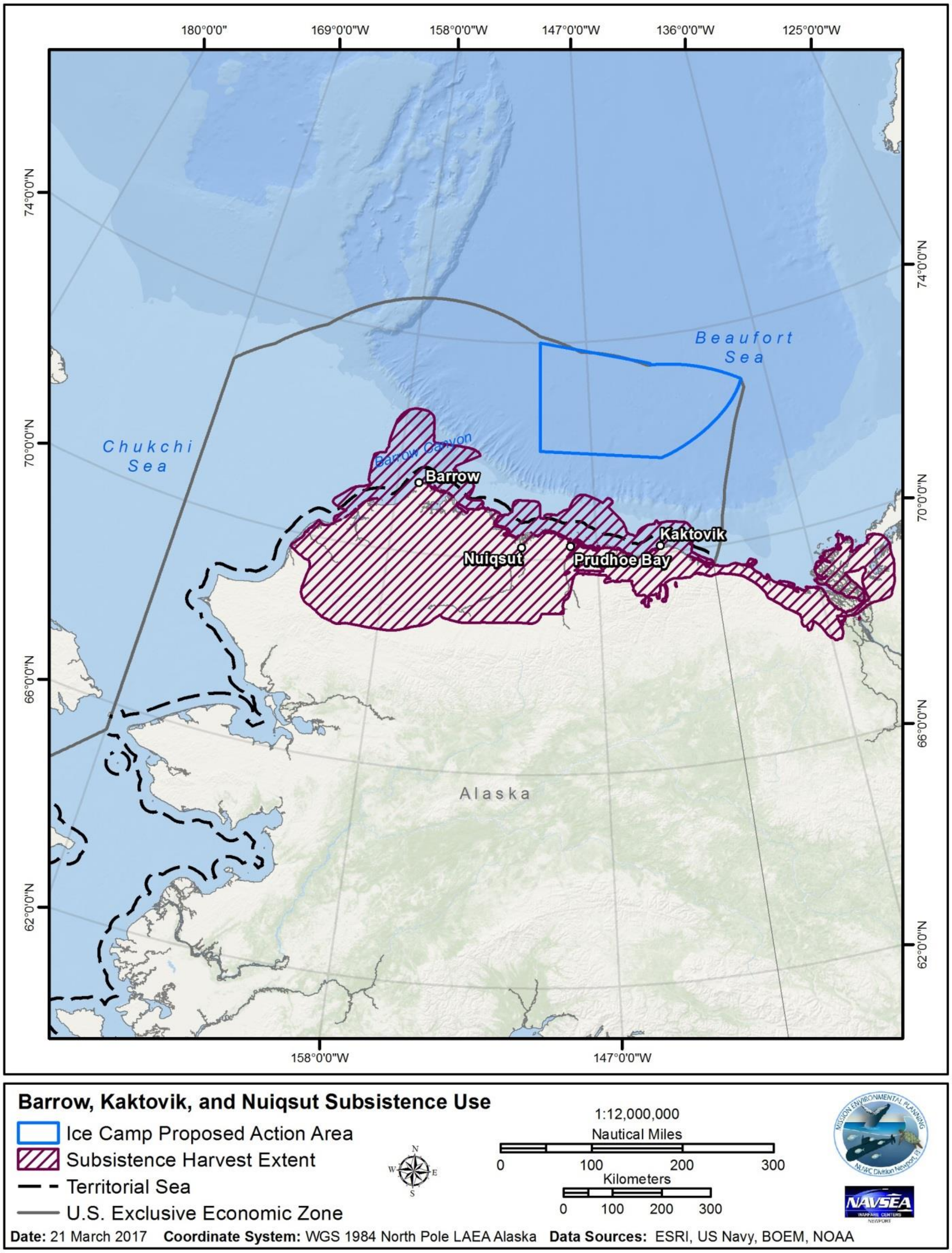

Figure 3-7. Subsistence Harvest Extent for Villages of Barrow, Kaktovik, and Nuiqsut

CHAPTER 4 ENVIRONMENTAL CONSEQUENCES

This chapter discusses the potential environmental consequences of the Proposed Action to the natural and physical environments described in Chapter 3. Stressors resulting from the Proposed Action that may potentially impact or harm the biological or physical environment include:

- Acoustic: acoustic transmissions, aircraft noise, on-ice vehicle noise
- Physical: aircraft strike, on-ice vehicle strike, in-water vessel and vehicle strike, human presence
- Expended Material: bottom disturbance, entanglement, ingestion

The Proposed Action would not impact air quality within the Study Area during the timeframe of the Proposed Action. The addition of flight traffic into and out of the Deadhorse Airport, in Prudhoe Bay, would not be substantial enough to have a significant impact on overall emissions levels within the region. Any other emissions, created by generators or aircraft near the 2018 ice camp proposed action area, would be outside of any attainment areas or Clean Air Act jurisdiction. Therefore, no further analysis of air quality effects will be presented.

The Proposed Action would not impact subsistence hunting as hunting does not occur within the Study Area during the timeframe of the Proposed Action for bearded and ringed seals. While aircraft may fly over a subsistence hunting area near the coast, it would be within the flight corridors already used by aircraft from Deadhorse Airport. Any potential impact to a bearded or ringed seal from aircraft overflights within a subsistence hunting area would be temporary and minor. Otherwise all other activities associated with the Proposed Action would be outside of known subsistence hunting areas. Although hunting for polar bears and arctic foxes does occur year-round, the Proposed Action is far outside of the normal areas hunting occurs. Therefore, no further analysis of socioeconomic effects will be presented.

Under the No Action Alternative, the Proposed Action would not occur; therefore, there would be no impact or harm to the natural and physical environments. No further analysis of the No Action Alternative will be presented. Appendix F provides a description of each stressor, as well as matrices showing which activities generate each stressor and what resources are impacted by each stressor.

4.1 ACOUSTIC STRESSORS

The acoustic stressors from the Proposed Action include active acoustics, aircraft noise, and on-ice vehicle noise.

4.1.1 Acoustic Transmissions

Both submarine training and research activities have acoustic transmissions that require quantitative analysis. Some acoustic sources are either above the known hearing range of marine species or have narrow beam widths and short pulse lengths that would not result in effects to marine species. Potential effects from these "*de minimis*" sources are analyzed qualitatively in accordance with current Navy policy. Navy acoustic sources are categorized into "bins" based on frequency, source level, and mode of usage, as previously established between the Navy and NMFS (Department of the Navy 2013a). The acoustic transmissions associated with submarine training fall within bins HF1 (hull-mounted submarine sonars that produce high-frequency [greater than 10 kHz but less than 200 kHz] signals), M3 (mid-frequency [1-10 kHz] acoustic modems greater than 190 dB re 1 µPa), and TORP2 (heavyweight torpedo). These transmissions are associated with discrete events that may last up to 24 hours. Time between events would not have acoustic transmissions. The parameters for the acoustic transmissions associated with research activities can be found in Table 2-2 above. All events would occur over an approximately four-week timeframe. Although details about submarine training events are classified, the analysis below includes both submarine training and research activities. Details on submarine training events can be found in the classified Appendix E.

In assessing the potential for impacts to biological resources from acoustic transmissions, a variety of factors must be considered, including source characteristics, animal presence and associated density, duration of exposure, and thresholds for injury and harassment for the species that may occur in the Study Area. The types of potential consequences to biological resources from acoustic sources can be grouped in the following categories:

Non-auditory injury: Non-auditory injury can occur to lungs and organs and can cause tissue damage. Resonance occurs when the frequency of the sound waves matches the frequency of vibration of the air filled organ or cavity, causing it to resonate. This can, in certain circumstances, lead to damage to the tissue making up the organ or air filled cavity. Tissue damage can also be inflicted directly by sound waves in cases of sound waves with high amplitude and rapid rise time.

Auditory injury: A severe condition that occurs when sound intensity is very high or of such long duration that the result is a Permanent Threshold Shift (PTS) or permanent hearing loss on the part of the listener. The intensity and duration of a sound that will cause PTS varies across species and even between individual animals. PTS is a consequence of the death of sensory hair cells of the auditory epithelia of the ear and a resultant loss of hearing ability in the general vicinity of the frequencies of stimulation (Myrberg 1990; Richardson et al. 1995).

Physiological disruption: Sounds of sufficient loudness can cause a temporary condition impairing an animal’s hearing for a period of time, called a Temporary Threshold Shift (TTS). After termination of the sound, it characterized by a normal hearing ability returning over a period of time that may range anywhere from minutes to days, depending on many factors including the intensity and duration of exposure to the intense sound. The precise physiological mechanism for TTS is not well understood. It may result from fatigue of the sensory hair cells as a result of over-stimulation, or from some small damage to the cells that are repaired over time. Hair cells may be temporarily affected by exposure to the sound but they are not permanently damaged. Thus, TTS is not considered to be an injury (Richardson et al. 1995), although animals may be at some disadvantage in terms of detecting predators or prey in affected frequency bands while the TTS persists.

Behavioral disruption: Marine animals may exhibit short-term behavioral reactions such as cessation of feeding, resting, or social interaction, and may also exhibit alertness or avoidance behavior(Richardson et al. 1995).

Masking: The presence of intense sounds or sounds within a mammals hearing range in the environment potentially can interfere with an animal’s ability to hear relevant sounds. This effect, known as “auditory masking,” could interfere with the animal’s ability to detect biologically relevant sounds such as those produced by predators or prey, thus increasing the likelihood of the animal not finding food or being preyed upon (Myrberg 1981; Popper et al.

2004). Masking only occurs in the frequency band of the sound that causes the masking condition. Other relevant sounds with frequencies outside of this band would not be masked.

The potential effects of acoustic transmissions on invertebrates, fish, and marine mammals are provided below. Given the ice cover during the timeframe of the Proposed Action, bird species are not expected to be within the water column or potentially exposed to acoustic transmissions. Therefore, the impacts of acoustic transmissions on birds are not further analyzed. Additionally, bearded seals would not be located near the 2018 ice camp proposed action area during the timeframe of the Proposed Action. Therefore, the impacts of acoustic transmissions on bearded seals are not further analyzed.

4.1.1.1 Invertebrates

Hearing capabilities of invertebrates are largely unknown, although they are not expected to hear sources above 3 kHz (see section 3.2.2.4 for invertebrate hearing information). Invertebrates are only expected to potentially perceive the signals of a few sources used during the Proposed Action. In addition, most marine invertebrates in water are known to detect only particle motion associated with sound waves, which drop off rapidly with distance (Graduate School of Oceanography 2015).

Within the Study Area, marine invertebrate abundance is low within the sea ice and in the water column. The highest densities are on the seafloor, further reducing the likelihood of invertebrates hearing the frequencies of the active acoustic sources due to the dissipation of the acoustic transmission in the water column. As stated in Section 3.2.2.4, invertebrate hearing is largely unknown. In studies by Christian et al. (2003) and Payne et al. (2007), neither found damage to lobster or crab statocysts from high intensity air gun firings (which is of greater intensity than the acoustic transmissions of sound sources in the Proposed Action). Furthermore, in the study by Christian et al. (2003), no changes were found in biochemical stress markers in snow crabs.

Acoustic transmissions from both Alternatives 1 and 2 would result in the same potential for effects to invertebrates, in that the amount of acoustic transmissions in the frequency range that may impact invertebrates would be the same for both alternatives. A low likelihood exists that invertebrates would be able to perceive the acoustic transmissions, and if perceived, that an individual animal would react.

4.1.1.2 Fish

As discussed in Section 3.2.4.2, data on hearing sensitivities of fish species occurring in the Study Area are not known. Research on fish hearing is limited; however, there is the potential for a fish with hearing sensitivities yet to be determined to perceive the sound of the Proposed Action. PTS has not been documented in fish. A study regarding mid-frequency sonar exposure by Halvorsen et al. (2012) found that for temporary hearing loss or similar negative impacts to occur, the noise needed to be within the fish’s individual hearing frequency range; external factors, such as developmental history of the fish or environmental factors, may result in differing impacts to sound exposure in fish of the same species. The sensory hair cells of the inner ear in fish can regenerate after they are damaged, unlike in mammals where sensory hair cell loss in permanent (Lombarte et al. 1993b; Smith et al. 2006a). As a consequence, any hearing loss in fish may be as temporary as the timeframe required to repair or replace the sensory cells that were damaged or destroyed (Smith et al. 2006a), and no permanent loss of hearing in fish would result from exposure to sound.

Studies of the effects of long-duration sounds with sound pressure levels below 170–180 dB re 1 μPa indicate that there is little to no effect of long-term exposure on species that lack notable anatomical hearing specialization (Amoser and Ladich 2003; Scholik and Yan 2001; Smith et al. 2004a, 2004b; Wysocki et al. 2006). The longest of these studies exposed young rainbow trout (*Onorhynchus mykiss*) to a level of noise equivalent to one that fish would experience in an aquaculture facility (e.g., on the order of 150 dB re 1 μPa) for about nine months. The investigators found no effect on hearing (i.e., TTS) as compared to fish raised at 110 dB re 1 μPa. Though these studies have not directly determined impacts to the fish expected to be present within the Study Area, it can be assumed that they would react in a similar manner to sound exposure.

Behavioral responses to noise in wild fish could alter the behavior of a fish in a manner that would affect its way of living, such as where it tries to locate food or how well it can locate a potential mate. Behavioral responses to loud noise could include a startle response, such as the fish swimming away from the source, the fish "freezing" and staying in place, or scattering (Popper 2003a).

Fish use sounds to detect both predators and prey, and for schooling, mating, and navigating (Myrberg 1981; Popper 2003b). Masking of sounds associated with these behaviors could have impacts to fish by reducing their ability to perform these biological functions. Any noise (i.e., unwanted or irrelevant sound, often of an anthropogenic nature) detectable by a fish can prevent the fish from hearing biologically important sounds including those produced by prey or predators (Myrberg 1981; Popper 2003b). The frequency of the sound is an important consideration for fish because many marine fish are limited to detection of the particle motion component of low frequency sounds at relatively high sound intensities (Amoser and Ladich 2005). The frequencies of the acoustic transmissions associated with the Proposed Action are higher than those expected to be perceived by those species within the Study Area; therefore, masking is not likely as the mid- and high-frequency sources are not within the hearing range a fish would use to detect predators or prey. Behavioral responses are possible for those fish close to the active sonar sources, but there is little evidence of these responses at the frequency levels on the ICEX activities.

Acoustic transmissions from both Alternatives 1 and 2 would result in the same potential for effects to fish. There is a low likelihood that fish within the Study Area would be able to perceive the acoustic transmissions, and if perceived, that an individual animal would react; this reaction would be temporary or minimal, and the animal would be expected to resume normal behavior after exposure.

4.1.1.3 Essential Fish Habitat

Acoustic transmissions could have an effect on the features of the Essential Fish Habitat due to the increase in ambient sound level during the transmissions. However, this potential reduction in the quality of the acoustic habitat would be localized to the area of the training and research activity and temporary in duration. The quality of the water column environment as Essential Fish Habitat would be restored to normal levels immediately following the completion of each individual training event, which would only occur for a few hours over a period of a couple of weeks. Secondary effects to federally managed fish species (i.e., Arctic cod) are considered in Section 4.1.1.2 above.

Acoustic transmissions from both Alternatives 1 and 2 would result in the same potential effects to Essential Fish Habitat. The quality of the water column as Essential Fish Habitat would only be affected locally and temporarily and the quantity would not be adversely impacted.

4.1.1.4 Mammals (Marine)

The only marine mammal susceptible to impacts from acoustic transmissions from the Proposed Action is the ringed seal, as polar bears are anticipated to remain on the ice surface and not be exposed to acoustic transmissions in the water column and bearded seals are not present near the 2018 ice camp proposed action area or in any areas where acoustic transmissions could cause an effect. In assessing the potential effects on ringed seals from the Proposed Action, a variety of factors must be considered, including source characteristics, animal presence, animal hearing range, duration of exposure, and impact thresholds for species that may be present. Potential acoustic impacts could include PTS, TTS, or behavioral effects. To make these assessments, a model was used to quantitatively estimate the potential number of exposures that could occur, followed by a qualitative analysis to account for other factors not reflected by the model.

The Navy Acoustic Effects Model (NAEMO) was used to produce a quantitative estimate of PTS, TTS, and behavioral exposures for ringed seals (See Appendix G for additional details on NAEMO and the modeling process). The Navy then further analyzed the data and conducted an in-depth qualitative analysis of the species distribution and likely responses to the acoustic transmissions based on available scientific literature. The determination of the effects to the ringed seal was based on this combination of quantitative and qualitative analyses.

4.1.1.4.a Quantitative Analysis

A quantitative analysis of the potential effects to ringed seals from the proposed acoustic transmissions was conducted using a method that calculates the total sound exposure level and maximum sound pressure level that a ringed seal may receive from the acoustic transmissions. NAEMO was used for all modeling analysis (U.S. Department of the Navy In Prep-b). Environmental characteristics (e.g., bathymetry, wind speed, and sound speed profiles) and source characteristics (i.e., source level, source frequency, transmit pulse length and interval, horizontal and vertical beam width and source depth) were used to determine the propagation loss of the acoustic energy, which was calculated using the Comprehensive Acoustic System Simulation/Gaussian Ray Bundle (CASS/GRAB) propagation model. Additionally, an under-ice model (OAML ICE) for surface interaction was implemented in NAEMO. The propagation loss then was used in NAEMO to create acoustic footprints. The NAEMO model then simulated source movement through the Study Area and calculated sound energy levels around the source. Animats, or representative animals, were distributed based on density data obtained from the Navy Marine Species Density Database (U.S. Department of the Navy In Prep-c). The Navy used a Seasonal Relative Environmental Suitability model (Kaschner et al. 2006), based on seasonal habitat preferences and requirements of known occurrences, such as temperature, bathymetry, and distance to land data and literature review, because occurrence information for ringed seals in the Study Area is not well known. Empirical data is coupled with Relative Environmental Suitability modeling data to generate predictions of density data for locations where no survey data exist. The energy received by each animat distributed within the model was summed into a total sound exposure level. Additionally, the maximum sound pressure level received by each animat was also recorded.

NAEMO provides two outputs. The first is the number of animats recorded with received levels within 1 dB bins at and greater than 120 dB re 1 µPa and the total sound exposure level (in dB re 1 $\mu Pa^2 \cdot s$) for each animat, prior to effect thresholds being applied (referred to as unprocessed animat exposures). These results are used to determine if a marine mammal may be exposed to the acoustic energy resulting from the Proposed Action, but they do not infer that any such exposure results in an effect to the animal from the action. The second output, referred to as calculated exposures, is the predicted number of exposures that could result in effects as determined by the application of acoustic threshold criteria. Criteria and thresholds for measuring these effects induced from underwater acoustic energy have been established for phocids. The thresholds established for physiological effects (sound exposure levels for PTS and TTS) and behavioral effects are provided in Table 4-1 and are described in detail in National Marine Fisheries Service (2016).

Table 4-1. In-Water Criteria and Thresholds for Predicting Physiological and Behavioral Effects on Marine Mammals Potentially Occurring in the Study Area

Group	Behavioral Criteria	Physiological Criteria	
		Onset TTS	Onset PTS
Phocidae (in water)	Pinniped Dose Response Function*	181 dB SEL cumulative	201 dB SEL cumulative

*See Figure 4-1

Behavioral response criteria are used to estimate the number of exposures that may result in a behavioral response. The Navy has defined a mathematical function used to predict potential behavioral effects (Figure 4-1 provides the function used for pinnipeds). This analysis assumes that the probability of eliciting a behavioral response from individual animals to active transmissions would be a function of the received sound pressure level (dB re 1 µPa). This analysis also assumes that sound poses a negligible risk to marine mammals if they are exposed to sound pressure levels below a certain basement value (120 dB re 1 µPa). Details regarding the behavioral risk function are provided in Department of the Navy (In Prep-d).

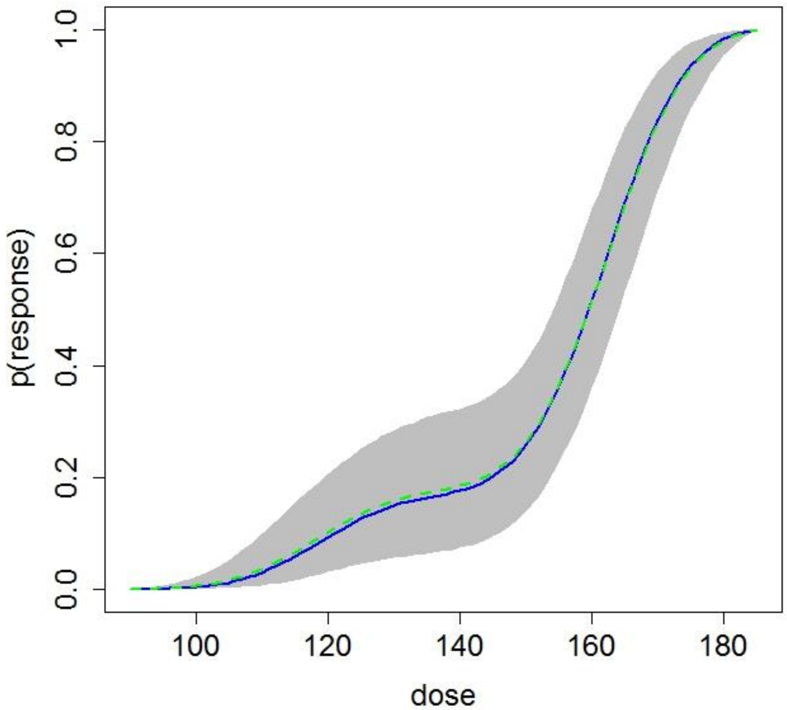

Figure 4-1. The Bayesian biphasic dose-response BRF for Pinnipeds. The blue solid line represents the Bayesian Posterior median values, the green dashed line represents the biphasic fit, and the grey represents the variance. [X-Axis: Received Level (dB re 1 µPa), Y-Axis: Probability of Response]

The results from the NAEMO acoustic analysis are provided in Table 4-2. NAEMO calculated that eleven ringed seals are likely to experience received sound exposure levels that may result in TTS. No ringed seals are likely to experience received sound exposure levels that may result in PTS. 1,665 ringed seals were calculated to potentially be exposed to sound pressure levels that may elicit a behavioral response. Due to the potential behavioral and TTS exposures, an incidental harassment authorization application was submitted to NMFS for take by Level B harassment of the ringed seal.

Table 4-2. NAEMO-Calculated Ringed Seal Exposures

Species	**PTS** (sound exposure level of 201 dB re 1 µPa^2·s)	**TTS** (sound exposure level of 181 dB re 1 µPa^2·s)	**Behavior**
Ringed Seal	0	11	1665

These quantitative calculations were then analyzed qualitatively, taking into account the best available data on the species itself, and how the species has been observed to respond to similar types of influences.

4.1.1.4.b Qualitative Analysis

No research has been conducted on the potential behavioral responses of ringed seals to the type of acoustic sources used during the Proposed Action. However, data are available on (1) effects of non-impulsive sources (e.g., sonar transmissions) on other phocids in water, and (2) reactions of ringed seals while in subnivean lairs. All of this available information was assessed and incorporated into the findings of this analysis.

Effects of Non-impulsive Sources on Phocids in Water

For non-impulsive sounds (i.e., similar to the sources used during the Proposed Action), data suggest that exposures of pinnipeds to sources between 90 and 140 dB re 1 µPa do not elicit strong behavioral responses; no data were available for exposures at higher received levels for Southall et al. (2007) to include in the severity scale analysis. Reactions of harbor seals (*Phoca vitulina*) were the only available data for which the responses could be ranked on the severity scale. For reactions that were recorded, the majority (17 of 18 individuals/groups) were ranked on the severity scale as a 4 (moderate change in movement, brief shift in group distribution, or moderate change in vocal behavior) or lower; the remaining response was ranked as a 6 (minor or moderate avoidance of the sound source). Additional data on hooded seals (*Cystophora cristata*) indicate avoidance responses to signals above 160–170 dB re 1 µPa (Kvadsheim et al. 2010), and data on grey (*Halichoerus grypus*) and harbor seals indicate avoidance response at received levels of 135–144 dB re 1 µPa (Götz et al. 2010). In each instance where food was available, which provided the seals motivation to remain near the source, habituation to the signals occurred rapidly. In the same study, it was noted that habituation was not apparent in wild seals where no food source was available (Götz et al. 2010). This implies that the motivation of the animal is necessary to consider in determining the potential for a reaction. In one study aimed to investigate the under-ice movements and sensory cues associated with under-ice navigation of ice seals, acoustic transmitters (60–69 kHz at 159 dB re 1 µPa at 1 m) were attached to ringed seals (Wartzok et al. 1992a; Wartzok et al. 1992b). An acoustic tracking system then was installed in the ice to receive the acoustic signals and provide real-time tracking of ice seal movements. Although the frequencies used in this study are at the upper limit of ringed seal hearing, the ringed seals appeared unaffected by the acoustic transmissions, as they were able to maintain normal behaviors (e.g., finding breathing holes).

Seals exposed to non-impulsive sources with a received sound pressure level within the range of calculated exposures, (142–193 dB re 1 µPa), have been shown to change their behavior by modifying diving activity and avoidance of the sound source (Götz et al. 2010; Kvadsheim et al. 2010). Although a minor change to a behavior may occur as a result of exposure to the sources in the Proposed Action, these changes would be within the normal range of behaviors for the animal (e.g., the use of a breathing hole further from the source, rather than one closer to the source, would be within the normal range of behavior) (Kelly et al. 1988).

Effects on Ringed Seals within Subnivean Lairs

Adult ringed seals spend up to 20 percent of the time in subnivean lairs during the timeframe of the Proposed Action (Kelly et al. 2010a). Ringed seal pups spend about 50 percent of their time in the lair during the nursing period (Lydersen and Hammill 1993). Ringed seal lairs are typically used by individual seals (haul-out lairs) or by a mother with a pup (birthing lairs); large lairs used by many seals for hauling out are rare (Smith and Stirling 1975). The acoustic modeling does not account for seals within subnivean lairs, and all animals are assumed to be in the water and susceptible to hearing acoustic transmissions 100 percent of the time. Therefore, the acoustic modeling output likely represents an overestimate given the percentage of time that ringed seals are expected to be in subnivean lairs, rather than in the water. Although the exact amount of transmission loss of sound traveling through ice and snow is unknown, it is clear that some sound attenuation would occur due to the environment itself. In-air (i.e., in the subnivean lair), the best hearing sensitivity for ringed seals has been documented between 3 and 5 kHz; at higher frequencies, the hearing threshold rapidly increases (Sills et al. 2015).

If the acoustic transmissions are heard and are perceived as a threat, ringed seals within subnivean lairs could react to the sound in a similar fashion to their reaction to other threats, such as polar bears and Arctic foxes (their primary predators), although the type of sound would be novel to them. Responses of ringed seals to a variety of human-induced noises (e.g., helicopter noise, snowmobiles, dogs, people, and seismic activity) have been variable; some seals entered the water and some seals remained in the lair (Kelly et al. 1988). However, in all instances in which observed seals departed lairs in response to noise disturbance, they subsequently reoccupied the lair (Kelly et al. 1988).

The Proposed Action would overlap with the beginning of the ringed seal pupping season, but would be concluded before the height of the pupping season. Ringed seal mothers have a strong bond with their pups and may physically move their pups from the birth lair to an alternate lair to avoid predation, sometimes risking their lives to defend their pups from potential predators (Smith 1987). Additionally, it is not unusual to find up to three birth lairs within 100 m of each other, probably made by the same female seal, as well as one or more haul-out lairs in the immediate area (Smith et al. 1991). If a ringed seal mother perceives the acoustic transmissions as a threat, the network of multiple birth and haul-out lairs allows the mother and pup to move to a new lair (Smith and Hammill 1981; Smith and Stirling 1975). However, the acoustic transmissions are unlike the low frequency sounds and vibrations felt from approaching predators. Additionally, the acoustic transmissions are not likely to impede a ringed seal from finding a breathing hole or lair, as captive seals have been found to primarily use vision to locate breathing holes and no effect to ringed seal vision would occur from the acoustic transmissions (Elsner et al. 1989; Wartzok et al. 1992a). It is anticipated that a ringed seal would be able to relocate to a different breathing hole relatively easily without impacting their normal behavior patterns.

4.1.1.4.c Summary

The behavioral responses of ringed seals and other phocids to underwater sound vary. Non-impulsive sources have been shown to elicit minor or moderate avoidance responses from other phocids at the sound pressure levels potentially received from the Proposed Action.

Submarine training and research activities would occur over an approximate four-week period during ICEX. During this time, the submarines, unmanned underwater vehicles, and active buoys would conduct intermittent acoustic events, and even during these events acoustic transmissions are not constant. The training and testing would occur in different locations and at different depths and speeds depending on the objective of the event. Transmissions from the submarines would occur within different locations but within the general area around the ice camp, so that they are within the tracking range acoustic boundary. As such, there likelihood of a single lair being exposed to the submarine activity for the entirety of the four-week period is low. Additionally, as the acoustic transmissions would not be conducted continuously for the four-week period, the short duration of the events would result in only short term reactions by ringed seals, after which time normal behavior would resume (Harris et al. 2001; Kvadsheim et al. 2010). An individual ringed seal could potentially react to the acoustic transmissions by alerting to or temporarily avoiding the area close to the source (e.g., using a breathing hole/lair further from the source). Data show that likely reactions would be within the normal repertoire of the animal's typical movements, as ringed seals routinely utilize a complex of breathing holes and lairs (Kelly et al. 1986; Smith and Hammill 1981; Smith and Stirling 1975). As most lairs are only used by single seals or by a mother-pup pair, acoustic transmissions would not result in a significant abandonment of a haul-out location by many seals. These and similar reactions would not disrupt the animal's overall behavioral pattern (e.g., feeding or nursing), and would therefore not affect the animal's ability to survive, grow, or reproduce.

As described above, the sound sources in the Proposed Action are expected to result in, at most, minor to moderate avoidance responses of animals, over short and intermittent periods of time. The Proposed Action is not expected to cause significant disruptions such as mass haul outs, or abandonment of breeding, that would result in significantly altered or abandoned behavior patterns. Since the acoustic transmissions from the Proposed Action may cause a behavioral effect (e.g., seal temporarily avoiding an area or using a different subnivean lair father away from acoustic transmissions) the Navy applied and received an Incidental Harassment Authorization from NMFS for Level B take of ringed seals in accordance with MMPA. Given this, in accordance with the ESA, the acoustic transmissions in the Proposed Action may adversely affect the ringed seal, but is not likely to jeopardize the existence of the species.

4.1.2 Aircraft Noise

Multiple types of aircraft would be used during the Proposed Action, including commercial small twin-engine fixed-wing aircraft, commercial rotary-wing aircraft (helicopters), military fixed-wing and rotary-wing aircraft, and two types of unmanned aerial systems. Flights to and from the ice camp would originate at Deadhorse Airport, which currently supports 90 daily flights. ICEX would only increase air traffic from the airport by 10 percent (maximum of 9 trips per day). Though some of the aircraft used during ICEX (such as the unmanned aerial systems) are small, most would create enough noise to potentially affect biological resources, during the Proposed Action. Noise may affect biological resources in a variety of ways. Aircraft make noise in flight, which propagates through the air. This sound also interacts with the ice surface and potentially propagates through the ice into the water. Lastly, aircraft spend time on the ice warming up, taxiing, and taking off and landing, all of which produce noise and are considered herein.

Sound generated by aircraft is analyzed for both in-air and in-water effects. Airborne sound levels are normally expressed in decibels (dB). The decibel value is given with reference to ("re") the value and unit of the reference pressure. The standard reference pressures are 1 μPa for water and 20 μPa for air. It is important to note that, because of the difference in reference units between air and water, the same absolute pressure would result in different dB values for each medium. In air, sound levels are frequently "A-weighted" and seen in units of dBA (A-weighted decibels).

Transmission of sound from a moving airborne source to a receptor underwater is influenced by numerous factors and has been addressed by Urick (1983), Young (1973), Richardson et al (1995), Eller and Cavanagh (2000), Laney and Cavanagh (2000), and others. Sound is transmitted from an airborne source to a receptor underwater by four principal means: (1) a direct path, refracted upon passing through the air-water interface; (2) direct-refracted paths reflected from the bottom in shallow water (not applicable here given the depth of the water in the Study Area); (3) evanescent transmission in which sound travels laterally close to the water surface; and (4) scattering from interface roughness due to wave motion (not applicable here given anticipated ice cover).

Airborne sound is refracted upon transmission into water because sound waves move faster through water than through air (a ratio of about 0.23:1). Based on this difference, the direct sound path is reflected if the sound reaches the surface at an angle more than 13 degrees from vertical. As a result, most of the acoustic energy transmitted into the water from an aircraft arrives through a relatively narrow cone extending vertically downward from the aircraft (Figure 4-2). The intersection of this cone with the surface traces a “footprint” directly beneath the flight path, with the width of the footprint being a function of aircraft altitude. Sound may enter the water outside of this cone due to surface scattering and as evanescent waves, which travel laterally near the water surface.

The inhomogeneous nature of sea ice does not necessarily allow for attenuation of noise from the air through the ice layer and into the water. At frequencies less than 500 Hz, which is the acoustic energy range of most aircraft, the ice layer is acoustically thin and causes little attenuation of sound (Richardson et al. 1991). This implies that low frequency sound travelling through the sea ice would only be slightly lower than that same noise travelling directly from the air to the water. (Richardson et al. 1995). Use of the air-water transmission model would provide slight overestimates of underwater sound levels from aircraft overflights, but this is the best model available to analyze airborne sound transmission through ice, allowing for a qualitative analysis of impacts on bearded seals under sea ice (Richardson et al. 1995).

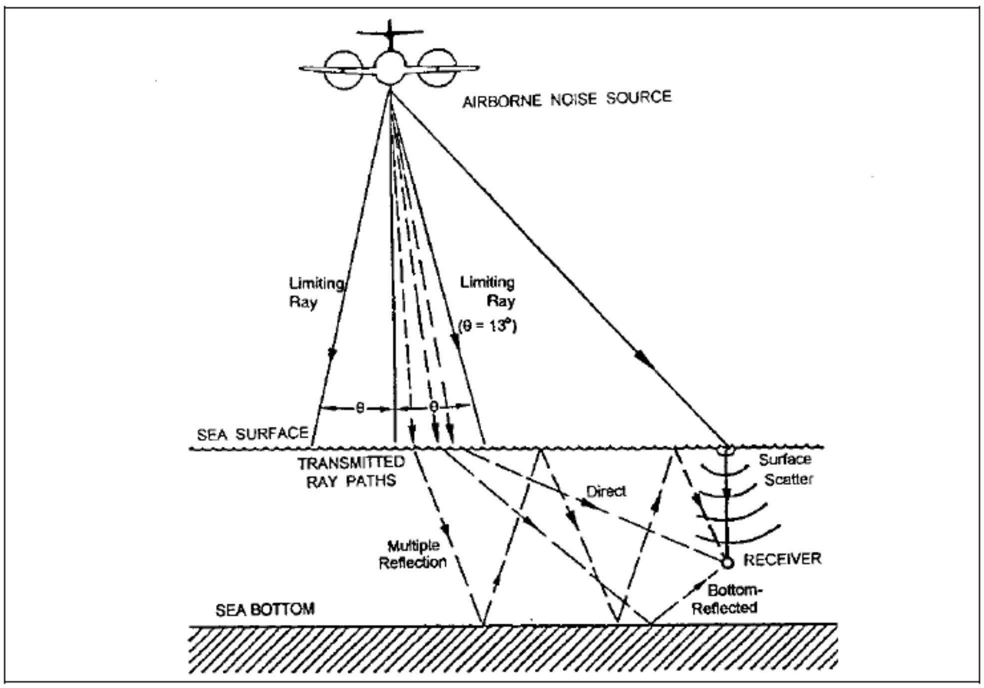

Figure 4-2. Characteristics of Sound Transmission through the Air-Water Interface
(Richardson et al 1995)

Table 4-3 provides a list of manned aircraft similar to those used during the Proposed Action and their associated in-air and in-water source levels. In addition to the manned aircraft, two unmanned aerial systems would be utilized during the Proposed Action. The fixed-wing unmanned aerial system is similar to, but smaller than, small fixed-wing aircraft (Piper PA-46-500TP, Cessna 180, and Cessna 185) included in the table below. The rotary-wing unmanned aerial system operates in a similar manner as helicopters, but on a smaller scale. Acoustic data for the unmanned fixed-wing aerial systems are not currently available, but based on the small size of the systems and their engines, it is not anticipated that they would create enough sound to cause a disturbance for the resources within the Study Area. Based on a study by Christiansen et al.(2016), an initial analysis of underwater recordings at 1 m below the water surface of noise produced by a rotary-wing unmanned aerial system was only detectable above ambient noise when the system was flown at altitudes lower than 10 m. Though the study found that in-air recordings showed that the noise levels produced by the unmanned aerial systems were within noise-level ranges known to cause disturbance in some marine mammals, the in-water received noise levels at 1 m depth were orders of magnitude below those shown to cause any direct damage on auditory systems or compromise physiology in marine mammals (Christiansen et al. 2016; Southall et al. 2007).

Table 4-3. Source Levels of Representative Aircraft[1]

Aircraft Description	Aircraft Altitude (ft)[2]	Frequency (Hz)	In-air Source Level (dB re 20 μPa)	In-water Source Level (dB re 1 μPa)[3]
Fixed-wing takeoff	300	125		106
Fixed-wing (Piper PA-46-500TP)	25,000[2]	1700	73.7	
Fixed-wing (Cessna 180)	17,700[2]	1700	63-69	
Fixed-wing (Cessna 185)	17,900[2]	1700	64-66	
Fixed-wing (C-130)	300	63		170
Fixed-wing (F/A-18)	5000		85	
Fixed-wing (V-22)[5]	400		94	
Rotary-wing (H-60)	50			125
Rotary-wing warmup	-	160		131[4]
Rotary-wing (Bell 250)	300	200		155
Rotary-wing (Sikorsky S61)	300	40		156
Rotary-wing (V-22)[6]	100		94.6	

[1] All source level information was obtained from Malme et al (1989), Federal Aviation Administration (2012), and V-22 EA 1999.
[2] Where no altitude was given for flyovers, maximum aircraft cruising altitude was assumed, based on cruise ceiling values from Aircraft Owners and Pilots Association (2015).
[3] Depth of measurement is 1 m, unless otherwise noted.
[4] Measurement taken at a depth of 20 m under ice.
ft = feet; dB re 20 µPa = decibels referenced to 20 microPascals
[5] Nacelle angle at 0 degrees; lateral offset of 500 ft, flight speed 228 knots
[6] Nacelle angle at 90 degrees; lateral offset 500 ft, hovering condition.

Fixed-wing aircraft noise propagates through air at rates depending on factors such as frequency, temperature, relative humidity, and atmospheric pressure (Richardson et al. 1995). At middle frequencies, sound absorption has more influence on sound transmission in the atmosphere than in the ocean; for example, at 1 kHz the underwater sound absorption coefficient is approximately 0.06 decibels per kilometer (dB/km), whereas the typical value for in-air attenuation is approximately 4 dB/km. The absorption coefficient for in-air attenuation decreases rapidly with frequency to approximately 130 dB/km at 10 kHz, depending on temperature and humidity; thus, only low-frequency sound is transmitted well in air. It has been noted that the takeoff noise levels 1 m under the ice for small fixed wing aircraft is 106 dB re 1 µPa at 125 Hz (Malme et al. 1989). Aircraft on takeoff and landing tend to be noisier than those during cruising or especially approaching.

During the Proposed Action, small, fixed-wing aircraft (the most frequently used aircraft) would generally operate at altitudes up to 3,500 m. At this altitude, the footprint of airborne noise at the ice surface would be an approximate 2 km^2 area which would move along the flight path of the aircraft. Due to the relatively small area over which aircraft noise would radiate outward, the noise would be transient. As noise levels would be lowered by the time they reach the surface from an overhead flight, the noise levels would have decreased; these noise levels would still have to attenuate through the ice, and therefore underwater noise would be generally brief in nature.

Helicopter flights associated with the Proposed Action are used for logistical purposes (transport of personnel and equipment) and are not conducting training or testing and therefore would not be hovering or flying a route pattern for an extended period. Helicopters produce low-frequency sound and vibration (Pepper et al. 2003; Richardson et al. 1995). Helicopter sounds contain dominant tones from the rotors that are generally below 500 Hz. Noise generated from helicopters is transient in nature and variable in intensity. Helicopters often radiate more sound forward than aft. The underwater noise produced is generally brief when compared with the duration of audibility in the air. Rotary-wing aircraft tend to be noisier than similar-sized fixed wing aircraft.

For fiscal year 2015, the total operations of Deadhorse Airport, in Prudhoe Bay, including air carrier, air taxi, general aviation local, general aviation international, and military, was 32,912 flights (Federal Aviation Administration 2017). Assuming an even distribution throughout the year, the average number of daily flights served by this airport is approximately 90. Though ICEX could increase the daily number of flights by 10 percent (the maximum number [9] of daily flights which could go to the ice camp), the duration of the Proposed Action is temporary, and overall there is a low number of flights, so the effects of additional air traffic would not be significant.

It is not anticipated that aircraft noise would impact marine habitats, vegetation, invertebrates, or fish, as the transmission of airborne noise through the ice would be limited, and outside of the hearing sensitivity of the applicable resources. Therefore, they are not further discussed. The only potential effects would be on marine birds and mammals (both marine and terrestrial), analysis for these species are provided below.

4.1.2.1 Marine Birds

Most migrating birds would be present below the altitude of fixed-wing aircraft flights, but could potentially be exposed to nearby noise from helicopters at lower altitudes. Altitudes at which migrating birds fly can vary greatly based on the type of bird, where they are flying (over water or over land), and other factors such as weather. Approximately 95 percent of bird flight during migrations occurs below 3,048 m with the majority below 914 m (Lincoln et al. 1998). While there is considerable variation, the favored altitude for most large birds varies based upon wind currents, and some have been observed flying at heights just above sea level to over 6,000 m (Warnock et al. 2002).

Unlike fixed-wing aircraft, helicopters typically operate below 305 m in altitude and often as low as 23–30 m. This low altitude increases the likelihood that birds would respond to noise from helicopter overflights. Helicopters travel at slower speeds (less than 100 knots), which increases durations of noise exposure compared to fixed-wing aircraft. In addition, some studies have suggested that birds respond more to noise from helicopters than from fixed-wing aircraft (Larkin et al. 1996). Noise from low-altitude helicopter overflights may elicit short-term behavioral or physiological responses, such as alert responses, startle responses, or temporary increases in heart rate, in exposed birds. Repeated exposure of individual birds or groups of birds is unlikely, based on the dispersed nature of the overflights and that birds would not be resident in the area during the Proposed Action. The general health of individual birds would not be compromised.

If a bird is close to an intense sound source, it could suffer auditory fatigue. Studies have examined hearing loss and recovery in only a few species of birds, and none studied hearing loss in marine birds (Hashino et al. 1988; Ryals et al. 1999; Ryals et al. 1995; Saunders et al. 1974). A bird may experience PTS if exposed to a continuous sound pressure level over 110 dBA re 20 μPa in air. Continuous noise exposure at levels above 90-95 dB(A) re 20 μPa can cause TTS (Dooling et al. 2012), while physical damage to birds' ears occurs with short-duration but very loud sounds (>140 dBA re 20 µPa for a single blast or 125 dBA re 20 µPa for multiple blasts) (Dooling and Popper 2007). Unlike many other species, birds have the ability to regenerate hair cells in the ear, usually resulting in considerable anatomical, physiological, and behavioral recovery within several weeks. Still, intense exposures are not always fully recoverable, even over periods up to a year after exposure, and damage and subsequent recovery vary significantly by species, though a species' appearance, behavior, or lifestyle cannot be used to predict the time-course of loss or recovery from acoustic trauma (Dooling and Popper 2007; Ryals et al. 1999). Though hair cell regeneration may restore hearing sensitivity, there are subtle, enduring changes to complex auditory perception, though these changes do not appear to provide any obstacle to future auditory and vocal learning for affected birds (Ryals et al. 2013). Birds may be able to protect themselves against damage from sustained sound exposures by regulating inner ear pressure, an ability that may protect ears while in flight (Ryals et al. 1999).

Chronic stress due to disturbance may compromise the general health and reproductive success of birds (Kight et al. 2012), but a physiological stress response is not necessarily indicative of negative consequences to individual birds or to populations (Bowles et al. 1991; National Parks Service 1994). It is possible that individuals would return to normal almost immediately after exposure, and the individual's metabolism and energy budget would not be affected long-term. Studies have also shown that birds can habituate to noise following frequent exposure and cease to respond behaviorally to the noise (Larkin et al. 1996; National Parks Service 1994; Plumpton 2006). However, the likelihood of habituation is dependent upon a number of factors, including species of bird (Bowles et al. 1991), and frequency of and proximity to exposure. A study by Komenda-Zehnder et al. (2003) examined the stressed behavioral shift during airplane and helicopter overflights at different altitudes. They observed that flights operating at lower altitudes elicited a greater behavioral response, and that larger, slower moving aircrafts also lead to greater stressed response. However, this study also concluded that the stressed behaviors exhibited decreased to a normal level around five minutes after the overflight occurred; thus the behavioral responses were temporary and of very short duration.

Responses by birds to aircraft overflights include flying, swimming (which would not be applicable within the Study Area), and displaying alert behaviors (Conomy et al. 1998; Mallory 2016; Ward et al. 1999). Even if a behavioral response is not observed, studies have shown that birds physiologically may be affected based on increased heart rates during aircraft overflights (Wooley Jr. and Owen Jr. 1978). Occasional startle or alert reactions to aircraft are not likely to disrupt major behavior patterns (such as migrating) or to result in serious injury to any marine bird. Helicopter overflights would be more likely to elicit responses than fixed-wing aircraft, but the general health of individual birds would not be compromised.

Aircraft noise associated with Alternative 1 would be from C-130 survey flights, small, fixed-wing aircraft, and small (i.e., non-military) helicopters. Noise associated with these aircraft may elicit responses in individual birds potentially migrating through the area. However, individual stress responses do not necessarily result in negative consequences to populations. Due to the limited duration of activities and the small number of birds that are expected to be around the camp on a sustained basis, population-level effects are not anticipated. Therefore, pursuant to the Migratory Bird Treaty Act, aircraft noise associated with this alternative would not result in a significant adverse effect on migratory bird populations.

Under Alternative 2, the number and types of aircraft flights would increase. Alternative 2 would result in additional fixed-wing overflights (due to increased number of personnel and equipment transfers and the inclusion of research activities) and the inclusion of additional types of aircraft (LC-130, military helicopters, unmanned aerial systems). The increase in activity would increase the potential for birds to be exposed to aircraft noise. Although an increase in noise would occur under this alternative, reactions of birds would be limited to individuals migrating through the area. Additionally, individual stress responses do not necessarily result in negative consequences to populations. Due to the limited duration of activities (up to four hours per flight and one flight per day for unmanned aerial systems used in and around the camp) and the small number of birds that are expected to be around the camp on a sustained basis, population-level effects are not anticipated. As such, pursuant to the Migratory Bird Treaty Act, aircraft noise associated with this alternative would not result in significant adverse effects on bird populations.

4.1.2.2 Mammals (Marine and Terrestrial)

Potential effects to mammals from aircraft activity could involve both acoustic and non-acoustic effects. It is uncertain if an animal reacts to the sound of the aircraft or to its physical presence flying overhead, or both. It has been noted that pinniped hearing sensitivity is reduced at frequencies below 2 kHz, and generally pinnipeds are less sensitive than humans to airborne sounds less than 10 kHz (Richardson et al. 1995). Reactions of hauled out pinnipeds to aircraft flying overhead have been noted, such as looking up at the aircraft, moving on the ice or land, entering a breathing hole or crack in the ice, or entering the water (Blackwell et al. 2004; Born et al. 2004). Reactions depend on several factors including the animal's behavioral state, activity, group size, habitat, and the flight pattern of the aircraft (Richardson et al. 1995). Studies have shown both hauled out ringed and bearded seals sometimes react to low flying aircraft or helicopter by diving into the water (Alliston 1981; Burns 1970; Burns and Frost 1979; Burns and Harbo 1972; Burns et al. 1982). Additionally, a study conducted by Born et al (1999) found that wind chill was also a factor in level of response of ringed seals hauled out on ice (higher wind chill increases probability of leaving the ice), as well as time of day and relative wind direction. Mammal reactions to helicopter disturbance are difficult to predict, though helicopters have been recorded to elicit a stronger behavioral response from ringed and bearded seals than a fixed-wing aircraft (Born et al. 1999; Burns and Frost 1979). Furthermore, Perry et al. (2002) found sex and age compositions of haulout groups (for grey and harbor seals) are important factors in determining the severity of the reaction to aircraft. Salter (1979) studied the Atlantic walrus and concluded small groups of pinnipeds composed of either adolescent seals or mother pup pairs have been shown to react most strongly. During the breeding season females were more alert than males (Perry et al. 2002).

More studies have been conducted on ringed seals reaction to aircraft noise than bearded seals. Due to the fact that they are both pinnipeds and are both ice obligate species reactions of both species are thought to be similar. The response by ringed seals to aircraft noise is variable based upon time of year, prevailing weather, and location. Another factor that could impact ringed seal response is whether the animal is hauled out or in a subnivean lair, as the subnivean response is typically stronger than that of a basking ringed seal (Burns et al. 1982). During the Proposed Action, ringed seals may be on the ice, but are more likely to be within their subnivean lairs or in the water during this period. Bearded seals may be hauled out on the ice or in the water (since they can maintain breathing holes in the ice with their claws and foreflippers) (Reeves et al. 2002) near Prudhoe Bay during the Proposed Action. Ringed seals were shown to leave their subnivean lairs and enter the water when a helicopter was at an altitude of less than 305 m and within 2 km lateral distance (Richardson et al. 1995). However, ringed seal vocalizations in water were similar between areas subject to low-flying aircraft and areas that were less disturbed (Calvert and Stirling 1985). These data suggest that although a ringed seal may leave a subnivean lair, aircraft disturbance does not cause the animals to leave the general area. Additionally, ringed seals construct multiple breathing holes and lairs within their home ranges (Smith and Stirling 1975); these additional lairs and breathing holes are used as escape lairs from predators, and therefore would be a suitable alternative in the event they leave a lair directly below the flightpath of an aircraft. Observations of ringed seals within the water column showed some ringed seals surfaced 20–30 m from the edge of an ice sheet only a few minutes after a helicopter had landed and shut down near the ice edge (Richardson et al. 1995). However, the specific responses by ringed seals to aircraft have not been observed frequently.

Overall, there has been no indication that single or occasional aircraft flying above pinnipeds in water cause long term displacement of these animals (Richardson et al. 1995). The lowest observed adverse effects levels are rather variable for pinnipeds on land, ranging from just over 150 m to about 2,000 m (Efroymson and Suter 2001). A conservative (90th percentile) distance effects level is 1,150 m. Most thresholds represent movement away from the overflight. As a general statement from the available information, pinnipeds exposed to intense (approximately 110 to 120 dB re 20 μPa) non-pulse sounds often leave haul-out areas and seek refuge temporarily (minutes to a few hours) in the water (Southall et al. 2007). Per Richardson et al. (1995), approaching aircraft generally flush animals into the water and noise from a helicopter is typically directed down in a ‘‘cone’’ underneath the aircraft. As bearded seals occur near the ice edge or on a large floe, seals would need to be located directly below the flight path of the aircraft, during takeoff or landing, to be affected.

Polar bears have been seen running away from helicopters flying at an altitude of less than 200 m or at a distance of less than 400 m (Richardson et al. 1995). A helicopter approaching close to a polar bear den does not usually cause the polar bear to abandon the den since snow greatly attenuates helicopter noise (Amstrup 1993; Blix and Lentfer 1992). It is unlikely that an individual would be exposed repeatedly for long periods of time due to the short duration of the aircraft overflights during the Proposed Action and that the ice camp would not likely be established near polar bear dens, considering the vast size of the polar bear home range and the small size of the ice camp. Therefore, the likelihood of a polar bear being under the flight path for multiple flights would be low. Any reactions to aircraft overflights would be short-term, infrequent, and would not be expected to disrupt major behavior patterns such as migrating, breeding, feeding, and sheltering, or injure any polar bears.

Research regarding the reactions of Arctic foxes to aircraft noise is not available. Research has been conducted on game-farm minks, which are also small predatory mammals. When minks were exposed to aircraft hidden from view there was little response and when the aircraft could be seen, minks oriented to the stimulus; no severe reactions were recorded (literature review in (Larkin et al. 1996)). Expected reactions range from looking up at a helicopter or fixed wing aircraft as it passes by to running away from the aircraft noise. Any reactions to aircraft overflights would be short-term, infrequent, and would not be expected to injure any Arctic foxes or disrupt natural behavior patterns such as migrating, breeding, feeding, and sheltering to the point where these behaviors would be abandoned or significantly altered.

Bearded seals have a low probability of being encountered near Prudhoe Bay based on their seasonal movements to the Bering Sea during the winter season (Burns and Frost 1979; Cameron and Boveng 2007; Cameron and Boveng 2009; Frost et al. 2005; Frost et al. 2008) and association with drifting pack ice during late winter and early spring (Muto et al. 2016). Additionally, there is only a maximum of 9 flights per day to and from Deadhorse Airport, in Prudhoe Bay during ICEX. This would only be a temporary 10 percent increase to the daily number of flights going into and out of Deadhorse Airport, in Prudhoe Bay, as ICEX would occur over a six week duration. Flight paths do not occur directly over any known haul out location.

Aircraft noise associated with Alternative 1 would be from C-130 survey flights, small, fixed-wing aircraft, and small (i.e., non-military) helicopters. Under ESA, noise associated with these aircraft may affect, but not likely to adversely affect, polar bears, bearded seals, and ringed seals. Aircraft noise associated with Alternative 1 would not result in takes under the MMPA, as any disturbances would not be likely to disrupt normal behavior patterns to a point that they would be abandoned or significantly altered.

Under Alternative 2, the number and types of aircraft flights would increase. Alternative 2 would result in additional fixed-wing overflights (due to increased number of personnel and equipment transfers and the inclusion of research activities) and the inclusion of additional types of aircraft (LC-130, military helicopters, unmanned aerial systems). The increase in activity would increase the potential for marine and terrestrial mammals to be exposed to aircraft noise. Although an increase in noise would occur under this alternative, reactions of marine mammals would remain temporary and would not result in behaviors being significantly altered or abandoned. As a result, aircraft noise associated with Alternative 2 under ESA may affect, but not likely to adversely affect, polar bears, bearded seals, and ringed seals. Also, aircraft noise associated with Alternative 2 would not result in takes under the MMPA, as any disturbances would not be likely to disrupt normal behavior patterns to a point that they would be abandoned or significantly altered.

4.1.3 On-Ice Vehicle Noise

The use of on-ice vehicles throughout the Proposed Action is integral to ice camp logistics (e.g., personnel and equipment transport).

Small snowmobiles create sounds at higher frequencies than larger, slower machinery. Measurements of frequency content and A-weighted sound levels (dBA) of snow machine pass-bys have been recorded (Menge et al. 2002). The sound level associated with snowmobiles is dependent upon the model, engine size, and speed of the snowmobile. Snowmobiles produce sound at source levels of 104 dBA on average (Richardson et al. 1995). Generally, two- and four-stroke snowmobiles traveling at approximately 32 kilometers per hour (km/hr) had a resultant average sound level of 66–71 dBA re 20 µPa at 15 m. At higher speeds of approximately 64 km/hr, the average sound level increased to 73–75 dBA re 20 µPa at 15 m. During acceleration, the highest sound level was recorded as 80.2 dBA re 20 µPa at 15 m. As reported in Malme et al. (1989), the under-ice sound pressure level for a snowmobile driving 16 km/hr is 124 dB re 1 µPa at a frequency of 1600 Hz. Other studies have found different values for the amount of under-ice sound generated by snowmobiles. The spectrum of snowmobile sound as received under the ice includes much energy near 1–1.25 kHz in frequency, but source levels vary widely, from 90 dB re 1 μPa^2/Hz at range 148 m to 55–60 dB re 1 μPa^2/Hz at range of approximately 200 m in another (Holliday et al. 1980).

In addition to small snowmobiles, small unit support vehicles and all-terrain tracked vehicle may be used to support runway extension from 762 m in length used for small commercial aircraft to 1,524 m in length needed to support military aircraft (i.e., LC-130). The runway prep sled that would be dragged behind either a snowmobile or the small unit support vehicle is 3 m by 1.2 m by 0.6 m in size and 700 pounds (lb) in weight. Though limited information is available regarding the noise that small unit support vehicles produce, it is expected that they would have a similar sound profile as a Caterpillar tractor driving on the sea ice, which measured at an overall level of 77 dB re 1 µPa under the ice (Richardson et al. 1991). By extension, since Caterpillar tractors have a similar sound profile as the snowmobiles being used for the Proposed Action, it can then be inferred that the small unit support vehicles would produce source levels approximately the same as the snowmobiles. The all-terrain tracked vehicle would be similar in engine size as the snowmobiles and smaller than the small unit support vehicle. With the values for on-ice vehicle noise transmitting through the ice, it is important to remember that noise levels are affected by the ice condition, amount of snow on the ice, and other similar factors (Richardson et al. 1991).

It is not anticipated that on-ice vehicle noise would impact marine habitats, vegetation, invertebrates, or fish, as the transmission of airborne noise through the ice would be limited, coupled with the limited hearing ability of these resources. Similarly, the on-ice vehicle noise propagated through the ice would be low enough (e.g., less than 124 dB re 1 µPa based on Malme et al (1989)) to have no potential to effect marine mammals that are below the sea ice. Therefore, none of these resources are discussed further with respect to on-ice vehicle noise. Additionally, bearded seals would not be located near the ice camp proposed action area during the timeframe of the Proposed Action. Therefore, the impacts of on-ice vehicle noise on bearded seals are not further analyzed. The potential effects from on-ice vehicle noise on marine birds and mammals (both marine and terrestrial) are provided below.

4.1.3.1 Marine Birds

As discussed in Section 3.2.3, those species that would be present in the Study Area during the Proposed Action would be predominantly foraging and migrating. They would not be engaging in activities, such as mating or reproducing, which would require them to remain in any given area for extended periods of time. The analysis of bird responses and effects from aircraft noise (Section 4.1.2.1) is similar to the anticipated potential responses from on-ice vehicle noise.

Noise associated with on-ice vehicles could elicit short-term behavioral or physiological responses, such as alert responses, startle responses, or temporary increases in heart rate. However, because of the short-term and temporary nature of these responses, the general health of an individual bird would not be compromised.

On-ice vehicle noise associated with Alternative 1 would be from snowmobiles only. Noise associated with these vehicles may elicit responses in individual birds potentially migrating through the area. However, individual stress responses do not necessarily result in negative consequences to populations. Due to the limited duration of activities and the small number of birds that are expected to be around the camp on a sustained basis, population-level effects are not anticipated. Therefore, pursuant to the Migratory Bird Treaty Act, on-ice vehicle noise associated with this alternative would not result in a significant adverse effect on bird populations.

Under Alternative 2, small unit support vehicles would be used in addition to snowmobiles. Additionally, the execution of the research activities would require increased use of the snowmobiles within and near the ice camp to move personnel and equipment. Due to the limited number of snowmobiles available and the need to support logistics within the camp, the addition of research activities would only minimally increase snowmobile usage. This increase would be due to a few excursions away from the camp each day to deploy equipment. The increase in activity would slightly increase the potential for birds to be exposed to on-ice vehicle noise. Although an increase in noise would occur under this alternative, reactions of birds would be limited to individuals migrating through the area. Additionally, individual stress responses do not necessarily result in negative consequences to populations. Due to the limited duration of activities and the small number of birds that are expected to be around the camp on a sustained basis, population-level effects are not anticipated. As such, pursuant to the Migratory Bird Treaty Act, on-ice vehicle noise associated with this alternative would not result in significant adverse effects on migratory bird populations.

4.1.3.2 Mammals (Marine and Terrestrial)

Limited information is available on the effects of on-ice vehicle noise on mammals; information available for snowmobile noise is included herein. Since no studies have been conducted on the effects of noise from a small unit support vehicle or an all-terrain tracked vehicle and they emit a similar noise level to the snowmobile, it is expected that mammals would have a similar reaction to the small unit support vehicle and all-terrain tracked vehicles as they would to a snowmobile. Since snowmobiles, small unit support vehicles, and all-terrain tracked vehicles emit sound at a low received level under the ice (up to 124 dB re 1 μPa); no effect to seals from on-ice vehicle noise would occur while they are below the ice. Polar bears swim in open waters; no open water is located near the ice camp proposed action area. Therefore, no under-ice effect to polar bears from on-ice vehicle noise is anticipated.

In a study by Andersen and Aars (2007) in Svalbard, Norway (an area of limited snowmobile traffic), two snowmobiles moved towards polar bears in a straight line at a speed between 30 and 40 km/hr. Snowmobiles would move towards where the polar bear was first seen until there was a flight response. At the time of the response, distances were measured between the snowmobile and the polar bear's original location. An important factor in this study was also the wind direction (which if moving in the direction of the snowmobile would enhance the sound or if blowing away from the snowmobile would reduce the sound). From this study, 20 polar bear reactions and distance of reactions were recorded. Reactions varied from walking away from the snowmobile and lifting its head, to running rapidly away from the snowmobile for an extended period of time. Female polar bears with cubs and medium sized polar bears had reactions at the farthest distances (1,534 m and 1,160 m, respectively) while adult females without cubs and males reacted at much closer distances (164 m and 326 m, respectively). Polar bears in this study were seen running for at least 1 km after disturbance from a snowmobile, and several bears left a ringed seal breathing hole where they were hunting. The snowmobiles in this study, however, were traveling in the direction of the polar bear to determine when the bear would react. During the Proposed Action, on-ice vehicles would not be used to follow a polar bear, and therefore their reactions are expected to be different. Polar bears have also been known to habituate to disturbances from snowmobiles. One female polar bear with a one year old cub stayed within a 50 km^2 area for three weeks despite heavy snowmobile presence. This area was a known, prime hunting habitat which was also inferred to be the reason why the bear tolerated such repeated disturbance (Andersen and Aars 2007; McLaren and Green 1985).

Snowmobiles may be used as a preventive measure to deter polar bears from an area for human safety. This deterrence includes using a snowmobile to patrol the periphery of the camp or by blocking their path with the noise made by the snowmobile. However, once a polar bear turns away from the human activity, the snowmobile would not follow or chase the animal, unless as part of an active deterrence measure for human safety. Since snowmobiles would be travelling mostly within the camp and along a few established routes in and out of the camp, any snowmobile disturbance would be localized.

Few studies are available on the reactions of Arctic foxes to snowmobiles. However, the short-term behavioral and physiological response of other species (e.g., muskoxen [*Ovibos moschatus*], mule deer [*Odocoileus hemionus*], and Svalbard reindeer [*Rangifer tarandus platyhunchus*]) to snowmobiles have been studied (Freddy et al. 1986; McLaren and Green 1985; Tyler 1991). Although individual responses varied, disturbance levels were generally low and no major negative effects from snowmobile disturbance were recorded. Additionally, habituation to snowmobile noise has also been recorded for these species (McLaren and Green 1985) and is expected to be similar for Arctic foxes.

Ringed seals in their subnivean lairs showed variable reactions to snowmobile noise (Burns et al. 1982; Kelly 1988b; Kelly et al. 1986). Some seals stayed within the subnivean lair when snowmobiles were greater than 2.8 km away, while one seal stayed within its lair when a snowmobile passed within 0.5 km (Richardson et al. 1995). Most (if not all) seals returned to their lairs after the sound had ceased. In a study by Green and Johnson (1982), no evidence of a lower ringed seal density existed within approximately 13 km of a highly-trafficked construction site compared to density in the region. However, within a few kilometers, the construction site density of ringed seal holes was lower, which could be attributed to localized displacement. Ringed seals will maintain subnivean lairs near their breathing holes, though some have adapted to moving to a nearby lair in the instance of a predatory threat (Hammill and Smith 1989; Smith et al. 1991). As it is easiest to establish the camp in flat terrain, the location for the ice camp would be selected to avoid smaller pressure ridges and snow drifts, if possible (see Chapter 5). If it is not possible to avoid pressure ridges, any seals with lairs in the vicinity of the ice camp would likely move to a new lair during the gradual establishment of the camp prior to being subject to higher levels of activity once the camp is fully operational. If, after the ice camp is established, a new pressure ridge forms nearby, it is unlikely that a ringed seal would construct a lair in the area near the ice camp. During excursions away from the ice camp (e.g., to deploy research equipment), on-ice vehicles would use the same routes once routes are established. Use of the same route would minimize the number of subnivean lairs potentially exposed to on-ice vehicle noise as the routes would be established with an eye toward avoiding any pressure ridges, and it is not expected that a ringed seal would create a lair in the vicinity of a snowmobile route once the route is established.

On-ice vehicle noise associated with Alternative 1 would be from snowmobiles only. Noise associated with these vehicles under ESA, may affect, but not likely to adversely affect, polar bears and ringed seals. Reactions of marine mammals would remain temporary and within the animal's normal repertoire of behaviors, and would not result in behavioral patterns being significantly altered or abandoned, therefore; on-ice vehicle noise associated with Alternative 1 would not result in incidental takes of marine mammals under the MMPA. However, the Navy has requested a permit for the intentional take of polar bears through the use of various deterrent methods, including vehicle movement (Appendix C), for purposes of human safety.

Under Alternative 2, small unit support vehicles would be used in addition to snowmobiles. Additionally, the execution of the research activities would require increased use of the snowmobiles within and near the ice camp. The increase in activity would increase the potential for marine and terrestrial mammals to be exposed to on-ice vehicle noise. Due to the limited number of snowmobiles available and the need to support logistics within the camp, the addition of research activities would only minimally increase snowmobile usage. This increase would be due to a few excursions away from the camp each day to deploy equipment. As a result, on-ice vehicle noise associated with Alternative 2 under ESA, may affect, but not likely to adversely affect, polar bears and ringed seals. Although an increase in noise would occur under this alternative, reactions of marine mammals would remain temporary and within the animal's normal repertoire of behaviors, and would not result in behavioral patterns being significantly altered or abandoned. Therefore, on-ice vehicle noise associated with Alternative 2 would not result in incidental takes under the MMPA. However, the USFWS issued the Navy a permit for the intentional take of polar bears through the use of various deterrent methods, including vehicle movement (Appendix C), for purposes of human safety.

4.2 Physical Stressors

Physical stressors resulting from the Proposed Action include aircraft strike, on-ice vehicle strike, in-water device strike, in-water vessel and vehicle strike, and human presence.

4.2.1 Aircraft Strike

The potential for aircraft strike is dependent upon the type of aircraft, altitude of flight, and speed of travel. Small, fixed-wing aircraft typically operate at altitudes up to 3,500 m, though most activities would occur below this altitude. Small, fixed-wing aircraft typically travel at speeds of 80–160 knots; large, fixed wing aircraft (C-130 and LC-130) have a maximum speed of

318 knots at an altitude of 6,100 m. Helicopters, by nature, would either be hovering or traveling at speeds up to 150 knots. Unmanned aircraft systems, used in Alternative 2 only, travel at a significantly slower speed than manned aircraft.

Aircraft strike would have the potential to harm marine birds. Other natural and physical resources (such as marine and terrestrial mammals) would not have the potential to be impacted by aircraft strike. Therefore, only an analysis of the potential effects to birds is provided below.

The majority of bird flight is below 914 m and approximately 95 percent of bird flight during migrations occurs below 3,048 m (U.S. Geological Survey 2006). Bird and aircraft encounters are more likely to occur during aircraft takeoffs and landings than when the aircraft is engaged in level, low-altitude flight. In a study of reported bird strikes to civil aircraft from 1990 to 2005, 60 percent of strike occurred below 30.5 m, 74 percent of strike occurred below 150 m, and 92 percent of strike occurred below 610 m (Cleary et al. 2006). Bird strike potential is greatest in foraging or resting areas (which are not present in the Study Area), in migration corridors, and at low altitudes. Since 1981, naval aviators reported 16,550 bird strikes. About 90 percent of wildlife/aircraft collisions involve large birds or large flocks of smaller birds (Federal Aviation Administration 2003), and more than 70 percent involve gulls, waterfowl, or raptors. From 2000 to 2009, the Navy Bird Aircraft Strike Hazard program recorded 5,436 bird strikes with the majority occurring during the fall period from September to November. Though bird strikes can occur anywhere aircraft are operated, Navy data indicate they occur more often over land or close to shore.

Strike of a marine bird by an aircraft associated with the Proposed Action is possible, though not likely. Although marine birds are likely to hear and see approaching aircraft, they cannot avoid all collisions. Birds are known to be attracted to aircraft lights, which can lead to collisions (Gehring et al. 2009; Poot et al. 2008). Those marine bird species that would be found within the Study Area during the Proposed Action typically occur in groups smaller than 20 animals, though they may occasionally be in larger groups in the case of black guillemot (Section 3.2.3.1). In this context, the loss of several or even dozens of birds due to physical strikes would not constitute a population-level impact, as these species would not be gathered in large flocks. Some bird strikes and associated bird mortality or injuries could occur as a result of aircraft use; however, population-level impacts to marine birds would not likely result from aircraft strikes due to the limited duration of aircraft operation, the likely flight response of marine birds to in-air noise and general aerial disturbance, and the fact that marine birds are not likely to approach an aircraft while it is in operation (Mallory 2016).

Marine bird presence in the Study Area during the Proposed Action would be limited to those individuals wintering around the sea ice. As discussed in Section 3.2.3.1, the birds that are expected to be within the Study Area are only those who are year-round residents or non-migrating individuals within a species. Most of these birds are expected to occur singly or in flocks up to 20 individuals, though black guillemot may flock in larger groups due to highly concentrated prey species. Generally, large flocks of marine birds are not anticipated to cross through the Study Area during the timeframe of the Proposed Action; while there is the potential for strike with an aircraft of small numbers of individuals, it is unlikely. As previously described in Section 4.1.2, the increase in aircraft presence due to the Proposed Action would be approximately 10 percent. A temporary increase in daily flights, such as this, would not be expected to result in significantly increased risk to marine birds.

Under Alternative 1, the potential for aircraft strike would be from small, fixed-wing aircraft, large fixed-wing aircraft (e.g., C-130), and helicopters. Although unlikely, aircraft strike with an individual marine bird is possible. However, because the birds are not expected to be traveling in large flocks, and aircraft operations would be limited to a few flights a day over the course of a few weeks, one or more isolated incidents of aircraft strike would not result in a significant adverse effect on migratory bird populations, pursuant to the Migratory Bird Treaty Act.

Under Alternative 2, the number of aircraft flights would increase and the use of unmanned aerial systems and an LC-130 would be added. A couple additional aircraft flights to and from the camp is anticipated each day due to the need to transport personnel and equipment. The unmanned aerial system flights would occur for up to 4 hours per system per day. The increase in activity would increase the potential for birds to be struck by aircraft, but only slightly. Although an increase in potential strike would occur under this alternative, the likelihood remains low and any impacts would be similarly limited to one or a small number of birds. As such, pursuant to the Migratory Bird Treaty Act, aircraft strike associated with this alternative would not result in significant adverse effects on migratory bird populations.

4.2.2 On-Ice Vehicle Strike

During the Proposed Action, four to six snowmobiles would be used for personnel and equipment transport, as well as supporting research activities away from the ice camp. Dependent on the type of equipment and supplies to be transported, the snowmobiles may tow a sled to accommodate the items. Additionally, small unit support vehicles may be used to establish the runway for LC-130 landings. An all-terrain tracked vehicle may be used by expeditionary forces to transport forces to and from the ice camp. Snowmobile excursions away from the ice camp would support various research activities during the height of the Proposed Action (for a period of approximately four weeks). Some excursions away from the ice camp may last up to six hours, while shorter trips would only last one to two hours. Snowmobiles would not be in constant use during these trips; they would transport personnel and equipment to an offsite location (generally up to 5 km without helicopter support) and then stand by until the experiment is complete before returning the personnel to the camp. Additionally, personnel movement on snowmobiles, small unit support vehicles both away from and around camp would only occur during daylight hours, which would reduce the potential for striking an animal.

Lima et al (2015) reviewed the reactions of various animal taxa to oncoming vehicles, and the likelihood of potential strike by the vehicle. In this review, animal-vehicle strike avoidance depends on an animal’s threat assessment capabilities and avoidance response. Vehicles are not perceived as a predatory threat by many animals, but when a collision is immediately forthcoming animals typically will have a flight response to avoid the vehicle, engaging their anti-predator behavior.

On-ice vehicle strike would only have the potential to affect mammals (i.e., polar bears, arctic foxes, and ringed seals) with the exception of the bearded seal. Bearded seals would not be located near the ice camp proposed action area during the timeframe of the Proposed Action. Therefore, the impacts of on-ice vehicle strike on bearded seals are not further analyzed. Marine birds are not expected to be nesting within the Study Area, and therefore would not be situated for long periods of time on the ice floe and available to be struck. Therefore, only an analysis of the potential effects to mammals is provided below.

Snowmobiles produce sound at source levels of 104 dBA re 20 µPa on average (Richardson et al. 1995), though sound would dissipate as it spreads away from the source. At this source level, all mammals in the area are capable of hearing the sound emitted from the snowmobile. Ringed seals would only be on the ice (and therefore susceptible to on-ice vehicle strike) while hauled out. Kelly et al. (1986) tagged ringed seals from Reindeer Island and Kotzebue Sound off the coast of Alaska, in the Beaufort and Chukchi Sea, respectively. The tagged ringed seals spent between 3.5 and 30.8 percent of the time out of the water during the pre-basking period. Time spent out of the water during this period was only spent in lairs and not on the open sea ice. The basking period for the tagged seals started between 15 April and 31 May for the tagged seals. Since the timeframe of the Proposed Action is almost entirely outside of the molting season (when seals spend most of the time hauled out on the sea ice), the likelihood of an on-ice vehicle strike would be exceedingly remote. Additionally, snowmobiles are highly mobile vehicles and would move easily to avoid any mammal spotted nearby (see mitigation measures, Chapter 5), and the risk of collision is further reduced by the mammal's avoidance of any vehicle making noise nearby.

Ringed seal subnivean lairs are concentrated in areas of deep snow and are associated with large, thick ice ridges (Furgal et al. 1996). Although the best conditions for subnivean lairs are in deep snow, the depth of snow where subnivean lairs are built does vary. Lairs that are built in areas with less snow are more susceptible to predation, and if within the Study Area, could be susceptible to disturbance from on-ice vehicles. Since the density of lairs is very low in the Beaufort Sea pack ice, generally less than 0.2 per 1 nm^2 (Burns et al. 1982), and that pressure ridges would be avoided in selecting a camp location (Chapter 5), the potential for an on-ice vehicle to run over and disturb a lair (by altering a structure) is very unlikely. Additionally, pups are not anticipated to be in the vicinity of the ice camp during operations, because any highly sensitive females would not likely whelp within the camp's disturbance zone (whelping is not expected prior to mid-March), and therefore would not need to move newborn pups through the water farther from camp at a time when such movement could affect pup survival. Therefore, ringed seal responses to noise and vibration associated with on-ice vehicles is extremely unlikely to result in significant disruption of feeding or natural behavioral patterns.

Since polar bears spend minimal time in the water and Arctic foxes are a terrestrial species, the probability of encounters with on-ice vehicles are higher than for seals. Both the polar bear and the Arctic fox spend almost all of their time on the ice or on land. Polar bears will swim when open water is available (not expected during the timeframe of the Proposed Action), but most of their time is spent roaming the ice or stalking leads or breathing holes for prey. As stated in Section 4.1.3, all mammals in the area (polar bears, Arctic foxes, and ringed seals) are capable of hearing the snowmobile noise and have shown an avoidance response (running away or moving into the water) when a snowmobile is nearby. Therefore, the potential for a strike between a polar bear or Arctic fox and an on-ice vehicle would be extremely low. Snowmobiles are highly mobile vehicles and could move easily to avoid any mammal spotted nearby, and the risk of collision is also reduced by the mammal's avoidance of any vehicle making noise nearby.

Under Alternative 1, the potential for strike from an on-ice vehicle would be limited to snowmobiles. Because of the potential disruption to ringed seal breathing holes, on-ice vehicle strike associated with Alternative 1 under ESA, may affect, but not likely to adversely affect, ringed seals. Because of their large size (and sightability), and the fact that close contact with polar bears would be avoided for human safety, the potential for on-ice vehicle strike to polar bears is not expected. Therefore under ESA, no effect to polar bears from on-ice vehicle strike under Alternative 1 is anticipated. On-ice vehicle strike would not result in takes of marine mammals.

Under Alternative 2, small unit support vehicles and an all-terrain tracked vehicle may be used in addition to snowmobiles. Additionally, the execution of the research activities would require increased use of the snowmobiles within and near the ice camp. Due to the limited number of snowmobiles available and the need to support logistics within the camp, the addition of research activities would only minimally increase snowmobile usage. This increase would be due to a few excursions away from the camp each day to deploy equipment. The increase in activity would increase the potential for mammals, particularly Arctic fox, to be impacted by on-ice vehicle noise. Similar to Alternative 1 under ESA, on-ice vehicle strike (and potential disturbance to ringed seal breathing holes), may affect, but not likely to adversely affect, ringed seals. Because of their large size (and sightability), and the fact that close contact with polar bears would be avoided for human safety, the potential for on-ice vehicle strike to polar bears is not expected. Therefore under ESA, no effect to polar bears from on-ice vehicle strike under Alternative 2 is anticipated. On-ice vehicle strike would not result in takes of marine mammals.

4.2.3 In-Water Vessel and Vehicle Strike

Submarines would be utilized during the Proposed Action during both Alternatives 1 and 2, and they would typically operate at speeds less than 10 knots. Unmanned underwater vehicles and associated towed arrays also have the potential to result in strike to marine resources (Alternative 2). Unmanned underwater vehicles are slow moving, typically less than 8 knots. Physical disturbance from the use of in-water devices is not expected to result in more than a momentary behavioral response. Any change to an individual animal’s behavior from in-water devices is not expected to result in long-term or population-level effects. Research on animal reactions to submerged submarines and unmanned underwater vehicles has not been conducted; the discussion below is based on potential reactions to boats, which is used as a surrogate for this analysis.

Vessels have the potential to affect invertebrates, fish, or marine mammals by eliciting a behavioral response or causing mortality or serious injury from collisions. It is difficult to differentiate between behavioral responses to vessel sound and visual cues associated with the presence of a vessel (Richardson et al. 1995); thus, it is assumed that both play a role in prompting reactions from animals. Reactions to vessels often include changes in general activity (e.g. from resting or feeding to active avoidance), changes in surfacing-respiration-dive cycles, and changes in speed and direction of movement. Past experiences of the animals with vessels are important in determining the degree and type of response elicited from an animal-vessel encounter. Some species have been noted to tolerate slow-moving vessels within several hundred meters, especially when the vessel is not directed toward the animal and when there are no sudden changes in direction or engine speed (Heide-Jørgensen et al. 2003; Richardson et al. 1995).

In-water vessel and vehicle strike would not affect bottom substrates, as none of the vehicles would be at bottom depth, nor would they affect marine vegetation, marine birds, or terrestrial mammals. Additionally, bearded seals would not be located near the ice camp proposed action area during the timeframe of the Proposed Action. Therefore, the impacts of in-water vessel and vehicle strike on bearded seals are not further analyzed. The potential effects on invertebrates, fish, and marine mammals are provided below.

4.2.3.1 Invertebrates

Vessels and in-water vehicles have the potential to harm marine invertebrates by disturbing the water column or directly striking organisms (Bishop 2008). Vessel movement may result in short-term and localized disturbances to invertebrates, such as zooplankton and cephalopods, utilizing the upper water column. Propeller wash (water displaced by propellers used for propulsion) from vessel and vehicle movement can potentially disturb marine invertebrates in the water column and are a likely cause of zooplankton mortality (Bickel et al. 2011). Since most of the macro-invertebrates within the Study Area are benthic and the Proposed Action takes place within the water column, potential for macro-invertebrate vessel or vehicle strike is extremely low. No measurable effects on invertebrate populations in the water column would occur because the number of organisms exposed to vessel movement would be low relative to total invertebrate biomass.

Under Alternative 1, the potential for vessel strike would be limited to submarines. Although some invertebrates could be disturbed or killed by vessel strike, population level effects are not anticipated because of the few number of individuals potentially impacted relative to the total invertebrate biomass in the region.

Under Alternative 2, the potential for in-water vessel and vehicle strike would be from submarines and unmanned underwater vehicles. Although an increase in potential disturbance and strike would occur from a few additional vehicles operating for up to 12 hours per day over a few weeks, no measureable effect on invertebrate populations would occur because of the few individuals potentially impacted relative to the total invertebrate biomass in the region.

4.2.3.2 Fish

Fish species within the Study Area are distributed throughout the surface, water column, and seafloor. Seafloor species would not come into contact with in-water vessels and vehicles, as the maximum depth that unmanned underwater vehicles would reach is 800 m, while the water depth in the Study Area is 3,000 to 4,000 m. Arctic cod would be exposed to in-water vessels and vehicles, as their distribution within the water column is from the surface to 400 m, as discussed in Section 3.2.4.1.a.

The potential for fish to be struck by in-water vessels or vehicles from the Proposed Action would be extremely low because most fish can detect and avoid vessel and in-water device movements. Fish would not be impacted by any wave produced by a vessel in motion. As a vehicle approaches a fish, the fish could have a behavioral or physiological response (e.g., swimming away and increased heart rate) as the passing vehicle displaces them. Potential harm from exposure to vessels, vehicles, and devices is not expected to result in substantial changes to an individual’s overall behavior patterns, or species fitness and recruitment, and is not expected to result in any harm at the population-level. Any isolated cases of vessels or vehicles striking an individual could injure that individual, impacting its fitness, but not to the extent that there would be harm to the viability of populations based on the small number of vessels involved, the relative short duration of the event (both in a given day and the overall length of ICEX), and fish normal response of avoiding vessels and in-water devices.

Under Alternative 1, the potential for vessel strike would be limited to submarines. The use of submarines may result in short-term and local displacement of fishes in the water column. However, these behavioral reactions are not expected to result in substantial changes to an individual's fitness, or species recruitment, and are not expected to result in any harm at the population-level, for the reasons described above. Isolated cases of vessel strike would potentially injure individuals, but would not result in population-level effects.

Under Alternative 2, the potential for in-water vessel and vehicle strike would be from submarines and the addition of a few unmanned underwater vehicles. Although a slight increase in potential disturbance and strike would occur from the additional vehicles operating for up to 12 hours per day over a few weeks, the effects would be similar to that of Alternative 1 because of the slow-moving nature of these vehicles, the small numbers that would be used, and the short-term duration of their use.

4.2.3.3 Mammals (Marine)

Marine mammals react to vessels in a variety of ways. Some respond by retreating or engaging in antagonistic responses, while other animals ignore the stimulus altogether (Terhune and Verboom 1999; Watkins 1986). The size of a vessel and speed of travel may affect the likelihood of a collision. Reviews of stranding and collision records indicate that larger surface ships (80 m or larger) and ships traveling at or above 14 knots have a much higher instance of collisions with marine mammals that result in mortality or serious injury (Laist et al. 2001). Depths at which submarines and unmanned underwater vehicles would operate would overlap with known dive depths of ringed seals, which have been recorded to 300 m in depth (Gjertz et al. 2000; Lydersen 1991). For most of the training and testing activities during the Proposed Action vessel and vehicle speeds would not typically exceed 10 knots during the time spent within the Study Area, which would greatly lessen the likelihood of collisions with marine mammals. Submarines and unmanned underwater vehicles are not expected to elicit an anti-predator response in a ringed seal. The only predator that would be in the Study Area during the Proposed Action would be the polar bear. Since the Proposed Action would be in an area where there are no gaps or leads in the ice, polar bears would not be swimming within the water column. Submarines are much larger than the natural predators to the ringed seal, and it would not be likely that a submarine would be mistaken for polar bear and cause a ringed seal to have an anti-predator response. Although unmanned underwater vehicles are much smaller than a submarine (and are closer in size to a polar bear, or smaller), the movement patterns of these vehicles would not resemble the swimming pattern of a polar bear, and therefore would not likely result in an anti-predator reaction.

Few authors have specifically described the responses of pinnipeds to vessels, and most of the available information on reactions to boats concerns pinnipeds hauled out on land or ice. No information is available on potential responses to underwater vehicles. Brueggeman et al. (1992) stated ringed seals hauled out on the ice showed short-term escape reactions when they were within 0.25–0.5 km from a vessel. A review of seal stranding data from Alaska found that during 2014, 13 bearded seal and 10 ringed seal strandings were recorded by the Alaska Marine Mammal Stranding Network. Within the Arctic region of Alaska, 13 bearded seal and 6 ringed seal strandings were recorded. Of the 23 strandings reported in Alaska (all regions included), none were found to be caused by vessel collisions (Savage 2014).

The chance of a vessel or in-water vehicle striking a polar bear is negligible. Polar bears, at the time of year during which the Proposed Action would occur, are found on the ice stalking breathing holes, or within their maternal dens, and are not expected to be in the water column. Therefore, no potential exists for a polar bear to be struck by a vessel or in-water vehicle.

Under Alternative 1, the potential for vessel strike would be limited to submarines. Although unlikely, ringed seals could be exposed to in-water vessel strike. Movement of submarines would likely elicit a response to avoid the vessel, which may affect, but not likely to adversely affect, ringed seals under ESA. Because polar bears would not be within the water column in the vicinity of the Study Area during the Proposed Action, in-water vessel strike to polar bears is not expected. Therefore under ESA, there would be no effect to polar bears from in-water vessel strike. In-water vessel strike would not result in takes of marine mammals.

Under Alternative 2, the potential for in-water vessel and vehicle strike would be from submarines and unmanned underwater vehicles. The slight increase in activity of a few additional vehicles operating for up to 12 hours per day over a few weeks would increase the potential for ringed seals to be exposed to vessel and vehicle movement. Similar to Alternative 1, in-water vessel and vehicle strike under ESA may affect, but not likely to adversely affect, ringed seals. Because polar bears would not be within the water column in the vicinity of the Study Area during the Proposed Action, in-water vessel and vehicle strike to polar bears is not expected. Therefore under ESA, there is no effect to polar bears from in-water vessel and vehicle strike under Alternative 2 is anticipated. In-water vessel and vehicle strike would not result in takes of marine mammals.

4.2.4 Human Presence

The ice camp would consist of a dining facility, berthing units, a runway, and heliport (Figure 2-2). Throughout the Proposed Action only essential personnel would be present at the ice camp since the Proposed Action is focused on having a small footprint on the physical and biological environment. All waste other than graywater and reverse osmosis reject water would either be removed at the end of the exercise by hauling it back to land for proper disposal. In addition to the ice camp, various personnel/equipment proficiency activities introduce additional potential human stressors, including adjacent berthing areas, human presence under water, submarine surfacings, and the potential for air-dropping equipment from military aircraft. Air-drop of equipment includes the use of a parachute and extensive packing material to slow the speed of the package and reduce the likelihood of damage to the equipment from impact.

The predominant stressor that could impact marine habitats during the Proposed Action is the ice camp, from which up to 2,925 gallons of graywater and 8,064 gallons of reject water from the reverse osmosis system could be discharged. Though solid debris would be removed from this water before it is released into the Beaufort Sea, water would contain some food particles smaller than 0.16 cm (the size of the mesh screen to capture solid food debris) as well as dishwashing detergent and hand soap. The need for washing dishes would be minimal since a tray ration heater would be used for the majority of food preparation. The heater would use approximately 20 gallons of heated potable water per meal. Since the food would never come in direct contact with the water it would be reused multiple times before replacement. Ration packaging and utensils would be disposed of in the ice camp’s solid waste containers. This detergent and hand soap would meet the U.S. Environmental Protection Agency’s Safer Choices standards. Safer Choice standards include, but are not limited to the following requirements: (1) products must not contain chemicals included on the Toxics Release Inventory chemical list, (2) products must not be categorized as an irritant under the Office of Pesticide Program, (3) product pH must be greater than or equal to 4 and less than or equal to 9.5, (5) products cannot contain chemicals listed as carcinogens, mutagens, or reproductive or developmental toxicants, and (6) products must not contain toxic elements such as heavy metals. Dish soap used during the Proposed Action, therefore would be biodegradable and chlorine- and phosphate-free. While graywater would be discharged in the Beaufort Sea, it would dissipate quickly due to the surrounding currents. The Navy has obtained a National Pollutant Discharge Elimination System permit, from the U.S. Environmental Protection Agency, for the discharge of graywater and reverse osmosis reject water to the Beaufort Sea.

The potential air-drop of equipment and material poses some potential risk, particularly from the drop of fuel drums. Fuel may be dropped in bundles of five 55-gallon drums from a military cargo aircraft (e.g., C-130 or C-17). Military aircrews are highly trained in this activity and routinely drop equipment and supplies, including fuel, in expeditionary environments across the globe (including environments similar to the Arctic such as Greenland and Antarctica) without incident. The air drop bundles are made of several layers of a plywood structure with honeycomb insulation protecting the drums. Although ruptured fuel drums are rare during air-drop operations, the potential risk does exist. Therefore, air-drop of material would occur only after initial construction of the camp has begun and personnel are available to respond to any potential rupture with proper spill containment procedures. Risks associated with the air-drop of equipment include direct strike on an animal, and the potential rupture of fuel drums in the event a parachute does not open.

Although all of the research activities have some sort of human involvement, only those activities that directly include humans in the activity (e.g., paratroopers and divers) are analyzed herein. Personnel operating unmanned vehicles, for example, would have such negligible impacts (e.g., operating the vehicle from a control room) that they are not discussed further.

Additionally, submarine surfacing occur under Alternative 1. The opening and closing of ice leads is a natural occurrence in the Beaufort Sea due to ocean currents causing ice to shift. Leads opened due to submarine surfacing would refreeze, or close when the ice floe shifts, and would therefore be temporary. Submarine surfacing would occur in either already open leads, or areas of thin ice without pressure ridges, where ringed seals construct lairs. Because submarine surfacing would have a negligible effect on marine habitat, it is not discussed further.

Human presence has the potential to affect marine habitats (e.g., water quality), marine vegetation, and Essential Fish Habitat through the discharge of graywater and reverse osmosis reject water, and mammals through disturbance or displacement by humans. Bearded seals would not be located near the ice camp proposed action area during the course of the exercise. Therefore, the impacts of human presence on bearded seals are not further analyzed. Since there would be no effect to invertebrates, birds, and fish from human presence, these resources are not discussed further.

4.2.4.1 Marine Habitats (Water Quality)

Potential harm to marine habitats from human presence would be from the graywater and reverse osmosis reject water discharges, which would be similar under both Action Alternatives. Though there would be a limited number of people at the ice camp under either Action Alternative, Alternative 1 may use slightly less water due to some decreases in personnel; however, since many essential staff serve more than one purpose, the reduction in people, and therefore water usage, between both action alternatives would be negligible.

The information available on the potential effects from graywater discharge on the environment includes more sources of graywater than only a galley sink. Most analyses, for example, also include the discharge from showers and laundry facilities, neither of which would be present during the Proposed Action. Graywater can contain highly biodegradable organics, oil and grease, and detergent residuals (U.S. Environmental Protection Agency 1999). The constituents that food waste would contribute to graywater include oxygen demand (biochemical oxygen demand and chemical oxygen demand), nutrients, and oil and grease. The U.S. Environmental Protection Agency has calculated weighted averages for contaminant concentrations in graywater that includes shower and laundry facilities. The contaminants include biochemical oxygen demand contributions of 1,097.8 milligrams per gallon (mg/gallon), oil and grease contributions of 620.8 mg/gallon, phosphate contributions of 23.5 mg/gallon, nitrate contributions of 12.11 mg/gallon, and ammonia contributions of 387.25 mg/gallon (U.S. Environmental Protection Agency 1999). The graywater discharged from the ice camp, however, would result in much fewer contaminants, as shower and laundry facilities are not available. These parameters would be expected to cause localized water quality effects, but these would be acute and temporary, and would therefore not make any significant impacts to the overall water quality of the Study Area.

As demonstrated in Section 3.1.2, currents in the Arctic would lead to a fairly rapid mixing of graywater and reverse osmosis reject water into the environment, diluting the contaminants and high salinity water into the environment relatively quickly.

The reject water from the reverse osmosis unit would contain all of the salt from the input stream, but with less water to dilute it. The reverse osmosis unit is expected to function at 33 percent efficiency (33 percent of the input stream would be returned as potable water) based on specifications for the unit; the resulting reject water would have a salinity three times that of the input. With a higher salinity, this water would be denser than the Beaufort Sea surface waters to which it would be added, and therefore would sink into the deep ocean waters. Though the rejected water would be warmer than that of the surrounding ocean, the higher temperature would not alter the trajectory of the sinking dense reject water. Assuming the reverse osmosis unit works as expected, a maximum capacity of 288 gallons per day would be rejected into the Beaufort Sea; the total amount of reject water over the course of ICEX would be 8,064 gallons. The rejection of this high salinity water would have minimal impacts on the overall environment since it is such a miniscule percentage of the overall Beaufort Sea waters. As this dense water reaches the deep bottom layers of the Beaufort Sea, it would become part of the deep sea currents and would disperse throughout the environment (Rainville et al. 2011; Thurman and Trujillo 1997). Because of the currents in the Beaufort Sea and the limited amount of discharge, the localized increase in salinity would be short-term, temporary, and would not result in harm to water quality.

Human presence resulting from both Alternatives 1 and 2 would result in the discharge of graywater and reverse osmosis reject water to the water column, and creation of leads from submarine surfacing. The short duration and relatively small release of gray water, however, would not have negative impacts on water quality of the Beaufort Sea.

4.2.4.2 Marine Vegetation

Depending on local conditions, the productivity of marine ecosystems may be limited by the amount of phosphorus available or, more often, by the amount of nitrogen available (Anderson et al. 2002; Cloern 2001). Too much of either can lead to a harmful condition known as eutrophication. When excess nutrients are discharged into the environment and are consumed, the algae population will increase and then die off and the remains are consumed by bacteria. Bacterial consumption can cause dissolved oxygen in the water to decrease (Boesch et al. 1997). However, the use of the Environmental Protection Agency’s Safer Choices dish detergent and hand soap, which is free of chlorine and phosphates, would limit the amount of nutrients entering the Beaufort Sea, lessening the potential for eutrophication to occur. Graywater would be discharged at a maximum rate of 155 gallons per day, and would immediately be picked up by under-ice currents, and therefore contaminants would not concentrate enough to allow for the eutrophication process to occur.

Human presence resulting from both Alternatives 1 and 2 would result in the discharge in graywater and reverse osmosis reject water to the water column. Although excess nutrients could result in a localized and temporary bloom of phytoplankton, it would not be to an extent that results in a decline of dissolved oxygen in the water column within the extent of the Study Area given the short duration of the Proposed Action and relatively small release.

4.2.4.3 Essential Fish Habitat

The only potential impact to Essential Fish Habitat from human presence would be from the graywater and reverse osmosis reject water discharges, which would be the same under both Action Alternatives.

The discharge of soapy dishwater and small food particles could cause acute, localized harm to water quality (see Section 4.2.4.1). Small releases would occur on a daily basis, primarily around meal times, with approximately 2,925 gallons of graywater released over the course of the Proposed Action. Graywater can contain highly biodegradable organics, oil and grease, and detergent residuals (U.S. Environmental Protection Agency 1999). The temporary and localized increase in nutrients could result in an increase in phytoplankton in the immediate vicinity of the ice camp. When excess nutrients are discharged into the environment and are consumed, the algae population will increase and then die off and the remains are consumed by bacteria. Bacterial consumption can cause dissolved oxygen in the water to decrease (Boesch et al. 1997). However, current velocity in the Beaufort Sea under the ice is typically between 0 and 10 centimeters/second (O’Brien et al. 2013), which would cause mixing and prevent the accumulation of nutrients. Although a minor increase in nutrients would occur in the immediate vicinity of the discharge pipe during the time of the discharge, it would not result in an increase in harmful algal blooms that could deprive Arctic cod and other organisms of oxygen within the Essential Fish Habitat. The likelihood of the formation of algal blooms is further reduced by the nature of the cold waters of the Arctic which would limit algal growth. Degradation of the water quality of the Study Area is especially unlikely, given the use of phosphate-free dish detergent and hand soap, as well as the relatively small amount of graywater flowing from the discharge outlet compared to the large Essential Fish Habitat area in consideration. Additionally, the use of the tray ration heater would reduce the amount of dishwashing needed at the ice camp, since meals will be heated in the tray ration heater and the ration packaging and utensils would be disposed of in the camp’s solid waste containers.

The reject water from the reverse osmosis unit would contain all of the salt from the input stream, but with less water to dilute it. Because of the currents in the Beaufort Sea and the limited amount of discharge, the localized increase in salinity would be temporary and would not result in secondary impacts to Arctic cod. Harm from the reverse osmosis discharge to the quality of the marine environment has been previously discussed in Section 4.2.4.1.

Human presence resulting from both Alternatives 1 and 2 would result in the discharge in graywater and reverse osmosis reject water to the water column. This discharge would result in a localized and temporary increase in oxygen demand, nutrients, and oil and grease. The short duration and relatively small release, however, would not have negative impacts on Essential Fish Habitat.

4.2.4.4 Mammals (Marine and Terrestrial)

All marine and terrestrial mammals that could occur within the vicinity of the ice camp could be behaviorally affected by the activities of setting up and dismantling the camp, and the human presence at the ice camp. Ringed seals within subnivean lairs or hauled out on the ice could be displaced if they are in the vicinity of the ice camp. Also, polar bears and Arctic foxes would either be drawn to the human presence (e.g., food scraps, and curiosity of humans and objects), or would avoid the area completely, due to noise and general disruption of the area.

The essential features associated with what was previously proposed as ringed seal critical habitat that could be affected by the Proposed Action are sea ice (effects from ice camp construction and air-drop of equipment and materials) and primary prey resources (effects from graywater discharge on fish). Two types of sea ice are important to ringed seals: sea ice habitat suitable for the formation and maintenance of subnivean birth lairs used for sheltering pups during whelping and nursing, and sea ice habitat suitable as a platform for basking and molting. Since ringed seals will not be basking or molting at the time of year ICEX is occurring, only sea ice suitable for the formation of subnivean lairs is analyzed for potential harm.

The construction of the ice camp and subsequent conduct of submarine training and testing and research activities requires the boring or melting of holes through the ice to deploy equipment. The ice camp would be constructed in an area without open leads or cracks, as well as away from pressure ridges where subnivean lairs would most likely occur. Although small areas of sea ice would be disturbed, the Proposed Action would not result in large-scale or long-term modification of sea ice that would be suitable for the formation and maintenance of subnivean lairs.

The U.S. Geological Survey has cataloged polar bear den locations in the Beaufort Sea and from the past surveys there was one den identified within the Study Area (Figure 3-1). Additional dens near or within the Study Area could occur since ice and snow varies from year to year within the Arctic. Polar bear dens on ice occur along pressure ridges (which are avoided as a location for establishing the ice camp). Pregnant bears typically enter dens in November, and generally emerge from dens between the end of March and the beginning April in the Beaufort Sea (Amstrup and Gardner 1994). Reactions of female polar bears to nearby disturbance have varied; responses to aircraft and on-ice vehicle noise are provided in Sections 4.1.1 and 4.1.2, respectively. The reactions of three bears after exposure to oil field operations have been described by Amstrup (1993). In each of these instances, no behavioral response (e.g., den abandonment) was observed as a result of the continuous noise from vehicle traffic, human activity, and associated noises. In one instance, a heavily used ice road passed within 400 m in front of a den, with the bear tolerating the nearness of the activity (Amstrup 1993). The presence of the ice camp is not likely to result in abandonment of a den by a polar bear; noise and vibrations from human activity would likely be greatly attenuated by snow and ice, such that a polar bear may not feel any vibrations from the activity (Blix and Lentfer 1992). The establishment of the ice camp would not require heavy construction activities; the majority of the shelters are tents, with only a few wooden structures requiring on-ice construction. Construction activities would occur only during the first few days of camp. Similarly, demobilization would not require heavy demolition, as the tents are portable and relatively easily packed up and removed. The Proposed Action would occur near the end of the denning season and away from any pressure ridges in the ice; as such, any disturbance would likely be far enough away from a den as to be unlikely to result in abandonment of the den.

Polar bears and Arctic foxes are known to be attracted to human trash (Pamperin 2008), and may be attracted to the ice camp in search of an easy food source. Polar bears have also shown high plasticity in their diet and would exploit abundant resources within their range (Clarkson and Stirling 1994; Gormezano and Rockwell 2013a, 2013b). Polar bears are also curious and have been observed investigating unfamiliar objects and smells (Stirling 1988), which has led to polar bears ingesting trash and hazardous materials including plastic, styrofoam, lead car battery, anti-freeze, and rhodamine B used as a runway marker (Amstrup 1989; Derocher and Stirling 1991; Lunn and Stirling 1985; Russell 1975). Since most cooking, storing, and consumption of food would be within the structures of the camp it would minimize the distance from which Arctic foxes and polar bears could smell the food. The only food scraps that would not be contained within the camp and removed at the end of the Proposed Action are food scraps that are less than 1/16 in (0.16 cm) which would be discarded with the graywater. Since graywater would be discharged underneath the ice, polar bears would not come in direct contact with the discharge, as they are expected to remain on the ice, not swimming beneath it, during this timeframe of the Proposed Action. All hazardous materials would be stored within buildings at the ice camp and therefore would not be encountered by polar bears or Arctic foxes.

All air-drop of materials would include the use of a parachute to stabilize the fall and slow the load so that it impacts the ice with minimal force. Equipment and material that may be air-dropped to the camp includes shelters, food, vehicles, and fuel. Two potential effects could occur from the air-drop of material: direct strike to a mammal from the dropped equipment, and rupture of the load (e.g., fuel or other material) during impact. The air-drop of equipment would occur in close proximity to the ice camp, as transporting the material to the camp from long distances would be logistically infeasible. As the ice camp site would be selected to avoid open leads and cracks in the ice, as well as pressure ridges (which would inhibit runway construction), and due to the large size of polar bears home ranges (average 149,000 km^2) (Amstrup et al. 2000) the likelihood of a polar bear occurring in the vicinity of the ice camp would be low, and the likelihood of air-dropped equipment and material landing on a polar bear even lower.

Additionally, the implementation of standard operating procedures requires that the drop location would be visually cleared of any obstructions prior to release. The drop location would also be visually cleared of any animals located on the ice prior to release, reducing the potential for direct strike. The second potential effect would be from the rupture of a load (e.g., fuel drums or other material) upon impact with the ice. Assuming a worst case scenario occurs in that a parachute fails to open for a load of fuel (five 55-gallon drums), the potential for 275 gallons of fuel to be released to the ice could occur. The likelihood of this occurring is extremely remote;

the military frequently drops equipment and material (including fuel) to support operations and humanitarian aid and, although ruptures have occurred, they are very infrequent. Even in the case of a parachute failure, typically only one or two barrels would be dented or ruptured. In the event of a fuel drum rupture, personnel would be standing by with applicable spill control measures and spill kits (e.g., absorbent materials) to remove or contain spilled fuel from the ice floe. All snow and ice cover that would become contaminated by fuel spill would be collected and removed from the ice floe to the greatest extent possible. All personnel would have oil spill response training, and oil spill response and reporting procedures would be followed. In addition to a rupture from air-dropped fuel, refueling activities at the camp (e.g., for snowmobiles and generators) could result in small spills. The majority of refueling operations would be conducted within secondary containment, thus greatly reducing the likelihood that a mammal would encounter these spills. The landing zone would be visually cleared prior to the air drop or refueling, this would ensure that a polar bear, ringed seal, or Arctic fox would not likely be on the ice floe in the area of a potential spill.

Reports of hauled out ringed seals (during late spring) indicate that they may avoid human presence at distances greater than 200 m (Smith and Hammill 1981). In these instances, the seals returned to the water from their haul-out position, based on apparently smelling the human observer. The construction of the ice camp and associated human presence could potentially cause ringed seals to leave an established lair or breathing hole. However, as discussed above, ringed seals typically build several lairs and breathing holes, are assumed to be readily able to move to another lair or breathing hole (Kelly 1988b) within its home range, and areas near pressure ridges where ringed seals might build lairs would be avoided when selecting a camp location.

Ringed seals create subnivean lairs within the large snow drifts on the ice in the Beaufort Sea. Snow depths of at least 50–65 cm are required for functional birth lairs (Kelly 1988a; Lydersen 1998; Lydersen and Gjertz 1986; Smith and Stirling 1975), and such depths typically are found only where 20–30 cm or more of snow has accumulated on flat ice and then drifted along pressure ridges or ice hummocks (Hammill 2008; Lydersen et al. 1990; Lydersen and Ryg 1991; Smith and Lydersen 1991). As previously discussed, the ice camp location would be selected, in part, to avoid areas near pressure ridges where ringed seals may build their subnivean lairs. If the ice camp were near a subnivean lair or breathing hole, it could cause ringed seals to evacuate the lair or leave their breathing hole. Although ringed seals may abandon their subnivean lair or breathing hole, the population effect would most likely be minor since ringed seals are assumed to be readily able to move to different areas under the ice (Kelly 1988b). Ringed seals have a strong fidelity to under-ice home ranges; disturbance in the area around one breathing hole may result in ringed seals needing to expend more energy to arrive at other breathing holes in the area (Kelly et al. 2010a). Although some abandonment from breathing holes or subnivean lairs could occur, a large part of the ringed seal population is found closer inland and in the Bering Sea during this time of year (Allen and Angliss 2013).

Human presence could potentially affect marine mammals within the water column during diving evolutions as part of the research objectives to measure personnel and equipment proficiency. Few divers would be in the water at any given time; diving activities would occur over a couple of weeks, with various personnel and equipment tested during this time. Data are not available on ringed seal reactions to humans in water; however, they would likely exhibit an avoidance response to the perceived predatory threat. This could result in a very short-term and localized behavioral response by marine mammals in the immediate area of the diving activity.

In determining the potential effects of the graywater discharge, Navy analyzed research on currents and gyres. Plueddemann et al. (1998) used an Ice-Ocean Environmental Buoy frozen into Arctic pack ice approximately 241 km north of Prudhoe Bay, Alaska, to obtain long-term measurements of meteorological and oceanographic variables in the Arctic. This buoy travelled within the vicinity of the Study Area for the first few months prior to moving into the Chukchi Sea. This study concluded that the ice drift within the Beaufort Gyre ranged from approximately 1 to 5 cm/s (Plueddemann et al. 1998). Ice Ocean Environmental Buoy deployment within the Beaufort Gyre has also been used to study various physical properties of Arctic eddies. A recent study by O'Brien et al (2013) used moorings with sequential sediment traps to study downward sediment flux in the Canada Basin. These sediment traps measured water current speed at multiple depths, finding that from the surface to 83 m, velocities were typically between 0 and 10 cm/s, though could increase to 40 cm/s in the event of encounter with an eddy.

Direct effects from the graywater discharge on ringed seals are unlikely, as the potential for a ringed seal to be in the vicinity of the discharge pipe during graywater discharged is minimal, given the propensity for ringed seals to avoid human presence and the location of the discharge near the center of the ice camp (rather than on the periphery or away from the camp) (Smith and Hammill 1981). However, the discharge of graywater may cause minor secondary effects to the surrounding water and therefore potentially prey species. Effects to the surrounding water are discussed in Section 4.2.4.1, and the effects to prey species are discussed in Section 4.2.4.3. The most likely potential effects to proposed critical habitat would be from the graywater and reverse osmosis reject water discharges and potential effects to primary prey resources. As discussed above for secondary effects to ringed seals, the graywater discharge would result in minor and temporary increases in nutrients in the immediate vicinity of the discharge location. Similarly, the reject water would result in minor and temporary increases in salinity and temperature in the immediate vicinity of the discharge location. However, currents within the Beaufort Sea would rapidly disperse the discharges, eliminating the possibility of eutrophication. An increase in nutrients from the graywater discharge would not result in potentially harmful algal blooms. Because of the currents in the Beaufort Sea and the limited amount of discharge, the localized increase in nutrients and salinity would not result in damaging algal blooms that could deprive fish (including cod, a primary prey of the ringed seal) and other organisms of oxygen. Therefore, prey availability would not be reduced.

Under Alternative 1, human presence would be limited to the ice camp and its associated graywater discharge. Ringed seals could be disturbed by the establishment of the ice camp; therefore, under ESA, Alternative 1 may affect, but not likely to adversely affect, ringed seals. Polar bears may be attracted to the ice camp due to food smells and the novelty of the human presence. As such under ESA, Alternative 1 may affect, but not likely to adversely affect, polar bears. Any effects to marine mammals (ringed seals, and polar bears) would be minimal and temporary (where behavioral patterns would not be significantly altered or abandoned), and therefore would not result in takes of marine mammals.

Under Alternative 2, human presence includes both the ice camp as well as diver activities in the water column. The addition of the personnel and equipment proficiency research activities would be minor given the low likelihood that a seal would come in contact with a human in the water. Even if an encounter were to occur, any behavioral response by the seal would be short-term and minor. Potential effects associated with the ice camp under Alternative 2 would be the same as Alternative 1. Therefore under ESA, human presence may affect, but not likely to adversely affect, ringed seals and polar bears. Any effects to marine mammals (ringed seals, and polar bears) would be minimal and short-term, and would not result in takes of marine mammals.

4.3 EXPENDED MATERIALS

The expended material stressors include bottom disturbance, entanglement, and ingestion.

4.3.1 Bottom Disturbance

During activities in the Study Area, various items would be expended into the marine environment, which, in the Study Area, has been determined to be soft bottom (Section 3.1.1). These expended materials have the potential to strike a resource once they sink to the seafloor and settle in the bottom substrate. Expended materials that are expected to sink to the seafloor include wooden posts, radiosondes deployed by weather balloons, expended buoys and radio-frequency tags, hydrophones and Expendable Mobile Anti-Submarine Warfare Training Targets (EMATTs). The footprint of the largest items (buoys) is approximately 0.8 square meters.

Forty weather balloons made of latex or Kevlar would be used during the Proposed Action, with two balloons released per day for twenty days. These weather balloons would have radiosondes suspended 25–35 m below them, and would be used for weather and atmospheric data collection purposes. These balloons would eventually burst, and the radiosondes and balloon fragments would fall to the ocean surface and eventually sink, or, if they land on the ice, would sink once the ice melts and the materials are released into the water. Weather balloons can travel up to 300 km from the area of deployment depending on meteorological conditions, and would have a diameter of 6–8 m at full inflation before bursting (National Oceanographic and Atmospheric Administration 2009).

Bottom disturbance is not expected to affect marine vegetation, birds, Essential Fish Habitat, or mammals as they do not inhabit the seafloor. Therefore, they would not be further discussed. The potential effects on marine habitats (bottom substrate), invertebrates, and fish are provided below.

4.3.1.1 Marine Habitat (Bottom substrate)

In general, three things happen to expended materials that come to rest on the ocean floor: (1) they lodge in sediment where there is little or no oxygen, usually below 10 cm, (2) they remain on the ocean floor and begin to react with seawater, or (3) they remain on the ocean floor and become encrusted by marine organisms. As a result, rates of deterioration depend on the material and the conditions in the immediate marine and benthic environment. If buried deep in ocean sediments, materials tend to decompose at much lower rates than when exposed to seawater (Ankley et al. 1996). In those situations where metals are exposed to seawater, they begin to slowly corrode, a process that creates a layer of corroded material between the seawater and uncorroded metal. This layer of corrosion removes the metal from direct exposure to the corrosiveness of seawater, a process that further slows movement of the metals into the adjacent sediment and water column. Any elevated levels of metals in sediment would be restricted to a small zone around the metal, and any release to the overlying water column would be diluted. In a similar fashion, as materials become covered by marine life, the direct exposure of the material to seawater decreases and the rate of corrosion decreases (Little and Ray 2002). Dispersal of these materials in the water column is controlled by physical mixing and diffusion, both of which tend to vary with time and location. The disturbance of bottom sediments by objects settling onto the seafloor could result in temporary and localized increases in turbidity that would quickly dissipate.

As the radiosondes and parachutes pull the balloon fragments to the seafloor, they too would be degraded over time. Marine microbes and fungi are known to degrade biologically produced polyesters, such as polyhydroxyalkanoates, a bacterial carbon and energy source (Doi et al. 1992). Marine microbes also degrade other synthetic polymers, although at slower rates (Shah et al. 2008).

Large-scale processes control sediment composition in the deep sea, so it tends to be uniform over hundreds of square miles. At the spatial scale at which most individual organisms experience their environment (millimeters to meters), the seafloor is made heterogeneous (Thistle 2003). The instances of bottom disturbance during the Proposed Action would be minimal, due to the few items expended over the large region of the Study Area or beyond the Study Area boundaries in the Beaufort Gyre, if these materials are picked up by the surface water currents and moved. Weather balloons may be expended beyond the Study Area boundaries if carried far enough by upper atmosphere air currents.

Under Alternative 1, bottom disturbance would occur only from expended buoys (geographic positioning system buoys used to locate the ice floe). Under this alternative, the amount of expended material would be minimal, due to the small number (five) of buoys.

Under Alternative 2, additional materials would be expended, including wooden posts, EMATTs, radiosondes, buoys, and radiofrequency tags (approximately 60 items total). Although the additional materials would result in a slightly increased risk of bottom disturbance, the overall harm would be minimal due to the large size of the area and the small number of items expended.

4.3.1.2 Invertebrates

Effects to invertebrates from bottom disturbance would be either from the temporary and localized disturbance of the sediment or the bottom habitat changing from a soft bottom habitat to hard bottom from the expended material. Expended material that would eventually sink may cause disturbance, injury, or mortality within the footprint of the device, may disturb marine invertebrates outside the footprint of the device, and would cause temporary local increases in turbidity near the ocean bottom. The largest footprint of any expended material is approximately 0.8 square meters, though most of the materials are much smaller. As most of these objects (e.g., buoys) would float within the ice for up to two years prior to degrading and sinking, it is highly unlikely that multiple items would be co-located on the seafloor. The overall footprint of the expended materials is minor compared to the size of the Study Area. The sediment disturbance would be temporary causing increased turbidity in the water locally. Objects that sink to the seafloor may attract invertebrates, or provide temporary attachment points for invertebrates. In the immediate area where the expended material settled the bottom type would change from soft to hard substrate and may displace any invertebrates requiring soft bottom habitat. This may also attract invertebrates that attach to hard bottom substrate.

Under Alternative 1, bottom disturbance would occur only from expended buoys (geographic positioning system buoys used to locate the ice floe). Under this alternative, the amount of expended material would be minimal, due to the small number (five) of buoys.

Under Alternative 2, additional materials would be expended, including wooden posts, EMATTs, radiosondes, buoys, and radiofrequency tags (approximately 70 items total). Although the additional materials would result in a slightly increased risk of bottom disturbance, the overall effect would be minimal due to the large size of the area and the small number of items expended.

4.3.1.3 Fish

Items on the seafloor may attract benthic fish, including fish of the Orders Scorpaeniformes and Perciformes, but their sensory abilities allow them to avoid colliding with expended materials (Bleckmann and Zelick 2009). Those materials expended by the Proposed Action would fall to the seafloor in a manner dictated by ocean currents, but would be unlikely to do so nearby each other. Since fish are able to sense and avoid materials within their path, and expended materials would be drifting with the currents, rather than being self-propelled, it is highly unlikely that a fish would collide with a piece of expended material either while it is sinking to the ocean floor or once it is on the ocean floor.

Under Alternative 1, bottom disturbance would occur only from expended buoys (geographic positioning system buoys used to locate the ice floe). Under this alternative, the amount of expended material would be minimal, due to the small number (five) of buoys. The disturbance would be localized and temporary as the buoys hit the seafloor, which may cause scatter behavior in fish.

Under Alternative 2, additional materials would be expended, including wooden posts, EMATTs, radiosondes, buoys, and radiofrequency tags (approximately 60 items total). Although the additional materials would result in a slightly increased risk of bottom disturbance, the overall effects would be minimal due to the large size of the area and the small number of items expended.

4.3.2 Combustive Byproducts

Chemicals that could be released from exercise torpedoes as a result of the Proposed Action are Otto Fuel II and combustion byproducts. Properly functioning torpedo runs combust most of their propellants, leaving benign or readily diluted soluble combustion byproducts. Otto Fuel II is composed of propylene glycol dinitrate and nitro-diphenylamine (76 percent), dibutyl sebacate (23 percent) and 2-nitrodiphenylamine as a stabilizer (2 percent). Combustion byproducts of Otto Fuel II include nitrous oxides, carbon monoxide, carbon dioxide, hydrogen, nitrogen, methane, ammonia, and hydrogen cyanide. During normal venting of excess pressure, the following are discharged: carbon dioxide, water, hydrogen, nitrogen, carbon monoxide, methane, ammonia, hydrochloric acid, hydrogen cyanide, formaldehyde, potassium chloride, ferrous oxide, potassium hydroxide, and potassium carbonate (U.S. Department of the Navy 1996, 1997).

Hydrogen cyanide would be the constituent of most concern because initial concentrations following a torpedo run would be above EPA discharge recommendations for marine waters (3.785 μg/gal) (U.S. Environmental Protection Agency 2006). Other combustion byproducts from Otto Fuel II released into the ocean would dissolve, dissociate, or be dispersed and diluted into the water column. However, hydrogen cyanide is extremely soluble in seawater and would rapidly be diluted to levels below 3.785 μg/gal (within a distance of 5.4 m from the center of the torpedo’s path when first discharged). The Navy has determined that five types of common marine bacteria (*Pseudomonas, Flavobacterium, Vibrio, Achromobacte*r, and *Arthrobacter*) attack and ultimately process Otto Fuel II, thereby removing trace amounts that may remain (Drzyzga and Blotevogel 1997; Powell et al. 1998; Sun et al. 1996; U.S. Department of the Navy 1997; Walker and Kaplan 1992).

Combustive byproducts would only be released in the water column and would dissipate quickly. Therefore, it would not affect any marine vegetation, or marine birds and they would not be further discussed. Additionally, bearded seals would not be located near the ice camp proposed action area during the timeframe of the Proposed Action. Therefore, the impacts of combustive byproducts on bearded seals are not further analyzed. The potential effects on marine habitats (water quality), Essential Fish Habitat, invertebrates, fish, and marine mammals are provided below.

4.3.2.1 Marine Habitats (Water Quality)

Approximately 30,000 exercise tests of the MK 48 torpedo have been conducted over the last 25 years. Most of these launches have been on Navy test ranges, where there have been no reports of harmful impacts on water quality from Otto Fuel II or its combustion products. Furthermore, U.S. Navy studies conducted at torpedo test ranges that have lower flushing rates than the open ocean did not detect residual Otto Fuel II in the marine environment (U.S. Department of the Navy 1996).

For properly functioning torpedoes, chemical, physical, or biological changes to sediment or water quality would not be detectable and would be below or within existing conditions. Impacts would be minimal for the following reasons: (1) the size of the area in which expended materials would be distributed is large; (2) the majority of propellant combustion byproducts are benign, while those of concern would be diluted to below detectable levels within a short time; (3) most propellants are consumed during normal operations; (4) the failure rate is low for such expended materials; and (5) most of the constituents of concern are biodegradable by various marine organisms or by physical and chemical processes common in marine ecosystems.

For lost or malfunctioning torpedoes, chemical, physical, or biological changes to sediment or water quality would not be detectable and would be below or within existing conditions. Impacts would be minimal for the following reasons: (1) the size of the area in which expended materials would be distributed is large; (2) the majority of propellants (99 percent) are consumed during normal operations and the failure rate is low, so quantities of unused propellants would be low; and (3) studies indicate that most of the constituents of concern are biodegradable by various marine organisms or by physical and chemical processes common in marine ecosystems.

Combustive byproducts and Otto Fuel II would be potentially released into the water column from torpedoes during Alternatives 1 and 2. The relatively small release and quick dilution into the water column however, would not have negative impacts on water quality of the Beaufort Sea.

4.3.2.2 Essential Fish Habitat

The only potential impact to Essential Fish Habitat from combustive byproducts would be from the chemicals released into the water column from the torpedoes. There have been no reports of harmful impacts on water quality from Otto Fuel II or its combustion products used in previous torpedo launches. As demonstrated in Section 3.1.2, currents in the Arctic would lead to a fairly rapid mixing of released Otto Fuel II or the combustive byproducts from the torpedo into the environment, diluting the contaminants into the environment relatively quickly.

As stated in Section 4.3.2.1 above for properly functioning materials, chemical, physical, or biological changes to sediment or water quality would not be detectable and would be below or within existing conditions or designated uses. Impacts would be minimal for the following reasons: (1) the size of the area in which expended materials would be distributed is large; (2) the majority of propellant combustion byproducts are benign, while those of concern would be diluted to below detectable levels within a short time; (3) most propellants are consumed during normal operations; (4) the failure rate is low for such expended materials; and (5) most of the constituents of concern are biodegradable by various marine organisms or by physical and chemical processes common in marine ecosystems.

Combustion byproducts associated with Alternative 1and 2 would not significantly reduce the quantity or quality of Essential Fish Habitat. The quality of Essential Fish Habitat would only be temporarily reduced, as physical, chemical, or biological properties of the water would not be altered to a degree where it could be meaningfully measured or observed at the completion of the event. Additionally, combustion byproducts would not result in a potential loss of or injury to either prey species or their habitat. The short duration and relatively small release, however, would not have negative impacts on Essential Fish Habitat.

4.3.2.3 Invertebrates

Properly functioning torpedoes combust most of their propellants, leaving benign or readily diluted soluble combustion byproducts (e.g., hydrogen cyanide). Operational failures allow release of propellants and their degradation products into the marine environment. Torpedo propellant poses little risk to marine invertebrates because the chemicals have relatively low toxicity. Marine invertebrates may be exposed by contact with the chemical, contact with chemical contaminants in the sediment or water, and ingestion of contaminated sediments. These situations typically include rapid dilution, and doses large enough to have detectable effects are uncommon in most circumstances. Additionally, direct ingestion of chemicals expended from the torpedoes by an invertebrate is unlikely.

Under Alternative 1 and 2, the release of Otto Fuel II and other combustive byproducts would occur. Although, potential ingestion of Otto Fuel II and other combustion byproducts may occur, no measureable effect on invertebrate populations would occur due to the low amount of combustion byproducts discharged, and that the number of potentially affected invertebrates would be low relative to total invertebrate biomass.

4.3.2.4 Fish

Potential harm to fish from the release of combustion byproducts would be governed by the amount of harmful substances remaining in the water following the torpedo run. Fish can readily vacate the area and are less susceptible to potential harm from chemical releases. Additionally, chemical byproducts will rapidly disperse in the seawater.

4.3.2.5 Marine Mammals

Potential harm to marine mammals from the release of combustion products would be governed by the amount of harmful substances remaining in the water following the torpedo run. Marine mammals can readily vacate the area and are less susceptible to potential harm from chemical releases. Additionally, chemical byproducts will rapidly disperse in the seawater.

Stressors from chemical releases could pose indirect effects on marine animals by affecting habitat, water quality, or prey. In accordance with the ESA, combustion byproducts would have no effect on ringed seals or polar bears. In accordance with the MMPA, combustion byproducts would not result in takes of marine mammals.

4.3.3 Entanglement

Devices that pose an entanglement risk are those with lines or tethers; devices with a potential for entanglement include weather balloons/radiosondes, in-water devices (buoys, hydrophones, and acoustic arrays), and towed devices from unmanned underwater vehicles. Buoys include sensors deployed to a maximum depth of 800 m, hydrophones are deployed to depths of 31 m, and acoustic arrays are deployed to depths of 732 m. All lines hanging from buoys or ice would be weighted, and therefore would not have any loops or slack. The final line that could be a threat for entanglement is the use of a device tethered to an unmanned underwater vehicle (depth of 91 m). The tether for this research initiative has a diameter of 8.9 millimeters, and is made of Kevlar. This tether has a very high breaking strength (1,543 lb force), but environmental resources should not be at high risk due to the small likelihood of any loops or slack developing in this line.

The weather balloons being released could introduce the potential for entanglement upon their descent; these balloons would consist of shredded plastic from bursting balloons, a parachute used to slow the descent of the radiosonde, and all of the ropes and twine used to keep all of the components together (the radiosonde would be suspended 25–35 m below the balloon). The components from the weather balloons present the highest risk of entanglement. Balloon fragments would temporarily be deposited on the ice, until the ice melts and the materials sink to the seafloor. Birds are not anticipated to be feeding on the sea ice, and therefore would not likely become entangled in balloon materials. The ultimate disposition of the material on the seafloor would occur outside the area where a bird or terrestrial mammal would access them.

It is not anticipated that entanglement would affect marine habitats, vegetation, birds, terrestrial mammals, or Essential Fish Habitat, as they are not within an area to be adversely affected or cannot become entangled in expended material. Therefore, they will not be further discussed. Additionally, bearded seals would not be located near the ice camp proposed action area during the timeframe of the Proposed Action. Therefore, the impacts of entanglement with expended materials on bearded seals are not further analyzed. The potential effects on invertebrates, fish, and marine mammals are provided below.

4.3.3.1 Invertebrates

A marine invertebrate that might become entangled may only be temporarily confused and escape unharmed, it could be held tightly enough that it could be injured during its struggle to escape, it could be preyed upon while entangled, or it could starve while entangled. The likelihood of these outcomes cannot be predicted with any certainty because interactions between invertebrate species and entanglement hazards are not well known. Potential entanglement scenarios are based on observations of how marine invertebrates are entangled in marine debris that typically floats at the sea surface for long periods of time (e.g., plastic bags and food wrappers), which is far more prone to tangling than weighted sensors dangling from buoys, lines from acoustic arrays, or the tether from the unmanned underwater vehicle, because these devices would not have materials prone to developing loops (Environmental Sciences Group 2005; Ocean Conservancy 2010). Deployments of the sensors and acoustic arrays could cause short-term and localized disturbances to invertebrates utilizing the upper water column. Since most of the invertebrates within the Study Area are benthic, the risk of entanglement from deployment of sensors and arrays is extremely low. Although, there is a risk of entanglement between benthic invertebrates and expended lines once they land on the seafloor. Since a small number of lines would be expended within the Study Area the risk of an invertebrate encountering a line and becoming entangled is low.

Invertebrates also have an entanglement risk from the expended materials as they sink and land on the seafloor. Unlike marine mammals and fish, some invertebrates are sessile and would not be able to move out of the path of an expended material as it sinks and settles on the seafloor. Although there is a risk of an expended material entangling around and potentially injuring or killing an individual invertebrate, there would be no long term population level effects due to the small amount of expended materials over the large Study Area and the limited number of organisms potentially exposed to the material.

Weather balloon parachutes pose a potential, though unlikely, entanglement risk to susceptible marine invertebrates. The most likely method of entanglement would be a marine invertebrate crawling through the fabric or cord that could then tighten around it. The number of parachutes expended across the whole Study Area is extremely small relative to the presumed number of marine invertebrates. Although invertebrate biomass within the Study Area has not been fully researched, it is assumed that no measurable effects on invertebrate populations in the water column would occur because the number of organisms exposed to the lines and towed device would be low relative to total invertebrate biomass.

Under Alternative 1, the potential for entanglement would be limited to the hydrophones used for the underwater tracking range at the ice camp. Lines extending from the hydrophones would be retrieved at the completion of the exercise. Given that most invertebrates in the Study Area are benthic, the likelihood of entanglement is extremely limited.

Under Alternative 2, the execution of research activities (such as in-water devices used for data collection) would introduce additional potential for entanglement both within the water column and once the material sinks to the seafloor. Although an increase in potential entanglement would occur from the additional devices, no measureable effect on invertebrate populations would occur.

4.3.3.2 Fish

The likelihood of fish being affected by an entanglement stressor is a function of the physical properties, location, and buoyancy of the object, and the behavior of the fish. Most entanglement observations involve abandoned or discarded nets, lines, and other materials that form loops or incorporate rings (Derraik 2002; Keller et al. 2010; Laist 1987; Macfadyen et al. 2009). A 25-year dataset assembled by the Ocean Conservancy (2010) reported that fishing line, rope, and fishing nets accounted for approximately 68 percent of fish entanglements, with the remainder due to encounters with various items such as bottles, cans, and plastic bags.

Fish entanglement occurs most frequently at or just below the surface or in the water column where objects are suspended; however, the physical properties (taught lines with no slack) of the materials associated with ICEX are not expected to cause any entanglement. More fish species are entangled in coastal waters and the continental shelf than elsewhere in the marine environment because of higher concentrations of human activity (e.g., fishing, sources of entangling debris), higher fish abundances, and greater species diversity (Helfman et al. 2009; Macfadyen et al. 2009). The consequences of entanglement range from temporary and inconsequential to major physiological stress or mortality.

Some fish are more susceptible to entanglement in derelict fishing gear and other marine debris, compared to other fish groups. Physical features, such as rigid or protruding snouts of some elasmobranchs (e.g., the wide heads of hammerhead sharks), increase the risk of entanglement compared to fish with smoother, more streamlined bodies (e.g., lamprey and eels). Most other fish, except for jawless fish and eels that are too smooth and slippery to become entangled, are susceptible to entanglement gear specifically designed for that purpose (e.g., gillnets); however, no items would be expended that are designed to function as entanglement objects, nor are they designed to have slack or form loops. Expended materials have the potential to strike fish as they sink to the seafloor. Although individual fish may be at some marginal risk of injury, there would be no population-level impacts from these materials, due to the dispersed nature and small amount of the expended material.

Under Alternative 1, the potential for entanglement would be limited to the hydrophones used for the underwater tracking range at the ice camp. Lines extending from the hydrophones would be retrieved at the completion of the exercise. Entanglement of fish in the lines associated with the hydrophones are not anticipated, given the mobility of the fish and the weighted (e.g., no slack or loops) line of the hydrophone.

Under Alternative 2, the execution of research activities would introduce additional potential for entanglement both within the water column and once the material sinks to the seafloor. The highest risk of entanglement would be from the parachute, balloon shreds, and rope from the weather balloons. Two balloons would be released per day (a maximum of forty balloons total), and would travel varying distances before bursting, based on meteorological conditions and upper atmosphere air currents, and would not present a large threat to fish populations so much as individual animals. This equipment may harm individual animals, but the number of individuals that could be harmed would be few such that it would not result in significant population-level effects.

4.3.3.3 Mammals (Marine)

The risks of entanglement would be from the lines coming off the hydrophones associated with the underwater acoustic tracking range, from buoys and acoustic arrays from the in-water device data collection research activities, and from the lines and parachutes of the weather balloons after they have burst, fall back to sea level, and enter the water column. The hydrophones, buoys, and acoustic array lines would have weights attached so no loops or slack in the lines are anticipated. Potential entanglement from the Proposed Action would only occur with the wire hanging below the buoys or with the wire if a marine mammal used the hole to breathe. Furthermore, marine mammal occurrence is expected to be minimal within the water column during the Proposed Action.

The likelihood of a marine mammal encountering and becoming entangled in a line depends on several factors. The amount of time that the line is in the same vicinity as a marine mammal can increase the likelihood of it posing an entanglement risk. The length of the line varies (up to about 732 m), and greater lengths may increase the likelihood that a marine mammal could become entangled. The behavior and feeding strategy of a species can determine whether they may encounter items on the seafloor, where parachutes and associated lines would be available for longer periods. Given the water depths in the Study Area, marine mammals would not forage on the seafloor, eliminating the possibility of entanglement once the lines sink and settle on the seafloor.

The chance that an individual animal would encounter expended lines or parachutes is most likely low based on the distribution of both the lines and parachutes expended, and the depth of the water in the Study Area where these would be expended. In the 2014 NMFS stranding report, ten reported ringed seal strandings occurred in the Arctic and Western Alaska regions. Of those ten strandings, none were documented to be from human interactions such as entanglement with fishing gear (Savage 2014). Given the water depths in the Study Area, ringed seals are not expected to be feeding on the seafloor (Bluhm and Gradinger 2008); any materials that settle to the seafloor would therefore not pose an entanglement risk to ringed seals. An animal would have to swim through loops or become twisted within the lines to become entangled. Ringed seals could potentially become entangled if they attempt to use a hole from which equipment is being deployed. Given that most breathing holes would already be established at this time of year, and that the likelihood that a seal would choose a hole being used for human activities is very low, the likelihood of entanglement with a line through the bored hole would be low. Furthermore, the likelihood of entanglement with a line deployed through the bored hole would be very low because the line would generally be taut and connected to a buoy or underwater vehicle, and would not have slack or loops in the line. Based on the limited number of expended lines and parachutes, harm from lines or parachutes are extremely unlikely to occur. Although there is a potential for entanglement from an expended material the amount of materials expended would be low and ringed seals are very mobile within the water column and avoidance of any expended object is expected.

The chance of a polar bear becoming entangled with expended material is discountable. Polar bears at this time of year are found on the ice stalking breathing holes, or within their maternal dens, and not located within the water column. Since the weather balloons would pop and could only potentially fall onto the ice as small pieces of shredded plastic it would not present an entanglement risk to a polar bear (due to the small size of the pieces). Although, a polar bear could potentially become entangled within the weather balloon parachute or ropes and twine used to keep all of the components together, it is unlikely, but if it does occur, polar bears are strong and agile and would easily be able to untangle themselves from any potential expended materials on ice.

Under Alternative 1, the potential for entanglement would be limited to the hydrophones used for the underwater tracking range at the ice camp. Lines extending from the hydrophones would be retrieved at the completion of the exercise. In accordance with the ESA, lines extending from the hydrophones may affect, but are not likely to adversely affect, ringed seals. Because polar bears would not be within the water column during the Proposed Action, under ESA there would be no effect to polar bears. In accordance with the MMPA, any effects to marine mammals (ringed seals, and polar bears) would be minimal and temporary (where behavioral patterns would not be significantly altered or abandoned), and therefore would not result in takes of marine mammals.

Under Alternative 2, the execution of research activities would introduce additional potential for entanglement. Although the likelihood of entanglement remains low, due to the fact that the lines would not have slack or loops, entanglement associated with Alternative 2, under ESA, may affect, but not likely to adversely affect, ringed seals. Because polar bears would not be within the water column during the Proposed Action under ESA, there would be no effect to polar bears is anticipated from the ultimate disposition of the material on the seafloor. In accordance with the MMPA, any effects to marine mammals (ringed seals, and polar bears) would be minimal and temporary (where behavioral patterns would not be significantly altered or abandoned), and therefore would not result in takes of marine mammals.

4.3.4 Ingestion

During the Proposed Action, expended materials available for ingestion include buoys, radiofrequency tags, balloon fragments, and radiosondes. Food materials would only be present within the ice camp, and balloon fragments and radiosondes could be found on the ice, in the water column, or on the seafloor. Ingestion of these materials does not require the entire object to be ingested; pieces of objects that either break off or are bitten off are included in this analysis.

Ingestion stressors are not anticipated to effect marine habitats or vegetation, as neither resource would ingest materials. Therefore, they will not be further discussed. Additionally, bearded seals would not be located near the ice camp proposed action area during the timeframe of the Proposed Action. Therefore, the impacts of ingestion from expended materials on bearded seals are not further analyzed. The potential effects on invertebrates, marine birds, fish, and mammals are provided below.

4.3.4.1 Invertebrates

While marine invertebrates are present in the water column and the seafloor, the majority of individuals are smaller than a few millimeters (e.g., zooplankton, and most arthropods). Most expended materials and fragments of expended materials are too large to be ingested by marine invertebrates, although, it is possible for some invertebrates to ingest the balloon debris. Invertebrates could potentially ingest the small pieces of balloon after it popped and landed in the water column.

Few studies are available regarding the effects of debris ingestion on marine invertebrates. It is not feasible to speculate on which invertebrates in which locations might ingest specific types of expended materials. However, invertebrates that actively forage (e.g., worms, and sea cucumbers) are at much greater risk of expended materials ingestion than invertebrates that filter-feed (e.g., sponges, oysters, and barnacles). Though ingestion is possible in some circumstances, based on the little scientific information available, it seems that negative impacts on individuals are unlikely and the potential for harm to populations would be inconsequential and not detectable. Adverse consequences of marine invertebrates ingesting expended materials are possible, but not probable. Over the course of the Proposed Action, material (such as radiosondes, latex fragments, and cords) from 40 weather balloons would most likely float on the surface and could eventually sink to the seafloor. Since most of the invertebrates in the Study Area are benthic and the expended materials from the Proposed Action would be spread throughout the Study Area and throughout the surrounding waters of the Beaufort Sea, the chance of an encounter with expended materials is low, and the probability of ingestion is even lower. Due to this any ingestion of expended materials would be negligible.

Under Alternative 1, no materials would be expended. Therefore, there would be no risk of ingestion associated with Alternative 1.

Under Alternative 2, the execution of research activities would introduce additional materials that would be available for ingestion (e.g., balloon fragments from 40 balloons). Although an increase in potential ingestion of materials would occur from the additional devices, no measureable effect on invertebrate populations would occur due to the low number of materials, and that the number of potentially affected invertebrates would be low relative to total invertebrate biomass.

4.3.4.2 Marine Birds

The potential for ingestion of materials by marine birds would be limited to shredded pieces of burst weather balloons. Physiological harm to birds from ingesting foreign materials generally include blocked digestive tracts and subsequent food passage, blockage of digestive enzymes, lowered steroid hormone levels, delayed ovulation (egg maturation), reproductive failure, nutrient dilution (nonnutritive debris displaces nutritious food in the gut), and altered appetite satiation (the sensation of feeling full), which can lead to starvation (Azzarello and Vleet 1987). While ingestion of marine debris has been linked to bird mortalities, non-lethal harm is more common (Moser and Lee 1992).

Many species of marine birds are known to ingest floating plastic debris and other foreign matter while feeding on the surface of the ocean (Auman et al. 1997; Yamashita et al. 2011). For example, 21 of 38 marine bird species (55 percent) collected off the coast of North Carolina from 1975 to 1989 had ingested plastic particles, including both hard pieces of plastic and pieces of soft plastics such as shreds of balloons (Moser and Lee 1992). Some marine birds have used plastic and other marine debris for nest building which may lead to ingestion of that debris (Votier et al. 2011).

Birds of the order procellariiformes, which include petrels and shearwaters, tend to accumulate more plastic than other species, including chadriiformes (Azzarello and Vleet 1987; Moser and Lee 1992; Pierce et al. 2004). Some birds, including those of the order chadriiformes, commonly regurgitate indigestible parts of their food items such as shell and fish bones. However, the structure of the digestive systems of most procellariiformes makes it difficult to regurgitate solid material such as plastic (Azzarello and Vleet 1987; Moser and Lee 1992; Pierce et al. 2004).

Moser and Lee (1992) found no evidence that marine bird health was influenced by the presence of plastic, but other studies have documented negative consequences of plastic ingestion (Carey 2011). As summarized by Pierce et al. (2004), Auman et al. (1997), and Azzarello and Van Vleet (1987), the consequences of plastic ingestion by marine birds that have been documented include blockage of the intestines and ulceration of the stomach, reduction in the functional volume of the gizzard leading to a reduction of digestive capability, and distention of the gizzard leading to a reduction in hunger.

Ingestion associated with Alternative 1 would not result in a significant adverse effect on migratory bird populations, in accordance with the Migratory Bird Treaty Act. Under Alternative 1, no materials would be expended at the ice camp. Therefore, there would be no risk of ingestion associated with Alternative 1.

Ingestion associated with Alternative 2 would not result in a significant adverse effect on migratory bird populations. Under Alternative 2, the execution of research activities would introduce additional materials that would be available for ingestion (e.g., balloon fragments). Although an increase in potential ingestion of materials would occur from the additional devices, no measureable effect on bird populations would occur. Weather balloons typically disperse from the release point to another area based on meteorological conditions, where the direction would be dictated by wind and air masses. The density of the balloons returning to the earth surface would be low enough that even if a few individuals were to ingest some balloon fragments, there would be no population level impacts. In accordance with the Migratory Bird Treaty Act, the risk of ingestion associated with Alternative 2 would not result in a significant adverse effect on migratory bird populations.

4.3.4.3 Fish

Expended materials that may potentially impact fish are those that are of ingestible size and that are present in the water column where fish feed. The likelihood that expended items would cause potential harm to a given fish species depends on the size and feeding habits of the fish and the rate at which the fish encounters the item and the composition of the item. In this analysis, balloon fragments are considered to be of ingestible size for a fish. For many small fish species, even these items are too large to be ingested. The majority of studies involving plastic ingestion in fish look at the effects of fish eating hard plastic pieces; minimal work has been done evaluating the harm from weather balloon fragment ingestion. A study by Irwin (2012) found that natural latex weather balloon fragments would not have serious health implications on catfish.

Under Alternative 1, no materials would be expended at the ice camp. Therefore, there would be no risk of ingestion associated with Alternative 1.

Under Alternative 2, the execution of research activities would introduce additional potential for ingestion both within the water column and once the material sinks to the seafloor. The highest risk of harm from ingestion would be from the parachute, balloon fragments, and rope from the weather balloons. Two balloons would be released per day for a total of 40 balloons, and they would travel varying directions before bursting. Because of the small numbers of these balloons and expended materials, and the distance at which they would be dispersed, they would not present a significant threat to fish populations, although one or a few individuals could be impacted.

4.3.4.4 Mammals (Marine and Terrestrial)

During the Proposed Action, mammals could ingest any of the following objects: passive buoys and radiofrequency tags (polar bears only), balloon fragments and radiosondes. Passive buoys and radiofrequency tags would be within the water column/on the ice or on the seafloor, and balloon fragments and radiosondes could be found on the ice, in the water column, or on the seafloor.

Ringed seals feed both within the water column and on the seafloor (Bluhm and Gradinger 2008), but feeding on the seafloor would not occur in the Study Area given the water depths. Since ringed seals spend most of their time either in their subnivean lair or in the water column, the only ingestion potential would be from balloon fragments and radiosondes as they sink to the seafloor. A total of 40 balloons (2 per day) would be would be released over the course of the Proposed Action. It is important to note that the distance and direction each balloon would travel is directly related to the daily weather conditions and they are not anticipated to travel to the same locations on a daily basis. While each balloon could travel over 201 km before bursting and entering the water column, the likelihood of ingestion of a balloon fragment by a ringed seal is extremely low (Federal Aviation Administration (FAA) 2014). Balloon fragments do not resemble prey species of ringed seals; any ingestion of balloon fragments would be limited to small pieces incidentally ingested. The released weather balloons may have a potential effect on ringed seal prey (particularly fish), but would be an instance of ingestion by individual animals rather than populations at large; therefore, there is a possibility of a ringed seal consuming a fish that has small pieces of balloon in their digestive system, though these pieces would most likely be small enough to pass through a ringed seal. However, fish could also become entangled in weather balloon fragments in the water, creating a potential ingestion issue for ringed seals were they to consume the entangled fish. Data on ingestion of marine debris by ringed seals is not available. However, a study by Irwin (2012) found that natural latex weather balloon fragments would not have serious health implications on catfish. Given the larger size of ringed seals, it is assessed that balloon fragments would similarly not have serious health implication if incidentally ingested.

Arctic foxes are known to be attracted to human trash (Pamperin 2008). Therefore, they may be attracted to the ice camp in search of an easy food source. Polar bears are also known to be attracted to garbage. Polar bears have shown high plasticity in their diet and may exploit abundant resources within their range (Gormezano and Rockwell 2013a, 2013b). Additionally, polar bears will consume resources at all trophic levels to maximize caloric intake on seasonally abundant resources (Gormezano and Rockwell 2013a). Polar bears are also curious and have been observed investigating unfamiliar objects and smells (Stirling 1988), which has led to polar bears ingesting trash and hazardous materials as discussed above.

Polar bears typically find alternate food sources (e.g., land-based trash collection sites) when their primary prey (ringed seals) are unavailable (Lunn and Stirling 1985). In a study by Gormezano and Rockwell (2013a), polar bear scats (i.e., excrement) from five sites were surveyed. Sites included the town of Churchill and dens around inland lakes. In areas where humans and polar bears came in close proximity, a higher percentage of garbage was found in the scats than areas where polar bears and humans were not in close proximity. The likelihood of a polar bear encountering any human trash at or around the ice camp is remote as all trash would be collected within the dining facilities until incinerated or back hauled. Polar bears have also been known to bite buoys located on the ice. This behavior could be out of curiosity or to determine if the object is edible. Although ingestion of large pieces of a buoy is not anticipated, small bits could be ingested. A polar bear may encounter balloon fragments and may ingest a small portion to determine if it is edible, but would not be expected to ingest an entire balloon. If a polar bear does ingest pieces of human trash accidentally left at the ice camp or expended materials such as buoys, balloon fragments, or radiosondes while on the ice, the bear would likely excrete the material without detrimental effects, as studies indicate that bears foraging in land-based trash sites show no reproductive or survival advantage or disadvantage from feeding on these materials (Lunn and Stirling 1985). Additionally, due to the small number of expended buoys, radiofrequency tags, balloons, and radiosondes and the low density of polar bears, the chance of a bear encountering and ingesting expended material is low.

Under Alternative 1, the potential for ingestion would be limited to food materials at the ice camp. Ringed seals are not expected to be attracted to food materials, and therefore the Proposed Action. Under ESA, Alternative 1 would have no effect on ringed seals. Polar bears, however, may be attracted to the food materials; therefore, under ESA, the Proposed Action under Alternative 1 may affect, but is not likely to adversely affect, polar bears. Similarly, Arctic fox may be attracted to food materials at the ice camp, but the likelihood of a fox occurring at the camp is low.

Under Alternative 2, the execution of research activities would introduce additional potential materials for ingestion (e.g., balloons, buoys). Balloon fragments have a minimal potential to be mistaken as prey by ringed seals. Although ingestion of these pieces is unlikely, it cannot be ruled out. Therefore under ESA, the Proposed Action under Alternative 2 may affect, but is not likely to adversely affect, ringed seals. The introduction of buoys also increases the risk that a polar bear may ingest small pieces of material. As such under ESA, the Proposed Action under Alternative 2 may affect, but not likely to adversely affect, polar bears. Similarly, Arctic fox may be attracted to the ice camp, and the addition of research activities slightly increases the chance a fox may ingest small pieces of material. However, the likelihood of an Arctic fox occurring in or near the ice camp is relatively low.

4.4 SUMMARY OF ANALYSIS

The portion of the Proposed Action occurring in Prudhoe Bay would not increase the demands on resources due to an influx of personnel. Additionally, the Proposed Action would not impact subsistence hunting as hunting does not occur within the Study Area during the timeframe of the Proposed Action for bearded and ringed seals. Although hunting for polar bears and arctic foxes does occur year-round, the Proposed Action is far outside of the normal areas hunting occurs.

The analysis provided in Chapter 3 and Chapter 4, describes how the Proposed Action under NEPA would not result in significant impacts to the physical or biological environment. In accordance with E.O. 12114, the Proposed Action as analyzed above would have not cause significant harm to the human or biological environment.

CHAPTER 5 CUMULATIVE IMPACTS

This section (1) defines cumulative impacts, (2) describes past, present, and reasonably foreseeable future actions relevant to cumulative impacts, (3) analyzes the incremental interaction the Proposed Action may have with other actions, and (4) evaluates cumulative impacts potentially resulting from these interactions.

5.1 Definition of Cumulative Impacts

The approach taken in the analysis of cumulative impacts follows the objectives of National Environmental Policy Act (NEPA), Council on Environmental Quality (CEQ) regulations, and CEQ guidance. Cumulative impacts are defined in 40 CFR § 1508.7. as the impact on the environment that results from the incremental impact of the action when added to the other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time.

To determine the scope of environmental assessments, agencies shall consider cumulative actions, which when viewed with other proposed actions, have cumulatively significant impacts and should therefore be discussed in the same assessment.

In addition, CEQ and the USEPA have published guidance addressing implementation of cumulative impact analyses—Guidance on the Consideration of Past Actions in Cumulative Effects Analysis (Council on Environmental Quality 2005) and Consideration of Cumulative Impacts in EPA Review of NEPA Documents (United States Environmental Protection Agency 1999). CEQ guidance entitled *Considering Cumulative Impacts Under NEPA* (1997) states that cumulative impact analyses should "…determine the magnitude and significance of the environmental consequences of the proposed action in the context of the cumulative impacts of other past, present, and future actions...identify significant cumulative impacts…[and]…focus on truly meaningful impacts."

Cumulative impacts are most likely to arise when a relationship or synergism exists between a proposed action and other actions expected to occur in a similar location or during a similar time period. Actions overlapping with, or in close proximity to, the proposed action would be expected to have more potential for a larger potential for resource impacts than those more geographically separated. Similarly, relatively concurrent actions would tend to offer a higher potential for cumulative impacts. To identify cumulative impacts, the analysis needs to address the following three fundamental questions:

- Does a relationship exist such that affected resource areas of the Proposed Action might interact with the affected resource areas of past, present, or reasonably foreseeable actions?
- If one or more of the affected resource areas of the proposed action and another action could be expected to interact, would the Proposed Action affect or be affected by impacts of the other action?
- If such a relationship exists, then does an assessment reveal any potentially significant impacts not identified when the Proposed Action is considered alone?

5.2 Scope of the Cumulative Impact Analysis

The scope of the cumulative impacts analysis involves both the geographic extent of the effects and the time frame in which the effects could be expected to occur. For this EA/OEA, the study areas delimit the geographic extent of the cumulative impacts analysis for the action alternatives. The time frame for cumulative impacts centers on the timing of the Proposed Action, which will occur over a six-week period during February-April.

Another factor influencing the scope of cumulative impacts analysis involves identifying other actions to consider. Beyond determining that the geographic scope and time frame for the actions interrelate to the Proposed Action, the analysis employs the measure of "reasonably foreseeable" to include or exclude other actions. For the purposes of this analysis, public documents prepared by federal, state, and local government agencies form the primary sources of information regarding reasonably foreseeable actions.

5.2.1 Past, Present, and Reasonably Foreseeable Future Actions

In determining which projects to include in the cumulative impacts analysis, a preliminary determination was made regarding the past, present, or reasonably foreseeable future projects at or near the Study Area. Specifically, using the first fundamental question included in Section 5.1, it was determined if a relationship exists such that the affected resource areas of the Proposed Action might interact with the affected resource area of a past, present, or reasonably foreseeable action. If no such potential relationship exists, the project was not carried forward into the cumulative impacts analysis. In accordance with CEQ guidance (Council on Environmental Quality 2005), projects included in this cumulative impacts analysis are listed in Table 5-1 and briefly described in the following subsections.

Table 5-1. Recent Past, Present, and Reasonably Foreseeable Future Actions Within the Vicinity of the Study Area

Action	*Agency*	*Level of NEPA and/or E.O. 12114 Analysis Completed*
Ice Exercises (ICEX)	Navy	OEA (2014, 2016)
Outer Continental Shelf Leasing Programs	BOEM	PEIS (2012)
Liberty Project	BOEM	EIS in process
Canada Basin Acoustic Propagation Experiment	Navy ONR	OEA (2015, 2016)
Arctic Shield 2016 and 2017	USCG	EA (2016)
Pipeline projects (Alaska LNG; Donlin Gold, LLC)	BLM	Future
Polar Icebreaker	USCG	PEA, in progress

ONR = Office of Naval Research; BLM = Bureau of Land Management; PEIS = Programmatic Environmental Impact Statement; USCG = United States Coast Guard

Previous activities in the deep basin of the Beaufort Sea have been limited, primarily due to ice cover. The primary federal activity off the North Slope of Alaska is oil and gas exploration and extraction. BOEM has multiple projects in the region, utilizing large swaths of the federal waters and potential leasing sites for oil and gas developers. The BOEM Beaufort Sea Planning Area extends out to over 100 nm from shore and into the Study Area, though those areas within the Canada Basin are not presently used for any oil/gas related activity. The majority of the BOEM leasing sites used by Shell are in water depths of less than 30.5 m (U.S. Department of the Interior 2013), which is likely of most other lease sites as well, due to their presence primarily on the Outer Continental Shelf. Despite a temporary stay on drilling for oil in the Arctic (E.O. 13754), oil and gas presence may increase over time as needs for fossil fuels continue to rise.

With decreasing first-year and multi-year ice, the Arctic is becoming increasingly accessible. After the Northwest Passage opened in 2007, it paved the way for an increase in maritime traffic through the region, including recent tourism cruises through the region. This increase in accessibility is likely to lead to even more activities as vessels of different sizes and icebreaking capacity are able to enter the region- leading to increases in tourism, industry, research, and military vessels. Presently, the Navy, U.S. Coast Guard, Army, and Air Force operate in the in the Beaufort Sea. Activities through these agencies can be based either in national defense or research. Various research activities occur in the Arctic, conducted by agencies (e.g., NOAA, USFWS), other federal entities (e.g., National Science Foundation), universities (e.g., Massachusetts Institute of Technology), as well as other nations. Any activities in the North Slope of Alaska or in the Beaufort Sea would increase air emissions; any incremental GHG contributions by these activities are likely to cumulatively contribute to climate change and decreased overall air quality.

One of the most concerning issues associated with the Arctic is climate change and the disappearing of the sea ice in the region. The National Aeronautics and Space Administration Earth Observatory has determined via satellite imagery that multi-year sea ice is persistently declining in the Arctic (Lindsey 2015). This past year has been the first year the multiyear ice has not recovered from the summer melt. This is particularly problematic for ICEX due to the concerns about finding suitable ice on which the ice camp would be built; the past two Ice Exercises have concluded early due to cracking ice around the ice camp area, leading to emergency demobilizations in 2014 and 2016.

The other activities in the region, as laid out in Table 5-1, are likely to produce air emissions and noise into the surrounding environment. Ice cover increases the ambient noise underwater, and therefore increased vessel presence is unlikely to negatively impact the biological resources of the Beaufort Sea, but oil and gas drilling may. However, the ice camp proposed action area would be at least 100 nm offshore from existing leased oil and gas areas, and therefore noise from those activities would be unlikely to have an effect on underwater resources. Air emissions from ICEX would be produced by daily aircraft flights. Emissions would be produced at the ice camp from the use of snowmobiles, gas powered augers and saws, and diesel generators. Though the impacts to air quality from ICEX alone have been determined to have no effect on the air quality in the region, when combined with greenhouse gas emissions from other activities and actions in the Beaufort Sea, would contribute to global climate change. Atmospheric carbon dioxide levels have been steadily increasing over time; in October 2016 the global average was 402.31 parts per million, up from 398.60 parts per million in October 2015 (Dlugokencky and Tans 2017). GHGs in the atmosphere lead to higher temperatures, explaining the record high winter temperatures in the Arctic. These high temperatures have caused decreased sea ice and warmer water temperatures, which risk altering the physical environment indefinitely. These changes are likely to lead to increased risk to Arctic species, such as the polar bear, which rely on sea ice for their homes, and ringed seals, who pup in subnivean lairs within sea ice. In 2015, the average temperature across global land and ocean surfaces was 1.62 °F above the twentieth-century average; it was the hottest year in the 136-year record (Dahlman 2015).

ICEX would include a component in which weather balloons would be released daily during the ice camp component of the activity. These balloons could travel up to 300 km before returning to earth, at which point balloon fragments, radiosondes, parachutes, and wires would enter the natural environment of wherever they land. Similarly, buoys and hydrophone components left behind would also contribute to military expended materials in the area. These could contribute to increasing levels of plastics and refuse in the ocean, which has become an entanglement and ingestion issue for wildlife across the globe. As these materials disintegrate in the water over time, chemicals may be released, having a localized impact on water quality where they settle on the seafloor. For example, latex has been found to degrade in around 87 days in marine water; during this time, byproduct nanoparticles and other volatile substances were released into the environment (Lambert et al. 2013). While these pollutants are negligible for the release of a small amount of weather balloons, when considered in relation to all other weather balloons used worldwide and any other plastic pollution in the ocean, this can contribute to overall changes in water quality.

While emissions from aircraft using the Deadhorse Airport, at Prudhoe Bay would incrementally contribute to greenhouse gases and global climate change, this increase in traffic would have negligible impacts to the actual Prudhoe Bay, Alaska area. The project is brief and temporary in nature, and therefore would not require long-term residencies by any participants. No additional facilities would need to be built; all on-shore activities would utilize those already present.

Based on the past, present, and reasonably foreseeable future actions within the Study Area, ICEX would not be expected to considerably contribute to any cumulative impacts from all other actions and activities in the Beaufort Sea.

CHAPTER 6 STANDARD OPERATING PROCEDURES AND MITIGATION MEASURES

The Navy has identified multiple measures that would further reduce and avoid potential impacts resulting from the Proposed Action. Both standard operating procedures and mitigation measures would be implemented during the Proposed Action. Standard operating procedures serve the primary purpose of providing for safety and mission success, and are implemented regardless of their secondary benefits (e.g., to a resource), while mitigation measures are used to avoid or reduce potential impacts.

Though the Proposed Action would utilize both standard operating procedures and mitigation measures in a variety of manners, the activities using active acoustics would utilize passive acoustic listening. Submarines conducting training activities would utilize passive acoustic sensors to listen for vocalizing marine mammals, and active transmissions would be halted in the event that vocalizing marine mammals are detected.

Additional mitigations were considered for research activities, however, because those activities that result in exposures to marine mammals occur under the ice, there are no methods to visually or acoustically monitor the area, therefore no additional mitigation is feasible.

6.1 STANDARD OPERATING PROCEDURES

The following procedures would be implemented:

- The location for any air-dropped equipment and material would be visually surveyed prior to release of the equipment/material to ensure the landing zone is clear. Equipment and materials would not be released if any animal is observed within the landing zone.
- Air drop bundles would be packed within a plywood structure with honeycomb insulation to protect the material from damage.
- Spill response kits/material would be on-site prior to the air-drop of any hazardous material (e.g. fuel).

6.2 MITIGATION MEASURES

In addition to the standard operating procedures above, the following mitigation measures would be implemented to reduce or avoid potential harm to marine resources.

- Submarines would utilize passive acoustic sensors to listen for vocalizing marine mammals. Submarine active transmissions would be halted in the event vocalizing marine mammals are detected.
- Passengers on all on-ice vehicles would observe for marine and terrestrial animals; any marine or terrestrial animal observed on the ice would be avoided by 100 m. On-ice vehicles would not be used to follow any animal, with the exception of actively deterring polar bears if the situation requires.
- Personnel operating on-ice vehicles would avoid areas of deep snow drifts near pressure ridges, which are preferred areas for subnivean lair development.

- Camp development is scheduled to begin mid-February and would be completed well before ringed seal pupping season begins. This allows ringed seals to avoid the camp area prior to pupping, further reducing potential impacts.
- All material (e.g., shelters, unused food, excess fuel) and wastes (e.g., solid waste, hazardous waste) would be removed from the ice floe upon completion of ICEX.
- Dish and hand soap would be selected from the U.S. Environmental Protection Agency's "Safer Choice" list.
- All cooking and food consumption would occur within designated facilities to minimize attraction of nearby animals.
- All personnel will be required to complete environmental compliance training including environmental health and safety procedures.

APPENDIX A CLEAN WATER ACT PERMIT

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

OFFICE OF
WATER AND WATERSHEDS

DEC 21 2017

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Mr. H.A. Estrada, Director
UWDC DET ASL
140 Sylvester Road
San Diego, CA 92106

Re: Issuance of a National Pollutant Discharge Elimination System (NPDES) Permit Modification to the United States Navy Arctic Ice Camp (AK-005378-3)

Dear Mr. Estrada:

We are issuing a NPDES permit modification to the United States Navy ('Navy') for the facility referenced above. The enclosed document authorizes the facility to discharge pollutants from the outfalls identified in the permit to the specified receiving waters. In addition, we are enclosing the U.S. Environmental Protection Agency's response to comments that were received on the proposed permit modification during the public comment period.

This letter serves as service of notice under 40 CFR §124.15. The date of this letter initiates the 30-day appeal period set forth in 40 CFR §124.19(a)(3). The permit will become effective on the date indicated in the permit unless a timely appeal meeting the requirements of 40 CFR §124.19 is received by the Environmental Appeals Board (EAB). Information about the administrative appeal process may be obtained on-line at http://www.epa.gov/eab or by contacting the Clerk of the EAB at (202) 233-0122. The EPA appreciates the cooperation and assistance provided by your staff during our development of the permit.

Please do not hesitate to contact me at 206-553-1755 or Erin Seyfried, the NPDES permit writer, at seyfried.erin@epa.gov or 206-553-1448, if you have any questions.

Sincerely,

Susan Poulsom for

Michael J. Lidgard
Acting Director
Office of Water and Watersheds

Enclosure

cc (*via email*):
Michael Geremia, Environmental Management and Pollution Prevention Program Manager
Lindsey Kenyon, Environmental Review, Inc.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (EPA)
REGION 10
1200 SIXTH AVENUE, SUITE 900
SEATTLE, WASHINGTON 98101

AUTHORIZATION TO DISCHARGE UNDER THE
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Clean Water Act, 33 U.S.C. §1251 et seq., as amended by the Water Quality Act of 1987, P.L. 100-4, the "Act,"

UNITED STATES NAVY
140 SYLVESTER ROAD
SAN DIEGO, CALIFORNIA 92106

is authorized to discharge from the

ARCTIC ICE CAMP
located 100 – 200 nautical miles north of Deadhorse, Alaska

to

THE BEAUFORT SEA (the "receiving waters"),

in accordance with discharge point(s), effluent limitations, monitoring requirements and other conditions set forth herein.

This permit shall become effective: January 1, 2016

This permit and the authorization to discharge shall expire at midnight, December 31, 2020

THE PERMITTEE SHALL REAPPLY FOR A PERMIT REISSUANCE ON OR BEFORE
(180 days before the expiration of this permit) if the Permittee intends to continue operations and discharges at the facility beyond the term of this permit.

Signed this 14th day of December 2015

/s/

Daniel D. Opalski, Director
Office of Water and Watersheds

This permit modification is effective on February 1, 2018

Signed this 21st day December 2017

Susan Poulsom for

Michael J. Lidgard, Acting Director
Office of Water and Watersheds

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The following is a summary of some of the items the Permittee must complete and/or submit to EPA during the term of this permit:

ITEM	PERMIT SECTION	DUE DATE
DISCHARGE MONITORING REPORTS (DMR)	III.B.	DMRs are due annually and must be postmarked on or before the 1st day of June of each year of operation under this permit.
BEST MANAGEMENT PLAN (BMP)	II.A.	The Permittee must provide EPA with written notification that the Plan has been developed, or updated, and implemented within 60 days after the effective date of the final permit. The Plan must be kept on site and made available to EPA upon request.
ANNUAL BMP REVIEW	II.A.3.j.	The Permittee must provide EPA with an annual statement that the Plan has been reviewed and fulfills the requirements set forth in this permit. The statement shall be certified by the dated signatures of each BMP Committee member. This statement shall be submitted annually to EPA 14 calendar days prior to commencing operation under this permit after the initial BMP submittal.
QUALITY ASSURANCE PLAN (QAP)	II.B.	The Permittee must provide EPA with written notification that the Plan has been developed, or updated, and implemented within 60 days after the effective date of the final permit. The Plan must be kept on site and made available to EPA upon request.
TWENTY-FOUR HOUR NOTICE OF NONCOMPLIANCE REPORTING	III.G.1. and III.H.	The Permittee must report certain occurrences of noncompliance by telephone within 24 hours from the time the Permittee becomes aware of the circumstances.
NPDES APPLICATION RENEWAL	V.B	The application must be submitted at least 180 days before the expiration date of the permit.
DUTY TO PROVIDE INFORMATION	V.C	As specified in the request for information.

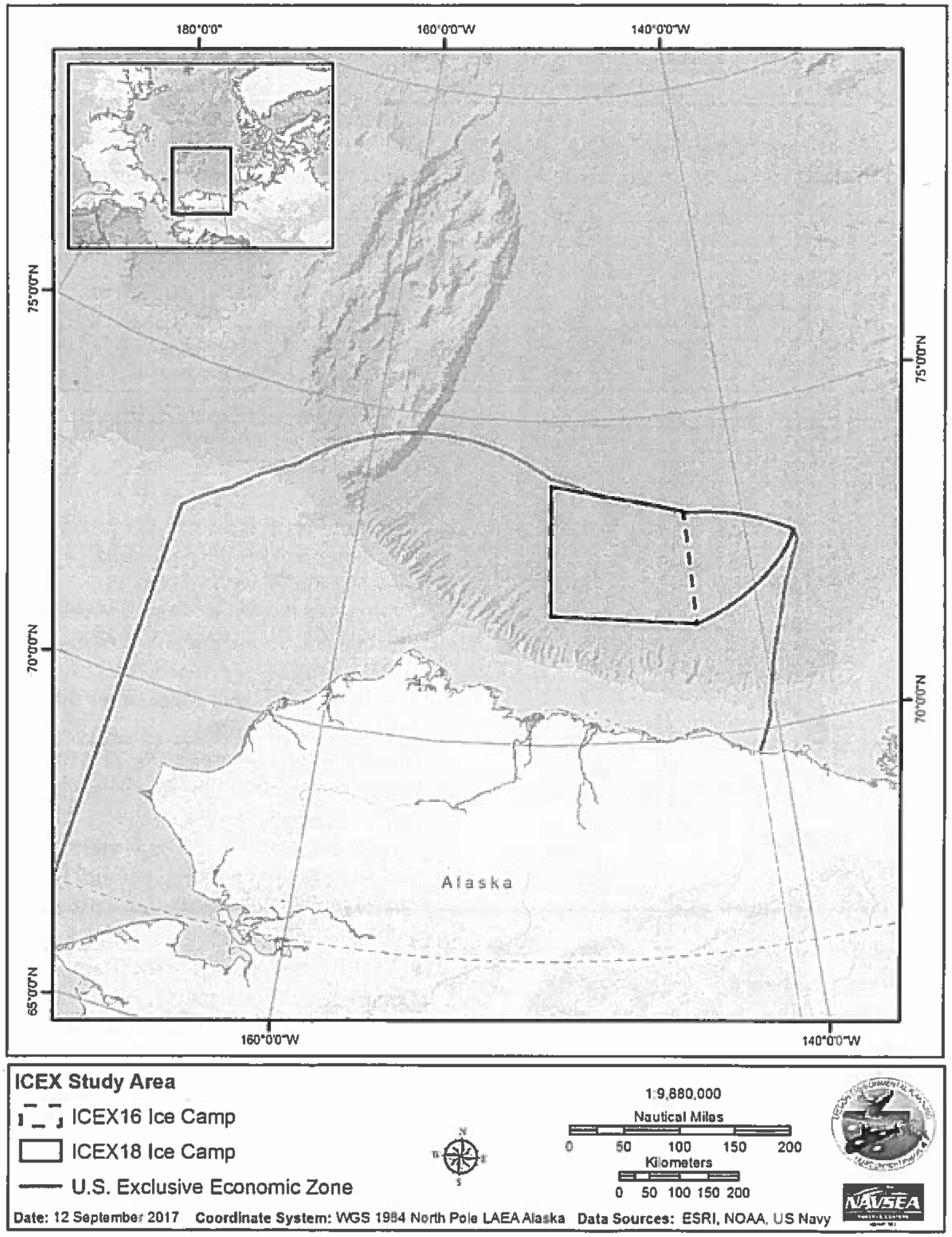

FIGURE 1: *Area of camp operations for the U.S. Navy Arctic Ice Camp.*

I. SPECIFIC LIMITATIONS AND MONITORING REQUIREMENTS

A. Discharge Authorization

During the effective period of this permit, the Permittee is authorized to discharge pollutants from specified outfalls located within the area of camp operations to the Beaufort Sea (see Figure 1), within the limits and subject to the conditions set forth herein. This permit authorizes the discharge of only those pollutants resulting from facility processes, waste streams, and operations that have been clearly identified in the permit application process.

B. Requirements for All Discharges

1. The Permittee must notify the Director in writing, within 14 calendar days of establishing the facility location, of the specific latitude and longitude of the Arctic Ice Camp. The notification described in this paragraph must be signed in accordance with the Signatory Requirements (VI.E) of this permit and is applicable each year that the Arctic Ice Camp is in operation.

2. The Permittee must submit all monthly Discharge Monitoring Reports (DMRs) in an Annual Report (See Permit Part III.B.) and must include the dates of when each authorized discharge commenced and ceased. If no discharges occur during a particular month (i.e. the months when the facility is not in operation), the permittee must indicate "no discharge" on the applicable month's DMR.

3. The Permittee must comply with the effluent limits in this permit at all times, unless otherwise indicated, regardless of the frequency of monitoring or reporting required by other provisions of this permit.

4. All effluent samples collected from any effluent stream must be taken after the last treatment unit and before discharge into receiving waters, except as otherwise required by discharge-specific provisions of this permit.

5. The Permittee must report all violations of the requirements established in Table 1 in accordance with the 24-hour reporting requirement in Part III.G.1. Violations of all other permit requirements are to be reported in the Annual Report (See Parts III.B., III.G. and III.H.).

6. This permit does not authorize the discharge of any waste streams, including spills and other unintentional or non-routine discharges of pollutants, that are not part of the normal operation of the facility as disclosed in the permit application.

7. For purposes of reporting on the DMR for a single sample, if a value is less than the method detection limit (MDL), the Permittee must report "less than {numeric value of the MDL}" and if the value is less than the minimum

level (ML), the Permittee must report "less than {numeric value of the ML}."

8. The Permittee is prohibited from discharging floating solids, garbage, debris, sludge, deposits, foam, scum or other residues of any kind.

9. The Permittee is prohibited from discharging surfactants and dispersants under this permit.

10. Any commingled discharges are subject to the most stringent effluent limitations for each individual discharge. If any individual discharge is not authorized, then a commingled discharge is not authorized.

11. When visual monitoring is required, the Permittee must conduct visual monitoring at the time of maximum estimated or measured discharge.

C. Graywater Effluent Limitations and Monitoring Requirements (Outfall 001)

1. The Permittee must limit and monitor discharges of graywater from Outfall 001 as specified in Table 1. The values represent maximum effluent limits unless otherwise indicated. The Permittee must comply with the effluent limits in Table 1 at all times, unless otherwise indicated, regardless of the frequency of monitoring or reporting required by other provisions of this permit.

2. The Permittee is prohibited from discharging food solids and kitchen oils from food preparation.

3. The Permittee must use phosphate-free and minimally-toxic soaps and detergents for any purpose if graywater will be discharged into waters subject to this permit. Soaps and detergents must be free from toxic or bioaccumulative compounds.

TABLE 1: *Graywater Effluent Limitations and Monitoring Requirements (Outfall 001).*

PARAMETER	EFFLUENT LIMITATIONS	SAMPLING FREQUENCY[1]	SAMPLE TYPE	REPORTED VALUES[6]
Flow	--	Daily	Estimate[5] or Meter	Average Weekly and Maximum Daily; *gpd*
pH	--	Weekly	Grab	Minimum and Maximum Values; *s.u.*
Total Suspended Solids (TSS)	--	Twice per year [2, 3]	Grab	*mg/L*
Biological Oxygen Demand (BOD_5)	--	Twice per year [2, 4]	Grab	*mg/L*
Oil and Grease	No Discharge	Daily	Observation	*Report*[7]
		When visual sheen observed	Grab	Average Monthly and Maximum Daily; *mg/L*
Floating Solids	No Discharge	Daily	Observation	*Report*[7]
Foam	No Discharge	Daily	Observation	*Report*[7]
Garbage	No Discharge	Daily	Observation	*Report*[7]
Oily Sheen	No Discharge	Daily	Observation	*Report*[7]

NOTES:
[1] Required during periods of discharge.
[2] The Permittee must monitor TSS and BOD_5 no less than twice (2) per year and may cease monitoring if a total of five (5) samples do not exceed numeric monitoring triggers for the respective parameters. The Permittee may collect and analyze all five samples during one operation season. All samples must be collected during maximum occupancy at the facility and during periods of maximum discharge. *See Footnotes 3 and 4.*
[3] The numeric monitoring trigger for TSS is 298 mg/L. If there is no exceedance of this value for a total of five (5) samples, then the Permittee may cease TSS monitoring for the duration of the permit term.
[4] The numeric monitoring trigger for BOD_5 is 914 mg/L. If there is no exceedance of this value for a total of five (5) samples, then the Permittee may cease BOD_5 monitoring for the duration of the permit term.
[5] Any estimation of effluent flow must include a narrative discussion of how the estimate is derived and a description of the procedures in the QAP (Permit Part II.B.).
[6] Refer to Permit Part I.B.2.
[7] The daily observations must occur during periods of maximum discharge.

D. REVERSE OSMOSIS REJECT WATER EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (OUTFALL 002)

The Permittee must monitor reverse osmosis reject water discharges from Outfall 002 as specified in Table 2. The Permittee must comply with the requirements in Table 2 at all times, unless otherwise indicated, regardless of the frequency of monitoring or reporting required by other provisions of this permit.

TABLE 2: *Reverse Osmosis Reject Water Effluent Limitations and Monitoring Requirements (Outfall 002)*			
PARAMETER	**SAMPLING METHOD**	**FREQUENCY[1]**	**REPORTED VALUES[3]**
Flow	Estimate[2] or Meter	Daily	Average Weekly and Maximum Daily; *gpd*
pH	Meter	Weekly	Maximum and Minimum; *s.u.*

NOTE:
[1] Required during periods of discharge.
[2] Any estimation of effluent flow must include a narrative discussion of how the estimate is derived and a description of the procedures in the QAP (Permit Part II.B.).
[3] See Permit Part I.B.2.

E. MONITORING PROCEDURES

Monitoring shall be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been approved by EPA.

1. Samples and measurements shall be representative of the volume and nature of the monitoring discharge.

2. The Permittee shall ensure that all effluent monitoring is conducted in compliance with good quality assurance and control procedures and the requirements of the permit.

II. SPECIAL CONDITIONS

A. BEST MANAGEMENT PRACTICES (BMP) PLAN

1. Purpose

The Permittee must develop and implement a BMP Plan that achieves the objectives and the specific requirements listed below. The Permittee must operate the facility in accordance with its current BMP Plan or in accordance with subsequent amendments to the BMP Plan.

The BMP Plan must be completed prior to commencing activities and kept onsite (Permit Part II.A.4.d.). Within 60 days of the effective date of this permit, the Permittee must submit a letter to EPA certifying that the BMP Plan has been developed or updated and is being implemented.

2. Through implementation of the BMP Plan, the Permittee must:

   (a) Prevent or minimize the generation and the potential for the release of pollutants from the facility to the waters of the United States through normal operations and ancillary activities; and

   (b) Ensure that methods of pollution prevention, control, and treatment will be applied to all wastes and other substances discharged.

3. The BMP Plan must be consistent with the following objectives and the general guidance contained in the publication entitled *Guidance Manual for Developing Best Management Practices* (EPA 833-B-93-004, October 1993) or any subsequent revisions to this guidance document:

   (a) The number and quantity of pollutants and the toxicity of effluent generated, discharged or potentially discharged at the facility must be minimized by the Permittee to the extent feasible by managing each influent waste stream in the most appropriate manner.

   (b) The Permittee must establish specific objectives for the control of pollutants by conducting the following evaluations:

      (i) Each facility component or system must be evaluated for its waste minimization opportunities and its potential for causing a release of significant amounts of pollutants to waters of the United States due to equipment failure, improper operation, and natural phenomena such as rain or snowfall, etc. The examination must include all normal operations and ancillary activities including loading or unloading operations or spillage or leaks.

(ii) Where experience indicates a reasonable potential for equipment failure, natural condition (e.g. precipitation), or other circumstances to result in significant amounts of pollutants reaching the surface waters, the Plan should include prediction of the rate of flow and total quantity of pollutants that could be discharged from the facility as a result of each condition or circumstance.

(c) Ensure that the requirements of the BMP Plan are considered as part of planned facility modifications, and that construction and supervisory personnel are aware of and take into account possible spills or releases of pollutants during facility construction or demobilization.

(d) Ensure no facility debris is left on the ice during the end-of-season demobilization of the Arctic Ice Camp.

(e) Establish specific best management practices for each component or system capable of generating or causing a release of significant amounts of pollutants, and identify specific preventative or remedial measures to be implemented.

(f) Ensure proper management of solid and hazardous waste in accordance with regulations promulgated under the Resource Conservation and Recovery Act (RCRA). Management practices required under RCRA regulations shall be referenced in the BMP Plan.

(g) Ensure that solids, sludges, or other pollutants removed in the course of treatment or control of water and wastewaters are disposed of in a manner such as to prevent any pollutant from such materials from entering navigable waters.

(h) Use of local containment devices such as liners, dikes, drip pans and other structures where chemicals, fuels, and/or oils are being managed or stored.

(i) Include the following provisions concerning BMP Plan review:

(i) Annual review by engineering staff and the responsible facility manager.

(ii) Annual review and endorsement by the Permittee's BMP Committee.

(iii) Include a statement that the above annual review has been completed and that the BMP Plan fulfills the requirements set forth in this permit. The statement must include the dated signatures of each BMP Committee member as certification of the annual reviews.

(iv) The Permittee must submit a copy of the annual certification statement and a report of all changes in the BMP Plan to the Director at least 14 calendar days prior the commencing activities at the facility.

4. Documentation

(a) Be documented in narrative form, and must include any necessary plot plans, drawings or maps, and shall be developed in accordance with good engineering practices.

(b) The BMP Plan must be organized with the following structure:

(i) name and location of the facility;

(ii) statement of BMP policy;

(iii) identification and assessment of potential effects of the pollutant discharges;

(iv) specific management practices and standard operating procedures to achieve the above objectives, including, but not limited to:

(a) The modification of equipment, facilities, technology, processes, and procedures, and

(b) The improvement in management, inventory control, materials handling, or general operational phases of the facility;

(v) Reporting of BMP incidents. The written reports must include a description of the circumstances leading to the incident, corrective actions take and recommended changes to operating and maintenance practices and procedures to prevent reoccurrence.

(vi) good housekeeping;

(vii) preventative maintenance;

(viii) inspections and records; and

(ix) employee training.

(c) The BMP Plan will include the following provisions concerning its review:

(i) provide for a review by the facility manager and appropriate staff; and

(ii) include a statement that the above review has been completed and that the BMP Plan fulfills the requirements set forth in the permit – the facility manager must certify and date the statement.

(d) The Permittee shall maintain a copy of its BMP Plan at the facility and shall make the plan available to EPA for review and approval upon request.

5. Modification of the BMP Plan

(a) The Permittee shall amend the BMP Plan whenever there is a change in the facility, its operations, or when any other circumstances materially increase the generation of pollutants and their release or potential release to the receiving waters. The Permittee shall modify the BMP Plan, as appropriate, when facility operations covered by the Plan change. Any such changes to the BMP Plan must be consistent with the objectives and specific requirements listed in Part II.A.2 and II.A.3. The facility manager or their designee must review and approve each change to the BMP Plan in accordance with Part II.A.3.j. and Part II.A.4.c.

(b) If a BMP Plan proves to be ineffective in achieving the general objective of preventing and minimizing the generation of pollutants and their release or potential release to the receiving waters and/or the specific requirements above, then the permit or the BMP Plan will be subject to modification to incorporate revised BMP requirements.

B. QUALITY ASSURANCE PLAN (QAP)

The Permittee must develop, or update, a quality assurance plan (QAP) for all monitoring required by this permit. Within 60 days of the effective date of this permit, the Permittee must submit written notice to EPA that the QAP has been developed and implemented. Any existing QAPs may be modified to fulfill the requirements under this section.

1. The QAP must be designed to assist in planning for the collection and analysis of effluent samples in support of the permit and in explaining data anomalies when they occur.

2. Throughout all sample collection and analysis activities, the Permittee must use the EPA-approved QA/QC and chain-of-custody procedures described in: *EPA Requirements for Quality Assurance Project Plans* (EPA/QA/R-5) and *Guidance for Quality Assurance Project Plans* (EPA/QA/G-5). The QAP must be prepared in the form specified in these documents.

   At a minimum the QAP shall include the following information:

   (a) Name(s), address(es) and telephone number(s) of the laboratories used by or proposed to be used by the Permittee.

   (b) Sample locations

   (c) Sample collection techniques and quality samples (field blanks, replicates, duplicates, control samples, types of containers, holding times, etc…).

   (d) Sample preservation methods.

   (e) Sample shipping requirements.

   (f) Instrument calibration procedures and preventative maintenance (frequency, standard, spare parts).

   (g) Analytical methods (including quality control checks, quantification/detection levels, precision and accuracy requirements.

   (h) Qualification and training of personnel.

3. All monitoring equipment shall be maintained in good working order and routinely calibrated. Calibration records shall be kept on all laboratory equipment and effluent monitoring equipment, including but not limited to effluent flow meters, pH meters, temperature meters, and weighing balances.

4. The Permittee must amend the QAP whenever there is a modification in sample collection, sample analysis, or other procedure addressed by the QAP or a change in the guidance cited above.

5. Copies of the QAP must be kept on site and made available to EPA upon request.

III. MONITORING, RECORDING AND REPORTING REQUIREMENTS

A. Representative Sampling (Routine and Non-Routine Discharges)

1. To ensure that the effluent limits set forth in this permit are not violated at times other than when routine samples are taken, the Permittee must collect additional samples at the appropriate outfall whenever any discharge occurs that may reasonably be expected to cause or contribute to a violation that is unlikely to be detected by a routine sample. The Permittee must analyze the additional samples for those parameters in Part I. of this permit.

2. The Permittee must collect additional samples as soon as the spill, discharge, or bypassed effluent reaches the outfall. The samples must be analyzed in accordance with Part III.C ("Monitoring Procedures"). The Permittee must report all additional monitoring in accordance with Part III.E ("Additional Monitoring by Permittee").

B. Reporting of Monitoring Results

1. The Permittee must submit all monthly monitoring results through the submission of Discharge Monitoring Report (DMR) forms (EPA No. 3320-1) or equivalent with an Annual Report. The DMRs must include the dates of when an authorized discharge commenced and ceased. If no discharge occurs during a particular month (i.e. the months when the facility is not in operation), the Permittee must indicate "no discharge" on the applicable month's DMR. The Permittee must submit the Annual Report, postmarked by the 1st day of June, for each year of facility operation.

2. The Permittee must either submit monitoring data and other reports in paper form, or must report electronically using NetDMR, a web-based tool that allows the Permittee to electronically submit DMRs and other required reports via a secure internet connection. Specific requirements regarding submittal of data and reports in paper form or electronic form using NetDMR are described as follows:

   (a) Paper Copy Submissions. The Permittee must sign and certify all DMRs, and other documents required by the permit, in accordance with the requirements of Part V.E of this permit ("Signatory Requirements"). The Permittee must submit legible originals of these documents to the Director, Office of Compliance and Enforcement at the following address:

U.S. Environmental Protection Agency, Region 10
1200 Sixth Avenue, Suite 900 (OCE-101)
Seattle, Washington 98101
ATTN: ICIS Data Entry Team

(b) Electronic Copy Submissions (NetDMR).

(i) The Permittee must sign and certify all DMRs in accordance with the requirements of Part V.E. of this permit ("Signatory Requirements"). Once a Permittee begins submitting reports using NetDMR, it will no longer be required to submit paper copies of DMRs or other reports to EPA.

(ii) The Permittee may use NetDMR after requesting and receiving permission from U.S. EPA, Region 10. NetDMR is accessed from https://netdmr.zendesk.com/home.

C. Monitoring Procedures

Monitoring must be conducted according to test procedures approved under 40 CFR 136 or other EPA-approved methods, unless other test procedures have been specified in this permit.

D. Additional Monitoring by Permittee

If the Permittee monitors any pollutant more frequently than required by this permit, using test procedures approved under 40 CFR 136 or as specified in this permit, the Permittee must include the results of that monitoring in the calculation and reporting of the data submitted in the DMR.

Upon request by EPA, the Permittee must submit results of any other sampling, regardless of the test method used.

E. Records Contents

Records of monitoring information must include the:

1. date, exact place, and time of sampling or measurements;
2. name(s) of the individual(s) who performed the sampling or measurements;
3. date(s) analyses were performed;
4. names of the individual(s) who performed the analyses;
5. analytical techniques or methods used; and
6. results of such analyses.

F. RETENTION OF RECORDS

The Permittee must retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, copies of DMRs, a copy of the NPDES permit, and records of all data used to complete the application for this permit, for a period of at least five (5) years from the date of the sample, measurement, report or application. This period may be extended by request of the EPA at any time.

G. TWENTY-FOUR HOUR NOTICE OF NONCOMPLIANCE REPORTING

1. The Permittee must report the following occurrences of noncompliance by telephone within 24 hours from the time the Permittee becomes aware of the circumstances:

   (a) any noncompliance that may endanger health or the environment;

   (b) any unanticipated bypass that exceeds any effluent limitation in the permit (See Part IV.G., "Bypass of Treatment Facilities");

   (c) any upset that exceeds any effluent limitation in the permit (See Part IV.H., "Upset Conditions"); or

   (d) any violations of the requirements established in Table 1.

2. The Permittee must also provide a written submission within five (5) days of the time that the Permittee becomes aware of any event required to be reported under Part III.H.1 ("Notice of Noncompliance Reporting"). The written submission must contain:

   (a) a description of the noncompliance and its cause;

   (b) the period of noncompliance, including exact dates and times;

   (c) the estimated time noncompliance is expected to continue if it has not been corrected;

   (d) steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance.

3. The Director of the Office of Compliance and Enforcement may waive the written report on a case-by-case basis if the oral report has been received within 24 hours by the NPDES Compliance Hotline in Seattle, Washington, by telephone, (206) 553-1846.

4. Reports must be submitted in paper form. The Permittee must sign and certify the report in accordance with the requirements of Part V.E. of this permit ("Signatory Requirements"). The Permittee must submit legible originals of these documents to the Director, Office of Compliance and Enforcement at the addresses in Part III.C ("Reporting of Monitoring Results").

H. Other Noncompliance Reporting

The Permittee must report all instances of noncompliance, not required to be reported within 24 hours, at the time that monitoring reports for Part III.C ("Reporting of Monitoring Results") are submitted. The reports must contain the information listed in Part III.H of this permit ("Twenty-Four Hour Notice of Noncompliance Reporting").

I. Notice of New Introduction of Pollutants

The Permittee must provide notice to the EPA as soon as it knows, or has reason to believe:

1. That any activity has occurred or will occur that would result in the discharge, on a routine or frequent basis, of any pollutant that is not limited in the permit.

2. That any activity has occurred or will occur that would result in the discharge, on a non-routine or infrequent basis, of any toxic pollutant that is not limited in the permit.

3. The Permittee must submit the notification to EPA, Region 10, Office of Water and Watersheds at the following address:

U.S. Environmental Protection Agency (OWW-191)
1200 Sixth Avenue, Suite 900
Seattle, Washington 98101
ATTN: NPDES Permits Unit Manager

J. Compliance Schedules

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit must be submitted no later than 14 days following each schedule date.

IV. COMPLIANCE RESPONSIBILITIES

A. Duty to Comply

The Permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Act and is grounds for enforcement action, for permit termination, revocation and reissuance, or modification, or for denial of a permit renewal application.

B. Penalties for Violations of Permit Conditions

1. Civil and Administrative Penalties. Pursuant to 40 CFR 19 and the Act, any person who violates section 301, 302, 306, 307, 308, 318 or 405 of the Act, or any permit condition or limitation implementing any such sections in a permit issued under section 402, or any requirement imposed in a pretreatment program approved under sections 402(a)(3) or 402(b)(8) of the Act, is subject to a civil penalty not to exceed the maximum amounts authorized by Section 309(d) of the Act and the Federal Civil Penalties Inflation Adjustment Act (28 U.S.C. § 2461 note) as amended by the Debt Collection Improvement Act (31 U.S.C. § 3701 note) (currently $37,500 per day for each violation).

2. Administrative Penalties. Any person may be assessed an administrative penalty by the Administrator for violating section 301, 302, 306, 307, 308, 318 or 405 of this Act, or any permit condition or limitation implementing any of such sections in a permit issued under section 402 of this Act. Pursuant to 40 CFR 19 and the Act, administrative penalties for Class I violations are not to exceed the maximum amounts authorized by Section 309(g)(2)(A) of the Act and the Federal Civil Penalties Inflation Adjustment Act (28 U.S.C. § 2461 note) as amended by the Debt Collection Improvement Act (31 U.S.C. § 3701 note) (currently $16,000 per violation, with the maximum amount of any Class I penalty assessed not to exceed $37,500). Pursuant to 40 CFR 19 and the Act, penalties for Class II violations are not to exceed the maximum amounts authorized by Section 309(g)(2)(B) of the Act and the Federal Civil Penalties Inflation Adjustment Act (28 U.S.C. § 2461 note) as amended by the Debt Collection Improvement Act (31 U.S.C. § 3701 note) (currently $16,000 per day for each day during which the violation continues, with the maximum amount of any Class II penalty not to exceed $187,500).

3. Criminal Penalties

   (a) Negligent Violations. The Act provides that any person who negligently violates sections 301, 302, 306, 307, 308, 318, or 405 of the Act, or any condition or limitation implementing any of such sections in a permit issued under section 402 of the Act, or any requirement imposed in a pretreatment program approved under

section 402(a)(3) or 402(b)(8) of the Act, is subject to criminal penalties of $2,500 to $25,000 per day of violation, or imprisonment of not more than 1 year, or both. In the case of a second or subsequent conviction for a negligent violation, a person shall be subject to criminal penalties of not more than $50,000 per day of violation, or by imprisonment of not more than 2 years, or both.

(b) Knowing Violations. Any person who knowingly violates such sections, or such conditions or limitations is subject to criminal penalties of $5,000 to $50,000 per day of violation, or imprisonment for not more than 3 years, or both. In the case of a second or subsequent conviction for a knowing violation, a person shall be subject to criminal penalties of not more than $100,000 per day of violation, or imprisonment of not more than 6 years, or both.

(c) Knowing Endangerment. Any person who knowingly violates section 301, 302, 303, 306, 307, 308, 318 or 405 of the Act, or any permit condition or limitation implementing any of such sections in a permit issued under section 402 of the Act, and who knows at that time that he thereby places another person in imminent danger of death or serious bodily injury, shall, upon conviction, be subject to a fine of not more than $250,000 or imprisonment of not more than 15 years, or both. In the case of a second or subsequent conviction for a knowing endangerment violation, a person shall be subject to a fine of not more than $500,000 or by imprisonment of not more than 30 years, or both. An organization, as defined in section 309(c)(3)(B)(iii) of the Act, shall, upon conviction of violating the imminent danger provision, be subject to a fine of not more than $1,000,000 and can be fined up to $2,000,000 for second or subsequent convictions.

(d) False Statements. The Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000, or by imprisonment for not more than 2 years, or both. If a conviction of a person is for a violation committed after a first conviction of such person under this paragraph, punishment is a fine of not more than $20,000 per day of violation, or by imprisonment of not more than 4 years, or both. The Act further provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or non-compliance shall, upon conviction, be

punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than 6 months per violation, or by both.

C. Need to Halt or Reduce Activity not a Defense

It shall not be a defense for the Permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with this permit.

D. Duty to Mitigate

The Permittee must take all reasonable steps to minimize or prevent any discharge in violation of this permit that has a reasonable likelihood of adversely affecting human health or the environment.

E. Proper Operation and Maintenance

The Permittee must at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) that are installed or used by the Permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems installed by the Permittee and used when necessary to achieve compliance with the conditions of the permit.

F. Removed Substances

Solids, sludges, or other pollutants removed in the course of treatment or control of water and waste waters shall be disposed of in a manner such as to prevent any pollutant from such materials from entering waters of the United States, except as specifically authorized in Part I.

G. Bypass of Treatment Facilities

1. Bypass not exceeding limitations. The Permittee may allow any bypass to occur that does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to ensure efficient operation. These bypasses are not subject to the provisions of Parts IV.G.2 and IV.G.3.

2. Notice.

   (a) Anticipated bypass. If the Permittee knows in advance of the need for a bypass, it must submit prior notice, if possible, at least 10 days before the date of the bypass.

   (b) Unanticipated bypass. The Permittee must submit notice of an unanticipated bypass as required under Part III.H ("Notice of Noncompliance Reporting").

3. Prohibition of bypass.

(a) Bypass is prohibited, and the Director of the Office of Compliance and Enforcement may take enforcement action against the Permittee for a bypass, unless:

(i) The bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

(ii) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass that occurred during normal periods of equipment downtime or preventive maintenance; and

(iii) The Permittee submitted notices as required under Part IV.G.2.

(b) The Director of the Office of Compliance and Enforcement may approve an anticipated bypass, after considering its adverse effects, if the Director determines that it will meet the three conditions listed above in Part IV.G.3.a.

H. Upset Conditions

1. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the Permittee meets the requirements of IV.H.2. of this permit. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

2. Conditions necessary for a demonstration of upset. To establish the affirmative defense of upset, the Permittee must demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

(a) an upset occurred and that the Permittee can identify the cause(s) of the upset;

(b) the permitted facility was being properly operated at the time of the upset;

(c) the Permittee submitted notice of the upset as required under Part III.H, "Notice of Noncompliance Reporting;" and

(d) the Permittee complied with any remedial measures required under Part IV.D, "Duty to Mitigate."

3. Burden of proof. In any enforcement proceeding, the Permittee seeking to establish the occurrence of an upset has the burden of proof.

I. Toxic Pollutants

The Permittee must comply with effluent standards or prohibitions established under Section 307(a) of the Act for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if the permit has not yet been modified to incorporate the applicable standard or prohibition.

J. Planned Changes

The Permittee must notify the Director of the Office of Water and Watersheds as soon as possible of any planned physical alterations or additions to the permitted facility whenever:

1. the alteration or addition to the facility may meet one of the criteria for determining whether a facility is a new source as determined in 40 CFR 122.29(b); or

2. the alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants that are not subject to effluent limitations in this permit, nor to requirements under Part III.J ("Notice of New Introduction of Pollutants").

K. Anticipated Noncompliance

The Permittee must give advance notice to the Director of the Office of Compliance and Enforcement of any planned changes in the permitted facility or activity that may result in noncompliance with this permit.

V. GENERAL PROVISIONS

A. Permit Actions

This permit may be modified, revoked and reissued, or terminated for cause as specified in 40 CFR 122.62, 122.64, or 124.5. The filing of a request by the Permittee for a permit modification, revocation and reissuance, termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

B. DUTY TO REAPPLY

If the Permittee intends to continue an activity regulated by this permit after the expiration date of this permit, the Permittee must apply for and obtain a new permit. In accordance with 40 CFR 122.21(d), and unless permission for the application to be submitted at a later date has been granted by the Director, the Permittee must submit a new application at least 180 days before the expiration date of this permit.

C. DUTY TO PROVIDE INFORMATION

The Permittee must furnish to EPA, within the time specified in the request, any information that the EPA may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The Permittee must also furnish to the Director, upon request, copies of records required to be kept by this permit.

D. OTHER INFORMATION

When the Permittee becomes aware that it failed to submit any relevant facts in a permit application, or that it submitted incorrect information in a permit application or any report to EPA, it must promptly submit such facts or information.

E. SIGNATORY REQUIREMENTS

All applications, reports or information submitted to EPA must be signed and certified as follows.

1. All permit applications must be signed as follows:

   (a) For a corporation: by a responsible corporate officer.

   (b) For a partnership or sole proprietorship: by a general partner or the proprietor, respectively.

   (c) For a municipality, state, federal, or other public agency: by either a principal executive officer or ranking elected official.

2. All reports required by the permit and other information requested by the EPA must be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

   (a) The authorization is made in writing by a person described above;

   (b) The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or

an individual or position having overall responsibility for environmental matters for the company; and

(c) The written authorization is submitted to the EPA.

3. Changes to authorization. If an authorization under Part V.E.2 is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of Part V.E.2. must be submitted to the EPA prior to or together with any reports, information, or applications to be signed by an authorized representative.

4. Certification. Any person signing a document under this Part must make the following certification:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

F. AVAILABILITY OF REPORTS

In accordance with 40 CFR Part 2, information submitted to EPA pursuant to this permit may be claimed as confidential by the Permittee. In accordance with the Act, permit applications, permits and effluent data are not considered confidential. Any confidentiality claim must be asserted at the time of submission by stamping the words "confidential business information" on each page containing such information. If no claim is made at the time of submission, EPA may make the information available to the public without further notice to the Permittee. If a claim is asserted, the information will be treated in accordance with the procedures in 40 CFR Part 2, Subpart B (Public Information) and 41 Fed. Reg. 36902 through 36924 (September 1, 1976), as amended.

G. INSPECTION AND ENTRY

The Permittee must allow the Director of the Office of Compliance and Enforcement, EPA Region 10, or an authorized representative (including an authorized contractor acting as a representative of the Administrator), upon the presentation of credentials and other documents as may be required by law, to:

1. Enter upon the Permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

2. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

3. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and

4. Sample or monitor at reasonable times, for the purpose of assuring permit compliance or as otherwise authorized by the Act, any substances or parameters at any location.

H. PROPERTY RIGHTS

The issuance of this permit does not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to persons or property or invasion of other private rights, nor any infringement of state or local laws or regulations.

I. TRANSFERS

Pursuant to 40 CFR §122.61(b)(1)-(3), this permit may be automatically transferred to a new permittee if:

1. The current permittee notifies the Director at least 30 days in advance of the proposed transfer date in section (2) of this paragraph;

2. The notice includes a written agreement between the existing and new permittees containing a specific date for transfer of permit responsibility, coverage, and liability between them; and

3. The Director does not notify the existing permittee and the proposed new permittee of his or her intent to modify or revoke and reissue the permit. A modification under this subparagraph may also be a minor modification under 40 CFR §122.63. If this notice is not received, the transfer is effective on the date specified in the agreement mentioned in section (2) of this paragraph.

J. OIL AND HAZARDOUS SUBSTANCE LIABILITY

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the Permittee from any responsibilities, liabilities, or penalties to which the Permittee is or may be subject under Section 311 of the Act.

K. State Laws

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the Permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state law or regulation under authority preserved by Section 510 of the Act.

L. Severability

The provisions of this permit are severable. If any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

M. Reopener Clause

1. This permit shall be modified, or alternatively, revoked and reissued, to comply with any applicable effluent standard or limitation issued or approved under Sections 301(b)(2)(C) and (D), 304(b)(2), and 307(a)(2) of the Act, as amended, if the effluent standard, limitation, or requirement so issued or approved:

   (a) Contains conditions more stringent than any effluent limitation in the permit; or

   (b) Controls any pollutant not limited in the permit.

   The permit as modified or reissued under this paragraph shall also contain any other requirements of the Act then applicable.

2. This permit may be modified, or alternatively, revoked and reissued in accordance with 40 CFR 122 and 124, to address the application of different permit conditions, if new information, such as future water quality studies or waste load allocation determinations, or new regulations such as changes in water quality standards, show the need for different conditions.

VI. DEFINITIONS AND ACRONYMS

1. § means section or subsection.

2. Act means the Clean Water Act.

3. Administrator means the Administrator of the EPA, or an authorized representative.

4. AML means average monthly limit; "monthly average limit" is synonymous.

5. Annual means once per calendar year

6. Average Monthly Discharge Limitation means the highest allowable average of "daily discharges" over a calendar month, calculated as the sum of all "daily discharges" measured during a calendar month divided by the number of "daily discharges" measured during that month.

7. Best Management Practices ("BMPs") means schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of "waters of the United States." BMPs also include treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

8. Biochemical Oxygen Demand (BOD_5) means the amount, in milligrams per liter, of oxygen used in the biochemical oxidation of organic mater in five days at 20°C.

9. BOD_5 means five-day biochemical oxygen demand.

10. Bypass means the intentional diversion of waste streams from any portion of a treatment facility, as specifically defined at 40 CFR § 122.41(m).

11. °C means degrees centigrade.

12. CFR means the Code of Federal Regulations.

13. CWA, or the Act, means the Clean Water Act.

14. Daily Discharge means the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in units of mass, the "daily discharge" is calculated as the total mass of the pollutant discharged over the day. For pollutants with limitations expressed in other units of measurement, the "daily discharge" is calculated as the average measurement of the pollutant over the day.

15. Daily Maximum Discharge means the highest allowable "daily discharge" and is also referred to as the "maximum daily discharge."

16. Director means the Director of the Office of Water and Watersheds, or Director of the Office of Compliance and Enforcement, EPA, or authorized representatives.

17. Discharge Monitoring Report ("DMR") means the EPA uniform national form, including any subsequent additions, revisions, or modifications for the reporting of self-monitoring results by Permittees. DMRs must be used by "approved States" as well as by EPA.

18. Discharge, when used without qualification, means the discharge of a pollutant.

19. Discharge of a pollutant means any addition of any "pollutant" or combination of pollutants to "waters of the United States" from any "point source".

20. Effluent means the segment of a wastewater stream that follows the final step in a treatment process and precedes discharge of the wastewater stream to the receiving environment.

21. EPA means the United States Environmental Protection Agency.

22. °F means degrees Fahrenheit.

23. GC/MS means gas chromatograph/mass spectrometer.

24. gpd means gallons per day.

25. Grab Sample is an individual sample collected over a period of time not exceeding 15 minutes.

26. Graywater means wastewater from a kitchen, sink, or other domestic source that does not contain excrement, urine or combined storm water.

27. Maximum means the highest measured discharge or pollutant in a waste stream during the time period of interest.

28. Maximum Daily Discharge Limitation means the highest allowable "daily discharge."

29. Measured means the actual volume of wastewater discharged using appropriate mechanical or electronic equipment to provide a totalized reading. Measure does not provide a recorded measurement of instantaneous rates.

30. Method Detection Limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.

31. MGD means million gallons per day.

32. Milligrams per liter (mg/L) means the concentration at which one thousandth of a gram (10^{-3}) is found in a volume of one liter.

33. mg/L means milligrams per liter.

34. Month means the time period from the 1st of a calendar month to the last day in the month.

35. Monthly average means the average of daily discharges over a monitoring month calculated as the sum of all daily discharges measured during a monitoring month divided by the number of daily discharges measured during that month.

36. NPDES means National Pollutant Discharge Elimination System.

37. Permittee means a company, organization, association, entity, or person who is issued a wastewater permit and is responsible for ensuring compliance, monitoring, and reporting as required by the permit.

38. pH means a measure of the hydrogen ion concentration of water or wastewater; expressed as the negative log of the hydrogen ion concentration in mg/L.

39. Pollutant means dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water.

40. Process Wastewater means any wastewater which, during processor operations, comes into direct contact with or results from the production or use of any raw material, intermediate product or by-product, or waste product.

41. QAP means the Quality Assurance Plan.

42. QA/QC means quality assurance/quality control.

43. Regional Administrator means the Regional Administrator of Region 10 of the EPA, or the authorized representative of the Regional Administrator.

44. Report means report results of an analysis.

45. Reverse Osmosis means a water purification technology that uses a semipermeable membrane to remove dissolved solids (e.g. salts) from water. Reverse osmosis is commonly used to purify drinking water and desalinate seawater to produce potable water.

46. R.O. means reverse osmosis.

47. Reverse Osmosis Reject Water means the concentrated waste stream that does not pass through the reverse osmosis membrane and is discharged from the system. The reject water consists of dissolved solids (e.g. salts) and a portion of the source water.

48. RWC means receiving water concentration, which is the inverse of the dilution factor.

49. Severe Property Damage means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

50. Sheen means an iridescent appearance on the water or ice surface.

51. s.u. means standard units for pH measurements.

52. Total Suspended Solids (TSS) means a measure of the filterable solids present in a sample, as determined by the method specified in 40 CFR Part 136.

53. Upset means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

54. Wastewater Treatment means any process to which wastewater is subjected in order to remove or alter its objectionable constituents and make it suitable for subsequent use or acceptable for discharge to the receiving environment.

55. 24-Hour Composite Sample means a combination of at least 8 discrete sample aliquots of at least 100 milliliters, collected at periodic intervals from the same location, during the operating hours of the facility over a 24 hour period. The composite must be flow-proportional. The sample aliquots must be collected and stored in accordance with procedures prescribed in the most recent edition of *Standard Methods for the Examination of Water and Wastewater*.

APPENDIX B ENDANGERED SPECIES ACT CONCURRENCE LETTERS

B.1 CONCURRENCE RECEIVED FROM THE NATIONAL MARINE FISHERIES SERVICE

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668

September 27, 2017

Elizabeth Nashold
Director, Fleet Installations and Environment
Department of the Navy
U.S. Fleet Forces Command
1562 Mitscher Ave., Suite 250
Norfolk, Virginia 23551-2487

Re: ESA Section 7 Consultation on Effects of Ice Exercise, NMFS #AKR-2017-9684

Dear Ms. Nashold:

The National Marine Fisheries Service (NMFS) has completed informal consultation under section 7(a)(2) of the Endangered Species Act (ESA) regarding the Department of the Navy's (Navy) proposed Ice Exercise 2018 (ICEX18) in the Beaufort Sea north of Alaska. Navy intends to carry out the action in accordance with section 5013 and 5062 of Title 10, United States Code (U.S.C.).

Based on our analysis of the information we received from you and on additional literature cited below, NMFS concurs with your determination that the proposed ICEX18 project is not likely to adversely affect Beringia Distinct Population Segment (DPS) bearded seals (*Erignathus barbatus*). This letter also addresses potential effects to Arctic ringed seals (*Phoca hispida hispida*). A complete administrative record of this consultation is on file in this office.

Consultation History

NMFS received your request for concurrence, dated June 12, 2017, that the proposed action may affect, but is not likely to adversely affect, the threatened Beringia DPS bearded seal. Your letter also indicated your determination that the ICEX18 project is likely to adversely affect Arctic ringed seals, and you requested a formal conference for this species. As we indicated in discussions with Laura Busch of your staff, we are unable to conduct a conference on ringed seals because this species is not currently proposed for listing under the ESA. The ESA listing of Arctic ringed seals was vacated by the U.S. District Court for the District of Alaska, and the case is presently on appeal. We are including in this letter an analysis of potential project effects to ringed seals and measures that would mitigate adverse effects to this species. Implementation of such measures is not required under the ESA because Arctic ringed seals are not listed.

A draft Letter of Concurrence (LOC) was sent to Ms. Laura Busch on July 17, 2017. Comments on the draft were received on September 1, 2017, at which point NMFS had received complete project information, and consultation was initiated.

Description of the Proposed Action and Action Area

The ICEX18 project involves constructing a temporary camp on an ice floe in the Beaufort Sea to conduct submarine training and testing and other research activities as described below. The primary purpose of the proposed action is to evaluate submarine operability in Arctic conditions. Secondarily, the proposed action will test emerging technologies and gather data on Arctic capabilities and environmental conditions.

The entire proposed action, including ice camp construction and demobilization, will occur over a six-week period from late February through early April 2018; the submarine training and testing and the research activities will occur over approximately four weeks within this time frame.

Action Area

The action area is defined in the ESA regulations (50 CFR 402.02) as the area within which all direct and indirect effects of the project will occur. The action area is distinct from and larger than the project footprint because some elements of the project may affect listed species some distance from the project footprint. The action area, therefore, extends out to a point where no measurable effects from the project are expected to occur.

The ice camp will be established in an area approximately 100 to 200 nautical miles (nmi) north of Prudhoe Bay, Alaska (Figure 1). The precise location for the ice camp cannot be predicted at this time, due to uncertainty of spring ice conditions. The ice camp requires both multi-year and first-year ice. Multi-year ice provides both stability for camp construction and a source of fresh water via ice mining. First year ice is smoother, which reduces the grooming time needed to prepare the runway for aircraft. NOAA's National Ice Center provides support to ICEX18 by locating and tracking potentially suitable ice floes for camp construction. Prior to set-up, reconnaissance flights are conducted over an area of approximately 70,374 square kilometers (km^2) to locate suitable ice conditions for the location of the ice camp.

The vast majority of training and research objectives will occur near the ice camp, although portions of the submarine training and testing may occur throughout the deep Arctic Ocean basin (Figure 1, purple area). Though the study area is large, the ice camp is only approximately 2 km^2 in size (Figure 1).

Camp Description

The ice camp consists of a command hut, dining tent, sleeping quarters, tents to house temporary visitors, a powerhouse, runway, and helipad (Figure 2). The number of shelters ranges from 10 to 20 and the shelters are typically 2 to 6 meters (m) by 6 to 10 m in size. The completed ice camp, including runway, is approximately 1.6 km in diameter. Support equipment for the ice camp includes snowmobiles, gas powered augers and saws (for boring holes through the ice), and diesel generators.

All ice camp materials, fuel, and food will be transported from Prudhoe Bay and delivered by air-drop from military transport aircraft (e.g., C-17 and C-130), or by small twin-engine aircraft and military and commercial helicopters landing on the ice camp runway. At the completion of ICEX, the ice camp will be demobilized, and all personnel and construction material, solid waste, hazardous waste, and sanitary waste will be removed from the ice floe. All wastes will be disposed of in accordance with applicable laws and regulations.

Prudhoe Bay Transport Hub

During the proposed action, flights to and from Prudhoe Bay would use the public Deadhorse Airport, located next to Prudhoe Bay. Up to nine round trips could occur daily in addition to the usual flight traffic that occurs at the airport (average of 90 flights per day). All flights would leave from Deadhorse Airport and fly directly to the ice camp. Additionally, exercise torpedoes (i.e., non-explosive) that are retrieved from the water column following submarine training and testing would be transported to and processed at Prudhoe Bay and then be prepared for transport in accordance with existing Navy policies.

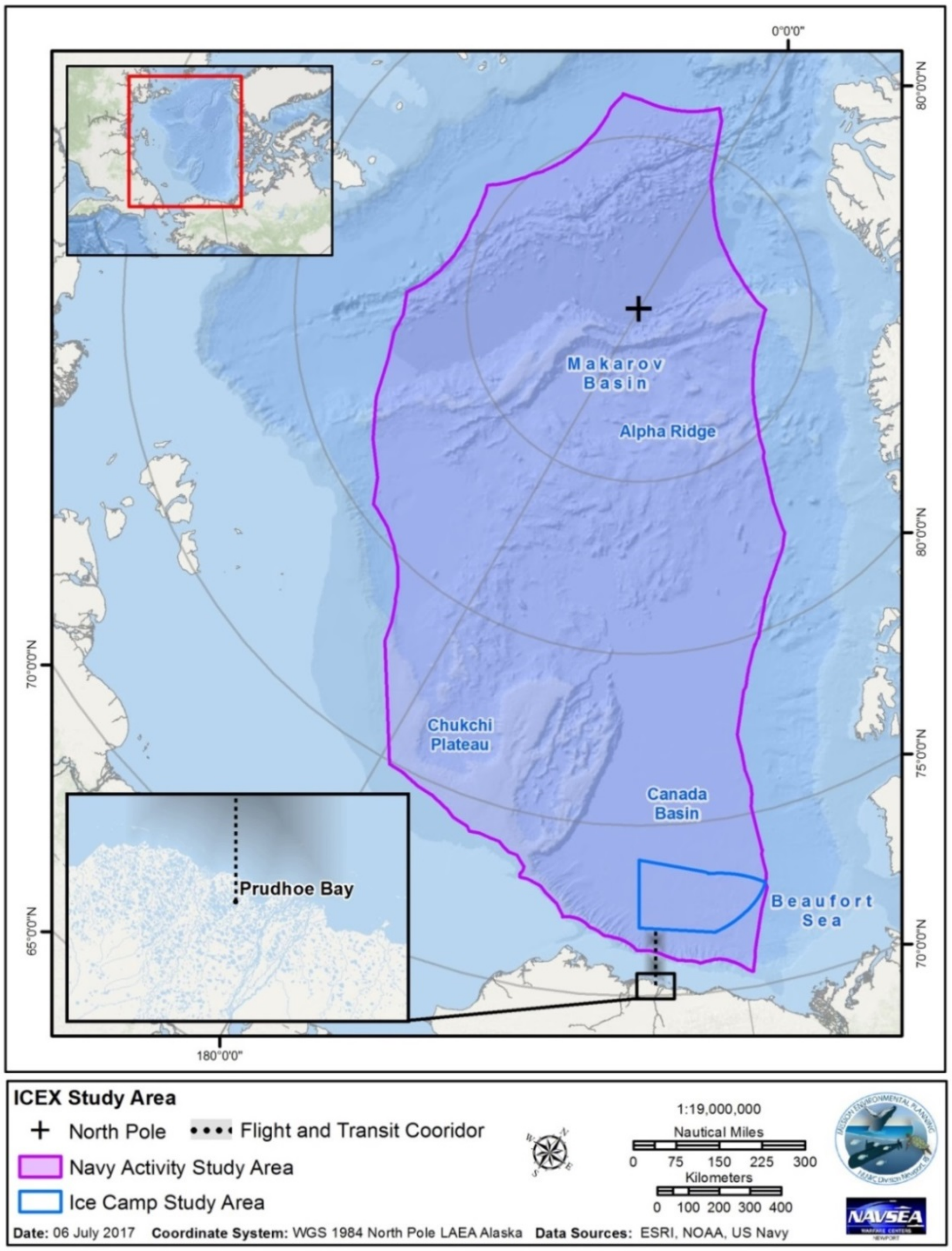

Figure 1. Project location, Navy ICEX18, Beaufort Sea

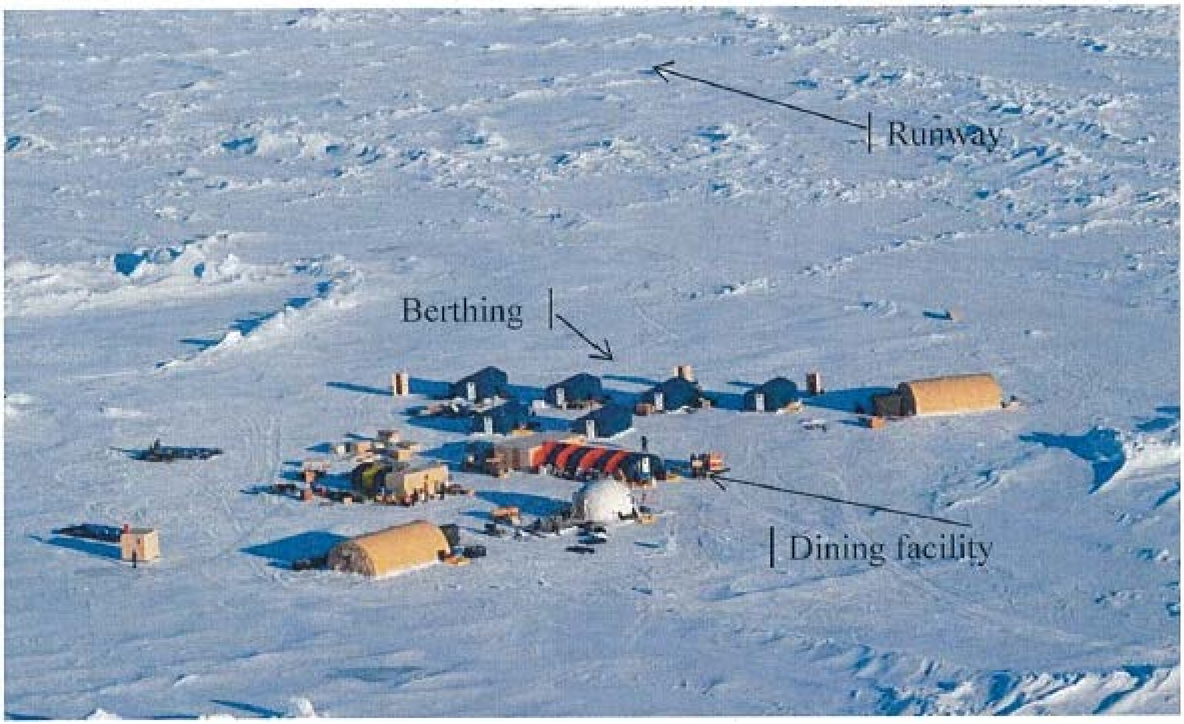

Figure 2. Typical layout of ice camp

Transportation Platforms

Typical platforms used for ice camp logistics and support include on-ice vehicles (e.g., snow machines), aircraft, unmanned vehicles (both aerial and underwater), and passive devices. The only platforms to be used in the vicinity of bearded seals are aircraft leaving from the Deadhorse Airport in Prudhoe Bay. All other platforms will be deployed far outside of the bearded seal range during the timeframe of the proposed action and were determined by the Navy to have no effect to this species.

Aircraft that may be used during ICEX18 include small, single or twin-engine fixed-wing aircraft and rotary-wing aircraft (helicopters) (Figure 3 *a-d*). These aircraft will transport shelters, personnel, and equipment to and from the ice camp and will also support many of the research activities. In addition to the typical commercial aircraft, military aircraft may be used, depending on their availability. Examples of military aircraft that may be used include C-130, V-22, and C-17 transport craft (as well as the LC-130, which is a modified C-130 suited to land on the ice) and CH-47 Chinook heavy-lift helicopters (Figure 3 *e-h*). These aircraft are much larger than the small, fixed-wing aircraft typically used and will allow for more efficient transport of supplies to and from the camp (i.e., fewer trips). Equipment and material may be dropped by parachute from these military aircraft. The LC-130 will conduct up to four round trip flights to the ice camp over the course of the exercise; these are included within the maximum number of daily flights to the ice camp.

Figure 3. Aircraft to be used during ICEX18. A-d: smaller aircraft ; e-h: Military Fixed-Wing Aircraft (left panel; LC-130), Rotary-Wing Aircraft (right panel; CH-47) and V-22 (lower left and right)

Research Activities

Details on submarine activities and specific systems associated with ICEX18 are classified, but generally entail safety maneuvers, use of active sonar (producing non-impulsive sounds) and non-explosive exercise torpedoes. These maneuvers and sonar use are similar to submarine activities conducted in other undersea environments; they are being conducted in the Arctic to test their performance in a cold environment. Submarines and other in-water vessels (see below) may deploy in ocean waters 3,000 to 4,000 m deep (Jakobsson *et al.* 2012), but will operate at a maximum depth of 800 m.

In addition to submarine training and testing, personnel and equipment proficiency testing and multiple research and development activities will be conducted. Each type of activity scheduled for ICEX18 has been placed into one of seven general categories of actions (Table 1).

Table 1. Summary of Training and Testing and Research Objectives

Activity Type	Category of Action	Project	Description
Submarine Training and Testing	Logistics	Ice Camp Operations	A camp is constructed and an associated underwater tracking range is deployed to support submarine training and testing.
	Submarine Training	Submarine Training and Testing	Submarines conduct various training events.
Research Objectives	Aerial Data Collection	Aircraft	Use of manned aircraft and sensors to collect ice and snow thickness data and to validate/calibrate satellite measurements.
		Balloon	Launch of balloons to collect atmospheric data, primarily for weather forecasting.
	In-water Device Data Collection	Buoy	Deployment of surface buoys through the ice to collect measurements of conductivity, temperature, and ocean/ice fluxes.
		Array	Use of acoustic arrays to collect data on ambient noise, as well as determine signal propagation through Arctic environments.
	Personnel/ Equipment Proficiency	Diving Evolutions	Diver personnel conduct cold water diving evolutions under the ice using various equipment.
		Personnel/ Equipment Air-Drop	Fixed-wing and rotary-wing aircraft deliver paratroopers and equipment to the ice camp. Equipment is dropped by parachute to support camp operations (e.g., food, fuel, building materials) as well as to verify search and rescue equipment delivery.
		Aircraft Landing Evaluation	Military aircraft are flown to the ice camp to evaluate the use of landing skis in the Arctic environment.
	Unmanned Aerial System Testing	Fixed-Wing	Fixed-wing unmanned aerial systems are launched by hand or pneumatic catapult. Fixed-wing systems may have up to a 10 ft (3 m) wingspan and fly at speeds up to 80 knots.
		Rotary-Wing	Rotary-wing unmanned aerial systems ("quadcopters") used individually or simultaneously. Rotary-wing systems are approximately 20 in (51 cm) square and fly at speeds up to 30 knots.
	Unmanned Underwater Vehicle Testing	Vehicle Testing	Autonomous and tethered unmanned underwater vehicles deployed to test navigation, control, and communications in the polar environment, as well as to gather data on existing oceanographic conditions.

Unmanned Vehicles and Systems

Unmanned underwater vehicles would either maneuver autonomously, or may be tethered to a command center. Unmanned underwater vehicles are typically slow moving (less than 5 knots), and range in size from approximately 52 cm in length and width to 493 cm in length and 53 cm in diameter. Some unmanned underwater vehicles would use active acoustic sources. Details for the active sources described above can be found in Table 2. Additionally, some unmanned underwater vehicles would operate at frequencies above (outside) known marine mammal hearing ranges; these are not discussed further in this document.

In addition to unmanned underwater vehicles, various unmanned aerial systems are proposed for testing. Systems used may be either fixed-wing or rotary-wing. Fixed-wing systems may have wingspans up to approximately 305 cm, and fly at speeds of about 80 knots. Rotary-wing systems are typically smaller, approximately 51 cm in length and width, and fly at speeds of about 30 knots (Figure 4).

Table 2. Parameters of devices with active acoustics

Research Institution	Source Name	Frequency Range (kHz)	Source Level (dB)	Pulse Length (milli-seconds)	Duty Cycle (Percent)	Associated Bin[1]	Source Type
Office of Naval Research	Autonomous Reverberation Measurement System	3 to 6	200	1,000	1.67	MF9	Moored
Naval Research Laboratory	SAS	Classified					Unmanned Underwater Vehicle
Massachusetts Institute of Technology/ Lincoln Labs	Continuous Wave[2]	0.20 to 1.2	190	continuous	100	LF4	Moored
	Chirp[2]	0.25 to 1.2	190	15,000	25	LF4	Moored

Figure 4. Examples of fixed and rotary-wing unmanned aerial systems for ICEX 18

Scientific Devices

Various passive and active acoustic devices would be used for data collection, including weather balloons, a vertical array, and buoys.

Passive Devices

--Weather Balloons

Accurate weather forecasting is essential for a successful ICEX. To support weather observations, up to two Kevlar or latex balloons would be launched per day for 20 days at the ice camp (40 balloons total). These balloons and associated radiosondes (a sensor package that is suspended below the balloon) are similar to those that have been deployed by the National Weather Service since the late 1930s. When released, the balloon is approximately 1.5- 1.8 m in diameter and gradually expands as it rises owing to the decrease in atmospheric pressure. When the balloon reaches a diameter of 4-7 m, it bursts and a parachute is deployed to slow the descent of the associated radiosonde. Weather balloons are not recovered.

--Vertical Line Array

A vertical line array would be deployed through the ice to measure ambient underwater noise and sound propagation through Arctic waters. This array would contain a series of acoustic recorders located at depths from 0 to 730 m. The array would be retrieved from the ice after approximately one week of data gathering.

--Scientific Buoys

Various scientific buoys (typically less than 1m in diameter) will be deployed. An estimated five geographic positioning system buoys will be dropped from an aircraft on various ice floes in order for smaller aircraft capable of landing on the ice to re-locate the floes to determine suitability for the establishment of the ice camp; none of these buoys would be retrieved. To support submarine self-tracking, an acoustic buoy would be deployed and would emit a homing signal so that the submarines can determine their location relative to the ice camp. This buoy will be retrieved at the completion of the exercise. The remaining buoys will be deployed as part of the research activities to collect data on the under-ice topography and environmental conditions. These buoys have sensors that can extend as much as 800 m below the ice; sensor packages may either remain stationary below the ice or may move vertically to gather data at various depths within the water column. These buoys would be left in place for up to two years to gather data, after which time they are expected to eventually sink to the seafloor. Finally, two radiofrequency identification tags would be deployed on the ice surface to determine their effectiveness in the Arctic environment for tracking ice movements. Radiofrequency tags would not be recovered.

Active Acoustic Devices

- An *Autonomous Reverberation Measurement System* will be attached to the bottom of the ice and may be active for up to 30 days during ICEX. The device would transmit up to four hours per day.
- Additionally, a *Massachusetts Institute of Technology/Lincoln Lab vertical line array* will be deployed through a hole in the ice to a source depth of 150 m. This array would have continuous wave and chirp transmission capability. The continuous wave and chirp transmissions would both be active four hours per day for no more than 8 days during ICEX. Acoustic parameters for all active sources can be found in Table 2.

Standard Operating Procedures and Mitigation Measures

Standard operating procedures and mitigation measures will be implemented during the proposed action. Standard operating procedures serve primarily to provide safety and mission success and are implemented regardless of their secondary benefits (e.g., to a resource). Mitigation measures are used to avoid or reduce potential impacts. The standard operating procedures and mitigation measures that are applicable to the proposed action are provided below.

Standard Operating Procedures

- Ice camp activities and personnel movement within the camp will only occur during daylight hours.
- Pilots will make every attempt to avoid large flocks of birds (which are unlikely) in order to reduce the safety risk involved with a potential bird strike.
- The location for any air-dropped equipment and material will be visually surveyed prior to release of the equipment/material to ensure the landing zone is clear. Equipment and materials will not be released if any animal is observed within the landing zone.
- Air drop bundles will be packed within a plywood structure with honeycomb insulation to protect the material from damage.
- Spill response kits/material will be on-site prior to the air-drop of any material.

Mitigation Measures

- Safety permitting, as aircraft approach the camp, aircraft crew will ensure that the landing zone is clear of any animals and will report the presence and behavior of any seals observed on the ice.
- For activities involving active acoustic transmission from submarines and torpedoes, passive acoustic sensors on the submarines will listen for vocalizing marine mammals. If a marine mammal is detected, the submarine would cease active transmissions, including the launching of torpedoes, and not restart until after 15 minutes have passed with no marine mammal detections.
- Passengers on all on-ice vehicles would observe for marine and terrestrial animals; any marine or terrestrial animal observed on the ice would be avoided by 100 m.
- On-ice vehicles would not be used to follow any animal [with the exception of actively deterring polar bears if the situation requires].
- Personnel operating on-ice vehicles would avoid areas of snow drifts >0.5 m in depth (often near pressure ridges), which are preferred areas for ringed seal subnivean lairs.
- All material (e.g., construction material, unused food, excess fuel) and wastes (e.g., solid waste, hazardous waste) would be removed from the ice floe upon completion of ICEX18; only scientific buoys and radiofrequency identification tags would be left behind.

Listed Species

<u>Bearded Seal, Beringia DPS</u>

The Beringia DPS bearded seal *(Erignathus barbatus)* is the only ESA-listed species under NMFS jurisdiction that may be affected by the ICEX18 activities. Bearded seals, members of the "true seal" family, Phocidae, are the largest of the Arctic seals, reaching lengths of 2.0 to 2.5 m and weights of 260 to 360 kg. They are distinguished by their small head, small, squared

foreflippers, and short snout with the thick, long, white whiskers that give them their namesake "beard" (Figure 5). Detailed information on the species' description, distribution, life history and status can be found at the following websites:
http://www.fisheries.noaa.gov/pr/species/mammals/seals/bearded-seal.html
http://www.nmfs.noaa.gov/pr/sars/pdf/stocks/alaska/2016/ak2016_bearded_seal.pdf

Figure 5. Bearded seal.

Distribution and Taxonomy
The bearded seal is a northern/arctic species with a circumpolar distribution. The species' range extends from the Arctic Ocean (85°N) south to Sakhalin Island (45°N) in the Pacific and south to Hudson Bay (55°N) in the Atlantic (Figure 6). Two subspecies have been described: *E. b. barbatus* from the Laptev Sea, Barents Sea, North Atlantic Ocean, and Hudson Bay; and *E. b. nauticus* from the remaining portions of the Arctic Ocean and the Bering and Okhotsk seas. Based on evidence for discreteness and ecological uniqueness of bearded seals in the Sea of Okhotsk, *E. b. nauticus* was further divided into an Okhotsk DPS and a Beringia DPS (Muto *et al.* 2017). Only individuals of the Beringia DPS occur in the ICEX18 action area.

Status
The Beringia DPS of bearded seals was listed as threatened under the ESA on December 28, 2012, due to the expected loss of sea ice and alteration of prey availability from climate change in the foreseeable future (77 FR 76739). On July 25, 2014, the U.S. District Court for Alaska issued a memorandum decision in a lawsuit challenging the listing, which vacated NMFS's threatened listing of the Beringia DPS. NMFS appealed this decision, and on May 12, 2017, the U.S. District Court for Alaska issued a final judgement reversing its prior ruling and reinstating the species' ESA threatened status. Critical Habitat has not been designated for the Beringia DPS bearded seal.

Life History and Movements
Bearded seals inhabit the seasonally ice-covered seas, where they whelp and rear their pups and molt their coats on the ice in the spring and early summer (Cameron *et al.* 2010). Males reach sexual maturity at six to seven years of age; recent evidence indicates that females mature at about 4 years of age (Quakenbush *et al*. 2011). Pups are usually born between mid-March and

May and are weaned within three to four weeks. Mating occurs toward the end of lactation (Cleator and Stirling 1990). The presence of sea ice is considered a requirement for whelping and nursing young (Cameron *et al.* 2010).

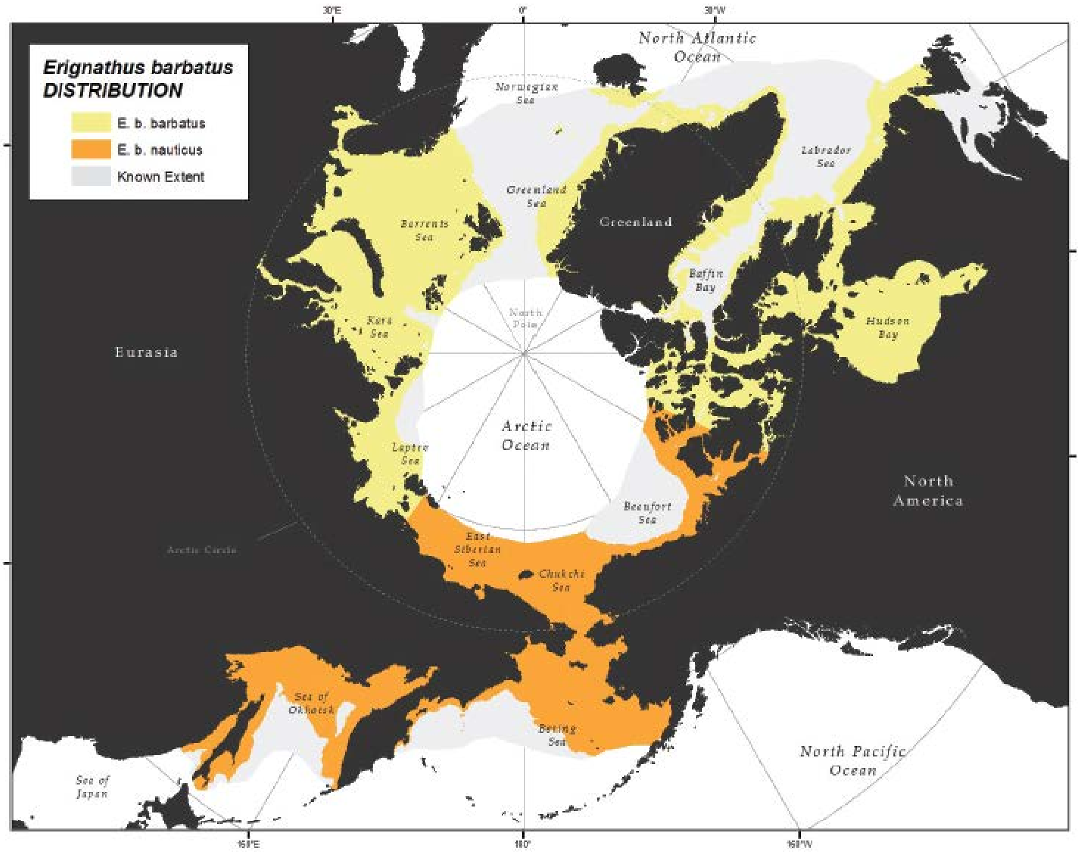

Figure 6. Rangewide distribution of both bearded seal subspecies

Bearded seals feed primarily on benthic organisms, including arctic cod, shrimp, clams, crabs, and octopus, and so are closely linked to areas where the seafloor is shallow (less than 200 m). Using stomach contents from 943 bearded seals collected between 1961 and 2009, Quakenbush *et al.* (2011) identified 213 different fish and invertebrate prey, of which 113 were common. Spring surveys conducted in 1999 and 2000 along the Alaskan coast indicate that bearded seals are typically more abundant 20-100 nmi (37-185 km) from shore than within 20 nmi of shore (Bengtson *et al*. 2005; Simpkins *et al*. 2003).

Although bearded seals are present in the Beaufort Sea year round (MacIntyre *et al*. 2013), during winter their highest densities are found in the central and northern Bering Sea shelf (Burns and Frost 1979; Nelson *et al*. 1984). From late April through June, many of the seals that winter in the Bering Sea move north through the Bering Strait and spend the summer in the Chukchi and Beaufort Seas (Burns 1981). Recent satellite telemetry data have confirmed this pattern, and showed male bearded seals in the Bering Sea appear to exhibit strong winter site fidelity, often establishing territories at preferred sites as sub-adults (Boveng and Cameron, 2013).

As the ice forms again in the fall and winter, most seals move south with the advancing ice edge through the Bering Strait, to spend the winter in the Bering Sea (Burns and Frost 1979; Cameron and Boveng 2009; Frost *et al*. 2008). In late winter and early spring, bearded seals are widely distributed from the Beaufort and Chukchi Seas south to the ice front in the Bering Sea, usually on drifting pack ice (Muto *et al*. 2017).

Hearing Ability

Male bearded seals produce distinctive underwater calls ranging from approximately 0.2 to 6 kHz (MacIntyre *et al.* 2015). NMFS classifies bearded seals in the phocid pinniped functional hearing group. As a group, it is estimated that phocid pinnipeds can hear frequencies between 0.075 and 100 kHz (NOAA 2016). Direct studies of bearded seal hearing have not been conducted, but it is assumed that they can hear the same frequencies that they produce and are likely most sensitive to this frequency range (Richardson *et al*. 1995).

<u>Arctic Ringed Seal</u> (listing currently vacated)

Status

Of the five ringed seal subspecies, the Arctic ringed seal is the smallest and most wide-ranging and the only subspecies of ringed seal in the action area. Information on Arctic ringed seal biology and habitat is available at: http://www.nmfs.noaa.gov/pr/species/mammals/seals/ringed-seal.html and http://www.nmfs.noaa.gov/pr/sars/pdf/stocks/alaska/2016/ak2016_ringedseal.pdf

The Arctic ringed seal was listed as threatened under the ESA on December 28, 2012 (77 FR 76739). On March 17, 2016, the U.S. District Court for Alaska issued a memorandum decision in a lawsuit challenging the listing of Arctic ringed seals (Alaska Oil and Gas Association v. NMFS, Case No. 4:14-cv-00029- RRB). The decision vacated NMFS's listing of the Arctic ringed seals as a threatened species. NMFS has appealed that decision to the Ninth Circuit. While the appeal is pending, our consultation documents will continue to address effects to Arctic ringed seals so that action agencies have the benefit of NMFS's analysis of the consequences of the proposed action on the species, even though the listing is not in effect.

Life History

Ringed seals can be found farther offshore than other pinnipeds since they can maintain breathing holes in ice thickness greater than 7 ft (2 m) (Smith and Stirling 1975). They remain in contact with ice most of the year, using it as a platform for pupping and nursing in late winter to early spring, for molting in late spring to early summer, and for resting at other times of the year. Ringed seals start to construct and maintain a series of breathing holes as soon as sea ice begins to form in late autumn or early winter (Smith and Stirling, 1975). Individual seals maintain many breathing holes (Hammill and Smith 1989; Kelly and Quakenbush 1990). As sufficient snow accumulates around these breathing holes, some are developed into lairs that afford protection from predators and weather (Smith and Stirling, 1975; Kelly *et al.*1986).

Prior to parturition, female ringed seals construct large, multi-chambered lairs under the snow that are used for pupping and protection from predators. These birthing lairs are typically constructed near pressure ridges where snow accumulates (Smith 1973). Most lairs are formed along ridges that are at least 30 inches (76 cm) in height (Hammill and Smith 1989). (Kelly

1988; Lydersen and Gjertz 1986; Smith and Stirling 1975), and such depths typically are found only where 8–12 inches (20–30 cm) or more of snow has accumulated on flat ice and then drifted along pressure ridges or ice hummocks (Lydersen and Ryg 1991). Far offshore areas of drifting but relatively stable pack ice are important pupping habitat for ringed seals (Smith and Stirling 1975; Wiig *et al.* 1999; Kelly *et al*. 1986).

Ringed seal pups are born in lairs from March through April, and females nurse their pups in the lairs for 5 to 8 weeks. The pups' high surface-to-body ratio and slow accumulation of blubber relative to other ice seals makes them dependent on their lairs for thermal protection (Smith and Stirling 1975). If compelled to flee into the water, pups can become hypothermic (Smith *et al*. 1991), and the probability of their survival can drop.

Distribution in Project Area

In Alaskan waters, when sea ice is at its maximal extent during winter and early spring, ringed seals are abundant in the northern Bering Sea, Norton and Kotzebue Sounds, and throughout the Chukchi and Beaufort Seas (Frost 1985; Kelly 1988b) and, therefore, are found in the study area. Passive acoustic monitoring in the Chukchi Sea (Jones *et al.,* 2014) detected ringed seals in the study area (120 km north-northwest of Barrow) between mid-December and late May over the four year study. Ringed seals may occur within the study area throughout the year and during the proposed action.

With the advancing ice pack, many seals disperse throughout the Chukchi and Bering Seas, although some remain in the Beaufort Sea (Crawford *et al.,* 2012; Frost and Lowry 1984; Harwood *et al.,* 2012). During the subnivean period (using shorefast ice), Kelly *et al.* (2010) report the size of the home ranges varied from less than 1 km^2 up to 27.9 km^2. Most (94 percent) of the home ranges were less than 3 km^2 during the subnivean period. Some adult ringed seals return to the same small home ranges they occupied during the previous winter (Kelly *et al.,* 2010). Home ranges of ringed seals not restricted to lairs may be much larger. Born *et al.* (2004) report that near large polynyas, ringed seals in Baffin Bay maintain ranges up to 7,000 km^2 during winter. However, the size of winter home ranges varied by up to a factor of 10 depending on the amount of fast ice; seal movements were more restricted during winters with extensive fast ice, and were much less restricted where amounts of fast ice were lower.

Hearing ability

Ringed seals produce underwater vocalizations ranging from approximately <0.1 to 1.5 kHz (Jones *et al*. 2014). NMFS classifies ringed seals in the phocid pinniped functional hearing group (NOAA 2016), with estimated hearing frequency range of 0.075 to100 kHz . Audiograms for two captive ringed seals showed best hearing at frequencies of 12.8 kHz in water and 4.5 kHz in air (Sills *et al*. 2015).

Effects of the Action

For purposes of the ESA, "effects of the action" means the direct and indirect effects of an action on the listed species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action (50 CFR 402.02). The applicable standard to find that a proposed action is "not likely to adversely affect" listed species is that all of the effects of the action are expected to be insignificant, discountable, or completely beneficial. Insignificant effects relate to the size of the impact and are those that one would not be able to meaningfully measure, detect, or evaluate, and should never reach the scale where take occurs. Discountable effects are those that are extremely unlikely to occur. Beneficial effects are positive effects without any adverse effects (even short-term) to the species.

This consultation analyzes the effects of the action in light of NMFS interim guidance on the term "harass" pursuant to the ESA, which means to: "create the likelihood of injury to wildlife by annoying it to such an extent as to *significantly* disrupt normal behavioral patterns, which include, but are not limited to, breeding, feeding, or sheltering" (Wieting 2016). This definition aligns with the Marine Mammal Protection Act definition of "harassment" for military readiness activities, as amended by the National Defense Authorization Act of 2004 (Pub. L. 108-136).

The potential effects of the proposed action on bearded and ringed seals include:

- *Acoustic effects* from active transmissions from submarines and research activities;
- *Incidental noise and ice vibration* from aircraft transporting supplies and personnel between the camp and Prudhoe Bay, on-ice vehicle operation, and human presence; and
- *Physical effects* from vessel or vehicle strike, entanglement in or ingestion of expended materials, waste and reject water discharge, and fuel spills.

Active Transmissions

Both submarine training and research activities have acoustic transmissions with potential effects to ringed seals. Some acoustic sources are either above the known hearing range of marine species or have narrow beam widths and short pulse lengths that affect a very small area of water for a very short amount of time, and are therefore extremely unlikely to affect marine mammals that are present at low densities in the action area. Submarine training and testing, which are proposed to occur over a two-week period, are the only portions of the proposed action with active acoustics that require quantitative analysis. Effects to seals swimming underwater are the primary concern regarding this active transmission, because the sound levels received by hauled out seals will be much lower, due to transmission loss through the ice and air.

Marine mammals exposed to high-intensity sound, or to lower-intensity sound for prolonged periods, can experience the loss of hearing sensitivity at certain frequency ranges (Finneran 2015). This hearing "threshold shift" (TS) can be permanent (PTS), not fully recoverable, or temporary (TTS), in which case the animal's hearing threshold would recover over time (Southall *et al*., 2007). Repeated sound exposure that leads to TTS could cause PTS. In severe cases of PTS, there can be total or partial deafness, while in most cases the animal has an impaired ability to hear sounds in specific frequency ranges (Kryter, 1985).

The Navy Acoustic Effects Model (NAEMO) was used to produce a quantitative estimate of the total sound exposure level and maximum sound pressure level that a ringed seal may receive underwater from acoustic transmissions. In NAEMO, "animats" (modeled animal unit) are distributed randomly based on species-specific density, depth distribution, and group size information, and animats record projected energy received at their location in the water column. A fully three-dimensional environment is used for calculating sound propagation and animat exposure in NAEMO. A full description of NAEMO can be found in the Naval Undersea Warfare Center Newport Technical Report available online at: http://hstteis.com/Portals/0/hstteis/SupportingTechnicalDocs/TR_12084A_HSTT_Final.pdf.

The Navy uses behavioral response functions (BRFs) to estimate the probability that marine mammals will display behavioral effects to received sound (Finneran and Jenkins 2012). Although the BRFs were originally derived from few studies, primarily on captive dolphins and belugas (Navy 2003, Finneran and Schlundt 2004, Nowacek *et al*. 2004, Navy 2008, Navy 2012), they have been updated to include data on captive hooded and gray seals and California sea lions (Gotz *et al.* 2010; Houser *et al*. 2013; Kvadsheim *et al.* 2010); they constitute the best science available at this time for assessing such effects.

For the ICEX18 acoustic transmissions, NAEMO calculated that zero ringed seals were likely to experience received sound exposure levels that may result in permanent threshold shifts (PTS). NAEMO further calculated that 11 ringed seals could experience TTS and an additional 1665 individuals could respond behaviorally to acoustic transmissions associated with ICEX 18 (Navy 2017).

Given these modeling results, NMFS is in the process of preparing an Incidental Harassment Authorization for ringed seals under the Marine Mammal Protection Act for this project, and a formal consultation under the ESA would be required if the Arctic ringed seal listing is reinstated prior to completion of the proposed action. However, it is worth noting that the number of ringed seals that will be disturbed to a degree that would be considered take under the ESA may be considerably lower than the modeled results, for several reasons.

- The Navy will implement a mitigation measure specifically for ICEX18 to minimize acoustic effects to ringed seals swimming underwater. Submarines will use passive acoustic sensors to listen for vocalizing marine mammals and will halt active transmissions in the event vocalizing marine mammals are detected.
- In a study conducted in the Beaufort Sea, ringed seals showed relatively minor responses to impulsive sounds from airgun arrays. Some, but not all ringed seals encountering airgun arrays with impulse output up to ~222 dB source level avoided the zone within 492 ft (150 m) of the source [received level of 189 dB], not moving much beyond 820 ft (250 m) from the source [received level of 186 dB]. The airgun operations did not cause seals to abandon the general area of the activity (Harris *et al.* 2001).
- Compiling data from available non-impulsive sounds (as will be used in this proposed action), Southall *et al.* (2007) concluded the limited data suggest that exposures between ~90 and 140 dB re: 1 μPa generally do not appear to induce strong behavioral responses in pinnipeds that are in the water when the sounds are encountered. No data exist regarding exposures at higher levels.
- Studies of ringed seal response in winter to underwater sounds from Northstar offshore oil production in the Beaufort Sea (with levels of sound and vibration in the strongest 1/3rd octave band often exceeding background levels beyond 5 km underwater) indicated that winter industrial activity (including ice roads and Vibroseis) did not affect ringed seal density in the spring (Moulton *et al*. 2002, 2003, 2008; Williams *et al*. 2008). Thus it appears that underwater sounds from the Northstar activity did not result in ringed seals abandoning the area.

In summary, the Navy will cease active transmissions if passive acoustic sensors detect the presence of a vocalizing marine mammal. Even if some proportion of ringed seals remain undetected, available data indicate that reactions of many ringed seals will likely be within the normal repertoire of the animals' typical movements and behavior (Kelly *et al.* 1986; Smith and Hammill 1981; Smith and Stirling 1975). Individual ringed seals could react to the Navy's ICEX18 active transmissions over the two-week operation period by alerting or temporarily avoiding the area close to the source, but feeding or reproduction is unlikely to be compromised, and it is unlikely that many individuals would relocate further away from the activity.

Aircraft Noise
Aircraft noise propagates through the air and can also potentially propagate through the ice into the water. In the context of this consultation, in-air sound transmission, particularly when aircraft are on ice during warmup, takeoff, and landing are most relevant, as these will be louder than sounds transmitted through the ice and will presumably result in a greater probability of disturbing seals on ice than animals underwater. Small planes such as the Cessna or Piper and helicopters can generate sounds over 100 dB during takeoff and landing (Berger *et al.*2015). During ICEX18, small, fixed-wing aircraft (the most frequently used aircraft) would generally operate at altitudes up to 3,500 m. At this altitude, the footprint of airborne noise at the ice surface would be an approximate 2 km^2 area which would move along the flight path of the aircraft (Navy 2017).

Effects to Ringed Seals
Studies of ringed seal response to aircraft noise have shown variable results. Kelly *et al*. (1986) report that some radio-tagged ringed seals departed lairs by diving into the water when helicopters flew over at or below an altitude of 305 m and within 0-3 km lateral distance of lairs. However, other individuals remained in their lairs when helicopters flew as low as an altitude of 122 m and within 0.6 km lateral distance from a lair. Helicopters landing 1 km and 3 km from lairs caused two ringed seals to escape into the water, but three other seals remained in their lairs when helicopters landed within 2.5 or 3 km away. Richardson *et al.* (1995) notes that following departure from their lairs in response to helicopters, some ringed seals surfaced 20 to 30 m from the edge of an ice pan only a few minutes after a helicopter had landed near the ice edge. Born *et al*. (1999) found that ringed seals on ice in Greenland showed escape behavior at up to 600 m ahead of approaching low-altitude (ca. 152 m) fixed wing aircraft, while 50% displayed escape behavior as far as1450 m ahead of helicopters flying at this same altitude.

The response by ringed seals to aircraft noise is variable, depending on time of year, prevailing weather, location, and other factors, including whether the animal is hauled-out or in a subnivean lair. Subnivean response of ringed seals is typically stronger than that of a basking ringed seal (Burns *et al.* 1982). Observations of ringed seals within the water column showed some ringed seals surfaced 20 to 30 m from the edge of an ice sheet only a few minutes after a helicopter had landed and shut down near the ice edge (Richardson et al. 1995).

Overall, there has been no indication that an occasional aircraft flying above pinnipeds in water causes long term displacement of these animals (Richardson *et al*. 1995). The lowest observed adverse effects levels are variable for pinnipeds on land, ranging from just over 150 m to about 2,000 m (Efroymson and Suter 2001). A conservative (90th percentile) distance effects level is 1,150 m. Most thresholds represent movement away from the overflight.

As a general statement from the available information, pinnipeds exposed to intense (approximately 110 to 120 dB re 20 μPa) non-pulse sounds associated with aircraft often leave haul-out areas and seek refuge temporarily (minutes to a few hours) in the water (Southall *et al*. 2007). This reaction could be considered within the normal behavioral repertoire of ringed seals and would therefore not necessarily constitute significant behavioral disruption. As a mitigation measure, the Navy has indicated that, safety permitting, as aircraft approach the camp, aircraft crew will ensure that the landing zone is clear of any animals and will report the presence and behavior of any seals observed on the ice.

<u>Effects to Bearded Seals</u>
Bearded seals are reported as reacting mildly to an airplane, remaining on the ice until the aircraft was directly overhead, at approximately 100 m altitude. Burns (1980) notes that on warm, calm days, bearded seals exhibit little concern for aircraft, yet in winter are extremely sensitive to sound sources on the ice. This sensitivity to on-ice sounds may be an adaptation to the threat of polar bear predation.

Although acoustic data indicate that some bearded seals remain in the Beaufort Sea year round (MacIntyre 2013, 2015), satellite tagging data (ADF&G 2017) confirm previous observations (Burns and Frost 1979; Frost *et al.* 2008; Cameron and Boveng 2009) that most animals move south with the advancing ice edge to spend the winter in the Bering Sea. During the ICEX18 time frame (February through early April), when there would not likely be any open water for escape, the probability of encountering bearded seals on the ice is extremely low. Despite this low probability, as aircraft approach the camp (safety permitting) aircraft crew will observe and report the presence and behavior of any seals hauled out on the ice.

In the extremely unlikely event that a bearded seal was hauled out and disturbed by the aircraft, such behavior would not likely interfere with any essential life function, such as breeding or feeding. We do not expect temporal overlap between breeding behaviors and aircraft activity associated with this project. Therefore, aircraft sound passing through the air-ice/water interface is extremely unlikely to impact breeding behaviors, including vocalizations. Taking all of these factors into account, we conclude that any effects of potential disturbance to bearded seals from aircraft are discountable.

Underwater Vessel or Torpedo Strike
The depths at which the submarines and unmanned underwater vehicles operate overlap with known dive depths of both ringed seals (typically 10 to 45 m, maximum recorded 300 m) (Lydersen 1991) and bearded seals (≤70 to 200 m) (Kotzebue IRA 2014). Operating speeds of submarines used during ICEX18 are typically less than 10 knots (11.5 mph). The size of a vessel and speed of travel affect the likelihood of a collision. Reviews of whale stranding and collision records indicate that larger surface ships (80 m or larger) and ships traveling at or above 14 knots have a much higher instance of collisions with marine mammals that result in mortality or serious injury (Vanderlaan and Taggert 2007). Speed reductions to 10 knots or less greatly reduce the probability of whale collisions (Conn and Silber 2013; Laist *et al.*2014). Due to their small size and maneuverability, seals are much less likely to be struck by slow-moving vessels. Additionally, personnel will be passively listening for marine mammals during marine training and testing activities, thereby further reducing the possibility of ship strike.

Although torpedoes travel much faster than ships, temporal and spatial overlap between ringed or bearded seals and torpedoes is extremely unlikely. Submarines launching torpedoes will be operating at a maximum depth of 800 m but will be travelling in waters where ocean depths reach 3,000 to 4,000 m (Jakobsson *et al.* 2012). Bearded seals are at very low densities in the Chukchi and Beaufort Seas during the ICEX18 late winter operating time frame. Further, both bearded and ringed seals are extremely unlikely to be foraging in the deep waters where the torpedoes will be launched. We therefore conclude that the probability of torpedo strike is extremely low. In the unlikely event that ringed or bearded seals or other marine mammals are detected underwater during submarine operations, torpedo launch will be delayed until all such animals are out of range. Taking all of this information into consideration, we conclude the that it is extremely unlikely that ringed or bearded seals will be struck or disturbed by torpedoes associated with this project, and conclude that the effects are therefore discountable.

Surface Vehicle Strike

Bearded seals are sufficiently unlikely to be hauled out on the ice in the ICEX18 action area that the Navy has determined that surface vehicles would have no effect to them. The probability of an on-ice vehicle striking a ringed seal is extremely low due to their projected low density in the action area. Based on responses of ringed seals to snow machines, Kelly *et al.* (1986) found that ringed seals exhibited escape responses at a minimum of 0.5 km from an approaching snow machine. In a recent review of animal reactions to vehicles, Lima *et al.* (2015) noted that when a collision seemed imminent, animals typically avoided vehicles. This behavior, coupled with the low density of ringed seals in the area, leads us to conclude that ringed seals are extremely unlikely to be struck by on-ice vehicles and therefore any associated effects are discountable.

Entanglement

Bearded seals are sufficiently unlikely to be present in the project area during ICEX18 that the Navy has determined entanglement would pose no risk to (have no effect on) them. Devices with lines or tethers that could pose entanglement risk to ringed seals include the hydrophones at the ice camp, weather balloons/radiosondes, in-water buoys and acoustic arrays, and towed and tethering lines from unmanned underwater vehicles. All lines hanging from buoys or ice will be weighted, and therefore will not have any loops or slack. In the unlikely event that Arctic ringed seals come into contact with buoy lines, entanglement will be highly unlikely due to the lines' weighted attachments. Due to current and vehicle operation, the likelihood of any loops or slack developing in this line is extremely small.

A total of 40 balloons (2 per day) will be released over the course of ICEX18. The distance and direction each balloon will travel is directly related to the daily weather conditions; balloons are not anticipated to travel to the same locations each day. Individual balloons could travel over 201 km before they burst and come to rest on land, sea ice, or in the water column. Weather balloons being released will introduce the potential for entanglement following their descent; these expended sensor packages will consist of shredded plastic from burst balloons, a parachute used to slow the descent of the radiosonde, and all of the ropes and twine used to keep all of the components together (the radiosonde will be suspended 25–35 m below the balloon).

The chance that an individual ringed seal will encounter expended lines or parachutes is low, based on two factors: the distribution of the lines and parachutes expended, and the depth of the water in the area where these will be expended. Given the water depths in the ICEX area, ringed seals are not expected to be feeding on the seafloor; any expended materials that settle to the seafloor will therefore pose a negligible entanglement risk to ringed seals. Based on the limited number (40) of expended lines and parachutes spread over a very large geographic area, and the likelihood that this gear will settle to the ocean bottom in waters too deep to pose a risk of entanglement, we have determined that ringed seal entanglement in expended weather balloon gear is extremely unlikely to occur. Therefore, we conclude that any effects of entanglement related to devices with tethers or weather balloon debris (including expended lines and parachutes) from ICEX18 are discountable.

Ingestion
Bearded seals are sufficiently unlikely to be present in the project area during ICEX 18 that the Navy has determined that the possibility of ingestion would pose no risk to (have no effect on) them. Expended materials potentially available for ingestion by ringed seals during ICEX18 include human food, balloon fragments, and radiosondes. Food materials will be present only within the ice camp; balloon fragments and radiosondes could be found on the ice, in the water column, or on the seafloor. A total of 40 balloons (2 per day) will be released over the course of ICEX18. By comparison, National Weather Service releases approximately 75,000 weather balloons each year. Since ringed seals spend most of their time either in their subnivean lairs or in the water column, the only feasible opportunity for the animals to encounter these expended sensor packages will be as they sink to the seafloor or as detached portions of the packages (such as balloon fragments) float on, or drift through, marine waters.

The distance and direction each balloon will travel is directly related to the daily weather conditions; balloons are not anticipated to travel to the same locations each day. Individual balloons could travel over 201 km before they burst and come to rest on land, sea ice, or in the water column. The likelihood that ringed seals will encounter and subsequently ingest balloon fragments is extremely low. Balloon fragment density across the land and seascape is extremely low. Remnants of burst balloons do not resemble prey species of ringed seals, further reducing the likelihood of ingestion. Expended weather balloon fragments may be ingested by ringed seal prey, but population-level effects on prey are extremely unlikely to occur.

Data on ingestion of marine debris by ringed seals are not available. Given the size of ringed seals, it is assumed that balloon fragments will not have notable health implications if incidentally ingested. Given the small number of balloons that will be released, the potential for ingestion by ringed seals of balloon fragments is very small. This fact, coupled with the unlikelihood of intentional ingestion and small likelihood of detrimental effects even if some fragments were ingested, results in our conclusion that the potential effects to ringed seals associated with ingestion of expended materials are discountable.

Conclusion
Based on our analysis, NMFS concurs with your determination that the Navy’s activities during ICEX18 may affect, but are not likely to adversely affect, Beringia DPS bearded seals. Reinitiation of consultation is required where discretionary federal involvement or control over the action has been retained or is authorized by law and if (1) take of listed species occurs, (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered, (3) the action is subsequently modified in a

manner that causes an effect to the listed species or critical habitat that was not considered in this concurrence letter, or (4) a new species is listed or critical habitat designated that may be affected by the identified action (50 CFR 402.16). Based on your analysis of acoustic effects to ringed seals, reinitiation of consultation will be required should the ESA listing of this species be reinstated prior to the completion of ICEX18.

Please direct any questions regarding this letter to Judy Jacobs at judy.jacobs@noaa.gov or (907) 271-5005.

Sincerely,

James W. Balsiger, Ph.D.
Administrator, Alaska Region

Cc: Laura Busch CIV USFF, N46 laura.busch@navy.mil

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B.2 CONCURRENCE RECEIVED FROM THE U.S. FISH AND WILDLIFE SERVICE

United States Department of the Interior
U.S. FISH AND WILDLIFE SERVICE
Fairbanks Fish and Wildlife Field Office
Endangered Species Branch
101 12th Avenue, Room 110
Fairbanks, Alaska 99701
November 16, 2017

Elizabeth Nashold
Director, Fleet Installations and Environment and Deputy Chief of Staff
1562 Mitscher Ave. Ste. 250
Norfolk, VA 23551-2487

Re: ESA section 7 consultation for
Ice Exercise 2018 to be conducted
by the United States Navy

Dear Ms. Nashold:

This letter is in response to your request for concurrence on your determination of effects of the Proposed Action to endangered and threatened species pursuant to section 7 of the Endangered Species Act (ESA) of 1973, as amended. The U.S. Fish and Wildlife Service (Service) has reviewed the proposed action to determine if it would adversely affect listed species under our jurisdiction. One species listed as threatened under the ESA may occur in the project area: polar bears (*Ursus maritimus*). The project is not within any designated critical habitat units.

THE PROPOSED ACTION

Based on information provided, we understand the United States Navy (Navy) plans to carry out Ice Exercise 2018 (ICEX18), in accordance with section 5013 and 5062 of Title 10, United States Code (U.S.C.) in the Arctic. The project involves the establishment of a temporary camp (ice camp) situated on an ice floe, submarine training and testing, and the execution of research activities. Camp maintenance would include discharges of graywater and reject water from reverse osmosis into the ocean. All submarine training and testing and all underwater research objectives would occur throughout the deep Arctic Ocean basin near the North Pole (Figure 1). The camp, most torpedo retrieval and all terrestrial research activities would occur within the smaller Ice Camp Study Area (Figure 1). For a more detailed description of the Proposed Action, please refer to the attached document provided by the Navy.

Project Ice Camp Study Area
The proposed Ice Camp Study Area encompasses an area of approximately 27,172 square miles (mi^2; 70,374 km^2) located 100–200 nautical miles north of Prudhoe Bay, Alaska (Figure 1). The ice camp will be within this study area and comprise an area of < 1mi^2 (1.6 km^2). Identification

of the specific ice camp location within the Study Area is not possible ahead of time, as required exercise conditions (e.g., ice cover) develop over the course of the winter. Remote sensing information would assess changing ice conditions during the winter season; as time draws closer to research activities, reconnaissance flights would survey potential areas to identify ice conditions suitable for the ice camp location.

Ice Camp

The ice camp would consist of a command hut, dining tent, sleeping quarters, a powerhouse, runway, and helipad (Figure 2-2). Toilet facilities will be located within the tents. The number of structures/tents ranges from 10–20, and they are typically 2–6 meters (m) by 6–10 m in size. There may be octagon-shaped tents approximately 6 m in diameter. Berthing tents would contain bunk beds, a heating unit, and a circulation fan. Support equipment for the ice camp includes snowmobiles, gas powered augers and saws (for boring holes through the ice), and diesel generators. All ice camp materials, fuel, and food would be transported from Prudhoe Bay, Alaska, and delivered by air-drop from military transport aircraft (e.g., C-17 and C-130), or by landing at the ice camp runway (e.g., small twin-engine aircraft and military and commercial helicopters). At the completion of ICEX, the ice camp would be demobilized, and all personnel and materials would be removed from the ice floe. All shelters, solid waste, hazardous waste, and sanitary waste would be removed and disposed of in accordance with applicable laws and regulations. To decrease food attraction, cooking and consumption of food would only occur within camp structures. Graywater generated from food preparation and washing would be discharged underneath the ice so polar bears would not come in direct contact with the discharge. Food scraps less than 1/16 in (0.16 cm) would be discarded along with graywater. Larger scraps would be stored within the camp in a localized area, in such manner to minimize odor and restrict bear access. All waste other than graywater and reverse osmosis reject water would either be removed at the end of the exercise by hauling back to land for disposal or would be incinerated on the ice, with the ash hauled to land. All hazardous materials would be stored within buildings at the ice camp to restrict polar bear access. In addition to the main ice camp, two smaller, adjacent berthing areas are proposed for ICEX. These areas (used for expeditionary forces) would leverage the facilities provided by the main camp (e.g., sanitary facilities) while verifying these groups could function independently if necessary. All materials from these adjacent areas would be removed from the ice upon completion of the activities.

Aircraft

Aircraft would be used to transport personnel and equipment from the ice camp to Prudhoe Bay; up to nine round trips could occur daily. The Proposed Action includes the use of multiple types of aircraft including fixed-wing aircraft, rotary-wing aircraft (helicopters), and various types of unmanned aerial systems. Polar bears may be affected by aircraft activity through acoustic and non-acoustic (visual) disturbance. Aircraft noise (acoustic disturbance) can be generated while in flight, and during ground operations while on the ice warming up, taxiing, and taking off and landing. All proposed Navy terrestrial research activities will occur in areas free of pressure ridges — the habitat typically selected by polar bears for denning.

On-ice Vehicles

On-ice vehicles such as snowmachines, small unit support vehicles, and all-terrain vehicles will be used at the ice camp (e.g., for personnel and equipment transport) and during research studies.

Proposed activities would occur in areas free from ice pressure ridges — the habitat typically selected by polar bears for denning.

Scientific Devices
Various passive and active acoustic devices would be used for data collection, including weather balloons, a vertical array, and buoys. To support weather observations, up to two Kevlar or latex balloons (Figure 2-10) would be launched per day for 20 days at the ice camp (40 balloons total). These balloons and associated radiosondes (a sensor package that is suspended below the balloon) are similar to those that have been deployed by the National Weather Service since the late 1930s. When released, the balloon is approximately 1.5–1.8 m in diameter and gradually expands as it rises owing to the decrease in air pressure. When the balloon reaches a diameter of 4–7 m, it bursts and a parachute is deployed to slow the descent of the associated radiosonde. Weather balloons are not recovered. Various scientific buoys (typically less than 1 m in diameter) would be deployed. Some will be retrieved while others will not.

POTENTIAL EFFECTS TO POLAR BEARS

Air Drop of Equipment
Two potential negative effects could result from air-dropped material: direct strike to a polar bear from the dropped equipment, and rupture of the load (e.g., fuel or other material) during impact in the event a parachute does not open.

Equipment air-drops would occur in close proximity to the ice camp. The ice camp site selection would preclude open leads and cracks in the ice, as well as pressure ridges which are the habitats preferred by polar bears, significantly reducing the probability that a bear would be in the drop zone area. Additionally, protocols require the drop location be visually cleared of any animals prior to release, reducing the potential for direct strike.

The second potential adverse effect would be from the rupture of a load (e.g., fuel drums or other material) upon impact with the ice. Fuel and other supplies may be dropped in bundles of five 55-gallon drums from a military cargo aircraft. Experience and training as well as packing will mitigate much of the risk of load rupture. The air dropped bundles are made of several layers of a plywood structure with honeycomb insulation protecting the drums. Although ruptured fuel drums are rare during air-drop operations, the potential risk does exist. Therefore, air-drop of material would occur only after initial construction of the camp has begun and personnel are available to respond to any potential rupture with proper spill containment and clean up procedures.

Assuming a worst case scenario, a parachute failing to open for a single load of fuel (five 55-gallon drums), the potential for 275 gallons (1,041 liters) of fuel would be released to the ice. The likelihood of this worst case scenario occurring is extremely remote; the military frequently drops equipment and material (including fuel) to support operations and humanitarian aid and although ruptures have occurred, they are very infrequent. Even in the case of a parachute failure, typically only one or two barrels would be dented or ruptured. In the event of a fuel drum rupture, personnel would be standing by with applicable spill control measures (e.g., absorbent materials) to remove any spilled fuel from the ice floe. All fuel contaminated snow and ice cover would be collected and removed from the ice floe. Therefore, it is extremely unlikely a polar bear would come into contact with any materials spilled as a result of an air drop.

Ingestion of Waste Materials
As described in the ice camp section above, food waste protocols will be implemented which will prevent polar bears from obtaining human food. However, polar bears are curious, and their behavior of chewing things to determine if the object is edible can lead to non-food materials being ingested. If polar bears encounter buoys, weather balloons, radiosondes, discarded equipment, or trash they may bite it and ingest small pieces. If a polar bear does ingest pieces of human trash, the bear would likely excrete the material without detrimental effects. Additionally, due to the small number of expended buoys, balloons, and radiosondes and the low density of polar bears, the chance of a bear encountering expended material is very low.

Disturbance
Polar bears may occasionally pass through or den in the project area, although their density is low and encounters are expected to be infrequent. Transient (non-denning) bears entering the area of Navy activities could be disturbed by the presence of humans or equipment noise. However, we expect disturbances would be minor and temporary because transient bears would be able to respond to human presence or disturbance by departing the area. Furthermore, several measures included in the Navy's *Polar Bear Interaction management and Avoidance Plan* as well as MMM Office LOA stipulations would minimize potential impacts in the event a polar bear is encountered.

In addition to transient animals, female polar bears may find suitable habitat to den in the action area. Because the action area is outside of the critical habitat, it is reasonable to consider polar bears den in the action area infrequently. Also, because the majority of activities will be conducted in areas free of ice ridges and other features typically selected for polar bear denning, the probability of encountering a den is very low.

Potential Intentional Harassment of Polar Bears
Snowmachines may be used to deter polar bears from an area for human safety. This deterrence could include using a snowmachine to patrol the periphery of the camp or blocking a bear's path with the snowmachine. However, once a polar bear turns away from the human activity, the snowmachine would not follow or chase the animal. The Service conducted a section 7 consultation on the polar bear deterrence guidelines (see attached Federal Register document) developed by the Service's Marine Mammals Management Office (MMM) in 2010 and determined deterrence methods, such as those which could be implemented as part of the Proposed Action are not likely to adversely affect polar bears.

Minimization Measures
We understand the Navy has applied for a Letter of Authorization from the MMM Office. The permittee or designee shall follow all terms and condition of Letters of Authorization (LOAs) issued by the Service for take of polar bears.

Conclusion

Given 1) the density of polar bears in the action area is low, 2) encounters with polar bears are expected to be infrequent, 3) behavioral effects to transient bears would be minor and temporary, 4) mitigation measures are included in Navy's *Polar Bear Interaction Management and Avoidance Plan*, and MMM's LOA to minimize potential impacts in the event transient or denning polar bears are encountered, and 5) the very low probability of polar bears denning in the action area; we expect effects of the proposed action on polar bears would be insignificant. Therefore, we concur that the proposed action is not likely to adversely affect polar bears. Thank you for the opportunity to comment on this project. If you need further assistance, please contact Amal Ajmi at (907) 456-0324.

Sincerely,

Sarah C. Conn
Field Supervisor

Cc: Laura Busch, U.S. Fleet Forces Environmental Readiness

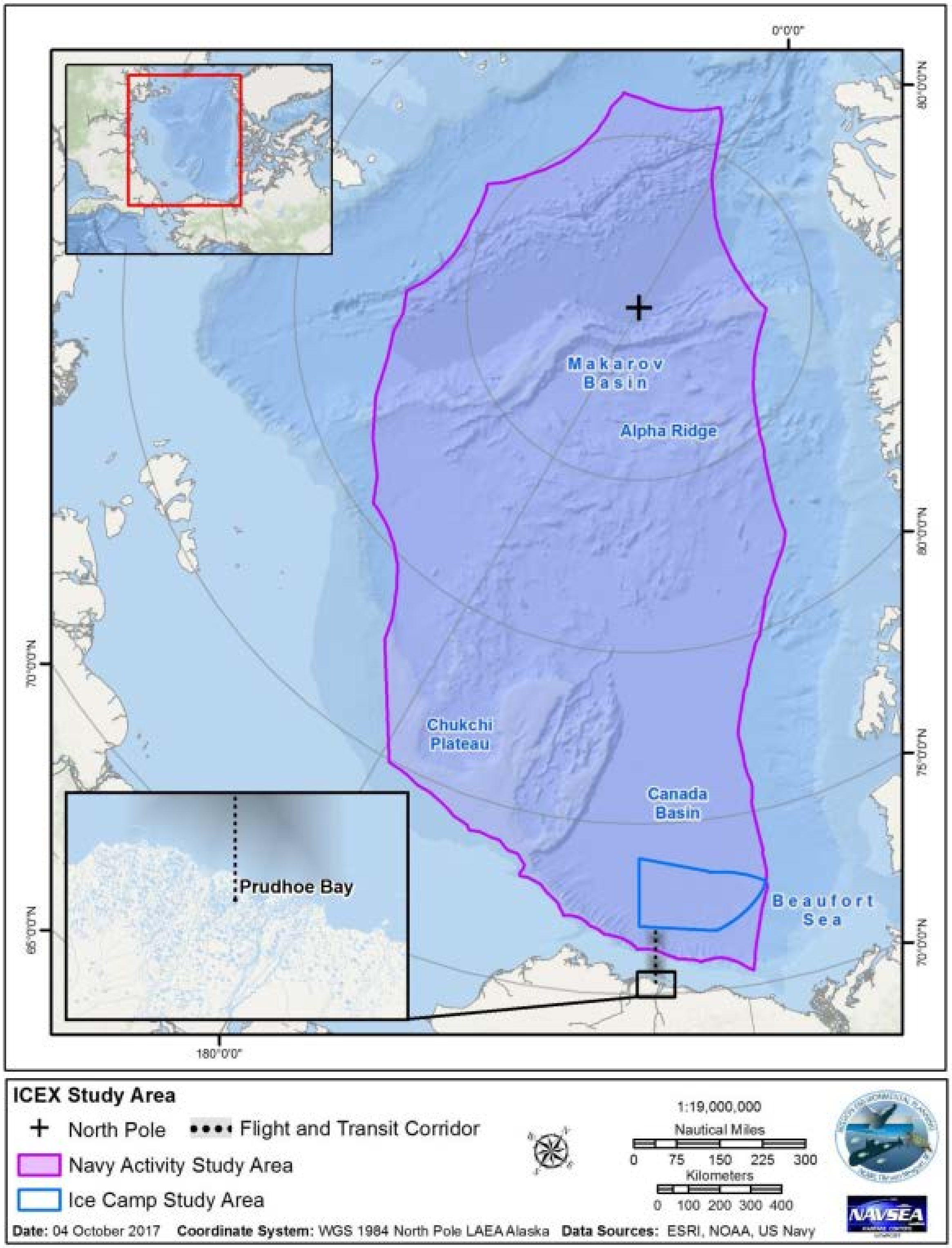


Figure 1. Potential ICEX 18 Study Area where most proposed activities would occur.

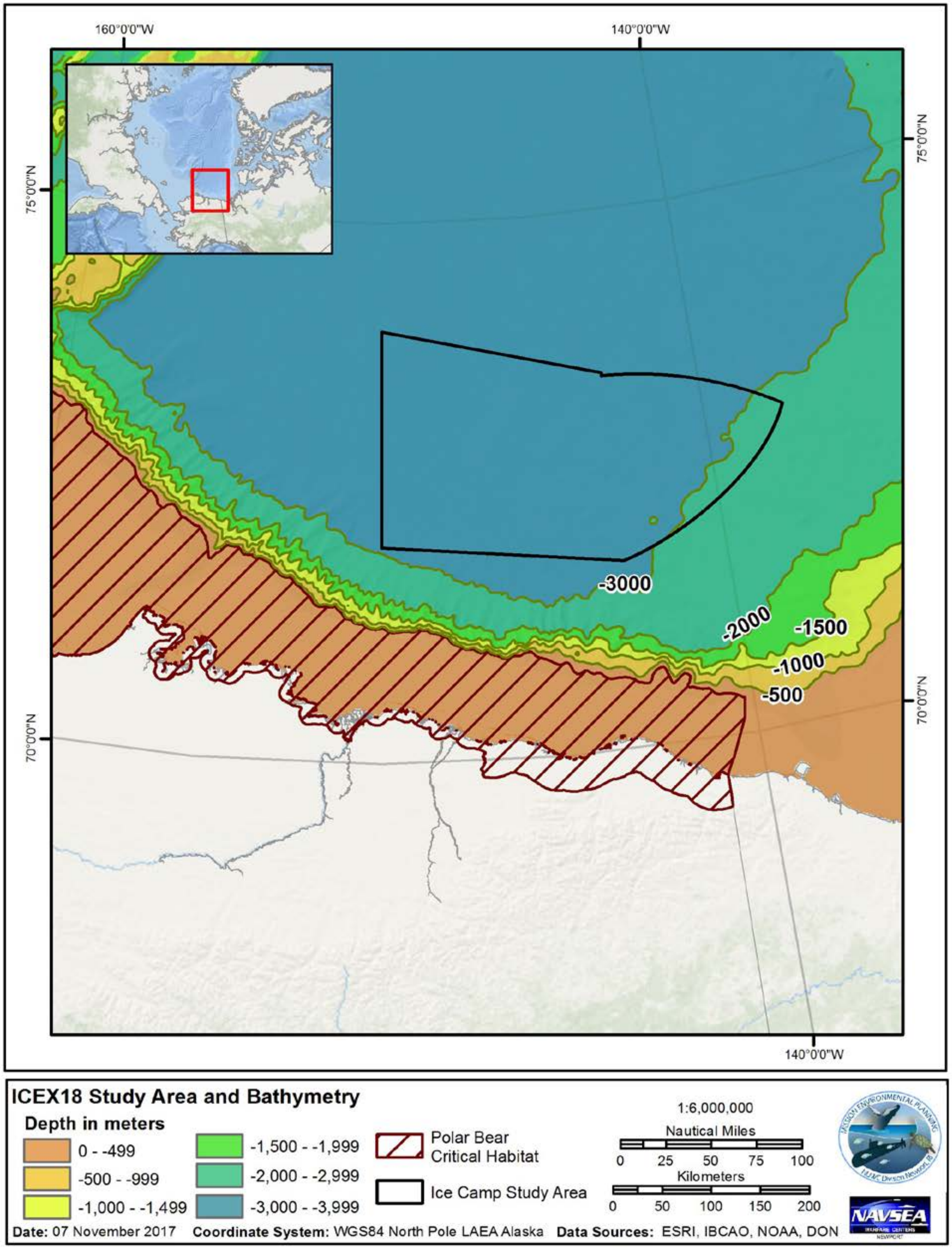


Figure 2. Location of ICEX 18 Ice Camp Study Area with respect to polar bear Critical Habitat 300m bathymetry.

APPENDIX C MARINE MAMMAL PROTECTION ACT INTENTIONAL TAKE (DETERRENCE) PERMIT

United States Department of the Interior

U.S. FISH AND WILDLIFE SERVICE
1011 East Tudor Road
Anchorage, Alaska 99503-6199

IN REPLY REFER TO:
AFES/MMM

DEC 27 2017

Ms. Elizabeth Nashold
Director, Fleet Installations and Environment
U.S. Fleet Forces Command
1562 Mitscher Avenue, Suite 250
Norfolk, Virginia 23551-2487

Dear Ms. Nashold:

The U.S. Fish and Wildlife Service has reviewed your request, dated October 16, 2017, for a Letter of Authorization (LOA) for intentional take by Level B non-lethal harassment (deterrence) of polar bears (*Ursus maritimus*). Polar bear deterrence will be conducted during activities associated with the Navy Ice Exercise 2018 (ICEX 18). A detailed description of the proposed activities is provided in the Department of Navy, U.S. Fleet Forces Command *Polar Bear Interaction Management and Avoidance Plan, Ice Exercise* (October 2017).

In accordance with sections 101(a)(4)(A), 109(h), and 112(c) of the Marine Mammal Protection Act of 1972, as amended, enclosed is LOA 18-INT-04 authorizing the intentional take of small numbers of polar bears by deterrence for the protection of life, both human and polar bear, under the specified terms and conditions. This LOA is for deterrence activities associated with ICEX 18.

Should you have any questions regarding this LOA and the required terms and conditions, please contact Supervisory Wildlife Biologist, Mr. Christopher Putnam at (907) 786-3844 or Biologist, Mr. Forrest Hannan at (907) 786-3551, or by email at christopher_putnam@fws.gov or forrest_hannan@fws.gov.

Sincerely,

Chief, Marine Mammals Management

Enclosure

Email cc: Mr. Richard Shideler, Alaska Department of Fish and Game
Ms. Kaiti Ott, Fairbanks Fish and Wildlife Field Office, U.S. Fish and Wildlife Service
Office of Law Enforcement, U.S. Fish and Wildlife Service
Department of Law, North Slope Borough

United States Department of the Interior

U.S. FISH AND WILDLIFE SERVICE
1011 East Tudor Road
Anchorage, Alaska 99503-6199

IN REPLY REFER TO:
AFES/MMM

LETTER OF AUTHORIZATION
Intentional Take
(18-INT-04)

VALID: January 1, 2018
EXPIRES: August 31, 2018

In accordance with sections 101(a)(4)(A), 109(h), and 112(c) of the Marine Mammal Protection Act of 1972, as amended (MMPA), the U.S. Fish and Wildlife Service (Service) Marine Mammals Management Office (MMM) is hereby granting this Letter of Authorization (LOA) to The Department of Navy (Navy), allowing intentional take by Level B non-lethal harassment (deterrence) of polar bears (*Ursus maritimus*) during the Navy Ice Exercise 2018 (ICEX 18).

This LOA applies to the Navy's plans to carry out ICEX 18. The project involves the establishment of a temporary ice camp situated on an ice floe, submarine training and testing, and the execution of research activities. The vast majority of submarine training and testing and all research objectives would occur near the ice camp. Some submarine training and testing activities may occur outside of the study area throughout the deep Arctic Ocean basin. The ice camp would be established in an area approximately 100–200 nautical miles north of Prudhoe Bay, Alaska. The study area would be approximately 27,172 square miles (70,374 km^2) and the ice camp would be no more than 1 mile (1.6 km) in diameter [approximately 0.79 mi^2 (2 km^2) in area]. A specific location for the establishment of the ice camp cannot be identified ahead of time as the required conditions for the exercise (e.g., ice cover) cannot be forecasted. The study area is within the range of the polar bear (*Ursus maritimus*), and proposed activities may affect this species. Polar bears may den within the ice camp and study area or transit through it. For a more detailed description of ICEX 18, refer to the Navy *Polar Bear Interaction Management and Avoidance Plan, Ice Exercise* (October 2017).

Section 101(a)(4)(A) of the MMPA states that, "Except as provided in subparagraphs (B) and (C), the provisions of this chapter [prohibiting take] shall not apply to the use of measures:

i. by the owner of fishing gear or catch, or an employee or agent of such owner, to deter a marine mammal from damaging the gear or catch;
ii. by the owner of other private property, or an agent, bailee, or employee of such owner, to deter a marine mammal from damaging private property;
iii. by any person, to deter a marine mammal from endangering personal safety; or
iv. by a government employee, to deter a marine mammal from damaging public property, so long as such measures do not result in the death or serious injury of a marine mammal."

Section 109(h)(1) states that, "nothing in this title [Conservation and Protection of Marine Mammals]… shall prevent a Federal, State, or local government official or employee or a person designated under section 112(c) from taking, in the course of his or her duties as an official, employee, or designee, a marine mammal in a humane manner (including euthanasia) if such taking is for: A) the protection or welfare of the mammal; B) the protection of the public health and welfare; or C) the non-lethal removal of nuisance animals."

Section 112(c) allows for the transfer of Federal authority, "...as may be necessary to carry out the purposes of this title [Conservation and Protection of Marine Mammals]... and on such terms as he [the Secretary] deems appropriate with any Federal or State agency, public or private institution, or other person."

The purpose of authorizing take by Level B non-lethal harassment, or deterrence, is to maintain human safety in polar bear habitat and reduce the likelihood of a polar bear death or injury. The primary objectives are to:

- Prevent bears from associating food with humans and facilities;
- Condition bears to avoid people;
- Allow bears to use travel routes (natural and human made) to move along the coast; and
- Prevent bears from extended use of areas around facilities.

This LOA is subject to the following conditions:

1. The "Navy *Polar Bear Interaction Management and Avoidance Plan, Ice Exercise* (October 2017)," is approved and incorporated in this LOA by reference. Project activities must be conducted in accordance with this plan. A copy of the plan and this LOA must be kept on-site and available for reference by all personnel.

2. It is the responsibility of the Navy to ensure that only trained and qualified personnel are assigned the task of polar bear deterrence. Prior to initiation of activities, a list of trained personnel responsible for deterrence and a description of their training shall be submitted to the Service MMM.

3. Should firearms be used for polar bear deterrence, it is the responsibility of the Navy to ensure that personnel operating under this LOA (hereafter "operators") comply with all laws and regulations regarding the carry and use of firearms.

4. Within 48 hours of occurrence, Navy, or its designated agent, is responsible for documenting and reporting to the Service MMM, all instances involving polar bear deterrence activities. A final report of all polar bear deterrence activities shall be submitted to the Service MMM no later than 60 days from the expiration date of this LOA. Reports shall be submitted to the Service MMM via email at fw7_mmm_reports@fws.gov.

5. Appropriate deterrence techniques may include, but are not limited to bear monitors, air horns, electric fences, bear spray, acoustic recordings, vehicles, and projectiles (e.g., beanbags, rubber bullets, "cracker" shells, "bangers," and "screamers").

Deterrence techniques must not cause the injury or death of a polar bear. Any injury or death of a polar bear must be reported to the Service MMM as soon as possible but not later than 48 hours after the incident.

6. Prior to conducting a deterrence activity, operators must:
   a. Make a reasonable effort to reduce or eliminate attractants;
   b. Secure the site, notify supervisor, and move personnel to safety;
   c. Ensure the bear has escape route(s); and
   d. Ensure communication with all personnel.

7. When conducting a deterrence activity, operators must:
   a. Never deter a polar bear for convenience or to aid project activities. The safety and welfare of the bear is second only to the safety and welfare of humans in a deterrence situation;
   b. Shout at the bear before using projectiles or other techniques; and
   c. Begin with the lowest level of force or intensity that is effective and increase the force or intensity of the technique, or use additional techniques, only as necessary to achieve the desired result.

8. After a deterrence event operators must:
   a. Monitor bear's movement (to ensure no return);
   b. Notify supervisor and personnel when it is safe to resume work; and
   c. Submit a report to the Service MMM within 48 hours.

The Service MMM must be notified of changes in the project, including changes to activities, locations, or methods, prior to their implementation. Such changes may invalidate this LOA unless approved in writing by the Service MMM.

Per the "Biological Opinion for the USFWS Region 7 Polar Bear and Pacific Walrus Deterrence Program (January 13, 2014)," the Service concluded that issuing this LOA is not likely to jeopardize the continuing existence of polar bears. This LOA also serves as an "Incidental Take Statement," which is required by the Endangered Species Act in order for incidental take to be authorized.

Should you have any questions regarding this LOA and the required terms and conditions, please contact Supervisory Wildlife Biologist, Mr. Christopher Putnam at (907) 786-3844 or Biologist, Mr. Forrest Hannan at (907) 786-3551, or by email at christopher_putnam@fws.gov or forrest_hannan@fws.gov.

Chief, Marine Mammals Management

27 Dec 2017
Date

APPENDIX D MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT CONCURRENCE LETTER

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668
November 9, 2015

B.B. McCutcheon, JR., US Navy
Acting Deputy Chief of Staff
Fleet Installations and Environmental Awareness
1562 Mitscher Ave., Suite 250
U.S. Fleet Forces Command
Norfolk, VA 23551-2487

Re: Essential Fish Habitat Assessment for Ice Exercise 2016

Dear Mr. McCutcheon:

The National Marine Fisheries Service (NMFS) has reviewed the Essential Fish Habitat (EFH) Assessment for Ice Exercise 2016 (ICEX16) recently submitted by the U.S. Navy (Navy). The proposed action includes construction of a temporary camp on an Arctic ice flow to conduct submarine training and acoustic transmission testing. As proposed, the project would occur over a six-week period from February-April 2016 in the Beaufort Sea, approximately 100-200 nm north of Prudhoe Bay, Alaska.

Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act requires federal agencies to consult with NMFS on any action that may adversely affect EFH. The Navy has determined ICEX16 will occur within EFH for Arctic cod, as described in the Fisheries Management Plan for the Arctic Management Area. NMFS agrees with this assessment. The Navy has further determined that their proposed actions may adversely affect EFH. The two proposed activities that the Navy has determined may adversely affect Arctic cod are acoustic transmissions and human presence.

NMFS has reviewed ICEX16 EFH Assessment, including mitigation measures, and has determined that the proposed action will not likely reduce the quantity or quality of EFH. Therefore, NMFS offers no EFH Conservation Recommendations at this time. EFH Consultation has been satisfied. Should activities significantly change, NMFS wishes to be informed of any such changes in order to reassess this determination.

NMFS appreciates the Navy initiating the EFH consultation process with a thorough assessment and applauds this effort to meet its environmental responsibilities. Should you have further questions or concerns, please contact LT Charlene Felkley of my staff at charlene.felkley@noaa.gov or at (907) 271-1301.

Sincerely,

for James W. Balsiger, Ph.D.
Administrator, Alaska Region

Cc:
Jeanne Hanson - Jeanne.hanson@noaa.gov
Jon Kurland - Jon.kurland@noaa.gov
Greg Balogh - Greg.Balogh@noaa.gov

G:USNavy 2016 Ice Exercise EFH consult cf 11-9-15

APPENDIX E SUBMARINE TRAINING AND TESTING ACTIVITIES

Details on the activities conducted by the participating submarines are classified. This appendix will be provided to authorized personnel upon request.

APPENDIX F STRESSOR MATRICES

Ten categories of stressors were identified and analyzed within this EA/OEA. A description of each stressor, including the platforms that contribute to the stressor, is provided below.

- **Acoustic Transmissions:** Includes only those active sources that produce acoustic impacts that are not considered de minimis and require quantitative analysis.
- **Aircraft Noise:** Includes the noise generated by manned (e.g., small twin-engine fixed wing aircraft, small rotary-wing aircraft, and large military aircraft such as the LC-130 and CH-47 Chinook helicopter) and unmanned (fixed- and rotary-wing unmanned aerial systems) aircraft.
- **On-Ice Vehicle Noise:** Includes the noise generated by the snowmobiles and small unit support vehicle.
- **Aircraft Strike:** Includes the potential for strike from both manned and unmanned aircraft.
- **On-Ice Vehicle Strike:** Includes the potential for direct contact of a snowmobile or small unit support vehicle with a resource, but also includes the potential disturbance to subnivean lairs.
- **In-water Vessel and Vehicle Strike:** Includes the potential for vessels (i.e., submarines) and vehicles (e.g., unmanned undersea vehicles) to come into direct contact with a resource.
- **Human Presence:** Although human presence would occur as part of all activities, the stressor is only included for the ice camp and for the research activities that include humans as part of the action (e.g., paratroopers and divers).
- **Bottom Disturbance:** Includes the potential for the material to strike a resource while both at the sea surface and once it sinks and settles on the sea floor. Expended material is also analyzed for potential disturbance to the sea floor.
- **Combustive Byproducts:** Includes the potential for chemicals to be released into the water from exercise torpedoes.
- **Entanglement:** Includes the potential for a resource to become entangled in a temporarily-deployed device (e.g., vertical array) and those materials that will be expended.
- **Ingestion:** Includes the possibility of ingesting complete objects as well as small pieces of objects to determine if they are edible.

Appendix Table F-1. Stressors by Activity

Category of Action	Project	Acoustic Stressors			Physical Stressors				Expended Material			
		Acoustic Transmissions	Aircraft Noise	On-Ice Vehicle Noise	Aircraft Strike	On-Ice Vehicle Strike	In-water Vessel and Vehicle Strike	Human Presence	Bottom Disturbance	Combustive Byproducts	Entanglement	Ingestion
Logistics	**Ice Camp**		X	X	X	X		X	X		X	
Submarine Training and Testing	**Submarines**	X					X			X		
Aerial Data Collection	**Aircraft**		X	X	X	X			X			X
	Balloon								X		X	X
In-water Device Data Collection	**Buoy**	X							X		X	X
	Array						X		X		X	
Personnel/ Equipment Proficiency	**Diving**						X	X				
	Air-Drop		X	X	X	X		X				
	Aircraft		X		X							
Unmanned Aerial System Testing	**Fixed-Wing**		X		X							
	Rotary-Wing		X		X							
Unmanned Underwater Vehicle Testing	**Vehicle Testing**	X					X				X	

Appendix Table F-2. Stressors by Resource

Resource		Acoustic Stressors			Physical Stressors				Expended Material			
		Acoustic Transmissions	Aircraft Noise	On-ice Vehicle Noise	Aircraft Strike	On-ice Vehicle Strike	In-water Vessel and Vehicle Strike	Human Presence	Bottom Disturbance	Combustive Byproducts	Entanglement	Ingestion
Bottom Substrate									X			
Water Quality								X		X		
Marine Vegetation								X				
Mammals	**Marine**	X	X	X		X	X	X		X	X	X
	Terrestrial		X	X		X		X			X	X
Marine Birds			X	X	X							X
Invertebrates		X					X		X	X	X	
Fish		X					X		X	X	X	X
EFH		X						X		X		

APPENDIX G ACOUSTIC MODELING

G.1 INTRODUCTION

The marine mammal acoustics effects analysis was conducted in accordance with current Navy sonar policy, as advised by the Chief of Naval Operations Environmental Readiness Division. Accordingly, ensonified areas and exposure estimates for marine mammals were reported based on Sound Exposure Level (SEL) and Sound Pressure Level (SPL) thresholds. PTS is the criterion used to establish the onset of non-recoverable physiological effects. TTS is the criterion used to establish the onset of recoverable physiological effects, and a behavioral response function is used to determine non-physiological behavioral effects. Environmental parameters were collected and archived, and propagation modeling was performed with the Naval Oceanographic Office's Oceanographic and Atmospheric Master Library (OAML) CASS/GRAB model (Weinberg and Keenan 2008). The acoustics effects modeling utilized the databases and tools collectively referred to as the Navy Acoustic Effects Model (NAEMO) (U.S. Department of the Navy In Prep-b). Results were then computed for the defined operational scenario. This section provides a brief discussion of several key components of the acoustics effects modeling process, specifically: environmental inputs, acoustic sources, propagation modeling, and the NAEMO modeling software suite.

G.2 SOURCE CHARACTERISTICS AND SCENARIO DESCRIPTION

The acoustic transmissions associated with the Proposed Action fall within bins HF1 (hull-mounted submarine sonars that produce high-frequency [greater than 10 kHz but less than 200 kHz] signals) and M3 (mid-frequency [1-10 kHz] acoustic modems greater than 190 dB re 1 µPa). The parameters for the acoustic transmissions associated with research activities can be found in Table 2-2 above. Additional details about submarine training and testing and the Naval Research Laboratory source are classified can be found in the classified Appendix E.

G.3 ENVIRONMENTAL CHARACTERISTICS

Data for four environmental characteristics (bathymetry, sound speed profile, sediment characteristics, and wind speed) were obtained for the cold season to support the acoustic analysis. The databases used to obtain these data and the resulting parameters are provided in Appendix Table G-1. All of the databases are maintained by OAML.

Appendix Table G-1. Environmental Parameters for ICEX

Model / Parameter	Data Input	Database
Propagation Model	Specific data are not applicable for this parameter.	Comprehensive Acoustic System Simulation Version 4.2a
Absorption Model	Specific data are not applicable for this parameter.	Francois-Garrison (the CASS/GRAB default)
Analysis Locations	Study Area	Database not used for this parameter
Analysis Specifics	18 radials => 1 radial per 20 degrees Range increment: 50 meters Depth increment: 25 meters	Database not used for this parameter
Bathymetry	Data was obtained from a location centered around 72° 53'N, 146° 28'W. Resolution was at five hundredths (0.5) of a degree.	Digital Bathymetric Data Base Variable Resolution (DBDB-V) Version 5.4
Sound Speed Profiles	Sound speed profiles were extracted at the highest database resolution of 0.25 degree.	Generalized Digital Environmental Model Variable (GDEM-V) Version 3.0
Wind Speed	Wind speed was extracted at the highest database resolution of one (1) degree. Average wind speed: N/A for the cold season since the Study Area is ice covered	Surface Marine Gridded Climatology (SMGC) Version 2.0
Geo-Acoustic Parameters	Sediment type of sand was determined for the Study Area.	High Frequency Environmental Acoustics Version 1.1 HFEVA
Surface Reflection Coefficient Model	Specific data are not applicable for this parameter.	Navy Standard Forward Surface Loss Model

G.4 Marine Mammal Density Estimates

Marine mammal densities utilized in the acoustic analysis were based on the best available science for the Study Area. Baseline marine mammal distribution and density data from the (U.S. Department of the Navy In Prep-c) were first extracted for the Study Area. Datasets that comprise the Navy Marine Species Density Database include surveys, average published population estimates, and Relative Environmental Suitability models (Kaschner et al. 2006).

G.5 Criteria and Thresholds

Harassment criteria for marine mammals are evaluated based on thresholds developed from observations of trained cetaceans exposed to intense underwater sound under controlled conditions (Finneran et al. 2003; Kastak and Schusterman 1996; Kastak and Schusterman 1999; Kastak et al. 2005; Kastelein et al. 2012). These data are the most applicable because they are based on controlled, tonal sound exposures within the typical sonar frequency ranges and because the species studied are closely related to the animals expected in the Study Area. Studies have reported behavioral alterations, or deviations from a subject's normal trained behavior, and exposure levels above which animals were observed to exhibit behavioral deviations (Finneran and Schlundt 2003; Schlundt et al. 2000).

Criteria and thresholds used for determining the potential effects from the Proposed Action are from NMFS technical guidance on acoustic thresholds for PTS/TTS. The behavioral criteria was developed in coordination with NMFS to support Phase III environmental analyses and MMPA Letter of Authorization renewals (U.S. Department of the Navy In Prep-d). Appendix Table G-2 below provides the criteria and thresholds used in this analysis for estimating quantitative acoustic exposures of marine mammals from the Proposed Action. Weighted criteria are shown in the table below. Frequency-weighting functions are used to adjust the received sound level based on the sensitivity of the animal to the frequency of the sound. For weighting function derivation, the most critical data required are TTS onset exposure levels as a function of exposure frequency. These values can be estimated from published literature by examining TTS as a function of SEL for various frequencies.

To estimate TTS onset values, only TTS data from behavioral hearing tests were used. To determine TTS onset for each subject, the amount of TTS observed after exposures with different SPLs and durations were combined to create a single TTS growth curve as a function of SEL. The use of (cumulative) SEL is a simplifying assumption to accommodate sounds of various SPLs, durations, and duty cycles. This is referred to as an “equal energy” approach, since SEL is related to the energy of the sound and this approach assumes exposures with equal SEL result in equal effects, regardless of the duration or duty cycle of the sound. It is well-known that the equal energy rule will over-estimate the effects of intermittent noise, since the quiet periods between noise exposures will allow some recovery of hearing compared to noise that is continuously present with the same total SEL (Ward 1997). For continuous exposures with the same SEL but different durations, the exposure with the longer duration will also tend to produce more TTS (Finneran et al. 2010; Kastak et al. 2007; Mooney et al. 2009).

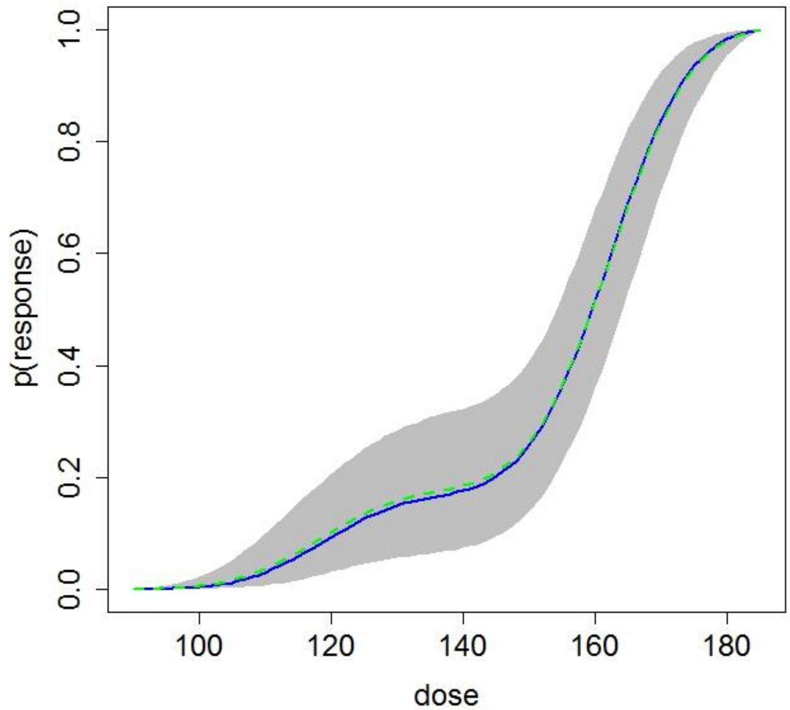
As in previous acoustic effects analysis (Finneran and Jenkins 2012; Southall et al. 2007), the shape of the PTS exposure function for each species group is assumed to be identical to the TTS exposure function for each group. A difference of 20 dB between TTS onset and PTS onset is used for all marine mammals including pinnipeds. This is based on estimates of exposure levels actually required for PTS (i.e. 40 dB of TTS) from the marine mammal TTS growth curves, which show differences if 13 to 37 dB between TTS and PTS onset in marine mammals. Details regarding these criteria and thresholds can be found in National Marine Fisheries Service (2016).

G.5.1 Behavioral Reactions or Responses

The response of a marine mammal to an anthropogenic sound will depend on the frequency, duration, temporal pattern and amplitude of the sound as well as the animal’s prior experience with the sound and the context in which the sound is encountered (i.e., what the animal is doing at the time of the exposure). The distance from the sound source and whether it is perceived as approaching or moving away can also affect the way an animal responds to a sound (Wartzok et al. 2003). For marine mammals, a review of responses to anthropogenic sound was first conducted by Richardson *et al*. (1995). Reviews by Nowacek *et al.* (2007) and Southall *et al.* (2007) address studies conducted since 1995 and focus on observations where the received sound level of the exposed marine mammal(s) was known or could be estimated. Multi-year research efforts have conducted sonar exposure studies for odontocetes and mysticetes (Miller et al. 2012; Sivle et al. 2012). Several studies with captive animals have provided data under controlled circumstances for odontocetes and pinnipeds (Houser et al. 2013a; Houser et al. 2013b). Moretti *et al.* (2014) published a beaked whale dose-response curve based on passive acoustic monitoring of beaked whales during U.S. Navy training activity at Atlantic Underwater Test and Evaluation Center during actual Anti-Submarine Warfare exercises. This new information has necessitated the update of the Navy’s behavioral response criteria.

Southall *et al.* (2007) synthesized data from many past behavioral studies and observations to determine the likelihood of behavioral reactions at specific sound levels. While in general, the louder the sound source the more intense the behavioral response, it was clear that the proximity of a sound source and the animal's experience, motivation, and conditioning were also critical factors influencing the response (Southall et al. 2007). After examining all of the available data, the authors felt that the derivation of thresholds for behavioral response based solely on exposure level was not supported because context of the animal at the time of sound exposure was an important factor in estimating response. Nonetheless, in some conditions, consistent avoidance reactions were noted at higher sound levels depending on the marine mammal species or group allowing conclusions to be drawn. Phocid seals showed avoidance reactions at or below 190 dB re 1 μPa @1m; thus, seals may actually receive levels adequate to produce TTS before avoiding the source.

The Phase III pinniped behavioral criteria was updated based on controlled exposure experiments on the following captive animals: hooded seal, gray seal, and California sea lion (Götz et al. 2010; Houser et al. 2013a; Kvadsheim et al. 2010). Overall exposure levels were 110-170 dB re 1 μPa for hooded seals, 140-180 dB re 1 μPa for gray seals and 125-185 dB re 1 μPa for California sea lions; responses occurred at received levels ranging from 125 to 185 dB re 1 μPa. However, the means of the response data were between 159 and 170 dB re 1 μPa. Hooded seals were exposed to increasing levels of sonar until an avoidance response was observed, while the grey seals were exposed first to a single received level multiple times, then an increasing received level. Each individual California sea lion was exposed to the same received level ten times, these exposure sessions were combined into a single response value, with an overall response assumed if an animal responded in any single session. Because these data represent a dose-response type relationship between received level and a response, and because the means were all tightly clustered, the Bayesian biphasic Behavioral Response Function for pinnipeds most closely resembles a traditional sigmoidal dose-response function at the upper received levels (Appendix Figure G-1), and has a 50% probability of response at 166 dB re 1 μPa. Additionally, to account for proximity to the source discussed above and based on the best scientific information, a conservative distance of 10 km is used beyond which exposures would not constitute a take under the military readiness definition.



Appendix Figure G-1. The Bayesian biphasic dose-response BRF for Pinnipeds. The blue solid line represents the Bayesian Posterior median values, the green dashed line represents the biphasic fit, and the grey represents the variance. [X-Axis: Received Level (dB re 1 µPa), Y-Axis: Probability of Response]

Appendix Table G-2. Injury (PTS) and Disturbance (TTS, Behavioral) Thresholds for Underwater Sounds.[1]

Group	Species	Behavioral Criteria	Physiological Criteria	
			Onset TTS	Onset PTS
Phocidae (in water)	Ringed seal	Pinniped Dose Response Function*	181 dB SEL cumulative	201 dB SEL cumulative
Ursidae (in water)	Polar bear	Pinniped Dose Response Function*	199 dB SEL cumulative	219 dB SEL cumulative

[1] The threshold values provided are assumed for when the source is within the animal's best hearing sensitivity. The exact threshold varies based on the overlap of the source and the frequency weighting.
[2] See Table 4-1

G.6 NAEMO Software

The Navy performed a quantitative analysis to estimate the number of mammals that could be harassed by the underwater acoustic transmissions during the Proposed Action. Inputs to the quantitative analysis included marine mammal density estimates obtained from the Navy Marine Species Density Database, marine mammal depth occurrence distributions (U.S. Department of the Navy In Prep-a), oceanographic and environmental data, marine mammal hearing data, and criteria and thresholds for levels of potential effects. The quantitative analysis consists of computer modeled estimates and a post-model analysis to determine the number of potential animal exposures. The model calculates sound energy propagation from the proposed sonars, the sound received by animat (virtual animal) dosimeters representing marine mammals distributed in the area around the modeled activity, and whether the sound received by a marine mammal exceeds the thresholds for effects.

The Navy developed a set of software tools and compiled data for estimating acoustic effects on marine mammals without consideration of behavioral avoidance or Navy's standard mitigations. These databases and tools collectively form the Navy Acoustic Effects Model (NAEMO). In NAEMO, animats are distributed nonuniformly based on species-specific density, depth distribution, and group size information. Animats record energy received at their location in the water column. A fully three-dimensional environment is used for calculating sound propagation and animat exposure in NAEMO. Site-specific bathymetry, sound speed profiles, wind speed, and bottom properties are incorporated into the propagation modeling process. NAEMO calculates the likely propagation for various levels of energy (sound or pressure) resulting from each source used during the training event.

NAEMO then records the energy received by each animat within the energy footprint of the event and calculates the number of animats having received levels of energy exposures that fall within defined impact thresholds. Predicted effects on the animats within a scenario are then tallied and the highest order effect (based on severity of criteria; e.g., PTS over TTS) predicted for a given animat is assumed. Each scenario or each 24-hour period for scenarios lasting greater than 24 hours is independent of all others, and therefore, the same individual marine animal could be impacted during each independent scenario or 24-hour period. In few instances, although the activities themselves all occur within the Study Area, sound may propagate beyond the boundary of the Study Area. Any exposures occurring outside the boundary of the Study Area are counted as if they occurred within the Study Area boundary. NAEMO provides the initial estimated impacts on marine species with a static horizontal distribution.

There are limitations to the data used in the acoustic effects model, and the results must be interpreted within these context. While the most accurate data and input assumptions have been used in the modeling, when there is a lack of definitive data to support an aspect of the modeling, modeling assumptions believed to overestimate the number of exposures have been chosen:

- Animats are modeled as being underwater, stationary, and facing the source and therefore always predicted to receive the maximum sound level (i.e., no porpoising or pinnipeds' heads above water).
- Animats do not move horizontally (but change their position vertically within the water column), which may overestimate physiological effects such as hearing loss, especially for slow moving or stationary sound sources in the model.
- Animats are stationary horizontally and therefore do not avoid the sound source, unlike in the wild where animals would most often avoid exposures at higher sound levels, especially those exposures that may result in PTS.
- Multiple exposures within any 24-hour period are considered one continuous exposure for the purposes of calculating the temporary or permanent hearing loss, because there are not sufficient data to estimate a hearing recovery function for the time between exposures.

- Mitigation measures that are implemented were not considered in the model. In reality, sound-producing activities would be reduced, stopped, or delayed if marine mammals are detected within the mitigation zones around sound sources.

Because of these inherent model limitations and simplifications, model-estimated results must be further analyzed, considering such factors as the range to specific effects, avoidance, and the likelihood of successfully implementing mitigation measures. This analysis uses a number of factors in addition to the acoustic model results to predict acoustic effects on marine mammals.

For non-impulsive sources, NAEMO calculates the SPL and SEL for each active emission during an event. This is done by taking the following factors into account over the propagation paths: bathymetric relief and bottom types, sound speed, and attenuation contributors such as absorption, bottom loss and surface loss. Platforms such as a ship using one or more sound sources are modeled in accordance with relevant vehicle dynamics and time durations by moving them across an area whose size is representative of the training event's operational area. For each modeled iteration, the slow moving platform in this experiment was programmed to move along straight line tracks from a randomly selected initial location with a randomly selected course. Specular reflection was employed at the boundaries to contain the vehicle within the Study Area.

NAEMO records the SPL and SEL received by each animat within the ensonified area of the event and evaluates them in accordance with the species-specific threshold criteria. For each animat, predicted SEL effects are accumulated over the course of the event and the highest order SPL effect is determined. Each 24-hour period is independent of all others, and therefore, the same individual animat could be exposed during each independent scenario or 24-hour period. Initially, NAEMO provides the overpredicted exposures to marine species because predictions used in the model include: all animats facing the source, not accounting for horizontal avoidance and mitigation is not implemented. After the modeling results are complete they are further analyzed to produce final estimates of potential marine mammal exposures.

G.7 RESULTS

For non-impulsive sources, NAEMO calculates maximum received SPL and accumulated SEL over the entire duration of the event for each animat based on the received sound levels. These data are then processed using a bootstrapping routine to compute the number of animats exposed to SPL and SEL in 1 dB bins across all track iterations and population draws. SEL is checked during this process to ensure that all animats are grouped in either an SPL or SEL category. Additional detail on the bootstrapping process is included in Section G.7.1.

A mean number of SPL and SEL exposures are computed for each 1 dB bin. The mean value is based on the number of animats exposed at that dB level from each track iteration and population draw. The behavioral risk function curve is applied to each 1 dB bin to compute the number of behaviorally exposed animats per bin. The number of behaviorally exposed animats per bin is summed to produce the total number of behavior exposures.

Mean 1 dB bin SEL exposures are then summed to determine the number of PTS and TTS exposures. PTS exposures represent the cumulative number of animats exposed at or above the PTS threshold. The number of TTS exposures represents the cumulative number of animats exposed at or above the TTS threshold and below the PTS threshold. Animats exposed below the TTS threshold were grouped in the SPL category.

G.7.1 Bootstrap Approach

Estimation of exposures in NAEMO is accomplished through the use of a simple random sampling with replacement by way of statistical bootstrapping. This sampling approach was chosen due to the fact that the number of individuals of a species expected within an area over which a given Navy activity occurs is often too small to offer a statistically significant sampling of the geographical area. Additionally, NAEMO depends on the fact that individual animats move vertically in the water column at a specified displacement frequency for sufficient sampling of the depth dimension. By overpopulating at the time of animat distribution and drawing samples from this overpopulation with replacement, NAEMO is able to provide sufficient sampling in the horizontal dimensions for statistical confidence. Sampling with replacement also produces statistically independent samples, which allows for the calculation of metrics such as standard error and confidence intervals for the underlying Monte Carlo process.

For each scenario and each species, the number of samples equating to the overpopulation factor is drawn from the raw data. Each sample size consists of the true population size of the species evaluated. Exposure data is then computed for each sample using 1 dB exposure bins. The average number of exposures across the sample and scenario iteration is then computed.

For example, assuming that an overpopulation factor of 10 was defined for a given species and that 15 ship track iterations were completed. The bootstrap Monte Carlo process would have generated statistics for 10 draws on each of the 15 raw animat data files generated by the 15 ship tracks evaluated for this scenario, thereby yielding 150 independent sets of exposure estimates. Samples drawn from the overpopulated population are replaced for the next draw, allowing for the re-sampling of animals. The resultant 150 sets of exposures were then combined to yield a mean number of exposures and a 95 percent confidence interval per species for the scenario. In addition to the mean, the statistics included the upper and lower bounds of all samples.

G.7.2 Estimated Exposures

Based on the methodology contained herein, Appendix Table H–3 provides the modeled marine mammal exposures associated with the thresholds defined in Section G.5.

Appendix Table G-3 Predicted Marine Mammal Exposures.

Common Name	Behavioral	TTS	PTS
Pinnipeds			
Ringed Seal	1,665	11	0

APPENDIX H PREPARERS

Name	Role	Education and Experience
Naval Undersea Warfare Center, Division Newport		
Code 1023, Environmental Branch, Mission Environmental Planning Program		
Jen James	Project Lead, Project Coordination, Document Development	MESM Wetlands Biology, B.S. Wildlife Biology and Management. Experience: 13 years Environmental Planning, Biological Research 16 years.
Laura Sparks	GIS Support	Masters of Environmental Science and Management, B.A. Political Science, B.A. Marine Affairs. GIS Experience: 4 years
Code 70, Ranges, Engineering, and Analysis Department		
Sarah Blackstock	Oceanographer, Marine Mammal Modeling and Prototyper	Masters of Oceanography, B.S. Biology. Modeling and Prototype Experience: 2 years
McLaughlin Research Corporation (MRC)		
Jocelyn Borcuk	Document Development	B.S. Marine Biology. Experience: 3 years Marine Acoustic Modeling, 3 years Environmental Planning.
Emily Robinson	Document Development	Masters of Environmental Science and Management, B.S. Integrated Science and Technology. Experience: 2 years Environmental Planning
Benjamin Bartley	GIS Analyst	B.S. Fisheries Science and Management, Experience: 4 years Marine Acoustic Modeling, 2 years GIS Analysis

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U.S. Department of the Navy

United States Fleet Forces Command

FINDING OF NO SIGNIFICANT IMPACT/FINDING OF NO SIGNIFICANT HARM (FONSI/FONSH) FOR ICE EXERCISE 2018

Introduction

Pursuant to Section 102(2) of the National Environmental Policy Act (NEPA) of 1969, as amended; Council of Environmental Quality regulations (40 Code of Federal Regulations [CFR] parts 1500-1508) implementing NEPA; Executive Order (EO) 12114, *Environmental Effects Abroad of Major Federal Actions,* Department of Defense regulations found at 32 Code of Federal Regulations Part 187; U.S. Department of Navy (Navy) regulations (32 C.F.R. part 775); and the Chief of Naval Operations Instruction 5090.1D and its accompanying manual (M-5090), CH-10, the Navy gives notice that an Environmental Assessment/Overseas Environmental Assessment (EA/OEA) and Finding of No Significant Impact/Finding of No Significant Harm (FONSI/FONSH) were prepared for Ice Exercise 2018 (ICEX 18) north of Alaska during February to April 2018.

Purpose and Need

The primary purpose of the Proposed Action is to evaluate submarine tactics and operability in an Arctic environment. Secondarily, the Proposed Action would also evaluate emerging technologies and assess capabilities in the Arctic environment and gather data on Arctic environmental conditions.

The need for the Proposed Action is to prepare forces capable of extended operations and warfighting in the Arctic in accordance with Title 10 U.S.C. § 5062 and the U.S. Navy Arctic Roadmap Strategic Objectives.

Description of the Proposed Action

The Proposed Action is to conduct submarine training and testing activities, which includes the establishment of a tracking range and temporary ice camp, and to conduct research in an Arctic environment. The Proposed Action, as well as the construction and demobilization of the ice camp, would occur over a six-week period from late February through early April 2018 (considered winter through early spring). The submarine training and testing and the research activities would occur over approximately four weeks during the six-week period.

Alternatives

To develop and screen alternatives, the Navy used the following screening criteria:

- ICEX must be conducted during a time of year when there are sufficient hours of daylight to support several hours of training and testing each day.
- The location must be on a large area of stable ice that does not have (and is not likely to develop) leads or "gaps" and can sustain a runway and a camp for several weeks.
- The location must have sufficient water depth to accommodate safe submarine activities.
- The location must be in sufficient proximity to shore logistics centers to allow for transfers of personnel and equipment to and from the ice camp.

Based on these screening criteria, a No Action Alternative and two Action Alternatives were analyzed.

Under the **No Action Alternative**, ICEX would not occur. The Navy would not establish an ice camp and would not conduct submarine training and testing activities or research in the Arctic in winter/spring 2018. This alternative required no analysis of potential consequences to environmental resources as no action would occur. The No Action Alternative does not meet the purpose and need of the Proposed Action. However, it does serve as a baseline against which impacts of the Proposed Action were evaluated.

Under **Alternative 1**, Navy would establish an ice camp and conduct submarine training and testing activities at and near the camp.

Under **Alternative 2**, Navy would conduct the activities under Alternative 1, plus research activities aimed at gathering data on environmental conditions and evaluating various technologies and capabilities in the Arctic.

Other **action alternatives considered but not carried forward for detailed analysis** include geographic, seasonal, and operational variations. As discussed in the screening criteria, holding ICEX in a different location or at a different time of year would not satisfy the purpose and need. For example, holding ICEX closer to shore would not afford sufficiently thick ice to support an ice camp as well deep enough water for the submarine tracking range to conduct the required submarine training and testing. Positioning the camp further from shore would put the camp beyond the reach of logistics support required to sustain the activity. Seasonal alternatives are likewise not feasible because the ice conditions required to support the ice camp are only available in the timeframe identified for the Proposed Action. Additionally, altering how submarine training and testing is conducted is not feasible because the training and test plans are designed to specifically meet or test certain objectives. Conducting the training and testing differently would not meet the purpose and need of these requirements.

Environmental Impacts of the Proposed Action

The portion of the Proposed Action occurring in Prudhoe Bay would not increase the demands on local resources because the amount of personnel added to the community for the duration of ICEX would easily be absorbed into the community's existing infrastructure. Flights to and from the ice camp would utilize Deadhorse Airport, which usually experiences up to 90 commercial flights per day. ICEX would result in an increase of only nine flights per day at Deadhorse Airport. Additionally, the Proposed Action would not impact subsistence hunting for bearded and ringed seals as hunting does not occur within the Study Area during the timeframe of the Proposed Action. Although hunting for polar bears and arctic foxes does occur year-round, the Proposed Action is far outside of the normal areas used for hunting.

The EA/OEA evaluated the Proposed Action in terms of stressors and their potential to impact natural and physical resources. The following stressors were analyzed for their potential to affect the natural or manmade environment: acoustic transmissions, aircraft noise, on-ice vehicle noise, aircraft strike, on-ice vehicle strike, in-water vessel and vehicle strike, human presence, expended material, entanglement, and ingestion. Resources that were not considered for analysis because the Proposed Action has no potential to affect them include airspace, terrestrial wildlife (except Arctic fox), deep sea corals and coral reefs, sea turtles, and cultural resources.

The EA/OEA analyzed each stressors' potential effects to the following resources and Table 1 provides the determination summary for all resources.

PHYSICAL ENVIRONMENT:

Air Quality

- No significant impact/harm to local or regional air quality would be expected under the Proposed Action from either Action Alternative.
- Air emissions would occur from mobile generators, aircraft, and on-ice vehicles, however, the ice camp is located outside of the jurisdictional limit of the Clean Air Act, and therefore the conformity rule does not apply. Prudhoe Bay falls within in the North Slope attainment area, therefore, Prudhoe Bay is not subject to a conformity analysis. Emissions from aircraft at Prudhoe Bay would represent a negligible percentage of air emissions and none of the potential air emissions would cause or contribute to a violation of the National Ambient Air Quality Standards. Therefore, no significant impacts to local or regional air quality are expected, and a formal conformity determination is not required.
- In terms of greenhouse gases (GHG), implementing the Proposed Action would contribute directly to emissions of GHGs from the combustion of fossil fuels. However, due to the minor increase in overall average flights around Prudhoe Bay/ Deadhorse Airport, the emissions are very limited. Emissions of GHGs from the Proposed Action are similar amongst the Action Alternatives and do not conflict with DoD, Navy, state, or local GHG goals and programs.
- The potential effects of the GHG emissions from the Proposed Action are by nature global and cumulative, as individual sources of GHG emissions are not large enough to have an appreciable effect on climate change. Neither of the Action Alternatives would introduce significant emissions to affect climate change.

Bottom Substrate

No significant impact/harm to bottom substrates would be expected from either Action Alternative.

- Bottom disturbance could occur from expended buoys, expendable mobile anti-submarine training targets (EMATT), radiosondes, buoys, and radiofrequency tags (approximately 65 items total).
- Although these materials would result in a slightly increased risk of bottom disturbance, the overall harm would be minimal due to the large size of the area and the small number of items expended.

Water Quality

No significant impact/harm to water quality would be expected from either Action Alternative.

- Discharge of graywater from the galley and handwashing station, and reverse osmosis reject water to the water column could affect water quality, however, the short duration and relatively small release of this type of discharge would not negatively impact the water quality of the Beaufort Sea.
- Additionally, combustive byproducts and Otto Fuel II would only be potentially released into the water column from torpedoes during both Action Alternatives. The relatively small release and quick dilution into the water column would not negatively impact the water quality of the Beaufort Sea.

BIOLOGICAL ENVIRONMENT:

Marine Vegetation

No significant impact/harm to marine vegetation would be expected from either Action Alternative.

- Human presence would result in the discharge in graywater and reverse osmosis reject water to the water column.
- Although excess nutrients could result in a localized and temporary bloom of phytoplankton, it would not be to an extent that results in a decline of dissolved oxygen in the water column within the Study Area given the short duration of the Proposed Action and relatively small release.

Invertebrates

No significant impact/harm to invertebrates would be expected from either Action Alternative.

- Although some invertebrates could be disturbed or killed by in-water vessel and vehicle strike, population level effects are not anticipated because of the few number of individuals potentially impacted relative to the total invertebrate biomass in the region. Additionally, since most of the macro-invertebrates within the Study Area are benthic and the Proposed Action takes place within the water column, potential for macro-invertebrate vessel or vehicle strike is extremely low.
- Under both Action Alternatives, the release of Otto Fuel II and other combustive byproducts would occur which could lead to a potential ingestion, no measurable effect on invertebrate populations would occur due to the low amount of combustion byproducts discharged and the amount of potentially affected invertebrates would be low relative to total invertebrate biomass.
- A low likelihood exists that invertebrates would be able to perceive the acoustic transmissions, and if perceived, that an individual animal would react.
- Hydrophones used for the underwater tracking range and in-water data collection devices would introduce potential for entanglement both within the water column and once the material sinks to the seafloor. Given that most invertebrates in the Study Area are benthic, the likelihood of entanglement is extremely limited.

Marine Birds

No significant impact/harm to marine birds would be expected from either Action Alternative.

- Research activities would introduce materials available for ingestion (e.g., balloon fragments); though no measureable effect on bird populations are expected.
- There is potential for aircraft strike from small, fixed-wing aircraft, large fixed-wing aircraft (e.g., C-130), and helicopters. However, because birds are not expected to be traveling in large flocks and aircraft operations would be limited to a few flights a day over the course of a few weeks, any potential incidents of aircraft strike would be isolated and would not result in a significant adverse effect on migratory bird populations.
- Noise associated with aircraft and on-ice vehicles may elicit responses in individual birds potentially migrating through the area. However, due to the limited duration of activities, population-level effects would not be anticipated.

- The Proposed Action would not result in a significant adverse effect on a population of migratory bird species and therefore consultation under the Migratory Bird Treaty Act is not warranted.

Fish

No significant impact/harm to fish would be expected from either Action Alternative.

- There is a low likelihood that fish within the Study Area would be able to perceive the acoustic transmissions, and if perceived, that an individual fish would react.
- Submarines, torpedoes, and unmanned underwater vehicles have the potential to strike fish. These vessels and in-water vehicles would be slow moving, occur in small numbers, and be of short-term use. Isolated cases of vessel strike could potentially injure individuals, but are not expected to result in population level effects.
- Entanglement of fish in hydrophone cables is not anticipated.
- The highest risk of harm from ingestion would be from parachutes, balloon fragments, and weather balloon ropes. Because of the small numbers of balloons and expended materials, and the distance at which they would be dispersed, they would not present a significant threat to fish populations, although one or a few individual fish could be impacted.

Essential Fish Habitat

No significant impact/harm or reduction in the quality or quantity of Essential Fish Habitat (EFH) would be expected from either Action Alternative.

- Acoustic transmissions could have an effect on the features of the EFH due to the increase in ambient sound level during the transmissions. The water column is EFH for the Arctic cod; however, because the quality of the water column would only be affected locally and temporarily, acoustic transmissions would not result in significant harm to EFH.
- Graywater and reverse osmosis reject water discharge could result in a localized and temporary increase in oxygen demand, nutrients, and oil and grease, but would not have long-term effects on EFH.

Mammals

No significant impact/harm to marine mammals would be expected from either Action Alternative.

- Under the Endangered Species Act (ESA) for both Action Alternatives, the Proposed Action may affect, but is not likely to adversely affect, bearded seals and polar bears.
- Regardless of the alternative selected, the Navy received an intentional take permit from U.S. Fish and Wildlife Service (USFWS) to allow certain trained ICEX participants to use specifically authorized deterrent measures to deter polar bears form entering the camp, or to reduce the potential for a lethal human-bear interaction. Allowable methods include vehicle noise, flares, and warning shots.
- The Proposed Action may adversely affect the ringed seal were it a listed species under the ESA, therefore consultation with NMFS was initiated but not completed.[1]

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[1] While the ringed seal is not currently listed as a threatened species under the ESA, litigation surrounding the de-listing of the species is ongoing. In an abundance of caution should the ringed seal be re-listed prior to ICEX 18, the Navy initiated consultation with NMFS.

- Under the Marine Mammal Protection Act (MMPA) for both Action Alternatives, the Proposed Action may cause a behavioral effect to ringed seals. The Navy applied to NMFS for an Incidental Harassment Authorization (IHA) for the Level B take of ringed seals due to acoustic transmissions. The effect would be expected, at most, as minor to moderate avoidance responses from a few animals over short and intermittent periods. The Proposed Action would not be expected to cause significant disruptions such as mass haul outs, or abandonment of breeding, that would result in significantly altered or abandoned behavior patterns.
- Aircraft noise associated from C-130 survey flights, small fixed-wing aircraft, tilt-rotor aircraft, and small (i.e., non-military) helicopters may cause a reaction if a flight occurs above a marine mammal, but any reaction would be temporary and would not result in behavioral patterns being significantly altered or abandoned.
- Noise from on-ice vehicles could affect marine mammals; however, these reactions would be temporary and within these animals' normal repertoire of behaviors, and would not result in behavioral patterns being significantly altered or abandoned.
- The potential for strike from an on-ice vehicle would be limited to snowmobiles. As discussed below, ICEX participants will maintain certain standoff distances from pressure ridges where ringed seals tend to build their lairs.
- Submarines, torpedoes, and unmanned underwater vehicles have the potential to strike marine mammals. However, the potential would be low because these vessels and in-water vehicles would be slow moving, occur in small numbers, and be of short-term use.
- Polar bears can be easily seen because of their large size; therefore, on-ice vehicle strike of a polar bear is not expected.

SOCIOECONOMIC ENVIRONMENT:

Subsistence Hunting

No impact/harm to subsistence hunting would be expected from either Action Alternative.

- While the Proposed Action has the potential to temporarily impact species which are used in subsistence hunting, such as the ringed seal and bearded seal, this hunting would not be stopped or interrupted as part of the Proposed Action due to the distance from shore that the majority of the action would occur as well as the time of year.
- While aircraft may fly over subsistence hunting areas near the coast, it would be within flight corridors already used by aircraft from Deadhorse Airport. Any potential impact to ringed or bearded seals would be minor and temporary.
- Although subsistence hunting for polar bears and Arctic fox occur year-round, the Proposed Action is far outside of the normal areas hunting occurs.

Table 1 Determination Summary

Resource	Alternative 2
Air Quality	No significant impact/harm
Bottom Substrate	No significant impact/harm
Water Quality	No significant impact/harm
Marine Vegetation	No significant impact/harm
Invertebrates	No significant impact/harm
Marine Birds	No significant impact/harm
Fish	No significant impact/harm
Essential Fish Habitat	No significant impact/harm No reduction in quality or quantity of essential fish habitat
Mammals	No significant impact/harm May affect, but not likely to adversely affect, polar bears and bearded seals IHA for ringed seals
Subsistence Hunting	No effect
Conclusion	No significant impact/harm to the environment

The analysis provided in Chapter 3 and Chapter 4 of the EA/OEA, describes how the Proposed Action under NEPA would not result in significant impacts to the human, physical or biological environment. In accordance with E.O. 12114, the Proposed Action would also have not cause significant harm to the physical or biological environment.

No significant direct, indirect, or cumulative impacts would be expected on any of the resources analyzed for ICEX 18. As described in the EA/OEA, implementation of either Action Alternative would result in no significant impact/harm to the natural or physical environment.

Cumulative Impact

Under the Proposed Action, no significant cumulative impacts would be expected from other past, present, and reasonably foreseeable Navy and non-Navy projects. Resource areas that would be impacted are air quality, bottom substrate, water quality, marine vegetation, invertebrates, marine birds, fish, essential fish habitat, mammals, and subsistence hunting. However, these cumulative impacts would not be considered significant because the impacts are minor, short-term, and/or temporary.

Mitigation and Standard Operating Procedures

During ICEX18, the following standard operating procedures would be implemented:

- Ice camp activities and personnel movement within the camp would only occur during daylight hours.

- Pilots would make every attempt to avoid large flocks of birds (which are unlikely) in order to reduce the safety risk involved with a potential bird strike.
- The location for any air-dropped equipment and material would be visually surveyed prior to release of the equipment/material to ensure the landing zone is clear. Equipment and materials would not be released if any animal is observed within the landing zone.
- Air drop bundles would be packed within a plywood structure with honeycomb insulation to protect the material from damage.
- Spill response kits/material would be on-site prior to air-drop of any hazardous material (e.g. fuel).

In addition to the standard operating procedures above, the following mitigation measures would be implemented to reduce or avoid potential harm to marine resources.

- Safety permitting, as aircraft approach the camp, aircraft crew will ensure that the landing zone is clear of any animals and will report the presence and behavior of any seals observed on the ice.
- For activities involving active acoustic transmission from submarines and torpedoes, passive acoustic sensors on the submarines will listen for vocalizing marine mammals. If a marine mammal is detected, the submarine would cease active transmissions, including the launching of torpedoes, and not restart until after 15 minutes have passed with no marine mammal detections.
- Passengers on all on-ice vehicles would observe for marine and terrestrial animals; any marine or terrestrial animal observed on the ice would be avoided by 100 m.
- On-ice vehicles would not be used to follow any animal [with the exception of actively deterring polar bears if the situation requires].
- Personnel operating on-ice vehicles would avoid areas of snow drifts >0.5 m in depth (often near pressure ridges), which are preferred areas for ringed seal subnivean lairs.
- All material (e.g., construction material, unused food, excess fuel) and wastes (e.g., solid waste, hazardous waste) would be removed from the ice floe upon completion of ICEX18; only scientific buoys and radiofrequency identification tags would be left behind.

Agency Consultation and Coordination

<u>Marine Mammal Protection Act</u>: The Navy submitted an application to United States Fish and Wildlife Service (USFWS) for the intentional take (deterrence) of polar bears and USFWS issued a letter of authorization (LOA) on November 16, 2017. The LOA authorizes the intentional taking of polar bears for safety reasons through active deterrence measures. The Navy applied for an IHA for the taking of ringed seals and NMFS provided a draft IHA on 5 January 2018; the IHA will be finalized and issued upon completion of this EA/OEA. Both of these authorizations are pursuant to 101(a)(4)(A), 109)h), and 1112(c) of the Marine Mammal Protection Act.

<u>Endangered Species Act</u>: The Navy informally consulted with the NMFS, Alaska Region, on bearded seals and NMFS concurred with Navy's determination of may affect, but not likely to adversely affect, on September 27, 2017. Due to the potential re-listing of the ringed seal prior to ICEX 18, NMFS also included an analysis of the Proposed Action on the ringed seal in their Letter of Concurrence. NMFS determined the construction and running of the ice camp, may affect, but would not adversely affect the ringed seal. NMFS did not provide an opinion on the acoustic transmission, which the Navy determined may adversely affect the ringed seal.

The Navy also informally consulted with USFWS, Fairbanks Fish and Wildlife Field Office, on polar bears and USFWS concurred with Navy's determination of may affect, but not likely to adversely affect, on November 16, 2017.

Magnuson-Stevens Fishery Conservation and Management Act: NMFS concluded that the Proposed Action would not likely reduce the quantity or quality of Essential Fish Habitat for previous ICEX events on November 9, 2015 and recommended informing NMFS should there be a significant change to the action. Navy sent a letter on 15 December 2017 stating the Navy was conducting ICEX18 but it was not significantly different from ICEX16.

Clean Water Act: The Navy consulted with the Environmental Protection Agency, Region 10, on the modification to the ICEX 16 National Pollutant Discharge Elimination System (NPDES) permit for ICEX 18 in order to account for the expansion of the ice camp study area over the previous ICEX and to include the addition of the handwashing station to the graywater outfall and reverse osmosis reject water discharges previously analyzed. On 21 December 2017, the EPA Region 10 issued the NPDES permit modification to the Navy.

Coastal Zone Management Act

Alaska withdrew from the voluntary National Coastal Zone Management Program on 1 July 2011. Therefore, coastal zone resources were not evaluated for federal consistency under the Coastal Zone Management Act or any state enforcement policies.

Outreach

The Navy published Notice of Availability (NOA) in the Arctic Sounder (both in print and on the website) advertising the availability of the draft EA/OEA for a 17-day comment period. The draft EA/OEA was available electronically at http://www.aftteis.com/ICEX. Additionally, prior to the public release of the draft EA/OEA, the Navy informed the Village of Nuiqsut, the Village of Kaktovic, and the Inupiat Community of the Arctic Slope and mailed a CD containing the draft EA/OEA directly to them. No comments were received on the draft EA/OEA.

Finding

Alternative 2 is the preferred alternative. Based on analysis provided in the ICEX18 EA/OEA, the Navy finds that implementation of Alternative 2 will not significantly impact or harm the quality of the human or natural environment. Therefore, preparation of an Environmental Impact Statement/Overseas Environmental Impact Statement is not required. Copies of the EA/OEA, including this FONSI/FONSH, may be obtained at http://www.aftteis.com/ICEX.

19 Jan 2018
Date

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