SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT FOR THE ISSUANCE OF INCIDENTAL HARASSMENT AUTHORIZATIONS TO TAKE MARINE MAMMALS BY HARASSMENT INCIDENTAL TO CONDUCTING OPEN WATER SEISMIC SURVEYS AND SHALLOW HAZARD AND SITE CLEARANCE SURVEYS IN THE CHUKCHI AND BEAUFORT SEAS, ALASKA

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LIST OF ACRONYMS, INITIALISMS, ABBREVIATIONS, AND SYMBOLS

2D	two-dimensional
3D	three-dimensional
4MP	marine mammal monitoring and mitigation program
AES	ASRC Energy Service
AEWC	Alaska Eskimo Whaling Commission
ARBO	Alaska Regional Biological Opinion
BPXA	BP Exploration (Alaska) Inc.
CAA	Conflict Avoidance Agreement
CBD	Center for Biological Diversity
CFR	Code of Federal Regulations
CPAI	ConocoPhillips Alaska, Inc.
dB	decibel
EA	environmental assessment
EFH	essential fish habitat
EIS	environmental impact statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FDU	Field Digitizing Unit
ft	foot/feet
FN	Field Nyquist
FONSI	Finding of Non-Significant Impact
FR	*Federal Register*
FWS	U.S. Fish and Wildlife Service
G&G	geophysical and geological (permit)
GPS	global positioning system
GXT	GXTechnology
Hz	hertz
IHA	incidental harassment authorization
in^3	cubic inch
ITA	Incidental Take Authorization
ITS	Incidental Take Statement
kHz	kilohertz
km	kilometer(s)
LOA	letter of authorization
LS	Lease Sale
m	meter(s)
mi	mile(s)
MMO	marine mammal observer
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
M/V	Marine Vessel

msec	milisecond
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OBC	ocean bottom cable (seismic survey)
OBC/TZ	ocean bottom cable/transition zone
OBH	ocean bottom hydrophone
OBRL	Ocean Bottom Receiver Location
OCS	Outer Continental Shelf
PEA	Programmatic Environmental Assessment
PEIS	Programmatic Environmental Impact Statement
PGS	Petroleum Geo-Service Onshore, Inc
POC	Plan of Cooperation
p-p	peak-to-peak
psi	pound per square inch
PTS	permanent threshold shift in hearing sensitivities
QC	quality control
rms	root-mean-square
R/V	Research Vessel
SEA	supplemental environmental assessment
SOI	Shell Offshore Inc.
TTS	temporary threshold shift in hearing sensitivities
USC	United States Code
μPa	micro-Pascal
μPa-m	micro-Pascal at 1 meter

I. Introduction

Pursuant to the National Environmental Policy Act (NEPA), this Supplemental Environmental Assessment (SEA) has been prepared to analyze the potential impacts to the human environment that may result from the National Marine Fisheries Service's (NMFS) proposed issuance of five incidental harassment authorizations (IHAs) under section 101(a)(5)(D) of the Marine Mammal Protection Act (MMPA; 16 USC 1371(a)(5)(D)) to the oil and gas industry for seismic and similar surveys in the Chukchi and Beaufort Seas off Alaska. This document supplements the analysis contained in the June 2006 Final Programmatic Environmental Assessment (PEA) for "Arctic Ocean Outer Continental Shelf Seismic Surveys – 2006" prepared by the Minerals Management Service (MMS 2006-038). This document also incorporates by reference the applicable analysis contained in NMFS' August 2007 SEA (2007 SEA) prepared for the Shell Offshore, Inc. IHA, the MMS May 2007 Final Environmental Impact Statement (FEIS) on the "Chukchi Sea Planning Area Oil and Gas Lease Sale 193 and Seismic Surveying Activities in the Chukchi Sea" (MMS, 2007b), and the MMS Multi-Sale Lease EIS (MMS, 2003). To further the purposes of NEPA, this SEA addresses this group of five similar actions as a whole, rather than individually, by analyzing the environmental impacts of each industry request for an IHA in 2008. The level of oil and gas industry activity considered in this SEA is based on the receipt to date of requests for IHAs by industry, as discussed below. The amount, type, and degree of seismic effort evaluated in this SEA falls within the scope of activities evaluated in the PEA and 2007 SEA.

I.A. Background

Between October 2007 and May 2008, NMFS received the following five applications for the taking, by harassment, of small numbers of marine mammals, incidental to conducting open water seismic surveys and shallow hazard and site clearance surveys in the Chukchi and Beaufort Seas:

- On October 16, 2007, Shell Offshore Inc. (SOI) submitted an application for incidental take by Level B harassment of small numbers of marine mammals during its 2008 open water seismic and marine survey programs in the Chukchi and Mid- and Eastern Beaufort seas, Alaska (total of 4 survey activities: 1 3D deep seismic survey in the Chukchi Sea, 1 3D deep seismic survey in the Beaufort Sea, 1 shallow hazard/site clearance survey in the Chukchi Sea, and 1 shallow hazard/site clearance survey in the Beaufort Sea).

- On November 21, 2007, BP Exploration (Alaska) Inc. (BPXA) submitted an application for incidental take by Level B harassment of small numbers of marine mammals during its 2008 open water seismic survey in the Liberty Prospect, Beaufort Sea, Alaska (1 ocean-bottom cable (OBC) seismic survey).

- On May 9, 2008, Petroleum Geo-Services Onshore, Inc (PGS) submitted an application for incidental take by Level B harassment of small numbers of marine mammals during its 2008 open water seismic survey in the Beaufort Sea, Alaska (1 OBC seismic survey).

- On March 25, 2008, ASRC Energy Services (AES) submitted an application for incidental take by Level B harassment of small numbers of marine mammals during its 2008 shallow hazard and site clearance surveys in the Chukchi Sea, Alaska (1 shallow hazard/site clearance survey).

- On April 30, 2008, ConocoPhillips Alaska, Inc. (CPAI) submitted an application for incidental take by Level B harassment of small numbers of marine mammals during its 2008 shallow hazard and site clearance surveys in the Chukchi Sea, Alaska (1 shallow hazard/site clearance survey).

In response to these applications to take marine mammals incidental to open water seismic surveys and shallow hazard and site clearance surveys, NMFS is considering the issuance of five IHAs under section 101(a)(5)(D) of the MMPA. After reviewing the applications for completeness and requirements under the MMPA, *Federal Register* notices of receipt of these applications and proposed IHAs were published on the following dates for a 30-day public review and comment for each of these actions:

- April 28, 2008 (73 FR 22922): AES' proposed 2008 shallow hazard and site clearance surveys in the Chukchi Sea;

- May 2, 2008 (73 FR 24236): BPXA's proposed 2008 open water seismic surveys in the Beaufort Sea;

- May 23, 2008 (73 FR 30064): CPAI's proposed 2008 shallow hazard and site clearance surveys in the Chukchi Sea.

- June 17, 2008 (73 FR 34254): PGS' proposed 2008 open water seismic surveys in the Beaufort Sea; and

- June 25, 2008 (73 FR 36044): SOI's proposed 2008 open water seismic surveys and shallow hazard and site clearance surveys in the Chukchi and Beaufort seas;

I.A.1. Public Comments Process

The MMS 2006 PEA was released for public comment during its draft stage. During the public comment period, MMS received substantive written comments on the PEA from the following:

- Alaska Eskimo Whaling Commission

- Alaska Oil and Gas Association
- American Petroleum Institute
- ConocoPhillips, Alaska, Inc.
- ExxonMobil
- International Association of Geophysical Contractors
- Natural Resources Defense Council
- North Slope Borough
- John W. Richardson
- Shell Exploration and Production
- WesternGeco

In addition, MMS received approximately 500 email form letters.

The majority of comments received by MMS addressed similar sweeping issues (e.g., EIS versus EA, significance criteria, potential mitigation measures, reasonable alternatives, data quality, and data gaps), which were identified and responded to and were included in Appendix D of the MMS 2006. All comments received and responded to were part of the record of information used in developing the final PEA and were available to the decision makers during the decision-making process. The substantive comment letters are available for review on the MMS website at http://www.mms.gov/alaska.

Specific comments submitted to NMFS regarding each proposed IHA will be addressed and released at the stage NMFS has determined that an IHA is appropriate to process, and the responses to these comments will be included in the *Federal Register* notice for the issuance of such IHA.

I.A.2. Statutory and Regulatory Framework

In addition to the regulatory framework described in the PEA, more detailed information on NMFS mandates is presented here.

NMFS Statutory and Regulatory Mandates

Under the MMPA, the taking of marine mammals without a permit or exemption from NMFS is prohibited. "Take" under the MMPA means "to harass, hunt, capture, kill or collect, or attempt to harass, hunt, capture, kill or collect." Except with respect to certain activities not relevant here, the MMPA defines "harassment" as

> "...any act of pursuit, torment, or annoyance which (a) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (b) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but which does not

> have the potential to injure a marine mammal or marine mammal stock in the wild [Level B harassment]."

To date, NMFS' policy has been to use the 180-decibel (dB) root-mean-squared (rms) received level for cetaceans and 190-dB rms received level for pinnipeds to indicate where temporary threshold shift (TTS, or temporary loss of portion of hearing sensitivity) of these animals from acoustic exposure begins. Since TTS does not result in a permanent loss of hearing sensitivity, and the animal is expected to fully recover from TTS after a certain period of time (see review in Southall *et al.*, 2007), NMFS views TTS as Level B harassment. In addition, NMFS uses the 160-dB rms isopleth for cetaceans and 170-dB rms for pinnipeds to indicate where Level B behavioral harassment begins for acoustic sources, including impulse sounds, such as those used for seismic surveys.

In order to obtain an exemption from the MMPA's prohibition on taking marine mammals, a citizen of the United States who engages in a specified activity (other than commercial fishing) within a specified geographic region must obtain an incidental take authorization (ITA) under section 101(a)(5)(A) or (D) of the MMPA. An ITA shall be granted if NMFS finds that the taking of small numbers of marine mammals of a species or stock by such citizen will have a negligible impact on the affected species or stock(s) and will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses. NMFS shall also prescribe, where applicable the permissible methods of taking and other means of affecting the least practicable impact on the species or stock and its habitat (i.e., mitigation, monitoring and reporting of such takings). ITAs may be issued as either (1) regulations and associated Letters of Authorization (LOAs) where there is a potential for serious injury or mortality; or (2) IHAs, when there is no potential for serious injury or mortality or where any such potential can be negated through required mitigation measures.

As part of the MMPA authorization process, applicants are required to provide detailed mitigation plans that outline what efforts will be taken to reduce negative impacts to marine mammals, and their availability for subsistence use, to the lowest level practicable. In addition, IHA authorizations require that operators conduct monitoring, which should be designed to result in an increased knowledge of the species and an understanding of the level and type of takings that result from the authorized activities. Under the MMPA, NMFS further requires that monitoring be designed to provide information and data verifying (or disputing) that the taking of marine mammals are, in fact, negligible and there are no unmitigable adverse impacts on the availability of marine mammals for subsistence uses.

In making a determination of no unmitigable adverse impacts to subsistence uses of marine mammals, NMFS and MMS consider whether a Plan of Cooperation (POC) is negotiated between the affected Alaskan Native communities and the applicants.

MMS Statutory and Regulatory Mandates

Pursuant to 30 CFR § 251.4, a Geological and Geophysical (G&G) permit must be obtained from MMS to conduct geophysical exploration for oil, gas, and sulphur resources. The MMS authority is discussed in the 2006 PEA (section LA.1.) which is incorporated herein by reference.

NMFS and MMS Shared Mandates

Section 7 (16 USC § 1536) of the Endangered Species Act (ESA) states that all Federal agencies shall, in consultation with and with the assistance of the Secretary of the Interior/Commerce (Secretary), ensure that any actions authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species or threatened species, or result in the destruction or adverse modification of habitat of such species, which is determined by the Secretary to be critical.

A summary of NMFS' and MMS' ESA completed consultations with the NMFS Alaska Region Anchorage Field Office and the U.S. Fish and Wildlife Service (FWS) in regards to the actions proposed in the PEA is provided in Section VI of the 2006 Final PEA, which is incorporated herein by reference. The prior consultation concluded with issuance of the Arctic Regional Biological Opinion (ARBO) in 2006. For activities proposed in 2008, additional MMS consultation under section 7 of the ESA concerning the impact on humpback whales in the Chukchi Sea is under review between the MMS and NMFS' Anchorage Field Office. NMFS is also consulting under section 7 of the ESA on the issuance of the IHAs under section 101(a)(5)(D) of the MMPA to AES, SOI, and CPAI for their activities in the Chukchi Sea. The surveys proposed by BPXA and PGS in the Beaufort Sea, as well as issuance of IHAs for these projects, fall within the scope of the 2006 ARBO. Both the 2006 ARBO and the 2008 Biological Opinion, when issued, would apply to the actions analyzed in this SEA.

Consultation will be concluded prior to NMFS making a determination on the issuance of the IHAs. In response to the recent ESA-listing of polar bears as a threatened species, MMS will conduct a section 7 consultation with the FWS on this species (M. Cody, MMS, Personal Communication, May 15, 2008). Since the polar bear is under the FWS management, under the MMPA, incidental take of this species cannot be authorized unless the FWS finds that any take that is reasonably likely to occur will have no more than a negligible impact on the species.

Under the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), Federal agencies are required to consult with the Secretary of Commerce with respect to any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by such agency which may adversely affect essential fish habitat (EFH) identified under the MSFCMA.

A summary of NMFS' and MMS' EFH consultation with the NMFS Office of Habitat Conservation regarding the conduct of seismic surveys in the Arctic is provided in Section VI of the MMS 2006 Final PEA. NMFS has reviewed the scope of the project descriptions for 2008. Based on that review, the projects fall within the scope of the consultation. Therefore, additional consultation for EFH would not be needed unless implementation of the plan or operational conditions changes.

I.B. Purpose and Need for the Proposed Action

The purpose and need of the action is to ensure compliance with the MMPA (and its implementing regulations) for the activities associated with AES, BPXA, SOI, PGS, and CPAI's proposed 2008 open water seismic surveys and shallow hazard and site clearance surveys in the Beaufort and Chukchi Seas between July and November 2008. NMFS' proposed action is issuance of up to five IHAs for take of marine mammals by Level B harassment incidental to the seismic industry's conduct of seismic, marine, shallow hazard and site clearance surveys in the Beaufort and Chukchi Seas offshore of Alaska during the 2008 open water season. IHAs shall be granted for a period not to exceed one year if the Secretary of Commerce finds that the taking will have a negligible impact on the species or stock(s); the taking will involve only small numbers of marine mammals; and will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses. In accordance with the MMPA, the IHAs must set forth the permissible methods of taking by harassment (see below), other means of effecting the least practicable impact on the species or stock and their habitat, and requirements pertaining to the monitoring and reporting of such taking. NMFS has defined "negligible impact" in 50 CFR 216.103 as "...an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival."

Section 101(a)(5)(D) establishes a 45-day time limit for NMFS review of an application followed by a 30-day public notice and comment period on any proposed authorizations for the incidental harassment of small numbers of marine mammals. Within 45 days of the close of the comment period, NMFS must either issue or deny the authorization.

AES, BPXA, SOI, PGS, and CPAI determined that conducting open water seismic surveys and shallow hazard and site clearance surveys in the Chukchi and Beaufort Seas between July and November 2008 might potentially disturb marine mammals and, accordingly, submitted applications for IHAs. As part of NMFS' purpose and need to ensure compliance with the MMPA, the MMPA sets forth specific standards that must be met in order for an ITA to be issued. If these standards are not met, the authorization would be denied. Specifically, if the actions proposed for an IHA will result in no more than the incidental harassment of small numbers of marine mammals, have no more than a negligible impact on the species or stocks, will not have an unmitigable adverse impact on the availability of the species or stock for subsistence uses, and the permissible methods of taking and required monitoring are set forth, then NMFS shall issue the authorizations pursuant to MMPA, 16 USC 1371 (a)(5)(A)&(D).

I.C. Scope, Objective and Assumptions

In 2006, MMS prepared Draft and Final Programmatic Environmental Assessments (PEAs) on the *Arctic Ocean Outer Continental Shelf Seismic Surveys - 2006* (MMS, 2006, or PEA) for permitting up to four seismic surveys to be conducted in the open water season in both the Beaufort and Chukchi Seas, for a total of up to eight annual surveys. NMFS was a cooperating agency in the preparation of the MMS PEA.

On November 17, 2006, NMFS and MMS issued a notice of intent to jointly prepare a Programmatic Environmental Impact Statement (PEIS) to assess the impacts of MMS' annual authorizations under the Outer Continental Shelf (OCS) Lands Act to the U.S. oil and gas industry to conduct a higher level of offshore geophysical seismic surveys in the Chukchi and Beaufort Seas off Alaska over a longer time frame than evaluated in the PEA, and to assess the impacts of NMFS' authorizations under the MMPA to incidentally harass marine mammals while conducting those surveys. The Draft EIS assumes that up to six offshore geophysical seismic surveys would be conducted annually in both the Chukchi and Beaufort Seas off Alaska (for a total of up to 12 annual surveys), and evaluates the environmental effects of the increased level of seismic effort (which represents a 50 percent increase in activity compared to the level of seismic effort analyzed in the MMS 2006 PEA). On March 30, 2007, the Environmental Protection Agency (EPA) noticed the availability for comment of the NMFS/MMS Draft PEIS.

<u>Analysis of the Scope of the MMS 2006 Final PEA for the 2008 Proposed Action</u>

The proposed 2008 open water seismic surveys are expected to have environmental impacts similar to the activities analyzed in the MMS 2006 PEA. NMFS determined, therefore that it would be appropriate to supplement the previously adopted MMS 2006 PEA to support NMFS' NEPA compliance for the 2008 proposed issuance of IHAs to AES, BPXA, SOI, PGS, and CPAI. This approach is warranted while the preparation of the PEIS is underway, as the proposed issuance of up to eight proposed Arctic seismic surveys and shallow hazard and site clearance surveys for five applicants in the 2008 open water season. is similar in scope to the 2006 PEA's evaluation of eight seismic surveys. This SEA incorporates by reference the 2006 Final PEA and other related documents, specifically the agency's five proposed IHA *Federal Register* notices detailed above, the regional Biological Opinion issued for the 2007 SOI seismic survey in the Beaufort and Chukchi Seas, the 2007 SEA, and the 2007 MMS Chukchi Sea Lease Sale 193 FEIS, and the MMS multi-sale EIS in 2003.

NMFS reviewed the MMS 2006 Final PEA to determine which aspects of the proposed 2008 authorizations and their potential environmental consequences warrant supplementation to meet the spirit and intent of NEPA. Detailed comparable analyses of the PEA and the content of this SEA are provided in Table 1 below.

Table 1. A comparison of the activities and content contained in the MMS 2006 Final PEA and the proposed activities and content contained in this SEA

Section	SEA	MMS 2006 PEA
Introduction	Updated the purpose and need of the proposed action to reflect 2008 authorization via IHA (MMPA Sec 101(a)(5)(D)). Supplemented with additional detail on the NMFS statutory and regulatory mandates of the MMPA and ESA. Provided a detailed description of the 2008 proposed open water seismic surveys and shallow hazard and site clearance surveys in the Beaufort and Chukchi Seas by five oil and gas companies.	The proposed action is for MMS to issue up to four seismic surveys related geophysical exploration permits in both the Chukchi and Beaufort Seas (eight total). Described the statutory and regulatory framework of the permitting process. Provided a general description of the seismic surveys, including marine-streamer 3D and 2D surveys, ocean bottom cable seismic surveys, and high resolution site clearance surveys.
Description of the Alternatives	The six alternatives considered in the MMS 2006 PEA were incorporated herein by reference. Alternative 6 was chosen as the preferred alternative with additional mitigation measures to protect bowhead whales.	Six alternatives evaluated.
Existing Environment and Impact Analysis	For the most part there are no changes, and the MMS 2006 PEA is incorporated herein by reference. Updated to include the recent CBD petition to list ribbon seals as an endangered species and NMFS' planned status review of four ice seal species; the recent listing of polar bear as a threatened species by FWS; and new information on climate change and its potential impact to Arctic marine mammals. The proposed 2008 open water seismic surveys and shallow hazard and site clearance surveys in the Beaufort and Chukchi seas are expected to have the same or substantially similar environmental effects as analyzed in the 2006 PEA. Update to include discussion of additional information regarding potential impacts to bowhead whales. Provided description and analysis of the estimated numbers of marine mammals could be taken by the proposed 2008 open water surveys. For the most part, there is no change in the cumulative impacts analysis and the MMS 2006 PEA cumulative impacts analysis is incorporated herein by reference. Updated to include new development on SOI's drilling program in the Beaufort Sea, the State of Alaska lease sale in 2006 and 2007, and the MMS Lease Sale 200 in the Beaufort Sea in 2007 and Lease Sale 193 in the Chukchi Sea in 2008, and the 2007 SOI open water seismic surveys in the Chukchi and Beaufort Seas. Also	Affected physical, acoustic, biological (including bowhead, humpback, minke, gray, beluga, and killer whales, harbor porpoise, ringed, bearded, spotted, and ribbon seals, walruses, and polar bears, marine birds, fish), and socioeconomic environment of the Beaufort and Chukchi Seas, and subsistence uses of the resources, etc. were analyzed in detail. Environmental impacts from seismic surveys on marine mammals, marine birds, fish, and the physical environment of the Beaufort and Chukchi seas, acoustic environment, and subsistence uses of the resources, etc. were analyzed. Cumulative impact on fish/fishery resources and essential fish habitat, seismic survey activities, vessel and air traffic, oil and gas exploration and development, subsistence harvest activities, military activities, industrial development, and climate change were analyzed in detail.

Section	SEA	MMS 2006 PEA
	included an update on potential impacts from climate change to marine mammals in the Arctic.	
Mitigation and Monitoring	For the most part there is no change; MMS 2006 PEA incorporated herein by reference. Included an update from 2006 and 2007 open water seismic survey monitoring and mitigation reports and an assessment of the mitigation effectiveness. These reports show that no injury or mortality occurred as a result of these seismic surveys in the Arctic. In addition, actual take of marine mammals by Level B harassment was generally lower than expected due to the implementation of monitoring and mitigation measures.	Basic mitigation and monitoring measures include: 180/190 dB safety zones for cetaceans and pinnipeds, respectively; safety zone monitoring; shut-down and power down when marine mammals entering or approaching safety zones; ramp-up; sound source verification for seismic surveys, and using marine mammal observers for monitoring. Additional mitigation and monitoring measures were discussed in different alternatives.

In addition, NMFS compared the level of activities (number of surveys) and potential type of seismic effort in both the Chukchi and Beaufort Seas that were analyzed in the MMS 2006 PEA, NMFS 2007 SEA, and this 2008 SEA (Table 2). The MMS 2006 PEA did not analyze specific proposed seismic activities. Instead, it addresses the total level of four seismic surveys involving either a 2D or 3D deep seismic survey, an OBC seismic survey, a shallow hazard and site clearance survey, or a combination of any of the above survey types in each of the Beaufort and Chukchi Seas.

Pursuant to NEPA, this SEA has been prepared to determine the potential impacts that may result from the proposed actions, which would be the issuance of IHAs to AES, BPXA, SOI, PGS, and CPAI for taking, by Level B (behavioral or TTS) harassment of marine mammals during the 2008 open water seismic survey season (July to November) and through the early 2009 summer timeframe (through expiration of the IHAs), where appropriate.

The remaining scope, objectives, and assumptions in this SEA remain the same as those described in the MMS 2006 Final PEA (Section LC, pages PEA-4 and PEA-5, and Table LC-1). Note the relationship between the MMPA ITA and any required ESA Incidental Take Statement (ITS) required for take of ESA-listed species is presented in section 1.C. of the PEA. Since issuance of the PEA, the FWS has listed the polar bear as a threatened species. Since this is a species under FWS jurisdiction, details specific to any appropriate authorization or consultation for that species is not considered further in this SEA, which evaluates the environmental effects of NMFS' proposed issuance of IHAs. Further, NMFS has conducted an analysis of the 2008 proposed seismic survey and shallow hazard and site clearance survey activities by SOI, AES, BPXA, PGS, and CPAI, including the applicants' mitigation and monitoring programs as described in their applications, in order to determine whether each specified activity would result in no more than a negligible impact on small numbers of marine mammal species or stocks, or result in an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses.

Table 2. Comparison of level of activities (number of surveys) in the MMS 2006 PEA, NMFS 2007 SEA and this SEA.

	MMS 2006 PEA	NMFS 2007 SEA	NMFS 2008 SEA
Chukchi Sea	Total of 4 G&G permits. Each permit would authorize 1 seismic survey involving either a 2D or 3D deep seismic survey, an OBC seismic survey, a shallow hazard/site clearance survey, or a combination of any of the above survey types.	1 seismic survey: • 3D deep seismic survey (SOI)	4 seismic surveys: • 3D deep seismic survey (SOI) • Shallow hazard/site clearance survey (AES) • Shallow hazard site clearance survey (CPAI) • Shallow hazard/site clearance survey (SOI)
Beaufort Sea	Total of 4 G&G permits. Each permit would authorize 1 seismic survey involving either a 2D or 3D deep seismic survey, an OBC seismic survey, a shallow hazard/site clearance survey, or a combination of any of the above survey types.	2 seismic surveys: • 3D deep seismic survey (SOI) • Shallow hazard/site clearance survey (SOI)	4 seismic surveys: • 3D deep seismic survey (SOI) • OBC seismic survey (BPXA) • OBC seismic survey (PGS) • Shallow hazard/site clearance survey (SOI)

I.D. Description of 2008 Proposed Seismic Surveys and Shallow Hazard and Site Clearance Surveys

A general overview of seismic surveys, including marine-streamer three-dimensional (3D) and two-dimensional (2D) surveys, OBC seismic surveys, and high resolution site clearance surveys were provided in the MMS 2006 Final PEA. Specific seismic surveys and shallow hazard and site clearance surveys proposed for the 2008 open water season by SOI (2 deep seismic surveys and 2 shallow hazard and site clearance surveys), BPXA (1 OBC seismic survey), AES (1 shallow hazard and site clearance survey), PGS (1 OBC seismic survey), and CPAI (1 shallow hazard and site clearance survey) are described in this section. Figure 1 provides a schematic diagram showing the seismic surveys and shallow hazard and site clearance surveys that are proposed by oil and gas industries for the 2008 Arctic open water season. Figure 2 provides an overview of the approximate locations of the proposed 2008 Arctic open water seismic surveys and shallow hazard and site clearance surveys. More precise and detailed locations are presented in Figures 3 through 8 associated with the description of each proposed seismic survey activity.

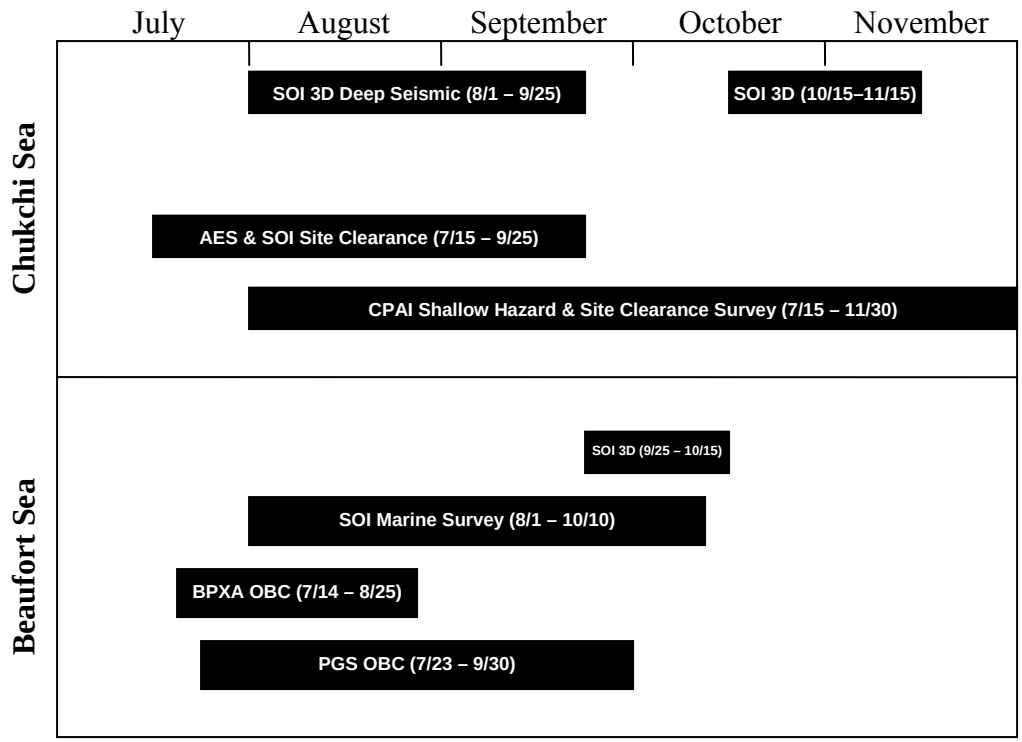

Figure 1. Schematic diagram showing a list of seismic surveys and shallow hazard and site clearance surveys being proposed for the 2008 Arctic open water season.

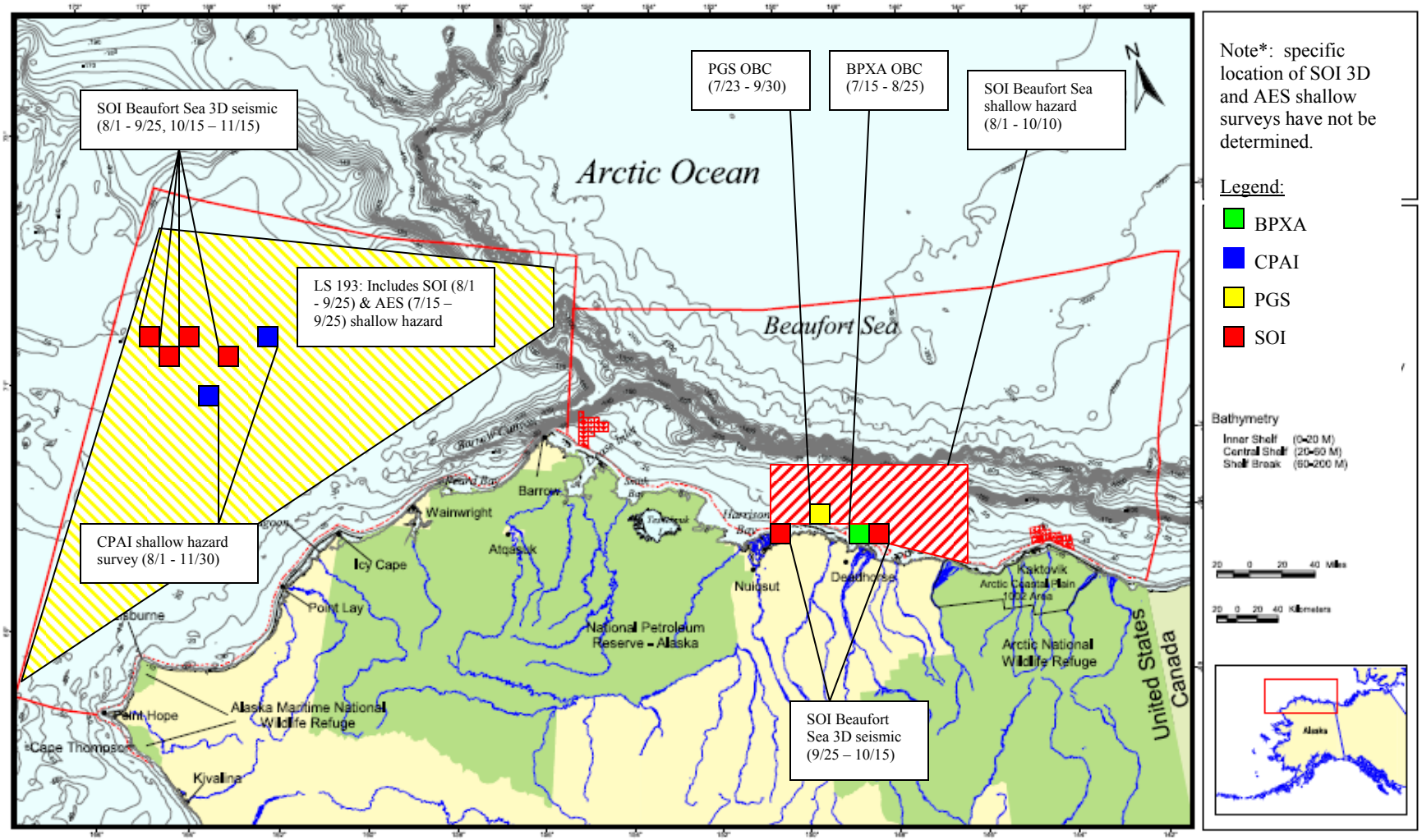

Figure 2. Approximate locations and dates of the proposed 2008 Arctic open water seismic surveys and shallow hazard and site clearance surveys in the Chukchi and Beaufort Seas (adopted from MMS, 2006).

I.D.1. AES Shallow Hazard and Site Clearance Survey in the Chukchi Sea

AES proposed to conduct shallow hazard and site clearance surveys on behave of SOI in the Chukchi Sea for up to 60 days from approximately July 15, 2008 until September 25, 2008. The marine surveys would be performed using a seismic vessel. The marine surveys would occur in MMS LS 193 located in the Chukchi Sea (Figure 3). The specific areas where the AES proposed shallow hazard and site clearance surveys would be are the Burger, Crackerjack, Ulu, and Caramel prospect sites in the Chukchi Sea.

The proposed shallow hazard and site clearance surveys involve geophysical data collection and interpretation that result in the characterization of potentially hazardous conditions at or below the seafloor. These data would be used for planning for the design and construction of a facility and for the safety of future associated activities. The proposed marine surveys are designed to identify and map hazards in the Chukchi Sea using the following methods: seafloor imaging, bathymetry, and high resolution seismic profiling.

(1) Seafloor Imagery

Seafloor imagery would use a side-scan sonar, which is sideward looking, two channel, narrow beam instrument that emits a sound pulse and listens for its return. The sound energy transmitted is in the shape of a cone that sweeps the sea floor resulting in a two dimensional image that produces a detailed representation of the seafloor and any features or objects on it. The sonar can either be hull mounted or towed behind the vessel. One of the following systems would be used in the proposed shallow hazard surveys:

- EdgeTech 4200 dual-frequency side scan sonar: The side-scan sonar emits sound at frequency of 120 kilohertz (kHz) during operation, occasionally reaching frequencies up to 410 kHz. The pulse length is up to 20 miliseconds (msec), and the source level is approximately 210 dB re 1 μPa-m (rms).

- Klein System 3000 dual-frequency digital side scan sonar: This side scan sonar would typically be run at the 132 kHz frequency band. However, the 445 kHz frequency may be used periodically during exploratory testing. The transmission pulse is variable from 25 msec to 400 msec. The peak in the 132 kHz source level beam reaches 234 dB re 1 μPa-m. The peak in the 445 kHz source level beam reaches 242 dB re 1 μPa-m.

(2) Bathymetry

Echo sounders for measuring water depth are generally mounted to the ship hull or on a side-mounted pole. Two different echo sounding systems would be used to provide bathymetric data during the proposed Chukchi Sea shallow hazard surveys.

- Odom Hydrotrac Digital Echo Sounder: This device is a single beam echo sounder, which emits a single pulse of sound directly below the ship along the

vessel trackline and provides a continuous recording of water depth along the survey track. Generally these records require heave compensation to rectify the data point. The Hydrotrac sonar operates at a frequency of 200 kHz and emits approximately 15 pulses per sec. Each pulse phase is between 0.03 and 0.12 msec. The peak within the source beam level transmits from 202 to 215 dB re 1 µPa-m.

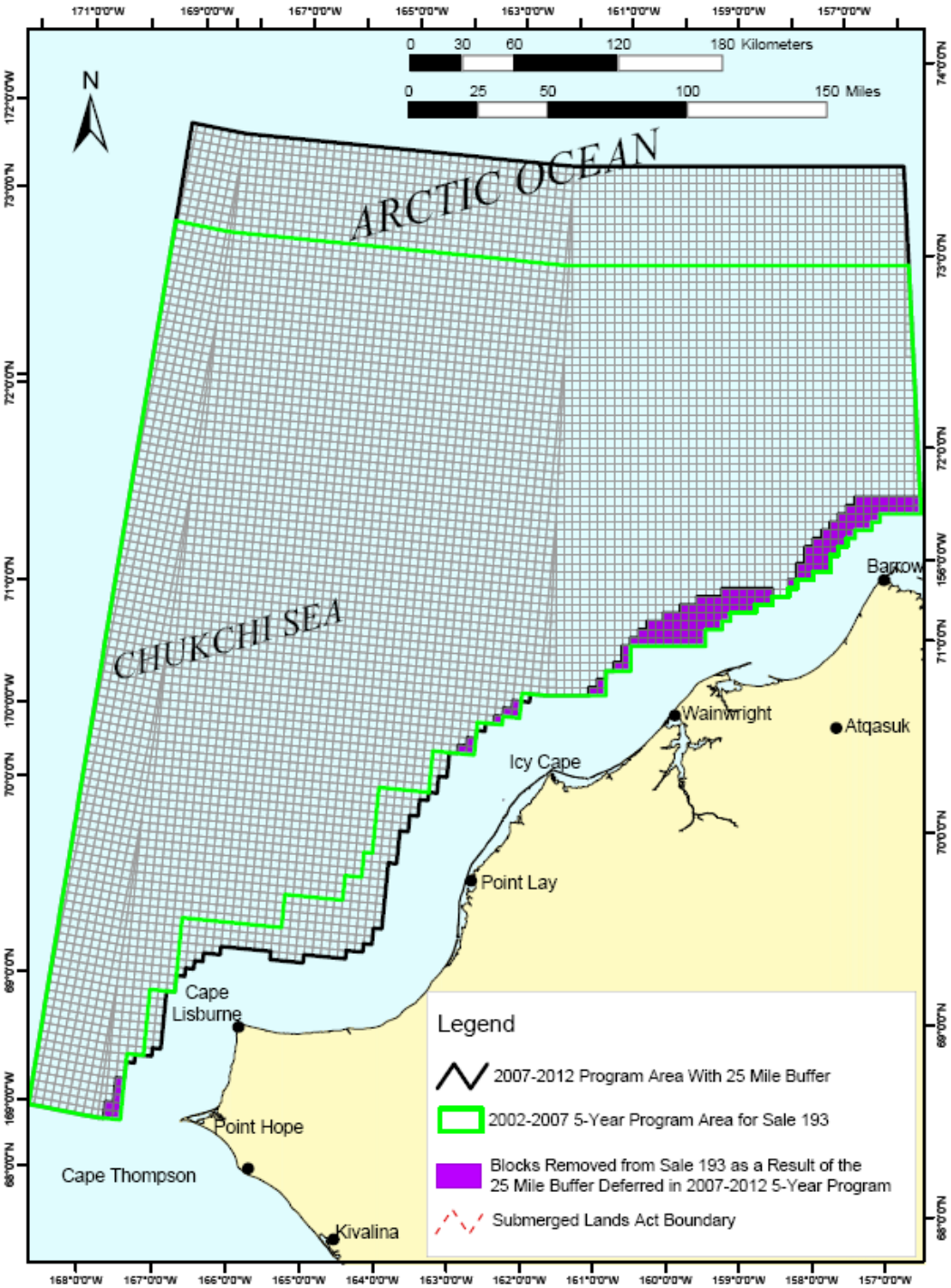

Figure 3. Location of the MMS Chukchi Sea Lease Sale 193 within which AES's and SOI's site clearance surveys are proposed. (Adopted from MMS, 2007b)

- Reson Seabat 8101 Multibeam Echo Sounder: This echo sounder consists of a transducer array that emits a swath of sound. The seafloor coverage swath of the multibeam sonar is water depth dependent, but is usually equal to two to four times the water depth. This sonar operates at a frequency of 240 kHz. It emits approximately 15 pulses per sec with each pulse duration lasting 21 msec to 225 msec for a swath that can cover up to 500 m (1,640 ft) in width. The peak in the source beam level for the Reson Seabat sonar transmits at 210 dB re 1 μPa-m.

(3) High Resolution Seismic Profiling

An integral part of the shallow hazard and site clearance surveys is high resolution seismic profiling using three different acoustic source systems. Seismic systems operate on the principal that an acoustic impulse would reflect part of its energy upon encountering a density interface. This would be accomplished through the use of a high frequency subbottom profiler, an intermediate frequency seismic profiling system, and a multichannel seismic system. The high resolution profiling systems, which use smaller acoustic sources, would be utilized as opposed to low resolution systems or deep exploration seismic systems. The proposed surveys are geared towards gaining detail of the surficial and shallow subsurface geology and not towards hydrocarbon exploration. The proposed high resolution profiles would provide the detailed information that is not resolved in the deep seismic profiles. The following equipment would be utilized for the high resolution seismic profiling portion of the marine surveys:

(a) High Resolution Subbottom Profiler

A Subbottom Profiler would be used to map geologic features in the proposed survey areas. Many of the modern subbottom profilers are "chirp" systems which are frequency or pulse rate modulated. This allows the energy, amplitude, and phase characteristics of the acoustic pulse to be precisely controlled. One of the following subbottom profiler systems would be used in the proposed marine surveys:

- GeoAcoustics GeoPulse subbottom profiling system: The subbottom profiler would be used in the 3.5 to 5 kHz frequency range. Pulse cycles range from 1 to 32 cycles of the selected frequency. The peak in the source level beam reaches 214 dB re 1 μPa-m. The source level beam reaches approximately 214 dB re 1 μPa-m (rms) (or approximately 225 dB peak).

- GeoAcoustics GeoChirp II sub-bottom profiling system: This subbottom profiler has a frequency range of 500 hertz (Hz) to 13 kHz, which is programmable. The transmission pulse length is typically 32 msec programmable sweeps or user defined pings. The pulse repetition rate is 4 pulses per sec (at maximum) for a 32 msec chirp sweep or 10 pulses per sec for pinger waveforms. The source level beam reaches 214 dB re 1 μPa-m (rms), (or approximately 224 dB peak).

(b) Intermediate Frequency Seismic Profiling System

One intermediate-frequency seismic system is referred to as a "Boomer." The "Boomer" transducer is a mechanical means of generating enough sound energy to penetrate the subsurface sediments. Signals are reflected from the various bedding planes (density/velocity interfaces) and received by a single channel hydrophone streamer. The sound reflections are converted into electrical impulses, filtered, and sent to a graphic recorder. The "Boomer" can effectively detail the upper 40 to 600 m (131 to 1,969 ft) of subbottom, outlining the fine strata and density layers that represent foundation formations for seafloor based structures.

The Boomer system would consist of an Applied Acoustics Model AA300 Boomer plate with housing. The maximum energy that would be used for these surveys is 300 Joules (J) per shot. The pulse length ranges from 150 to 400 msec with a reverberation of less than 1/10 of the initial pulse. The peak in the source level beam reaches 218 dB re 1 μPa-m at 300 J with a frequency range of 0.5 to 300 kHz. A Datasonics Model SPR-1200 seismic profiling system also known as a "bubble pulser" would also be used. It has an electromagnetic source. The frequency of the system is 400 Hz in a narrow band. The peak in the source level beam reaches 200 dB re 1 μPa-m.

(c) Multichannel Seismic System

The multichannel seismic system would consist of an ultra shallow water (USW) array comprised of a SeaSCAN USW Model 40 in^3 seismic sound source consisting of four 10-in^3 Input/Output (I/O) sleeve guns. If desired, the power can also be reduced to 20 in^3. The reflected energy would be received by a marine digital seismic recording streamer system with 48 channels and 12.5 m (41 ft) groups deployed and retrieved by SeaSCAN streamer reel/winch. This system would provide the lowest resolution of the high-frequency data. The sound source is expected to provide 1.5 to 3 sec of data, two-way travel time with a resolution of 10 msec. It operates at a frequency range of 20 - 200 Hz and a peak sound output of 196 dB re 1 μPa-m for all four guns combined. This tool is useful in finding shallow faults and amplitude anomalies.

I.D.2. BPXA Ocean Bottom Cable Seismic Survey in the Beaufort Sea

BPXA plans to conduct a 3D, OBC seismic survey in the Liberty area of the Alaskan Beaufort Sea in 2008. This survey would take place in shallow waters of maximum 9.1 m (30 ft) deep inside the barrier islands (Figure 4).

OBC seismic surveys are used to acquire seismic data in water that is too shallow for large marine-streamer vessels and/or too deep to have grounded ice in the winter. This type of seismic survey requires the use of multiple vessels for cable deployment/recovery, recording, shooting, and utility boats. The planned 3D OBC seismic survey in the Liberty area would be conducted by CGGVeritas, a company contracted by BPXA.

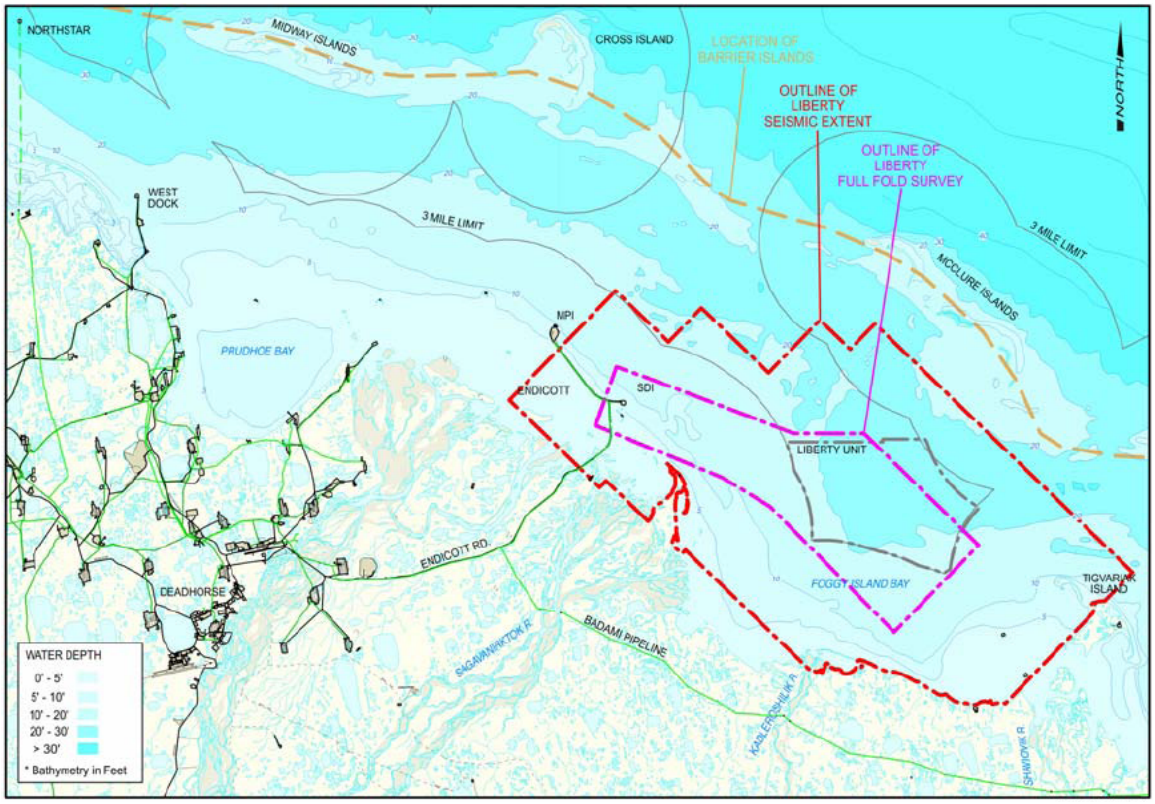

Figure 4. BP's proposed Liberty seismic survey area. The pink line represents the area were data needs to be acquired and the red dashed line shows the outline of the Liberty seismic extent, which is the area covered by the receiver and source lines. (Adopted from BPXA's IHA application.)

Receiver cable lines consist of a hydrophone and a Field Digitizing Unit (FDU) placed on the cables at 33.5 m (110 ft) intervals and placed on the seafloor according to a predefined configuration to record the reflected source signals from the airguns. The cables that would be deployed on mudflats and in very shallow water would consist of marsh phones and are placed in a similar configuration as those deployed at the seabottom. The receiver cables would be oriented in a NE-SW direction. A total of approximately 66 NE-SW oriented receiver lines would be deployed with increasing line spacing from west to east of approximately 268 m (880 ft) to 610 m (2,000 ft). Total receiver line length would be approximately 788 km (490 mi) of which approximately 16 km (10 mi) would be laid on mudflats. The source vessels would travel perpendicular over these receiver cables along lines which would have a NW to SE orientation and a varying total length of minimum 3.2 and maximum 5.6 km (2 to 3.5 mi). The total source line length is approximately 3,220 km (2,000 mi) in water depths varying from 1 to 9.1 m (3 to 30 ft). The Liberty seismic survey design is planned such that the most critical data along the well path can be acquired as highest priority, before time becomes limited.

To limit the duration of the total survey, two source vessels would operate, alternating airgun shots. The source vessels would be the *M/V Peregrine* and *R/V Miss Diane* owned by Peregrine Marine. The sources used for seismic data acquisition would be sleeve

airgun arrays with a total discharge volume of 880 in^3 divided over two arrays. Each source vessel would have two 440 in^3 arrays comprised of four guns in clusters of 2 x 70 in^3 and 2 x 150 in^3. The 880 in^3 array has an estimated source level of approximately 250 dB re 1 μPa-m.

The arrays would be towed at a distance of at approximately 8 - 10 m (26 - 32 ft) from the source vessel at depths varying from 1 - 4 m (3 - 13 ft), depending on the water depth. The vessel would travel along pre-determined lines at approximately 1 to 5 knots, mainly depending on the water depth. Each source vessel would fire shots every 8 seconds, resulting in 4 second shot intervals with two operating source vessels. The seismic data acquisition would occur over a 24 hr/day schedule.

The *M/V Peregrine*, *R/V Miss Diane* and 4 bow pickers would be used for the deployment and retrieval of the receiver cables. Each of the cable vessels would be powered with twin jet diesels and are rigged with hydraulically driven deployment and retrieval systems ("Squirters"). The *M/V Peregrine* and *R/V Miss Diane* function both as source and cable vessel and would be capable of carrying 120 hydrophone stations. The smaller bow picker cable vessels would also carry 120 hydrophone stations and are capable of beach landings. All cable vessels would maintain 24-hr operations.

Part of the receiver cables would be deployed on mudflats to pick up reflected source signals and allow for full interpretation of the data in the area of interest, i.e. well path (pink line in Figure 4). The deployment of these receiver cables would be conducted by other equipment that can operate in shallow waters and marshy conditions (such as swamp buggies, Jon boats).

The positions of each receiver need to be established. Due to the variable bathymetry in the survey area, receiver positioning may require more than one technique. A combination of Ocean Bottom Receiver Location (OBRL), global positioning system (GPS) and acoustic pingers would be used. For OBRL, the source vessel fires a precisely positioned single gun multiple times along either side of the receiver cables. Multiple gun locations are then calculated at a given receiver to triangulate an accurate position for the receiver. In addition, Dyne acoustical pingers would be located at predetermined intervals at the receiver lines. The pinger locations can be determined using a transponder and allow for interpolation of the receiver locations between the acoustical pingers and as calibration/verification of the OBRL method. The sonar Dyne pingers operate at 19 - 36 kHz and have a source level of 188 - 193 dB re μPa-m.

A Sercel 428 FDU would be located at each hydrophone. This system is lightweight and robust and rated to 14 m (45 ft) of water depth, which would allow it to operate well in the water depths for this survey. For approximately each 30 recorder-hydrophone units one or two battery pack(s) would be deployed at the sea bottom. This battery pack would be equipped with a buoy (or acoustic release) and a pinger, to ensure that the battery packs can be located and retrieved when needed.

The data received at each FDU would be transmitted through the cables to a recorder for further processing. This recorder would be installed on a pin-together boat barge combination and positioned close to the area where data are being acquired. While recording, the pin-together boat barge is stationary and is expected to utilize a four point anchoring system.

The proposed seismic survey would be conducted for a period of approximately 40 days between July and August 2008, given the uncertainties in ice conditions and other factors that can influence the survey. Seismic data acquisition is planned to start on July 14, 2008, depending on the presence of ice. Open water seismic operations can only start when the project area is ice free (i.e. < 10% ice coverage), which in this area normally occurs around July 20 (+/- 14 days). Limited layout of receiver cables might be possible on the mudflats in the Sagavanirktok River delta areas before the ice has cleared.

The project area encompasses 351.8 km^2 (135.8 mi^2) in Foggy Island Bay, Beaufort Sea of which 1 percent is on mudflats, 18.5 percent in water depths of 0.3 - 1.5 m (1 - 5 ft), 12.5 percent in water depths of 1.5 - 3 m (5-10 ft), 43 percent in water depths of 3 - 6 m (10 - 20 ft), and 25 percent in water depths of 6 - 9 m (20 - 30 ft). The approximate boundaries of the total surface area are between 70°11'N and 70°23'N and between 147°10'W and 148°02'W (Figure 4).

Since the proposed BPXA seismic surveys would be conducted within the barrier islands, much of the outgoing acoustic energy would be blocked by the islands, therefore, limiting the number of bowhead whale takes. In addition, the proposed seismic survey would be concluded before the bowhead whale fall migration.

I.D.3. CPAI Shallow Hazard and Site Clearance Survey in the Chukchi Sea

CPAI is planning to conduct site clearance and shallow hazard surveys of potential exploratory drilling sites in the Chukchi Sea during the 2008 open water season. The surveys would be in two areas within MMS LS 193. The geographic region of the proposed activities includes two areas spaced about 60 km (37 mi) apart and a path for sampling conditions along a potential pipeline route. Each area is about 2,000 km^2 (772.5 mi^2) with dimensions about 72 km (45 mi) by 62 km (38.5 mi). The two areas are about 111 km (69 mi) off the Alaska coast, generally west from the village of Wainwright (Figure 5). CPAI anticipates completing the survey in 30 - 45 days between mid July and the end of November, depending on weather and other operational factors. Site clearance and shallow hazard surveys would begin in August, after completing mobilization in July[1]. CPAI anticipates shooting approximately 5,300 linear km (3,294 mi). The operation would be active 24 hours per day and use a single vessel to collect the geophysical data.

[1] The mobilization work by CPAI will not involve the "shooting" of seismic activities. The use of seismic airguns or other acoustic sources will not begin until August.

Site clearance and shallow hazard surveys would be completed to confirm the seafloor has soil and surface characteristics that would support the safe set-down of a drill rig, and long term occupation of the site by a vessel. Acoustic instrumentation to be used for the proposed survey is designed to characterize the seabed topography, bathymetry, potential geohazards, and other seafloor features (e.g., boulders) using seafloor imaging, water depth measurements, and high-resolution seismic profiling. These instruments are essentially the same as those that would be used by AES and were described above, which include:

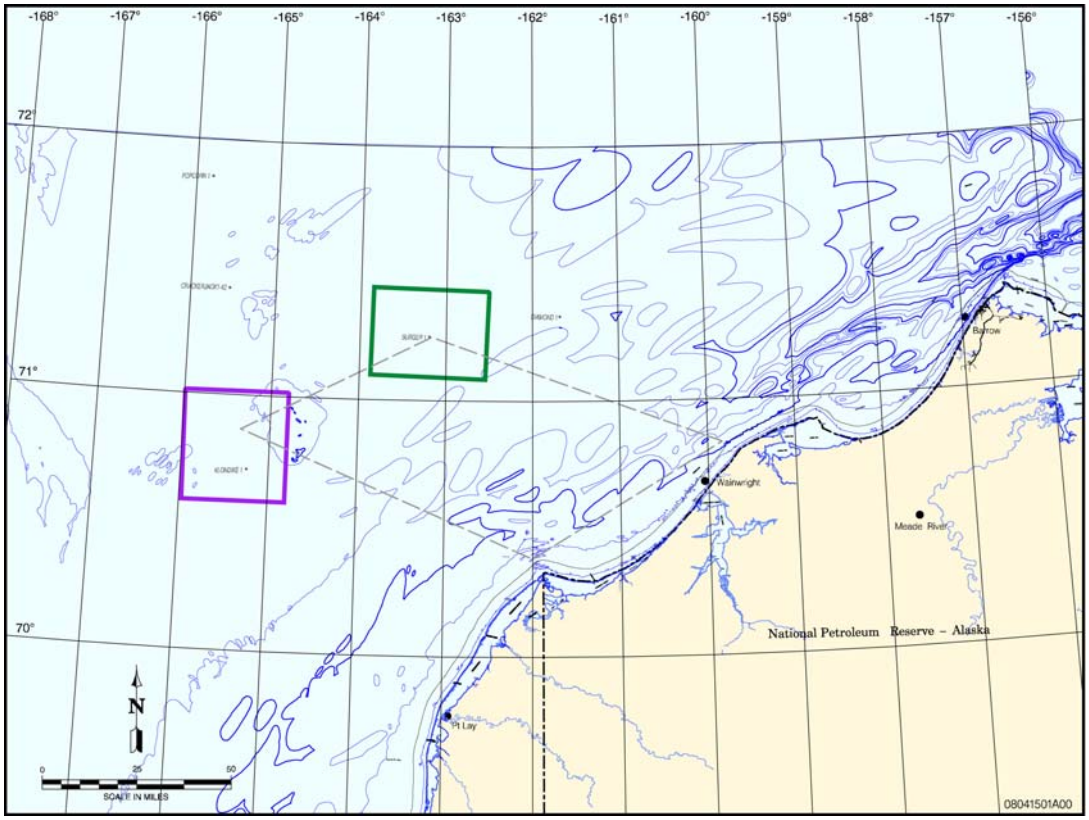

Figure 5. CPAI proposed 2008 shallow hazard and site clearance survey area in the Chukchi Sea. (Adopted from CPAI's IHA application.)

- Seafloor Imagery: a sonar system such as Marine Sonics Technology multi-frequency side-scan sonar, Edge Tech 4200 dual-frequency side-scan sonar, or Klein System 3000 dual-frequency digital side-scan sonar;

- Bathymetry: An Odom Hydrotrac digital single beam echsounder and Reason Seabat 8101 or EM2000 multibeam echsounder;

- High-resolution Seismic Profiling:
    - High Resolution Subbottom Profiler: Knudsen 320 BR sub-bottom profiling system, GeoAcoustics/GeoPulse or Nueson subbottom profiling system, or GeoAcoustics GeoChirp II subbottom profiling system;

- Intermediate Frequency Seismic Profiling System: Applied Acoustics Squid 2000 mini sparker Boomer, Applied Acoustics Model AA300 Boomer plate, or equivalent;
- Multichannel Seismic System: A Geo-Spark 1600 Sparker and an Ultra Shallow Water array composed of a 40 in^3 seismic sound source with four 10-in^3 sleeve guns.

I.D.4. PGS Ocean Bottom Cable Seismic Survey in the Beaufort Sea

PGS has been contracted by ENI to conduct an exploratory 3D, OBC marine seismic survey in the Beaufort Sea of Alaska, utilizing an ocean bottom cable/transition zone (OBC/TZ) technique. The proposed survey is scheduled to occur from mid-July to late-September 2008. Because the proposed survey is weather and ice dependent, the exact dates of the survey cannot be determined at this time. The proposed survey location is in the Nikaitchuq Lease Block (Figure 6), north of Oliktok Point and covering Thetis, Spy, and Leavitt Islands, and would extend to the 5-km (3-mi) state/federal water boundary line. The program would not go into federal waters. The water depth in this area ranges from 0 to 20 m (65 ft), and a third of the project waters are shallower than 3 m (10 ft). The total area covered by source or receiver lines is 304.6 km^2 (117.6 mi^2). Since the islands comprise approximately 1.7 km^2 (0.7 mi^2) of the area, the total marine area is 303 km^2 (117 mi^2). Total survey line would be 1,280 km (796 mi).

Similar to BPXA's proposed seismic surveys, this OBC/TZ survey also involves deploying cables from small boats, called DIB boats, to the ocean bottom, forming a pattern consisting of three parallel receiver line cables, each a maximum of 17.3 km (10.8 mi) long and spaced approximately 200 m (660 ft) apart. Hydrophones and geophones attached to the cables are used to detect seismic energy reflected back from rock strata below the ocean bottom.

PGS proposes using two shallow water source vessels for this survey. The source vessels would be used sequentially: one vessel would be active while the other travels to its next position. Both source vessels, *M/V Wiley Gunner* and *M/V Little Joe*, would be equipped with identical airgun arrays with an air discharge volume of 880 in^3. This airgun array produces maximum source level of 197 dB re 1 μPa-m (peak) at 42 Hz. These airgun arrays are expected to operate at a depth of between 0.91 m and 2.29 m (3 ft and 7.5 ft). Source lines would be spaced approximately 200 m (660 ft) apart.

The seismic recording system scheduled to be housed on the *M/V William Bradley* during the proposed 3D marine seismic survey is a Sercel 408. The system would record data using a tape emulator drive hard drive imbedded into the recorder so that verified IBM 3590 archive tapes can be created at the quality control processing laboratory. Digital records would be formatted in SEG D configuration and traced at three lines of 156 per record for every 2-msec periods. The digital filters would be linear or minimum phase, and the anti-alias filters would be high-cut 0.8 Field Nyquist Stop Band Attenuation greater than 120 dB. Record length would be six sec versus a shot point distance of 34 m

(110 ft). This Sercel system would be capable of an inter-record delay of equal to or less than 2 sec of overhead.

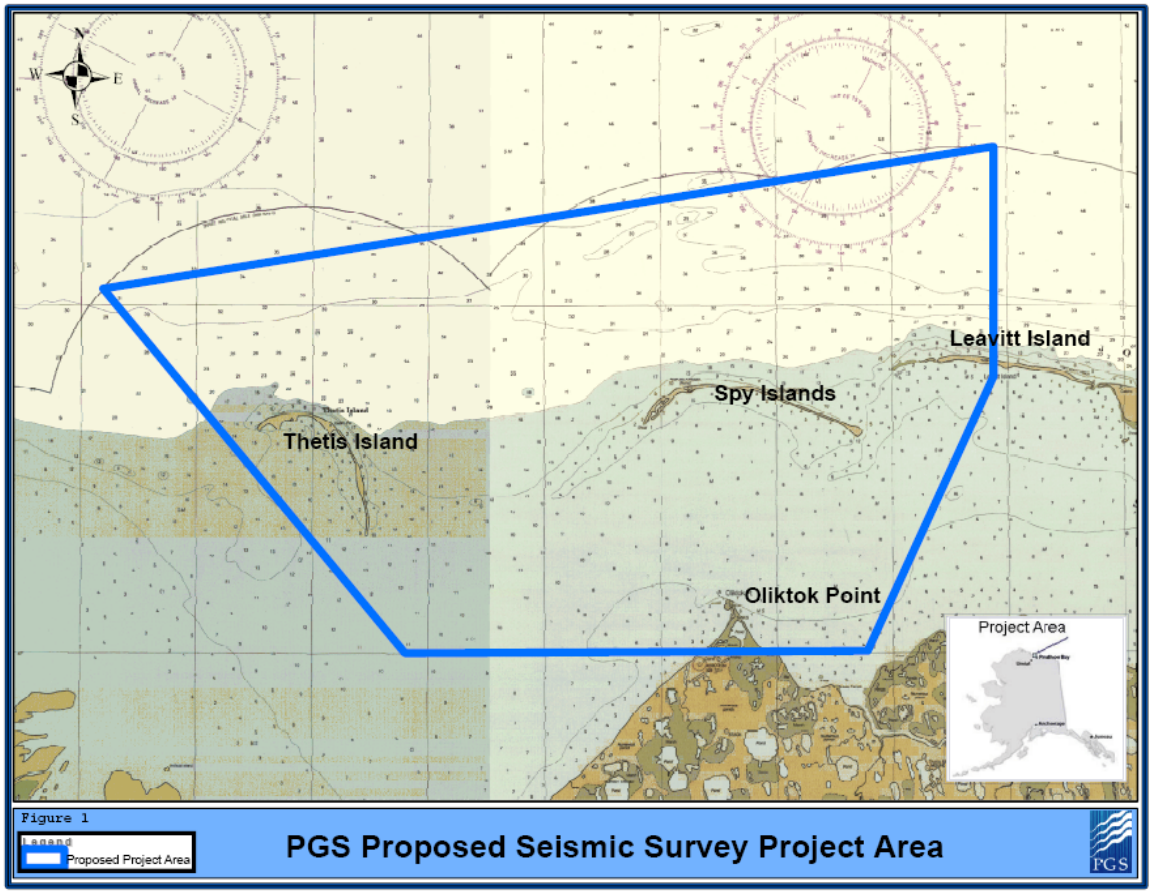

Figure 6. PGS proposed 2008 seismic survey area in the Beaufort Sea. (Adopted from PGS' IHA application.)

PGS would use an airgun energy source for the proposed data acquisition. A minimum of a 10-airgun array is expected to be used as a single output source; however, a maximum of a 12-airgun array may be necessary. The operating source depth for the guns is a minimum of 2.5 m (8.2 ft). Source centers separation would be from 1 m to 1.5 m (3.3 ft to 4.9 ft), and the shot point distance is 34 m (110 ft). The single source volume is 880 in^3. Although PGS is proposing to use only a 10-airgun array for acquisition, a 12 airgun array would be placed on each vessel. This would provide two spare airguns at all times. The source layout would be 8 m (26 ft) wide by 6 m (20 ft) long. At a depth of 2.5 m (8.2 ft), the point to point output pressure is plus or minus 22 bar meters, giving a signal/bubble ratio of 10:1.

For use during the proposed bathymetry survey in the Beaufort Sea, PGS would employ an Interspace Tech DX 150 (or equivalent), which can operate in water up to 120 m (400 ft) deep. This equipment has an operating frequency of 200 kHz and a sound source of 100 dB re 1 µPa. The digitizer and logger system would be a National Marine Electronic Association standard output to Horizon. PGS would use a Gator INM system and a Gator

INS system as source firing controllers. For measures of the depth, temperature, and salinity, a Valeport TS Dip Meter would be used.

To conduct the proposed 3D seismic survey in the Beaufort Sea, PGS would employ a Novatel system and a GPS mobile receiver with 8 to 12 channels of dual frequency. For the Novatel system, there would be three onshore reference stations and four valid satellites. As a second main system, PGS has available a Trimble 4700 system and a GPS Mobile Receiver, also with 8 to 12 channels of dual frequency. For the Trimble 4700, there would be two onshore reference stations. PGS would also have 700 active Sonardyne Acoustic transponders available for in-water positioning.

Since the proposed PGS seismic surveys would be conducted within the barrier islands, much of the outgoing acoustic energy would be blocked by the islands, therefore, limiting the number of bowhead whale takes.

I.D.5. SOI Deep Seismic Survey and shallow Hazard and Site Clearance Surveys in the Beaufort and Chukchi Seas

SOI is planning a variety of programs in the Chukchi and Beaufort Seas during the 2008 open water season[2], which include:

- Chukchi Sea Deep 3D Seismic Survey;
- Chukchi Sea Marine Surveys (including site clearance and shallow hazards);
- Beaufort Sea Deep 3D Seismic Survey; and
- Beaufort Sea Marine Surveys – this includes three components:
    - Site Clearance and Shallow Hazards Component
    - Ice Gouge Survey Component
    - Strudel Scour Survey Component

All of these individual activities would require marine vessels to accomplish the work.

For the Deep 3D seismic surveys, the WesternGeco's 3,147 cubic inch (in^3) bolt gun array will be used. WesternGeco's source arrays are comprised of identically tuned bolt gun sub-arrays operating at 2,000 pound per square inch (psi) air pressure. In general, the signature produced by an array comprised of multiple sub-arrays has the same shape as that produced by a single sub-array while the overall acoustic output of the array is determined by the number of sub-arrays employed.

The sub-array is comprised of six tuning elements; two 2-gun clusters and four single guns. The clusters have their component guns arranged in a fixed side-by-side fashion with the distance between the gun ports set to maximize the bubble suppression effects of

[2] SOI has requested that any IHA issued during the 2008 open water seismic season extend through July 31, 2009. NMFS expects that the analysis contained in this SEA would cover SOI's activities next summer should SOI find it necessary to operate under the 2008/2009 IHA, as the activities evaluated herein would be similar to those conducted in the mid-summer period of 2009.

clustered guns. A near-field hydrophone is mounted about 1 m (3.3 ft) above each gun station (one phone is used per cluster), one depth transducer per position is mounted on the gun's ultrabox, and a high pressure transducer is mounted at the aft end of the sub-array to monitor high pressure air supply. All the data from these sensors are transmitted to the vessel for input into the onboard systems and recording to tape.

The time series and amplitude spectrum for the far-field signature and the computed acoustic emission pattern for the vertical inline and cross-line planes for the 3,147 in^3 array with guns at a depth of 6 m (20 ft) were shown in detail in the SOI application.

SOI Chukchi Sea Deep 3D Seismic

SOI and its geophysical (seismic) contractor WesternGeco propose to conduct a marine geophysical (deep 3D seismic) survey program during the open water season on various MMS OCS Lease Sale 193 area in the northern Chukchi Sea (Figure 7). However, in general seismic data acquisition will occur at least 25 mi (40 km) offshore of the coast and in waters averaging depths greater than 40 m (131 ft).

The deep 3D seismic survey is proposed to be conducted from WesternGeco's vessel *M/V Gilavar*, with two chase boats accompanying the seismic vessel. These two chase boats will provide the following functions: (1) re-supply, (2) re-fueling, (3) marine mammal monitoring, (4) ice scouting, and (5) general support for the *M/V Gilavar*. The chase boats will not deploy seismic data acquisition gear. In addition, a crew change vessel and a landing craft will support the *M/V Gilavar* and the two chase boats in the Chukchi Sea. The crew change vessel will be used to move personnel and supplies from the seismic vessel, and two chase boats to the nearshore areas. In turn, the landing craft will move personnel and supplies from the crew change vessel, when it is located in nearshore areas, to the beach (most likely this will be at Barrow). Lastly, the marine mammal monitoring and mitigation program (4MP) will have a separate vessel for the proposed 2008 Program. The crew change vessel also will be used to move personnel and equipment from the 4MP vessel to the near shore areas.

The proposed deep 3D seismic survey in the Chukchi Sea is planned to begin on August 1 until September 25, 2008, then continue around October 15 and conclude in early November.

SOI Chukchi Sea Marine Surveys

Marine surveys in the Chukchi Sea will include site clearance and shallow hazards surveys of potential exploratory drilling locations as required by MMS regulations. These surveys gather data on: (1) bathymetry, (2) seabed topography and other seabed characteristics (e.g., boulder patches), (3) potential geohazards (e.g., shallow faults and shallow gas zones), and (4) the presence of any archeological features (e.g., shipwrecks). Marine surveys for site clearance and shallow hazards can be accomplished by one vessel with acoustic sources. No other vessels, such as chase boats, are necessary to accomplish

the proposed work. Any necessary crew changes or 4MP coordinated activities under this activity will utilize the same crew change, landing craft, or 4MP vessel mentioned under the Chukchi Sea deep 3D seismic. The Chukchi Sea Marine Surveys will be conducted by SOI on leases acquired in OCS LS 193. Site clearance surveys are confined to small specific areas within OCS blocks.

The vessel which will be conducting these marine surveys may also be involved in the deployment and retrieval of Ocean Bottom Hydrophones (OBHs) as described in the 4MP in Attachment B of the SOI application. These OBHs are anchored buoys that record mammal vocalizations and seismic sounds.

It is proposed that the following acoustic instrumentation, or something similar, be used. This is the same equipment as was used on the *M/V Henry Christofferson* (*Henry C*) during 2007:

- Dual frequency subbottom profiler Datasonics CAP6000 Chirp II (2 to7 kHz or 8 to 23 kHz) or similar;
- Medium penetration subbottom profiler, Datasonics SPR-1200 Bubble Pulser (400 Hz) or similar;
- High resolution multi-channel 2D system, 20 in^3 (2 by 10) gun array (0 to 150 Hz) or similar;
- Multi-beam bathymetric sonar, Seabat 8101 (240) or similar; and
- Side-scan sonar system, Datasonics SIS-1500 (190 to 210 kHz) or similar.

This proposed program would likely occur in August and September, and as proposed the total program would last a maximum of 45 days of active data acquisition (excluding downtime due to weather and other unforeseen delays). The source vessel also may be used to perform other activities such as deploying and retrieving the OBHs (sonabuoys). Time for deploying and retrieving OBHs (sonabuoys) is not included in the 45-day estimate. However, there is a good possibility that SOI would contract to AES to conduct this work (see Section I.D.1). In such case, SOI will not conduct the shallow hazard and site clearance surveys in the Chukchi Sea by itself.

SOI Beaufort Sea Deep 3D Seismic Survey

The same seismic vessel (*M/V Gilavar*), seismic equipment, and two chase boats that are described for the Chukchi Sea Deep 3D Seismic survey, would be used to conduct deep 3D seismic surveys in the central and eastern Beaufort Sea (Figure 7). The focus of this activity would be on SOI's existing leases, but some activity in the Beaufort Sea may occur outside of SOI's existing leases. The landing craft, which would be used to move personnel and supplies from vessels in the nearshore to docking sites would most likely use West Dock or Oliktok Dock. Smaller vessels such as the Alaska Clean Seas (ACS) bay boats, or similar vessels, may be used to assist in the movement of people and supplies and support of the 4MP in the Beaufort Sea.

The program is proposed to occur in open water from late September to early October. This program would last a maximum of 60 days of active data acquisition (excluding downtime due to weather and other unforeseen delays).

SOI Beaufort Sea Marine Surveys

The proposed Beaufort Sea marine survey activities include the following three components: (1) Site Clearance and Shallow Hazards, (2) Ice Gouge Surveys, and (3) Strudel Scour Surveys. Marine surveys for site clearance and shallow hazards, ice gouge, or strudel scour can be accomplished by one vessel with acoustic sources. No other vessels, such as chase boats, are necessary to accomplish the proposed work. Any necessary crew changes or 4MP coordinated activities under this activity would utilize the same crew change, landing craft, or 4MP vessel mentioned under the Beaufort Sea Deep 3D Seismic survey.

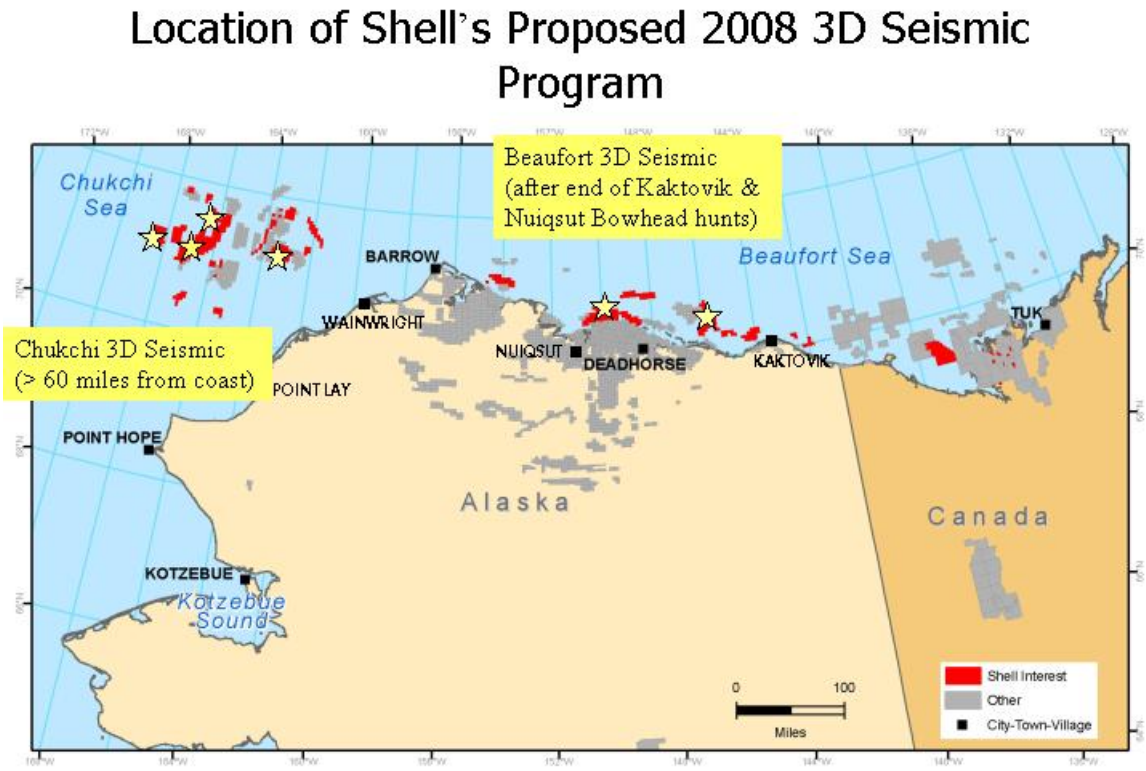

Figure 7. Area of the proposed SOI 2008 3D deep seismic surveys in the Chukchi and Beaufort Seas. (Provided by SOI)

(1) Site Clearance and Shallow Hazards Component

Marine surveys would include site clearance and shallow hazards surveys of potential exploratory drilling locations. These surveys gather data on: (1) bathymetry, (2) seabed

topography and other seabed characteristics (e.g., boulder patches), (3) potential geohazards (e.g., shallow faults and shallow gas zones), and (4) the presence of any archeological features (e.g., shipwrecks).

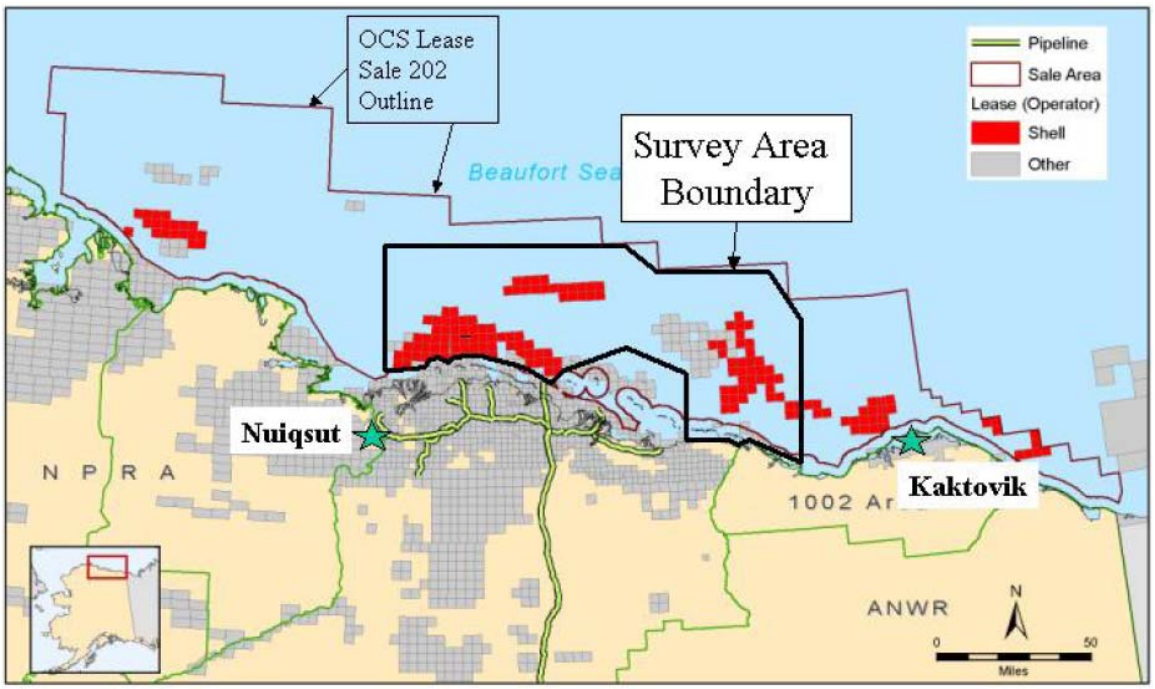

Figure 8. Area of the proposed SOI shallow hazard marine surveys in the Beaufort Sea. (Provided by SOI)

The focus of this activity would be on SOI's existing leases in the central and eastern Beaufort Sea, but some activity may occur outside of SOI's existing leases. Actual locations of site clearance and shallow hazard surveys have not been definitively set as of this date, although these would occur within the area outlined in Figure 8.

This program would use the *M/V Henry C*, or a similar vessel. The *M/V Henry C* is the same vessel used during SOI's 2006 and 2007 site clearance and shallow hazard surveys in the Beaufort Sea.

It is proposed that the following acoustic instrumentation, or something similar, be used. This is the same equipment that was used on the *M/V Henry C* during 2007:

- Dual frequency subbottom profiler Datasonics CAP6000 Chirp II (2 to 7 kHz or 8 to 23 kHz) or similar;
- Medium penetration subbottom profiler, Datasonics SPR-1200 Bubble Pulser (400 Hz) or similar;
- High resolution multi-channel 2D system, 20 in^3 (2 by 10) gun array (0 to 150 Hz) or similar;
- Multi-beam bathymetric sonar, Seabat 8101 (240 Hz) or similar; and

- Side-scan sonar system, Datasonics SIS-1500 (190 to 210 kHz) or similar.

This program is proposed to commence as soon as the ice clears substantially in the Beaufort Sea, which is normally in mid-July. The program would end when the ice starts to reappear, which is normally in early-October. As proposed, this program would last a maximum of 70 days of active data acquisition (excluding downtime due to weather and other unforeseen delays).

(2) Ice Gouge Survey Component

Ice Gouge surveys is a type of marine survey to determine the depth and distribution of ice gouges in the sea bed. An ice gouge is created by ice keels, which project from the bottom of moving ice that gouge into seafloor sediment. Remnant ice gouge features are mapped to aid in predicting the prospect of, orientation, depth, and frequency of future ice gouge. These surveys would focus on the potential, prospective pipeline corridor between the Sivulliq Prospect in Camden Bay and the nearshore Point Thomson area. The Sivulliq area would be surveyed to gather geotechnical and seafloor hazard information as well as data on ice gouges.

It is proposed that the following acoustic instrumentation, or something similar, be used. This is the same equipment as was used on the *M/V Henry C* during 2007:

- Dual frequency subbottom profiler Datasonics CAP6000 Chirp II (2 to 7 kHz or 8 to 23 kHz) or similar;
- Medium penetration subbottom profiler, Datasonics SPR-1200 Bubble Pulser (400 Hz) or similar;
- High resolution multi-channel 2D system, 20 in^3 (2 by 10) gun array (0 to 150 Hz) or similar;
- Multi-beam bathymetric sonar, Seabat 8101 (240 Hz) or similar; and
- Side-scan sonar system, Datasonics SIS-1500 (190 to 210 kHz) or similar.

This activity is proposed to be conducted sometime between late July and early October. The total program would last a maximum of 40 days (excluding downtime due to weather and other reasons).

(3) Strudel Scour Survey Component

During the early melt on the North Slope, the rivers begin to flow and discharge water over the coastal sea ice near the river deltas. That water rushes down holes in the ice ("strudels") and scours the seafloor. These erosion areas are called "strudel scours."

Information on these features is required for prospective pipeline planning. Before the strudel scour marine surveys to gather bathymetric data, helicopter overflights were used to locate the strudels and investigate possible sources of overflood water in the vicinity of Point Thomson including the Staines River, which discharges to the east into Flaxman Lagoon and the Canning River, which discharges to the east directly into the Beaufort Sea. These helicopter overflights occurred during late May/early June 2008. Areas that have strudel scour identified during the aerial survey would be verified and surveyed with

a marine vessel after the breakup of nearshore ice. The operation would be conducted in the shallow water areas near the coast in the vicinity of Point Thomson. This vessel would use the following equipment for the strudel scour survey component:

- Multi-beam bathymetric sonar, Seabat 8101 (240 Hz) or similar; and
- Side-scan sonar system, Datasonics SIS-1500 (190 to 210 kHz) or similar.

This proposed activity is not anticipated to take more than five days to conduct (excluding downtime due to weather and other unforeseen delays). It is anticipated to occur in late July or August.

II. DESCRIPTION OF THE ALTERNATIVES

The alternatives considered for Arctic open water seismic surveys are listed below and were previously described and analyzed in the MMS 2006 Final PEA, and are hereby incorporated by reference. However, several of the alternatives have been modified and supplemented to reflect input from the NEPA scoping and public comment processes for the separate Draft PEIS. For example, alternatives that include mitigation measures for "Temporal/Spatial/Operational Restrictions" now reflect FWS requirements to monitor critical habitat for spectacled eiders.

Alternative 1. No Authorizations for Seismic-Survey Permits for Geophysical Exploration Activities (No Action).

No seismic surveys would be authorized in the Beaufort and Chukchi Seas by MMS, and NMFS would not issue the IHAs. The oil and gas industry would have to rely on other means to obtain needed geophysical information, such as using new data-processing technology to reanalyze existing geophysical exploration seismic data and/or using survey techniques other than seismic. The No Action alternative analysis from the 2006 PEA is incorporated by reference for this SEA.

Alternative 2. Seismic Surveys for Geophysical-Exploration Activities would be Authorized with Existing Alaska OCS Geological and Geophysical Exploration Stipulations and Guidelines.

Proposed surveys would be approved only with existing MMS stipulations related to G&G exploration activities on the OCS. For a complete description of the standard MMS G&G Permit Stipulations, see the 2006 PEA Section IV.A.

This alternative is not considered to be within the reasonable range of alternatives for NMFS because issuance of an IHA without considering mitigation and monitoring would not be compliant with the MMPA. Accordingly, this alternative will not be analyzed in any greater detail because it fails to meet the statutory and regulatory requirements of the MMPA.

Alternatives 3 - 6: Additional Protective Measures

For Alternatives 3 - 6 below, additional protective measures for fish and wildlife resources would apply. These mitigation measures are described in more detail in Section V later in this SEA and in Section IV of the MMS 2006 PEA. These measures are based on: (1) the measures in the July 1999 and August 2001 IHAs from NMFS for marine geophysical permits in the Beaufort Sea OCS; (2) IHAs issued by NMFS for the Beaufort and Chukchi OCS during the 2006 and 2007 open water seasons; (3) Arctic Open Water meetings in 1999, 2001, 2006, 2007, and 2008; (4) NMFS' ARBO OCS activities, dated June 16, 2006 (NMFS, 2006); and (5) NMFS' *Supplemental*

Environmental Assessment of the 2007 Open Water Seismic Survey Season in the Chukchi and Beaufort Seas (NMFS, 2007).

Alternative 3. Seismic Surveys for Geophysical-Exploration Activities would be Authorized with Existing Alaska OCS Geological and Geophysical Exploration Stipulations and Guidelines and Additional Protective Measures for Marine Mammals, including a 120-dB Specified-Exclusion Zone.

The intent is to protect migrating bowhead whales against Level B (potential to disturb, i.e., behavioral harassment) incidental takes and Level A (potential for injury) incidental takes if the seismic operator has not received ITAs from NMFS. The mitigation measures identified under this alternative are sometimes proposed by and voluntarily undertaken by an applicant, with or without concurrence by NMFS, if they are using very small airguns or scientific equipment utilizing sound and can avoid Level B harassment takes.

The 120-dB isopleth is the approximate zone where Richardson *et al.* (1999) found at 20 km (12 mi) almost total bowhead whale exclusion. Sound levels received by bowhead whales at 20 km (12 mi) ranged from 117 - 135 re 1 μPa (rms) and 107 - 126 re 1 μPa (rms) at 30 km (19 mi), and it is the level recommended by the 2001 Open Water Meeting participants as where significant responses by bowhead whales in the Beaufort Sea may occur.

Alternative 4. Seismic Surveys for Geophysical-Exploration Activities would be Authorized with Existing Alaska OCS Geological and Geophysical Exploration Stipulations and Guidelines and Additional Protective Measures for Marine Mammals, including a 160-dB Specified-Exclusion Zone.

The intent is similar to Alternative 3, which is to help protect marine mammals (including bowhead whales) against potential Level B (potential to disturb, i.e., behavioral harassment) incidental takes and potential Level A (potential for injury) incidental takes if the seismic operator has not received incidental take authorizations from the NMFS and/or FWS.

The 160-dB isopleth is where Malme *et al.* (1984, 1986) found migrating gray whales avoided seismic noise along the California coast, and it is used by NMFS to indicate where Level B harassment begins for impulse sounds, such as airgun noise from seismic surveys.

Alternative 5. Seismic Surveys for Geophysical-Exploration Activities would be Authorized with Existing Alaska OCS Geological and Geophysical Exploration Stipulations and Guidelines and Additional Protective Measures for Marine Mammals, including 160-dB and 120-dB Specified-Exclusion Zones.

This alternative is the same as Alternatives 3 and 4, except that it provides special protection for: (1) bowhead whale calves; (2) reproductive-aged female bowhead whales; (3) aggregations of whales; and (4) fall subsistence hunting of bowhead whales in the Beaufort Sea. NMFS would determine if and when to expand the exclusion-zone isopleth from 160 dB to 120 dB, thereby increasing the size of the exclusion zone. The criteria used by NMFS for making this decision would be based on the presence of cow/calf pairs, aggregations of bowhead whales, and the timing and location of the subsistence hunt in both the Beaufort and Chukchi Seas.

Alternative 6. Seismic Surveys for Geophysical-Exploration Activities would be Authorized with Existing Alaska OCS Geological and Geophysical Exploration Stipulations and Guidelines and Additional Protective Measures for Marine Mammals, Including a 180/190 dB Specified-Exclusion Zone (Preferred Alternative).

This alternative establishes exclusion zone isopleths of 180 dB (Level A harassment – potential for injury) for cetaceans and 190 dB (Level A harassment – potential for injury) for pinnipeds. The 180-dB and 190-dB isopleths evolved when an expert panel (HESS, 1999) determined that at an unknown higher sound pressure level (SPL), cetaceans and pinnipeds respectively, potentially could incur permanent hearing impairment (Level A harassment). These levels are used by NMFS to indicate where the potential for injury (i.e., Level A harassment) begins.

This alternative is comprised of additional measures to minimize harm to marine mammals. The monitoring and mitigation measures identified in the above paragraph combined with additional mitigation measures described in section V.B.2 of this SEA make up the preferred alternative. These additional mitigation measures would impose temporal and spatial restriction to the 2008 Arctic open water seismic survey activities. In addition, the additional mitigation measures would require 120-dB or 160-dB re 1 μPa safety (shut-down) zones when four or more cow/calf pairs in the Beaufort Sea after August 25, or an aggregation of 12 or more bowhead or gray whales are present in the Beaufort Sea after August 25 and in the Chukchi Sea, respectively.

III. EXISTING ENVIRONMENT AND IMPACT ANALYSIS

III.A. Affected Environment

The physical, acoustic, biological, and socioeconomic environment of the Chukchi and Beaufort Seas, including its physical oceanography, air quality, ambient noise levels from natural and anthropogenic sounds, underwater sound propagation, seismic sound and its impacts to marine life, marine seismic surveys in the Beaufort and Chukchi Seas, vessel and air traffic, oil and gas development, fish/fishery resources and EFH, marine birds, marine mammals, community setting and regional economy, subsistence use of natural resources, culture and traditional knowledge, archaeological resources, land use plans and coastal zone management, and environmental justice, is described in the MMS 2006 PEA (MMS, 2006). For purposes of this analysis, updated information is available on several marine mammal species that are expected to be present in the action area. Table 3 therefore provides a summary of the marine mammal species from the PEA, and notes with an asterisk those species for which additional information is provided in this SEA to supplement the MMS 2006 PEA's description of the affected environment.

Table 3. List of marine mammals analyzed in the MMS 2006 PEA. Species with an asterisk indicates additional information is provided in this SEA

Species Common Name	Scientific Name
Bowhead whale*	*Balaena mysticetus*
Humpback whale	*Megaptera novaeangliae*
Fin whale	*Balanoptera physalus*
Minke whale	*B. acutorostrata*
Gray whale	*Eschrichtius robusta*
Beluga whale	*Delphinapterus leucas*
Killer whale	*Orcinus orca*
Harbor porpoise	*Phocoena phocoena*
Ringed seal*	*Phoca hispida*
Spotted seal*	*P. largha*
Ribbon seal*	*Histriophoca fasciata*
Bearded seal*	*Erignathus barbatus*
Pacific walrus	*Odobenus rosmarus divergens*
Polar bear*	*Ursus maritimus*

The action areas where the proposed 2008 seismic surveys and shallow hazard and site clearance surveys would be conducted are similar to those described in the MMS 2006 PEA. This conclusion is based on NMFS' review of the most recent scientific literature concerning the affected environment of the proposed action areas and the MMS 2006 PEA. Therefore, the affected physical, acoustic, biological, and socioeconomic environment of the proposed action areas described in the MMS 2006 PEA (MMS, 2006) is incorporated herein by reference. NMFS has also supplemented this information by

including species description and status information for five additional marine mammal species (four ice seal species and Polar bears).

Ice Seals

In late December 2007, the San-Francisco-based Center for Biological Diversity (CBD) petitioned NMFS to list the ribbon seal (*Histriophoca fasciata*) as threatened or endangered under the ESA. Their petition (CBD, 2007) states that global warming threatens ribbon seals with extinction because of the rapid melt of sea ice habitat. NMFS decided the petition provided enough information to indicate that action may be warranted under the law and accepted the petition. NMFS' finding was based, in part, on predicted changes in ribbon seals' sea ice habitat as a result of global climate change, the high allowable seal harvest set by the Russian Federation in recent years, the potential impacts of oil and gas development and production in both the United States and Russia, and the potential impacts of commercial fisheries and climate change on ribbon seal prey distribution and abundance. In addition to reviewing the ribbon seal, NMFS is preparing status reviews on bearded (*Erignathus barbatus*), ringed (*Phoca hispida*), and spotted (*P. largha*) seals for possible listing, since these four species of ice seals in Alaska all utilize various types of sea ice habitats. On March 28, 2008, NMFS published a *Federal Register* notice (73 FR 16617) and opened a 90-day public comment period to solicit scientific and commercial information regarding all of these ice seal species to ensure a comprehensive status review. The comment period for this action closed on May 27, 2008. NMFS is currently reviewing all relevant information and within 1 year of receipt of the petition, NMFS shall conclude the review with a finding as to whether or not the petitioned action is warranted.

To a large extent, the potential impact of seismic surveys to pinnipeds, ice seals included, were analyzed in the MMS 2006 PEA, the MMS 2007 FEIS on Chukchi Sea LS 193, and the MMS 2003 multi-sale EIS. However, the recent petition by CBD to list these species under the ESA and NMFS' status review of these species warrants additional discussion regarding the potential adverse effects on these species from the 2008 proposed seismic surveys and shallow hazard and site clearance surveys.

In its report *Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope*, the National Research Council (NRC, 2003), stated that "industrial activity in marine waters of the Beaufort Sea has been limited and sporadic and likely has not caused serious accumulating effects on ringed seals or polar bears;" and that "careful mitigation can help to reduce the effects of North Slope oil and gas development and their accumulation, especially if there is no major oil spill." Long-term marine mammal monitoring studies on the BPXA's Northstar Unit operations located in the Beaufort Sea showed that effects of oil and gas development on local distribution of ringed seals and seal lairs are no more than slight, and are small relative to the effects of natural environmental factors (Moulton *et al.*, 2005; Williams *et al.*, 2006).

As discussed above, large scale sea ice habitat loss caused by climate warming in the Arctic region is identified as one of the major threats to the survival of ice seals (CBD,

2007). According to CBD (2007), impacts to ribbon seals from offshore oil and gas development include (1) contact with and ingestion of oil from acute and chronic spills; (2) disturbance from industrial noise from ice-breakers, aircraft, and seismic surveys; and (3) harassment from aircraft, ships, and other vehicles that can disrupt ribbon seal breeding, foraging, resting, and breathing activities (Fair and Becker, 2000). However, the proposed 2008 seismic survey activities are temporary and short-term in nature, and would occur in limited areas of the Chukchi and Beaufort Seas. In addition, seismic surveys and shallow hazard and site clearance surveys *per se* only emit a small quantity of greenhouse gases by operating seismic and assistant vessels and survey related equipment and do not appreciably contribute to climate warming. Therefore, NMFS believes that the adverse impacts from the proposed 2008 seismic surveys and shallow hazard and site clearance surveys to ice seal survival are negligible.

Nevertheless, should new scientific information become available and should NMFS decide to list any of the four species of ice seals under the ESA, NMFS would, pursuant to the ESA, act accordingly.

Polar Bear

On May 14, 2008, FWS announced the listing of polar bear (*Ursus maritimus*) as a threatened species under the ESA. The listing is based on the best available science, which shows that loss of sea ice threatens and would likely continue to threaten polar bear habitat. Since the polar bear is a species under the FWS jurisdiction, NMFS would not consider this species for purposes of IHA issuance under the MMPA. Therefore the potential effects to this species from industry activity are not considered within the scope of NMFS' proposed action. Although effects to the polar bear are not considered in detail in this SEA, MMS indicated that a Section 7 consultation is underway between MMS and the FWS (M. Cody, MMS, Personal Communication, May 15, 2008).

III.B. Environmental Consequences

Available information indicates that marine mammals are responsive, in some cases highly responsive, to anthropogenic noise in their environment. At present, the primary documented response has been avoidance, sometimes, at least in the case of bowhead whales at a considerable distance (Richardson and Malme, 1993; Richardson *et al.*, 1999). Additional responses may include: tolerance (that is the capacity of the individuals to endure or become less responsive to the repeated exposure); masking of natural sounds; behavioral disturbance; auditory impacts (e.g., temporary and permanent threshold shifts); and other physiological effects. In addition, seismic surveys, either alone or in combination with other factors, can also have subtle, chronic effects such as: excluding marine mammals from important habitat and engaging in important behavioral activities (e.g., feeding and resting) at significant times; interfering with their migration and movement; contributing to habitat degradation, disrupting biologically significant behaviors; and increasing levels of stress. Responses to noise and disturbance are also

likely to vary with time of year, sex and reproductive status of individuals exposed, location (because of differences in noise propagation and use by marine mammals), activity levels and the exact characteristics of that activity (e.g., airgun source levels, array configuration and placement in the water column, context (e.g., feeding versus migrating whales), the animal's motivation to be in an area, and options for alternative routes or places to feed. A more detailed discussion of seismic surveys and the impacts to marine mammals are described by Richardson *et al.* (1995).

Southall *et al.* (2007) provides the most up-to-date literature reviews of impacts to marine mammals from anthropogenic noise. Those reviews indicate that onset of TTS for cetaceans and pinnipeds are likely to be much higher than the current standards (180 dB re 1 μPa rms for cetaceans, and 190 dB for pinnipeds) NMFS is using. Lab controlled experiments using a seismic watergun to induce TTS in one beluga whale and one bottlenose dolphin (Finneran *et al.*, 2002) showed measured TTS_2 (TTS level 2 minutes after exposure) was 7 and 6 dB in the beluga at 0.4 and 30 kHz, respectively, after exposure to intense single pulses (226 dB re: 1 μPa p-p). Threshold returned to within 2dB of the pre-exposure value within 4 minutes of exposure. No TTS was observed in the bottlenose dolphin at the highest exposure condition (228 dB re 1 μPa p-p). Lab controlled studies on three species of pinnipeds (harbor seal, California sea lion, and northern elephant seal) also point to the direction that TTS onset for these animals are higher than NMFS standard of 190 dB re 1 μPa rms (Southall *et al.*, 2007).

In addition, the general environmental consequences of open water seismic surveys were analyzed in the MMS 2006 PEA (MMS, 2006), the MMS 2007 FEIS on the Chukchi Sea Lease Sale 193 (MMS, 2007b), the MMS 2007 draft PEIS (MMS, 2007a), and the MMS 2003 multi-sale lease EIS. The following sections supplement those analyses for certain species, in particular bowhead whales, and to provide additional information regarding this species.

Potential Effects to Bowhead Whales

A detailed overall description of the potential impacts of Arctic open water seismic surveys to bowhead whales is provided in the MMS 2006 PEA, the MMS 2007 draft PEIS, and the MMS 2003 EIS on Chukchi Sea Lease Sale 193 (MMS, 2003; 2006; MMS, 2007a). One of the greatest concerns associated with the impacts of seismic surveys on marine mammals has to do with potential impacts of noise on their ability to engage in normal behavioral activities and whether noise could have adverse effects on their health. During seismic surveys, noise is transmitted through the water and air from a variety of sources including, but not limited to, the acoustic sound source, support-vessel traffic, and helicopter and fixed-winged aircraft traffic. Southall *et al.* (2007) provide a thorough review of the scientific literature on the potential impacts from these anthropogenic sounds.

The levels of potential impacts are mainly dictated by the intensity (or SPL) of the acoustic sound source (airgun arrays and other acoustic sources), the duration, location,

and season of the surveys. The intensity or SPL from the airgun arrays are related to the total displacement volume of the airguns. The larger the displacement volume of an airgun array, the louder the source level, and the larger the ensonified area becomes, therefore, the more bowhead whales could be affected (assuming that whales are evenly distributed in the area). For the proposed eight Arctic open water seismic surveys and shallow hazard and site clearance surveys in the Chukchi and Beaufort Seas, two would be using relatively large airgun arrays with total displacement volume at 3,147 in^3 (SOI's 3D deep seismic surveys in the Chukchi and Beaufort Seas), two would be using intermediate size airgun arrays with total displacement volume at 880 in^3 (BPXA and PGS's 3D OBC seismic surveys in the Beaufort Sea), and the remaining four would be using small airgun arrays at 40 in^3 (AES and CPAI's shallow hazard and site clearance surveys in the Chukchi Sea) and 240 in^3 (SOI's shallow hazard and site clearance surveys in the Chukchi and Beaufort Seas). These airgun arrays have very different source levels, and therefore, the size of the area expected to be ensonified would differ. For example, larger airguns such as those proposed to be used by SOI's 3D deep seismic survey would ensonify a larger area, thereby resulting in the potential to expose larger numbers of marine mammals, assuming the density of animals is the same in all these areas. In contrast, the area expected to be ensonfied by the use of smaller airguns would be substantially smaller because of the lower level of energy output. The number of marine mammals potentially exposed to seismic energy therefore, would likely be smaller because there is a lower probability of animals being exposed to smaller airgun arrays. The effect on marine mammals from different size airguns could also vary, particularly if viewed in terms of the animal's distance from the source vessel (e.g., an animal's distance to the source array could mean the difference between a potential for injury or disturbance).

In addition, the potential acoustic impact to bowhead whales also depends on the location, such as bathymetry, ocean bottom topography, and sediment types; and the behavior of the animals. Generally speaking, in deeper water acoustic energy propagates in a spherical spreading model, thus there is more propagation loss of its energy when reaching a given distance when compared in shallow water, where the acoustic energy propagates in a cylindrical spreading model as is confined between the surface and ocean bottom (Urick, 1983), Therefore, using the same size airgun arrays, seismic surveys conducted in shallow water are expected to have a larger ensonified area as compared in deep water. One exception is that when the seismic surveys is conducted in extremely shallow water (1 to 6 m, or 3 to 18 ft), such as those proposed by BPXA and PGS, there is a "low frequency cutoff" of the airgun acoustic signals at the horizontal plane, making the ensonified zone much smaller (Greene, 1998).

Also, the degree of reaction an animal shows when exposed by anthropogenic sounds varies among different individuals, life stage (young vs. old), prior experience of the animals (naïve vs. previously exposed); habituation or sensitization of the sound by the animals; and behavior context (whether the animal perceives the sound as predatory or simply annoyance), etc (Southall *et al.*, 2007). In the case of bowhead whales, it has shown that migrating animals respond to seismic airgun received levels around 120 dB re 1 μPa (Richardson *et al.*, 1999), while for non-migrating bowheads, the behavioral

disturbance starts at received levels around 140 to 160 dB re 1 μPa (Malme *et al.*, 1983; 1984; Richardson *et al.*, 1986; Lijungblad *et al.*, 1988).

Furthermore, the ability of MMOs to monitor a smaller safety zone is easier than a larger safety zone; thus, the probability of detecting animals before they approach the safety zones increases. In addition, for the shallow hazard and site clearance surveys, additional acoustic equipment would also be used. However, source levels from these acoustic devices are much lower when compared to most of the airguns to be used in the proposed activities. Since the required monitoring and mitigation measures described in Section V would likely prevent any Level A harassment (i.e., injury) and mortality of bowhead whales and other marine mammals, the potential impact from each proposed 2008 Arctic open water seismic activity using different airgun arrays and acoustic sources would affect different numbers of bowhead whales that could be taken by Level B harassment. Furthermore, duration, location, and season of each seismic activity, in relation to the bowhead whale's migration and seasonal distribution, would also affect the number of bowhead whales that could potentially be affected by these activities. A more detailed analysis on the estimated bowhead whale take number by each proposed seismic activity is provided in Section III.C of this SEA.

In addition to these analyses, important current scientific issues of interest with regard to bowhead whales include the need for more information on their stock structures and the number of populations that may be affected by the proposed seismic activities. Knowledge of the stock structures is useful to assess the number of individuals from each stock that might experience temporary harassment associated with seismic activities. It is not currently clear whether one or more population stocks of bowheads potentially could be impacted by the proposed activities. If more than one population may be affected, it may be that the areas in which the two stocks are likely to be vulnerable to adverse effects varies. This analysis considers the potential effect to the western Arctic population of bowhead whales, and together with results from monitoring efforts in 2007 (Funk *et al.*, 2008) and gathering even more information on bowheads via monitoring efforts in 2008, will provide further additional data on these populations while still minimizing any potential effects through implementing mitigation measures appropriately.

More information is needed about the importance of feeding areas within the Alaskan Beaufort Sea during the summer before September 1, especially the western Alaskan Beaufort Sea, to the bowhead population as a whole and, more specifically, to certain segments of the population. While it is clear that there is considerable inter-annual variability in the use of the Beaufort Sea for feeding by bowheads, the factors underlying such variability are not entirely clear (MMS, 2006). In addition, the importance of specific areas to segments of the population and to the population as a whole during certain years when large aggregations are observed feeding is currently unclear.

More information is needed about the potential effects of such disturbance from single vessel and multiple seismic vessels operating concurrently to the health of females and young calves and to the next year's reproductive potential of adult females. There is a

current lack of scientific data about the effects of sound on the hearing of mysticete whales, particularly very young calves.

While these issues were discussed in detail in the PEA, this SEA provides additional information to clarify the extent to which, given a lack of scientific data, ***additional*** mitigation measures would be required specifically to gather additional data on bowheads and mitigate the potential for impacts on bowhead whale populations. There are knowledge gaps regarding stock structures, and aspects of the bowhead migration (e.g., remnant populations that may be present after the majority of the population has migrated). These issues are analyzed in the Draft EIS (MMS, 2007a) and described in this section. Overall, NMFS would require extensive monitoring for the presence of bowhead whales during all seismic activities, and would require additional monitoring and mitigation measures in addition to the standard measures required for seismic surveys (such as shut down, power down when the animals are entering the 180 dB or 190 dB re 1 μPa rms safety zone, for cetaceans and pinnipeds, respectively; and ramp up seismic sources, etc.). NMFS proposes to implement these additional monitoring and mitigation measures, such as 120-dB monitoring and shut down zone for four or more bowhead cow/calf pairs and 160-dB monitoring and shut down zone for an aggregation of 12 or more bowhead whales. These additional monitoring and mitigation measures are designed to (1) reduce impacts to ensure that any take of bowhead whales is negligible by providing more conservative measures to protect this species, and (2) gather additional information and data on bowhead whales using established monitoring techniques. In addition, these measures are meant to even further limit the potential for short-term harassment of marine mammals and thus avoid the potential for long-term, population level effects. A detailed description of these additional monitoring and mitigation measures are provided in Section V.B.2 of this SEA.

The effects to bowhead whales from BPXA's 3D OBC seismic survey inside the barrier islands in Foggy Island Bay in the Beaufort Sea are expected to be minimal. The shallow water environment (i.e., maximum 9.1 m (30 ft) depth) inside the islands is not considered as a high use habitat area for the species. Additionally, BPXA will complete data acquisition prior to the beginning of the fall bowhead migration westward across the Beaufort Sea. These factors, along with a shortened season of shooting seismic (approximately 40 days) should help to reduce the impacts to bowhead whales.

Similar to the BPXA survey, much of the data acquisition to be conducted by PGS will occur in the U.S. Beaufort Sea prior to the beginning of the fall bowhead migration. From about mid-August until mid-September, PGS plans to conduct seismic activity inside the barrier islands near Oliktok Point where the maximum water depth is approximately 6 m (20 ft). This is less than suitable habitat for bowhead whales. Moreover, the islands are expected to absorb much of the sound before it ever reaches the main migration corridor. Therefore, few bowhead whales are expected to be impacted by this survey.

The effects to bowhead whales from the proposed shallow hazard and site clearance surveys by AES and CPAI in the Chukchi Sea are expected to be negligible. The

acoustic sources, including airguns to be used for the activities are small. The 160-dB ensofinied zone for Level B behavioral harassment on these small acoustic sources has been modeled to be 50 km^2 (19.4 mi^2) at any given moment during the survey. Therefore, few bowhead whales would are expected to be affected at any given time.

NMFS also believes that the proposed 3D deep seismic surveys and shallow hazard and site clearance surveys by SOI in the Chukchi and Beaufort Seas would have minimum impacts to bowhead whales. This is supported by the fact that the majority of its 3D seismic surveys in the Chukchi Sea would be conducted during the period when most of the bowhead whales are expected to be in the Beaufort Sea, and the fact that its 3D seismic surveys in the Beaufort Sea do not start until the fall bowhead subsistence hunt is completed, thus a sizeable portion of the bowhead population will have migrated past the Beaufort Sea seismic area before SOI begins operations there. Any bowhead whales that may be left behind and potentially affected would be fewer in number.

Acoustic Effects

The 2006 PEA considered the potential for eight concurrent seismic survey activities in both the Chukchi and Beaufort Seas, but there were no specific industry applications requesting eight surveys. It is assumed under the 2006 PEA that all these seismic survey activities would be on-going for the entire open-water season with no interruption. For this proposed action of issuing five IHAs, specific information on the acoustic sources, locations, and seasons of each requested IHA are available and can be analyzed to supplement the analysis presented in the SEA. As a starting point for assessing the potential level of effects of the requested IHA activities, it is helpful to compare the proposed 2008 open water seismic surveys and shallow hazard and site clearance surveys with the seismic survey activities analyzed in the MMS 2006 PEA. Important points of comparison between the two actions include:

(A) The characteristics of the seismic sound sources are the same. The 2006 PEA considered a total of up to four seismic survey related geophysical explorations using airgun arrays measuring between 1,800 - 4,000 in^3 (and up to 6,000 in^3) and the use of marine streamer and OBC seismic surveys, and high resolution site clearance survey technologies in both the Chukchi and Beaufort Seas in the open water season. This SEA considers: (1) one marine streamer seismic survey with airgun arrays measuring 3,147 in^3 in both the Chukchi and Beaufort Sea; (2) one high resolution site clearance survey using a one airgun array (240 in^3) and subbottom profilers in both the Chukchi and Beaufort Sea; (3) two OBC seismic surveys with airgun arrays measuring 880 in^3 in the Beaufort Sea; and (4) up to two shallow hazard and site clearance surveys with small airgun array (40 in^3) and subbottom profilers in the Chukchi Sea. Except for the deep seismic proposed by SOI that would be using the relatively large 3,147 in^3 airgun array, all other seismic surveys and site clearance surveys proposed for 2008 would use small to mid-size airguns with displace volume between 40 in^3 and 880 in^3. These smaller airguns generate less energy than a mid-size or larger size airgun and thereby result in fewer acoustic impacts to the marine environment since the ensonified areas are smaller. Also,

the back-calculated source level of an air-gun array is proportional to the firing pressure and the number of guns, whereas it increases by the cube root of the gun volume (Caldwell and Dragoset, 2000). The modeled source levels of these airgun arrays are provided in the IHA applications and their sound characteristics would also be empirically measured before the initiation of each project.

(B) The action area and timeframes for seismic operations considered in this SEA are within the scope of those analyzed in the 2006 PEA. However, where practicable, the applicants will conduct the surveys within certain seasonal limits to reduce the potential for acoustic impacts on marine mammals.

(C) The species of marine mammals potentially affected by this SEA's proposed action, including their potential age/sex composition, reproductive state, behavior (e.g., migration, feeding), etc., should be less when compared to those identified in the 2006 PEA. This is mainly due to the fact that the proposed 2008 seismic surveys and shallow hazard and site clearance surveys would not be conducted for the entire open-water season, as was analyzed in the 2006 PEA. Therefore, marine mammals would be exposed to seismic activities for a shorter period of time, resulting in potentially fewer environmental impacts. The proposed Arctic open water seismic surveys would only occur for a maximum period of 30 - 70 days depending on projects (see Section I.D for the description of the proposed projects), between July to November on days when weather permits, as compared to 150 days for the entire open-water season analyzed in the MMS 2006 PEA.

(D) Acoustic impacts to marine mammals exposed from intense and chronic anthropogenic sound sources can be profound and long-lasting (Hildebrand, 2005). However, a series of monitoring and mitigation measures that would be required for these proposed seismic surveys, as discussed in Section V of this SEA, will largely prevent marine mammals being exposed to sound levels above 180 dB and 190 dB μPa rms for cetaceans and pinnipeds, respectively. Those SPLs are currently used by NMFS to determine the onset of TTS by cetaceans and pinnipeds, respectively. However, recent scientific research indicates that actual TTS-onset would occur at much higher levels for a bottlenose dolphin and a beluga when exposed by impulse seismic watergun sound (Finneran *et al.*, 2002).

From the above comparison, it is apparent that the proposed 2008 open water seismic surveys are expected to have less adverse impacts to marine mammals in the Chukchi and Beaufort Seas than those analyzed in the MMS 2006 PEA, due to seasonal limitation for certain projects, interruption in seismic survey activities, and the notion that most of the seismic surveys would be using small to midsize airguns with lower source levels than those analyzed in the 2006 PEA.

Therefore, for these aforementioned reasons, and with the implementation of the mitigation and monitoring measures described in the 2006 PEA, NMFS 2007 SEA, and in Section V of this SEA, NMFS expects that the take of marine mammals incidental to the proposed seismic surveys and shallow hazard and site clearance surveys would be

limited to Level B harassment only. In addition, no take by death and/or injury is anticipated or authorized.

NMFS believes that potential adverse effects and uncertainties associated to bowhead whales can be reduced through careful shaping of the action through the implementation of sufficient, effective and practicable monitoring and mitigation measures coupled with adaptive management (where the mitigation measures required are dependent on what is discovered during monitoring). These mitigation and monitoring measures are analyzed in Section V of this SEA.

Socioeconomic Effects

For the most part, the MMS 2006 PEA, the MMS 2007 draft PEIS, the MMS 2007 FEIS on the Chukchi Sea Lease Sale 193, and the MMS 2003 multi-sale EIS provided a thorough analysis of the effects to the Arctic native communities by seismic survey activities.

Subsistence hunting and fishing is historically, and continues to be, an essential aspect of Native life, especially in rural coastal villages. The Alaskan natives participate in subsistence hunting and fishing activities in and around the Chukchi and Beaufort Seas. The animals taken for subsistence provide a significant portion of the food that will last the community throughout the year. Along with the nourishment necessary for survival, the subsistence activities strengthen bonds within the culture, provide a means for educating the young, provide supplies for artistic expression, and allow for important celebratory events.

The potential impact of the noise produced by the proposed seismic surveys and shallow hazard and site clearance surveys on subsistence could be substantial. If whales are permanently deflected away from their migration path, there could be adverse repercussions, such as unavailability of whales in nearshore waters, to the subsistence use villages. However, mitigation measures will be implemented to minimize or avoid completely any adverse affects on all marine mammals to ensure no unmitigable adverse impact to the subsistence uses.

As part of the condition for the IHAs, oil and gas industry applicants are required to develop Plans of Cooperation (POCs) with the Native communities. The POCs specify measures the oil and gas industry applicant would take to minimize adverse effects on marine mammals where proposed activities may affect the availability of a species or stock of marine mammals for Arctic subsistence uses or near a traditional subsistence hunting area.

Oil and gas industry applicants have conducted or will be conducting POC meetings with native communities and the Alaska Eskimo Whaling Commission (AEWC) for their seismic operations in the Chukchi and Beaufort Seas. Additional meetings, depending on companies, would also be held with the Alaska Ice Seal Committee, Alaska Beluga

Committee, Eskimo Walrus Commission, and Alaska Nanuq Commission prior to seismic survey operations, as well as with members of affected communities.

In addition, some oil and gas industry applicants[3] may negotiate a Conflict Avoidance Agreement (CAA) with the AEWC and the affected villages Whaling Captain Association. The CAA likely would include a prohibition on conducting seismic surveys during the bowhead whale-hunting season in the Beaufort Sea, describe a dispute-resolution process, and provide emergency assistance to whalers at sea. Regardless, the signing of a CAA by a particular oil and gas industry applicant is not a requirement for the issuance of an IHA.

III.C. Numbers of Marine Mammals Estimated to be Taken

All anticipated takes would be by Level B harassment, involving temporary changes in behavior or brief TTS. The required mitigation and monitoring measures are expected to prevent the possibility of injurious takes.

The methods to estimate take by harassment and present estimates of the numbers of marine mammals that might be affected during the proposed seismic surveys and shallow hazard and site clearance surveys in the Beaufort and Chukchi Seas are described in detail in each of the IHA applications. Specifically, the average estimates of "take" for each proposed seismic project were calculated by multiplying the expected average animal densities by the area of ensonification for the 160 dB re 1 μPa (rms) for cetaceans and 170 dB re 1 μPa (rms) for pinnipeds. The area of ensonification was determined by multiplying the total proposed trackline times 2 (both sides of the trackline) times the distance to the 160-dB or 170-dB isopleths for cetaceans or pinnipeds, respectively.

Based on the calculations, the numbers of marine mammals expected to be taken by the proposed 2008 Arctic seismic surveys and shallow hazard and site clearance surveys for each proposed project are described below and in Table 4. In some cases, the numbers presented in the Table were proposed by the applicant. However, through the MMPA process, it is NMFS' responsibility to analyze and, as needed, refine the number of takes and method of take that would be authorized. Should any change to the proposed numbers analyzed in this SEA be warranted at the time an IHA is proposed for issuance, that IHA would include an evaluation of any refinement to the numbers.

III.C.1. AES Shallow Hazard and Site Clearance Survey in the Chukchi Sea:

It is estimated that up to approximately 7 bowhead, 11 gray, and 21 beluga whales, 2,118 ringed and 235 bearded seals would be affected by Level B behavioral harassment as a result of the proposed shallow hazard and site clearance surveys by AES. These take

[3] As of the publication of this SEA, BPXA and PGS are the only applicants that have signed the CAA for the 2008 open water seismic activities in the Arctic. AES informed NMFS that it would sign the CAA prior to its seismic operations.

numbers represent 0.06, 0.06, and 0.6 percent of the western Arctic stock of bowhead, eastern North Pacific stock of gray, and eastern Chukchi stock of Beluga whales, respectively; and 1 and 0.1 percent of the Alaska stocks of ringed and bearded seal populations within the Chukchi Sea, respectively.

In addition, a number of humpback, minke, and killer whales, harbor porpoises, and spotted and ribbon seals could also be affected by Level B behavioral harassment as a result of the proposed marine surveys in the Chukchi Sea. However, since the occurrence of these marine mammals is very rare within the proposed project area in the Chukchi Sea, take numbers cannot be estimated. Nonetheless, NMFS believes their take numbers would be much lower when compared to those marine mammals whose take numbers were calculated.

III.C.2. BPXA Ocean Bottom Cable Seismic Survey in the Beaufort Sea:

It is estimated that up to approximately 12 bowhead and 6 beluga whales, 222 ringed, 16 bearded, and 2 spotted seals would be affected by Level B behavioral harassment as a result of the proposed OBC seismic surveys by BPXA. These take numbers represent 0.1 and 0.02 percent of the western Arctic stock of bowhead and Beaufort Sea stock of Beluga whales, respectively; and 0.07, 0.01, and 0.01 percent of the Alaska stocks of ringed, bearded, and spotted seal populations within the Beaufort Sea, respectively.

III.C.3. CPAI Shallow Hazard and Site Clearance Survey in the Chukchi Sea:

It is estimated that up to approximately 10 bowhead, 37 gray, and 4 minke whales, 42 harbor porpoises, 1,379 ringed, 72 spotted, and 376 bearded seals would be affected by Level B behavioral harassment as a result of the proposed shallow hazard and site clearance surveys in the Chukchi Sea by CPAI. These take numbers represent 0.09, 0.19, 0.06, 0.66, and 0.15 percent of the western Arctic stock of bowhead, eastern North Pacific stock of gray whales, Bering Sea stock of harbor porpoise, and Alaska stocks of ringed and bearded seals in the Chukchi Sea region, respectively. Since no accurate current population estimates of minke whales and spotted seals are available, a specific estimate of the percentage of Level B harassment of these species is undetermined. Nonetheless, it is very low relative to the affected species or stocks in the proposed project area because: (1) for the minke whales, the Chukchi Sea is not their typical habitat (visual surveys in 1999 and 2000 counted 810 and 1,003 minke whales in the central-eastern and southeastern Bering Sea, respectively, not including animals missed on the trackline, and animals submerged when the ship passed (Moore *et al.*, 2002), therefore, the take estimate of 4 minke whale is small even in relation to these visual counts); and (2) for the spotted seal, the early population estimate of this species ranged from 335,000 - 450,000 seals (Burns, 1973), and there is no reason to believe that the population of this species has declined significantly.

In addition, a number of beluga, humpback, and killer whales, and ribbon seals could also be affected by Level B behavioral harassment as a result of the proposed marine surveys in the Chukchi Sea. However, since the occurrence of these marine mammals is very rare within the proposed project area during the late summer and fall in the Chukchi Sea, take numbers cannot be estimated. However, for the same reason, NMFS believes their take numbers would be much lower (including as a percentage of the affected species or stock) as compared to those marine mammals whose take numbers were calculated.

III.C.4. PGS Ocean Bottom Cable Seismic Survey in the Beaufort Sea:

Based on the IHA application from PGS, it is estimated that up to 28 bowhead and 25 beluga whales, 1,467 ringed, 20 bearded, and 73 spotted seals would be affected by Level B behavioral harassment as a result of the proposed OBC seismic surveys in the Beaufort Sea. These take numbers represent 0.26 and 0.06 percent of the western Arctic stock of bowhead and Beaufort Sea stock of Beluga whales, respectively; and 0.70, 0.008, and 0.02 percent of the Alaska stocks of ringed, bearded, and spotted seal populations within the Beaufort Sea, respectively.

III.C.5. SOI Deep Seismic Survey and Shallow Hazard and Site Clearance Surveys in the Beaufort and Chukchi Seas:

Based on the IHA application from SOI, it is estimated that approximately 1,540 bowhead, 2 fin, 183 gray, 2 humpback, 2 minke, 63 eastern Chukchi Sea stock beluga, 234 Beaufort Sea stock beluga, and 2 killer whales; 58 harbor porpoises; and 592 bearded, 2 ribbon, 13,256 ringed, and 422 spotted seals could be affected by Level B behavioral harassment as a result of the proposed deep seismic and shallow hazard and site clearance surveys in the Beaufort and Chukchi Seas. These take numbers represent 14.6, 0.04, 1, 0.05, 1.7, 0.6, 0.09, 0.23, and 5.3 percent of western Arctic stock bowhead, Northeast Pacific stock fin, eastern North Pacific stock gray, western North Pacific stock humpback, eastern Chukchi Sea stock beluga, and Beaufort Sea stock beluga whales; Bering Sea stock of harbor porpoises, Alaska stocks of bearded and ringed seals, respectively. Since no accurate current population estimates of minke and killer whales and spotted seals in Chukchi Sea are available, a specific estimate of the percentage of Level B harassment of these species is undetermined. Nonetheless, it is very low relative to the affected species or stocks in the proposed project area as discussed above.

Although it is estimated that up to 1,540 western Arctic bowhead whales (14.6 percent of the population) could be taken by Level B harassment as a result of SOI's proposed seismic surveys and shallow hazard and site clearance surveys in the Beaufort and Chukchi Seas, this estimate is based on density and abundance of the bowhead whales within the proposed project areas that could be exposed to received levels of 160 dB re 1 μPa rms without taking into account the implementation of additional monitoring and mitigation measures that would expend the safety (shutdown) zone to 160-dB and 120-dB isopleths for an aggregation of 12 or more bowhead or gray whales and four or more

bowhead whale cow/calf pairs in the Beaufort and Chukchi Seas. However, NMFS expects that the actual take numbers of bowhead whales would be significantly lower than what SOI requested in its IHA application because SOI has significantly reduced its planned days of seismic surveys in the Beaufort Sea to only 20 days (September 25 to about October 15 or when surveys are curtailed by ice). In addition, NMFS believes that the estimated number of bowhead exposures overestimate actual takings for the following reasons: (1) SOI plans to concentrate its 3D seismic survey program in 2008 in the Lease Sale 193 area of the Chukchi Sea and only move into the Beaufort Sea after the bowhead subsistence hunt is completed (and a sizeable portion of the bowhead population will have migrated past SOI's planned seismic location by that time), and (2) the proposed shallow hazard survey activities would occur in the Chukchi and Beaufort seas at a time when bowheads are mostly concentrated in the Canadian Beaufort Sea. Although at this point NMFS is unable to come up with an estimated take number of bowhead whales that could be affected as a result of SOI's 3D deep seismic surveys and shallow hazard and site clearance surveys in the Chukchi and Beaufort Seas, mainly due to the complexity of the project's scheduling and locations, the 90-day report of marine mammal monitoring and mitigation by SOI during its open water seismic surveys and shallow hazard and site clearance surveys between July and November 2007, which used the same acoustic equipment and airguns, conducted within the same ocean basins, and for the similar period of time, as those proposed for the 2008 open water surveys, showed that a total of 30 cetacean individuals (species were not broken out because some individuals were not positively identified) were exposed to received sound levels above 160 dB re 1 μPa rms (Funk *et al.*, 2008). Therefore, NMFS believes that only a small number of marine mammals would be exposed to sound pressure levels that could cause Level B harassment to those animals as a result of the proposed seismic surveys and shallow hazard and site clearance surveys in the Beaufort and Chukchi Seas.

Table 4. Numbers of marine mammals estimated to be taken incidental to the proposed 2008 seismic surveys and shallow hazard and site clearance surveys.

	AES		**BPXA**		**CPAI**		**PGS**		**SOI**	
Species / Stocks	no.	%	no.	%	no.	%	no.	%	no.	%
Bowhead whale / W. Arctic	7	0.06	12	0.1	10	0.09	28	0.26	1,540	14.6
Gray whale / E. N. Pacific	11	0.06	0	0	37	0.19	0	0	183	1
Humpback whale / W. N. Pacific	*	*	0	0	*	*	0	0	2	0.05
Fin whale / E. N. Pacific	0	0	0	0	0	0	0	0	2	0.04
Minke whale / Alaska	*	*	0	0	4	*	0	0	2	*
Beluga whale / E. Chukchi Sea	21	0.6	0	0	*	*	0	0	63	1.7
Beluga whale / Beaufort Sea	0	0	6	0.02	0	0	25	0.06	234	0.6
Killer whale / Unknown	*	*	0	0	*	*	0	0	2	*
Harbor porpoise / Bering Sea	*	*	0	0	42	0.06	0	0	58	0.09
Ringed seal / Alaska	2,118	1.0	222	0.07	1,379	0.66	1,467	0.70	13,256	5.3
Bearded seal / Alaska	235	0.1	16	0.01	376	0.15	20	0.01	592	0.23
Spotted seal / Alaska	*	*	2	0.01	72	*	73	0.02	422	*
Ribbon seal / Alaska	*	*	0	0	*	*	0	0	2	*

* Numbers or percentages not available either due to rarity of the animals in the project location or unknown population.

III.D. Additional Cumulative Scenario Information and Assessment

Cumulative impacts can result from individually minor but collectively significant actions taking place over time. Cumulative impacts may result when the effects of an action are added to or interact with other effects in a particular place and within a particular time. Thus the cumulative impacts of an action must consider the past, present, and reasonably foreseeable future actions within a relevant spatial and temporal scope that may affect the resources under consideration. Cumulative impacts describe the incremental impact (e.g., additive and synergistic impacts) from the proposed action when added to the aggregate effects of past actions together with other current and reasonably foreseeable future actions.

All proposed 2008 Arctic open water seismic surveys and shallow hazard and site clearance surveys would be conducted by independent industry applicants, and IHA applications were therefore submitted independently. Under the MMPA, these IHA applications are considered separately and the marine mammal take permits, if issued, would be granted independent from one another. However, NMFS is assessing these actions as whole for purposes of NEPA in order to evaluate whether the five separate IHAs, if authorized, have a potential for cumulative impacts. In addition, this cumulative impact analysis considers the potential for cumulative impacts associated with the IHAs issued for seismic activities in the Beaufort and Chukchi Seas in 2006 and the IHA issued in 2007.

Cumulative impacts on fish/fishery resources and EFH, seismic survey activities, vessel and air traffic, oil and gas exploration and development, subsistence harvest activities, military activities, industrial development, and climate change within the proposed action areas in the Beaufort and Chukchi Seas were analyzed in detail in the MMS 2006 PEA. The action areas where the proposed 2008 seismic surveys and shallow hazard and site clearance surveys would be conducted are within those that were analyzed in the MMS 2006 PEA. Therefore, the cumulative impact analysis from the MMS 2006 PEA is incorporated by reference herein and has been supplemented to account for more recent activities in the Arctic Ocean. These more recent activities include SOI's proposed offshore exploratory drilling operations in the Beaufort Sea; the State of Alaska lease sale in 2006 and 2007; and the MMS Lease Sales 202 and 193 in the Beaufort Sea in 2007 and the Chukchi Sea in 2008, and seismic survey activities by several oil and gas industries in the 2006 and 2007 Arctic open water season are discussed below in Section III.D.1.

In addition, this SEA also updated the analysis of cumulative impacts as the result of the ongoing climate change within the proposed action areas, especially in terms of global warming and its potential impacts to the Arctic region, due to the availability of new information after the publication of the MMS 2006 PEA. This updated cumulative impact analysis of climate is presented in Section III.D.2.

III.D.1. Additional Activities from Oil and Gas Explorations in the Beaufort and Chukchi Seas (since June 2006 SEA)

During the summer and fall, 2006, CPAI and GXT collected marine seismic data using 3D and 2D seismic surveys, respectively, in the Chukchi Sea in support of potential future oil and gas leasing and development. Also in the summer of 2006, SOI collected marine seismic data in both Chukchi and Beaufort Seas using 3D deep seismic surveys. During the summer and fall in 2007, SOI conducted two 3D deep seismic surveys in Chukchi and Beaufort Seas, and shallow hazard and site clearance surveys in the Beaufort Sea. Ninety-day marine mammal monitoring and mitigation reports from these open water seismic surveys and shallow hazard and site clearance surveys indicate that actual take of marine mammals by Level B harassment were generally lower than expected due to the implementation of monitoring and mitigation measures.

SOI proposed to conduct open-water offshore exploratory drilling operations during the 2007 open water season in order to drill priority exploration targets on their MMS OCS leases in the Beaufort Sea. SOI planned to utilize two drilling units to drill up to two wells each during the 2007 season. The highest priority exploratory drilling targets identified for the 2007 season were located offshore of Pt. Thomson and Flaxman Island, on the leaseholds referred to as Sivulliq and Olympia, in Camden Bay. However, SOI informed NMFS that they would not conduct any drilling activities during the 2007 open water season due to pending litigation and inclement weather, among other factors. Shortly thereafter, SOI requested that NMFS proceed with issuance of the IHA as it might have the opportunity to drill in 2008. NMFS is currently considering SOI's IHA application for its drilling operation in the 2008 open water season, and an IHA may be issued in the summer of 2008.

In 2006 and 2007, the State of Alaska, Division of Oil and Gas conducted two lease sales in state waters of the Beaufort Sea. The Beaufort Sea Area-wide 2006 sale, conducted on March 1, 2006, sold 62 tracts totaling 204,259 acres (319 mi^2 or 827 km^2). The Beaufort Sea Area-wide 2006A sale, conducted on October 25, 2006, sold 13 tracts totaling 29,157 acres (45.6 mi^2 or 118 km^2). The Beaufort Sea Area-wide 2007 sale, conducted on October 24, 2007, sold 21 tracts totaling 53,120 acres (83 mi^2 or 215 km^2) (ADNR DO&G, 2008). The Beaufort Sea Area-wide 2008 sale is scheduled for October 2008 (ADNR DO&G, 2008). No State of Alaska lease sales are scheduled to occur in the Chukchi Sea, nor are any State deep seismic survey permits scheduled to be issued for the Beaufort or Chukchi seas. However, the State issued two 2007 permits for conducting geophysical technical surveys in State waters near Point Thomson (NMFS, 2007). NMFS is unaware of any geophysical technical survey permits issued by the State in 2008. The State has not issued any exploration licenses within the aforementioned areas. State mitigation measures and lessee advisories for the Beaufort Sea can be found at: http://www.dog.dnr.state.ak.us/oil/products/publications/previous_sales.htm.

The MMS Lease Sale 202 in the Beaufort Sea, conducted on April 19, 2007, sold 90 tracts totaling 198,580 acres (310 mi^2 or 804 km^2). The MMS Lease Sale 193 in the Chukchi Sea was conducted on February 6, 2008, which offered 5,354 blocks totaling

29,389,287 acres (45,921 mi^2 or 118,985 km^2) for sale. The Lease Sale received bids on 488 blocks totaling 2,758,408 acres (4,310 mi^2 or 11,168 km^2) (MMS, 2008).

III.D.2. Update on Climate Change and Its Potential Impact to the Arctic Region

Evidence of climate change in the past few decades, commonly referred to as global warming, has accumulated from a variety of geophysical, biological, oceanographic, atmospheric, and anthropogenic sources. While the effects of climate change are considered in the cumulative impact analysis in the SEA, that information is summarized and updated here where additional literature has become available since publication of the MMS 2006 PEA.

The scientific evidence indicates that average air, land, and sea temperatures increasing at an accelerating rate. Although climate changes have been documented over large areas of the world, the changes are not uniform and affect different areas in different ways and intensities. Arctic regions have experienced some of the largest changes, with major implications for the marine environment as well as for coastal communities. Recent assessments of climate change, conducted by international teams of scientists (Gitay *et al.*, 2002; ACIA, 2004; IPCC, 2007), have reached several conclusions of consequence for this SEA:

- Average Arctic temperatures increased at almost twice the global average rate in the past 100 years.
- Satellite data since 1978 show that perennial arctic sea ice extent has shrunk by 2.7 percent per decade, with larger decreases in sea ice extent in summer of 7.4 percent per decade.
- Arctic sea ice thickness has declined by about 40 percent during the late summer and early autumn in the last three decades of the twentieth century.
- The ice pack is retreating from the land sooner in the spring and reforming later in the fall. This affects the timing of phytoplankton blooms and zooplankton concentrations.
- The ice pack is retreating further seaward than in the past, which creates larger areas of open water near coastal areas and leads to larger waves, higher storm surges, and accelerated rates of coastal erosion. This dynamic is exacerbated by rising sea levels due to thermal expansion of seawater and other sources.
- The arctic tundra is warming rapidly, causing permafrost to thaw deeper in the summer and over much larger areas than previously observed, accompanied by substantial changes in vegetation and hydrology.
- The melting ice pack, melting glaciers, and increased precipitation are adding large amounts of freshwater to the sea, causing decreases in salinity that may combine with longer ice-free seasons to affect the timing and intensity of phytoplankton blooms.

Bowhead and other Arctic whales are associated with and well adapted to ice-covered seas with leads, polynyas, open water areas, or thin ice that the whales can break through

to breathe. Arctic coastal peoples have hunted bowheads for thousands of years, but the distribution of bowheads in relation to climate change and sea ice cover in the distant past is not known. It has been suggested that a cold period 500 years ago resulted in less ice-free water near Greenland, forcing bowheads to abandon the range, and that this led to the disappearance of the Thule culture (McGhee, 1984; Aagaard and Carmack, 1994, as cited in Tynan and DeMaster, 1997). However, it is not clear if larger expanses and longer periods of ice-free water would be beneficial to bowheads. The effect of warmer ocean temperatures on bowheads may depend more on how such climate changes affect the abundance and distribution of their planktonic prey rather than the bowheads' need for ice habitat itself (Tynan and DeMaster, 1997).

Climate change associated with Arctic warming may also result in regime change of the Arctic Ocean ecosystem. Sighting of humpback whales in the Chukchi Sea during the 2007 SOI deep seismic surveys (Funk *et al.*, 2008) may indicate the expansion of habitat by this species as a result of ecosystem regime shift in the Arctic. These species, in addition to minke and killer whales, and four pinniped species (harp, hooded, ribbon, and spotted seals) that seasonally occupy Arctic and subarctic habitats may be poised to encroach into more northern latitudes and to remain there longer, thereby competing with extant Arctic species (Moore and Huntington, 2008)

In the past decade, geographic displacement of marine mammal population distributions has coincided with a reduction in sea ice and an increase in air and ocean temperatures in the Bering Sea (Grebmeier *et al.*, 2006). Continued warming is likely to increase the occurrence and resident times of subarctic species such as spotted seals and bearded seals in the Beaufort Sea. The result of global warming would significantly reduce the extent of sea ice in at least some regions of the Arctic (ACIA, 2004; Johannessen et al., 2004). Ringed seals, which are true Arctic species, depend on sea ice for their life functions, and give birth to and care for their pups on stable shorefast ice. The reductions in the extent and persistence of ice in the Beaufort Sea almost certainly could reduce their productivity (Ferguson *et al.*, 2005; NRC, 2003), but at the current stage, there are insufficient data to make reliable predictions of the effects of Arctic climate change on the Alaska ringed seal stock (Angliss and Outlaw, 2007). In addition, spotted seals and bearded seals would also be vulnerable to reductions in sea ice, although insufficient data exist to make reliable predictions of the effects of Arctic climate change on these two species (Angliss and Outlaw, 2007).

The most recent analysis of climate change (IPCC, 2007) concluded that there is very strong evidence for global warming and associated weather changes and that humans have "very likely" contributed to the problems through burning fossil fuels and adding other "greenhouse gasses" to the atmosphere. This study involved numerous models to predict changes in temperature, sea level, ice pack dynamics, and other parameters under a variety of future conditions, including different scenarios for how human populations respond to the implications of the study. It is not clear how governments and individuals will respond or how much these future efforts will reduce greenhouse gas emissions. Although the intensity of climate changes will depend on how quickly and deeply humanity responds, the models predict that the climate changes observed in the past

30 years will continue at the same or increasing rates for at least 20 years.

The implications of these trends for bowheads and other Arctic cetaceans are uncertain but they may be beneficial, in contrast to affects on ice-obligate species such as ice seals, polar bears, and walrus (ACIA, 2004). There will be more open water and longer ice-free seasons in the arctic seas which may allow them to expand their range as the population continues to recover from commercial whaling. However, this potential for beneficial effects on bowheads and other whales will depend on their ability to locate sufficient concentrations of planktonic crustaceans to allow efficient foraging. Since phytoplankton blooms may occur earlier or at different times of the season, or in different locations, the timing of zooplankton availability may also change from past patterns (Arrigo and van Dijken, 2004). Hence, the ability of bowheads to use these food sources may depend on their flexibility to adjust the timing of their own movements and to find food sources in different places (ACIA, 2004). In addition, it is hypothesized that some of the indirect effects of climate change on marine mammal health would likely include alterations in pathogen transmission due to a variety of factors, effects on body condition due to shifts in the prey base/food web, changes in toxicant exposures, and factors associated with increased human habitation in the Arctic (Burek *et al.*, 2008).

With the large uncertainty of the degree of impact of climate change to Arctic marine mammals, NMFS recognizes that warming of this region which results in the diminishing of ice could be a concern to ice dependent seals and polar bears. Nonetheless, NMFS considers the effects of the proposed seismic surveys and shallow hazard and site clearance surveys proposed by the five oil and gas entities on climate change are too remote and speculative at this time to conclude definitively that the projects would contribute to climate change, and therefore a reduction in Arctic sea ice coverage. More research is needed to determine the magnitude of the impact, if any, of global warming to marine mammal species in the Arctic and subarctic regions. Finally, any future oil and gas activities that may arise as a result of this year's open water seismic surveys would likely need to undergo separate permit reviews and analyses.

III.D.3. Analysis of Cumulative Impacts in Relation to the Proposed 2008 Arctic Open Water Seismic Surveys and Shallow Hazard and Site Clearance Surveys

Chukchi Sea

After considering the additional information and activities described above, NMFS considers the potential 2008 level of seismic survey and other oil and gas-related activities in the Chukchi Sea (i.e. one 3D deep seismic surveys using marine streamers with airgun arrays measuring 3,147 in^3 by SOI, one high resolution site clearance survey using airgun array measuring 240 in^3 by SOI, up to two shallow hazard and site clearance surveys with small airgun array measuring 40 in^3 and subbottom profilers by AES and CPAI, and zero exploration activities) to be substantially the same as what was

cumulatively analyzed in the MMS 2006 PEA (i.e. four seismic surveys operating simultaneously in the Chukchi Sea).

In addition, first, the proposed 2008 open water seismic surveys and shallow hazard and site clearance surveys in the Chukchi Sea are not likely to be conducted simultaneously for all the operations over a long period of time, thus the ensonified area at any given time would be small. Therefore, it would be easier for marine mammals to avoid the ensonified areas. Second, the proposed SOI 3D deep seismic surveys would be conducted between August 1, 2008 and November 15, 2008, less those days when its 3D deep seismic surveys are planned to be conducted in the Beaufort Sea; the SOI high resolution site clearance surveys are proposed to be conducted between August and September for a total of 45 days; the proposed CPAI shallow hazard and site clearance surveys are planed to occur for 30 - 45 days between early August and the end of November, depending on weather and other operational condition. In comparison, the MMS 2006 PEA provided an analysis for a period of 150-day seismic activities in the Arctic. AES scheduled its shallow hazard and site clearance surveys between mid-July to the end of September. Third, there is a possibility that AES would conduct site clearance surveys for SOI, thereby obviating the need for SOI to conduct its own site clearance survey. However, if SOI decides to conduct these site clearance surveys as mentioned earlier, AES would not be conducting surveys in 2008. So the total seismic activities for the 2008 Arctic open water season could be a total of seven activities instead of eight Therefore, no significant adverse cumulative impacts are expected to occur in the Chukchi Sea during the 2008 open water season.

Furthermore, all eight proposed Arctic surveys planned in the open water season of 2008 would occur separately, except the shallow hazard and site clearance surveys proposed by SOI which could be conducted by AES if the contracts between those companies work out. However, as mentioned previously, due to the size of the airguns proposed for these activities, there are no potential cumulative impacts anticipated to result from these simultaneous shallow hazard and site clearance surveys.

The negligible cumulative impacts analysis on marine mammals is further supported by comprehensive analyses presented in the marine mammal monitoring and mitigation reports for 2006 and 2007 Arctic open water seismic surveys activities, including the seismic survey operations by SOI, CPAI, and GXTechnology (GXT) in 2006 and by SOI in 2007 (Ireland *et al.*, 2007a; 2007b; Patterson *et al.*, 2007; Funk *et al.*, 2007; 2008). While the results of some of the 2006 monitoring and mitigation reports are still being analyzed by NMFS, the AEWC, the North Slope Borough (NSB) scientists, and others, in reviewing drafts of these documents, NMFS believes there does not appear to have been any significant adverse impacts by the three seismic vessels operating in 2006 and one in 2007.

<u>Beaufort Sea</u>

After considering the updated information and additional activities described above, NMFS considers the potential 2008 level of seismic survey and other oil and gas-related activities in the Beaufort Sea (i.e. one 3D deep seismic surveys using marine streamers with airgun arrays measuring 3,147 in^3 by SOI, one high resolution site clearance survey using airgun array measuring 240 in^3 by SOI, two OBC seismic surveys with airgun arrays measuring 880 in^3 by BPXA and PGS, and zero exploration activities) to be substantially the same as what was cumulatively analyzed in the MMS 2006 PEA (i.e. four seismic surveys operate simultaneously in the Beaufort Sea).

In addition, first, the proposed 2008 open water seismic surveys and shallow hazard and site clearance surveys in the Beaufort Sea are not likely to be conducted simultaneously for all the operations over a long period of time, thus the ensonified area at any given time would be small. Therefore, it would be easier for marine mammals to avoid the ensonified area. Second, the proposed SOI 3D deep seismic surveys would be conducted between September 25 and October 15, 2008; the SOI high resolution site clearance surveys are proposed to be conducted between August and September for a total of 45 days; the proposed BPXA OBC seismic surveys are planned to occur for approximately 40 days between July and August; and the proposed PGS OBC seismic surveys are proposed to be conducted between July and October. In comparison, the MMS 2006 PEA provided an analysis for a period of 150-day seismic activities in the Arctic. Therefore, no significant adverse cumulative impacts are expected to occur in the Beaufort Sea during the 2008 open water season.

Also, the monitoring and mitigation measures identified in the MMS 2006 PEA, supplemented by additional monitoring and mitigation by NMFS discussed below in this SEA for the proposed 2008 open water seismic surveys and shallow hazard and site clearance surveys, are expected to reduce any potentially significant adverse effects to marine mammals.

IV. SUMMARY OF FINDINGS, MITIGATION MEASURES, AND RECOMMENDATIONS

The MMS 2006 Final PEA, MMS 2007 Final EIS for the Chukchi Sea Lease Sale 193 (MMS, 2007b), NMFS 2006 Arctic Region Biological Opinion (NMFS, 2006), and the MMS 2007 Draft EIS for Seismic Surveys in the Chukchi and Beaufort Seas (MMS, 2007a), [and the 2003 multi-sale EIS?] document that the Beaufort and Chukchi Seas support a wide variety of fish and wildlife resources. Many of these resources also support the Inupiat community's subsistence-harvest culture and lifestyle. The conclusion generated by the collective analysis of open water seismic surveys indicates that operating high-energy acoustic equipment, i.e., airguns, in the marine environment has the potential to cause adverse environmental impacts on the biological resources inhabiting the Beaufort and Chukchi Seas. For example, marine mammals could be harassed and possibly harmed by the acoustic energy generated by the airgun source. Any potential adverse effects to marine mammals also might adversely impact subsistence communities that depend on marine mammals. Marine birds, although not thought to be directly injured by the sounds of an airgun or by repeated vessel and aircraft movements, potentially could be harassed from seismic operations, thereby causing them to flee resting and feeding areas. Fishery resources might also be harassed or blocked from desired spawning and feeding habitat under certain circumstances, and shellfish potentially could be harmed directly by the high-energy sound source.

In light of the potential effects identified above, NMFS believes that by incorporating the mitigation measures identified in Section IV.A.2 in the MMS 2006 Final PEA (also described in Section V.B of this SEA) and which are incorporated herein by reference into this section of the SEA, into the oil and gas industry's seismic survey plans-of-action and IHA applications, these measures eliminate the potential to cause significant adverse impacts on the fish, wildlife, and subsistence resources of the Beaufort and Chukchi Seas. The mitigation measures proposed by NMFS would facilitate in making a determination that no unmitigable adverse impacts to subsistence uses of marine mammals would occur.

V. PREFERRED ALTERNATIVES AND MITIGATION MEASURES

V.A. Identification and Description of the Preferred Alternative

The impact assessment of the proposed action from the MMS 2006 Final PEA (up to four seismic surveys simultaneously operating in both the Chukchi and Beaufort Seas) resulted in NMFS and MMS issuing mitigated findings of no significant impact (FONSIs) for their respective actions. This was based on the level of activity, the analysis of potential impacts, and the selected alternative and its associated mitigation and monitoring requirements. There is no new information, beyond updates to the discussion of additional listed species in the affected environment, potential effects to bowheads, and the cumulative impacts analysis, to suggest that there would be any change in the effects analysis from the MMS 2006 Final PEA. The potential effects to bowheads are analyzed in this SEA and no significant impacts are anticipated. No adverse cumulative impacts are expected to occur during the 2008 open water season because of the similar level of activities and the mitigation measures proposed in existing MMS G&G permits and NMFS and FWS ITAs. It is reasonable to assume therefore that there would be no potential for significant impacts to occur if the MMS 2006 Final PEA selected alternative and mitigation measures were applied to the 2008 open water seismic surveys and shallow hazard and site clearance surveys. Therefore, NMFS has chosen to implement the MMS 2006 Final PEA Selected Alternative 6 (Seismic Surveys for Geophysical Exploration Activities would be Authorized with Existing Alaska OCS Geological and Geophysical Exploration Stipulations and Guidelines and Additional Protective Measures for Marine Mammals, Including a 180/190 dB Specified-Exclusion Zone) and will impose additional mitigation measures, as proposed by SOI, BPXA, AES, PGS, and CPAI, and deemed by NMFS to be necessary for the 2008 SEA open water season. This decision is based on the review of the analyses contained in the following documents: (1) MMS 2006 Final PEA, (2) MMS 2007 Final EIS for the Chukchi Sea Lease Sale 193, (3) MMS 2007 Draft EIS for Seismic Surveys in the Beaufort and Chukchi Seas, (4) NMFS 2006 Arctic Region Biological Opinion, (5) NMFS 2007 Supplemental EA of the 2007 open water season in the Chukchi and Beaufort Seas, (6) MMS 2003 multi-sale lease EIS, and (6) IHA applications from SOI, BPXA, AES, PGS, and CPAI for the proposed 2008 open water seismic activities. Review of the comments received from the public and agencies during the 30-day public comment period on the applications from BPXA (73 FR 24236, May 2, 2008), AES (73 FR 22922, April 28, 2008), and CPAI (73 FR 30064, May 23, 2008) and associated proposed IHAs were also considered. These reviews prompted NMFS to decide that Alternative 6 and its associated mitigation and monitoring measures are able to fulfill both NMFS' statutory mission and responsibilities and meet the stated purpose and the need for the proposed action.

V.B. Description of Mitigation and Monitoring Measures

Mitigation and monitoring measures have been proposed by SOI, BPXA, AES, PGS, and CPAI for their 2008 seismic activities. Additional measures may be required by NMFS pursuant to its authority under the MMPA to ensure that the proposed activities will result in the least practicable adverse impact on marine mammal species or stocks in the Beaufort and Chukchi Seas. These mitigation and monitoring measures could appear as stipulations in any seismic survey authorizations granted by NMFS. These mitigation and monitoring requirements contained in the MMPA IHAs will ensure that takings are of small numbers, potential impacts to marine mammals will be negligible, and there will be no unrnitigable adverse impacts to subsistence uses. All mitigation and monitoring measures, especially those related to avoiding impacts to subsistence hunting under the MMPA authorizations will be followed.

The following sections describe the environmental protection measures associated with the selected alternative:

V.B.1. NMFS' Specific Requirements within Its MMPA and ESA Authorities

Exclusion Zone - A marine mammal exclusion zone of 180 dB (cetaceans) and 190 dB (pinnipeds) from the seismic-survey sound source shall be free of marine mammals before the survey can begin and must remain free of marine mammals during the survey. The purpose of the exclusion zone is to protect marine mammals from Level A harassment (e.g., potential for injury). The purpose of this mitigation measure is to prevent marine mammals from the onset of TTS from the intense airgun sound.

Monitoring of the Exclusion Zone - Trained marine mammal observers (MMOs) shall monitor the area around the survey for the presence of marine mammals to maintain a marine mammal-free exclusion zone and monitor for avoidance or take behaviors. Visual observers monitor the exclusion zone to ensure that marine mammals do not enter the exclusion zone for at least 30 minutes prior to ramp up, during the conduct of the survey, or before resuming seismic-survey work after shut down. The NMFS will set specific requirements for the monitoring programs and observers. The purpose of this mitigation measure is to ensure that no marine mammal is present within the exclusion zone during the seismic activities, thus preventing the onset of TTS.

Shut Down - The survey shall be suspended until the exclusion zone is free of marine mammals. All observers shall have the authority to, and will, instruct the vessel operators to immediately stop or de-energize the airgun array whenever a marine mammal is seen within the exclusion zone. If the airgun array is completely powered down for any reason during nighttime or poor sighting conditions, it shall not be re-energized until daylight or whenever sighting conditions allow for the exclusion zone to be effectively monitored from the source vessel and/or through other passive acoustic, aerial, or vessel-based monitoring. The purpose of this mitigation measure is to mitigate

impacts of intense noise to marine mammals in case an animal is sighted within the safety zone.

Ramp Up - Ramp up is the gradual introduction of sound to deter marine mammals from potentially damaging sound intensities and from approaching the exclusion zone. This technique involves the gradual increase (usually 5 - 6 dB per 5-minute increment) in emitted sound levels, beginning with firing a single airgun and gradually adding airguns over a period of at least 20 - 40 minutes, until the desired operating level of the full array is obtained. Ramp-up procedures may begin after observers ensure the absence of marine mammals in the exclusion zone for at least 30 minutes. Ramp-up procedures shall not be initiated at night or when monitoring the exclusion zone is not possible. A single airgun operating at a minimum source level can be maintained for routine activities, such as making a turn between line transects, for maintenance needs or during periods of impaired visibility (e.g., darkness, fog, high sea states), and does not require a 30-minute clearance of the exclusion zone before the airgun array is again ramped up to full output. This mitigation measure serves as a warning to any marine mammal that is not detected during the pre-survey observation period, so the animal has the opportunity to leave the exclusion zone before the airguns operate at full power.

Field Verification - Before conducting the survey, the operator shall verify the radii of the exclusion zones within real-time conditions in the field. This provides for more accurate exclusion-zone radii rather than relying on modeling techniques before entering the field. Field-verification techniques must be consistent with NMFS-approved guidelines and procedures. When moving a seismic-survey operation into a new area, the operator shall re-verify the new radii of the exclusion zones. The purpose of this mitigation measure is to establish and monitor more accurate safety zones, as compared to the zones based on empirical calculations and modeling.

Monitoring of the Seismic-Survey Area - Aerial-monitoring surveys or an equivalent monitoring program acceptable to the NMFS may be required. The purpose of this monitoring measure is to provide additional observation for areas that may be too large to monitor by vessel-based monitoring.

Temporal/Spatial/Operational Restrictions - Dynamic management approaches to avoid or minimize exposure, such as temporal or spatial limitations are based on marine mammals being present in a particular place or time, or being engaged in a particularly sensitive behavior (such as feeding).

> (1) No seismic survey activity, including re-supply vessels and other related traffic, will be permitted within the Ledyard Bay spectacled eider critical habitat area following July 1 of each year, unless human health or safety dictates otherwise. Incursions for human health or safety purposes shall be reported within 24 hours to MMS. Other incursions will be considered noncompliance with this condition.

(2) Seismic survey support aircraft must avoid overflights across the Ledyard Bay spectacled eider critical habitat area below an altitude of 1,500 ft (457 m) after July 1 of each year, unless human health or safety dictates otherwise. Incursions for human health or safety purposes shall be reported within 24 hours to MMS. Other incursions will be considered noncompliance with this condition. In other coastal areas, seismic-survey support aircraft would maintain at least a 1,500 ft (457 m) altitude over beaches, lagoons, and nearshore waters as much as possible.

(3) Seismic vessel transits must not occur prior to July 1 in the spring leads to ensure that there will be no conflict with the spring bowhead whale migration and subsistence hunts conducted by Barrow, Pt. Hope, or Wainwright or the beluga subsistence hunt conducted by the village of Pt. Lay in July.

(4) Seismic surveys must not occur prior to July 15 in the Chukchi Sea spring lead system, unless authorized by NMFS, to provide bowhead cow/calf pairs additional protection.

Reporting Requirements - Reporting requirements, such as the monitoring plans required by FWS for polar bears and walruses prior to the start of seismic activities, provide the regulating agencies with specific information on the monitoring techniques to be implemented and how any observed impacts to marine mammals will be recorded. In addition, operators must report immediately any shut downs due to a marine mammal entering the exclusion zones and provide the regulating agencies with information on the frequency of occurrence and the types and behaviors of marine mammals (if possible to ascertain) entering the exclusion zones.

In addition, the following reports will be required from the permit holders if IHAs are issued:

(1) Field Source Verification and the distances to the various radii are to be reported to NMFS within 5 days of completing the measurements. In addition to reporting the radii of specific regulatory concern, distances to other sound isopleths down to 120 dB re 1 μPa rms (if measurable) will be reported in increments of 10 dB.

(2) Seismic Vessel Monitoring Program: A draft report will be submitted to NMFS within 90 days after the end of the open water seismic survey or shallow hazard and site clearance program in the Arctic Ocean. The report will describe in detail:

(i) the operations that were conducted,

(ii) the results of the acoustical measurements to verify the safety radii,

(iii) the methods, results, and interpretation pertaining to all monitoring tasks;

(iv) the result of the 2008 shipboard marine mammal monitoring;

(v), a summary of all dates and locations of seismic operations, including summaries of power downs, shut downs, and ramp up delays;

(vi) marine mammal sightings (species, numbers, dates, times and locations, age/size/sex, environmental correlates, activities, associated seismic survey activities),

(vii) estimates of the amount and nature of potential take (exposure) of marine mammals (by species) by harassment or in other ways to industry sounds;

(viii) an analysis of the effects of seismic operations (e.g., on sighting rates, sighting distances, behaviors, movement patterns of marine mammals);

(ix) provide an analysis of factors influencing detectability of marine mammals, and

(x) provide summaries on communications with hunters and potential effects on subsistence uses.

(3) The draft reports will be subject to review and comment by NMFS. Any recommendations made by NMFS must be addressed in the final reports prior to acceptance by NMFS. The draft reports will be considered the final reports if NFMS has not provided comments and recommendations within 90 days of receipt of the draft reports.

(4) Draft comprehensive reports describing the acoustic, vessel-based, and aerial (if applicable) monitoring programs must be prepared and submitted within 240 days after the issuance of the IHAs. The comprehensive report shall describe the methods, results, conclusions and limitations of each of the individual data sets in detail. The report will also integrate (to the extent possible) the studies into a broad based assessment of all industry activities and their impacts on marine mammals in the Arctic Ocean during 2008.

(5) The draft comprehensive report will be reviewed by participants at the 2009 Open Water Scientific Meeting to be held in Anchorage, Alaska, in the spring of 2009. The draft comprehensive report will be accepted by NMFS as the final comprehensive report upon incorporation of recommendations by the workshop participants.

V.B.2. Additional Mitigation Measures

The following mitigation measures have the potential to further reduce adverse environmental impacts.

(1) For seismic activities in the Beaufort Sea after August 25, a 120-dB monitoring (safety) zone for bowhead whales will be established and monitored if four or more bowhead whale cow/calf pairs are observed at the surface during an aerial monitoring program within the area where an ensonified 120-dB zone around the vessel's track as projected for the next 24 hours. To the extent practicable, such monitoring should focus on upstream (eastward) of the bowhead migration. No seismic surveying shall occur within the 120-dB safety zone around the area where these whale cow/calf pairs were observed, until two consecutive surveys (aerial or vessel) indicate they are no longer present within the 120-dB safety zone of seismic-surveying operations.

(2) A 160-dB vessel monitoring zone for bowhead and gray whales will be established and monitored in the Chukchi Sea and after August 25 in the Beaufort Seas during all seismic surveys. Whenever an aggregation of bowhead whales or gray whales (12 or more whales of any age/sex class that appear to be engaged in a nonmigratory, significant biological behavior (e.g., feeding, socializing)) are observed during an aerial or vessel monitoring program within the 160-dB safety zone around the seismic activity, the seismic operation will not commence or will shut down, until two consecutive surveys (aerial or vessel) indicate they are no longer present within the 160-dB safety zone of seismic-surveying operations.

(3) Aerial and vessel surveys will be conducted in the Beaufort and Chukchi (vessel only in the Chukchi) Seas during the fall bowhead whale-migration period to detect bowhead whale cow/calf pairs and to detect aggregations of feeding bowhead and gray whales. In the Beaufort Sea, aerial surveys will commence for activities occurring after August 25. The protocols for these aerial and vessel monitoring programs will be specified in the IHAs granted by NMFS. The reason that aerial surveys are not required in the Chukchi Sea is due to safety and practical reasons (e.g., fewer airports can be utilized to support a survey aircraft for its survey activities).

(4) Survey information, especially information about bowhead whale cow/calf pairs or feeding bowhead or gray whales, shall be provided to NMFS as required in MMPA authorizations, and will form the basis for NMFS determining whether additional mitigation measures, if any, will be required over a given time period.

(5) The Holders of the IHAs shall notify NMFS in the event of any loss of cable, streamer, or other equipment that could pose a danger to marine mammals that are under NMFS juridiction.

(6) To avoid significant additive and synergistic effects from seismic-survey operations that occur simultaneously with other oil and gas industry activities (e.g., drilling) which might hinder the migration of bowhead whales, NMFS may require special restrictions, such as additional temporal or spatial separations.

(7) Seismic survey operations are to conform with the following mitigation measures to ensure that seismic activities do not have an unmitigable adverse impact on subsistence uses of marine mammals. These include:

(a) For the purposes of reducing or eliminating conflicts between subsistence whaling activities and the applicants' seismic program, the Holders of the IHAs will establish and operate at least five Communication Centers (Com-Centers) to be staffed by Inupiat operators. The Com-Centers will be operated 24 hrs/day during the 2008 fall subsistence bowhead whale hunt.

(b) Plan all vessel and aircraft routes to minimize any potential conflict with bowhead whale subsistence whaling activities. All vessels shall avoid areas of active or anticipated whaling activity.

(c) During the bowhead whaling season, aircraft shall not operate below 1,500 ft (457 m) unless approaching, landing or taking off, or unless engaged in providing assistance to a whaler or in poor weather (low ceilings) or other emergency situations.

(d) All geophysical activity in the Beaufort Sea and Chukchi seas shall be restricted from conducting seismic as set forth below:

(A) Kaktovik: No geophysical activity from the Canadian border to the Canning River (~146°04' W) from August 25 to the end of the fall bowhead whale hunt in Kaktovik and Nuiqsut;

(B) Nuiqsut: No geophysical activity from the Canning River (~146°04' W) to Point Storkersen (~148°45' W) from August 25 to the end of the fall bowhead whale hunt in Nuiqsut;

(C) Barrow: No geophysical activity from Pitt Point on the east side of Smith Bay (~152°15' W) to a location about half way between Barrow and Peard Bay (~157°20' W) from September 10 to the end of the fall bowhead whale hunt in Barrow.

(D) Chukchi Sea: To avoid possible deflecting bowhead whales from the coast, geophysical exploration may occur beginning July 20, but in any case no closer than 60 mi (97 km) from the Chukchi Sea coast at any point.

(d) Upon request for emergency assistance made by a subsistence whale hunting organization, or by a member of such an organization in order to prevent the loss of a whale. The Holders of the IHAs shall assist towing of a whale taken in a traditional subsistence whale hunt.

(f) Geophysical exploration may resume following the close of the fall 2008 bowhead whale subsistence hunt in Barrow.

(g) Post-season review and follow-up meetings:

(A) No later than 90 days following the end of the fall 2008 bowhead subsistence hunt, the Holders of the IHAs will host a joint meeting with all whaling captains of the Villages of Nuiqsut, Kaktovik and Barrow, the Inupiat Communicator(s) and with the Chairman and Executive Director of the AEWC at a mutually agreed upon place on the North Slope to review the results of the 2008 fall season (unless it is agreed by all designated individuals or their representatives that such a meeting should be held at a different location, should be postponed, or is not necessary.

(B) No later than 90 days following completion of geophysical operations in the Chukchi Sea, relevant Holders of the IHAs will host a meeting in each of the following villages: Wainwright, Point Hope, and Barrow (or a joint meeting of the whaling captain from all these villages if the whaling captains agree to a joint meeting) to review the results of operations and to discuss any concerns residents of those villages might have regarding the operations.

V.B.3. Review of the 2006 and 2007 Open Water Seismic Survey Marine Mammal Monitoring and Mitigations Reports

NMFS has reviewed the 90-day marine mammal monitoring and mitigation reports for the 2006 and 2007 open water seismic survey and shallow hazard and site clearance survey conducted by SOI, CPAI, and GXT in 2006 and by SOI in 2007 (Ireland *et al.*, 2007a; 2007b; Patterson *et al.*, 2007; Funk *et al.*, 2007; 2008). Based on the results of these studies collectively, NMFS concludes that the previous monitoring and mitigation measures prescribed in these marine mammal take authorizations were effective. In addition, actual take of marine mammals by Level B harassment was generally lower than expected due to the implementation of monitoring and mitigation measures. No Level A harassment (injuries included) or mortality was observed or suspected.

VI. Consultation and Coordination

Within the public review processes for the MMS 2006 Final PEA, MMS 2007 Final EIS for the Chukchi Sea Lease Sale 193, and MMS 2007 Draft EIS for Seismic Surveys in the Chukchi and Beaufort Seas, NMFS and MMS have repeatedly and extensively solicited input from the public regarding potential effects from seismic survey activities. This has included several public comment periods, public hearings, outreach and scoping, and government-to-government meetings. These efforts began in early 2006 and have been directed at Federal and State agencies, Native Alaskan organizations, environmental groups, and the general public. The results of the input from the public received to date have been considered in developing this 2008 SEA. Collectively, these consultations support this 2008 SEA and subsequent environmental review of 2008 MMPA authorizations.

NMFS indicated that the findings in the 2006 ARBO are still relevant to the 2008 open water seismic surveys season for activities in the Beaufort Sea. For the proposed 2008 open water seismic activities in the Chukchi Sea, NMFS has begun consultation under section 7 of the ESA. NMFS will also consult under section 7 of the ESA on the issuance of the IHAs under section 101(a)(5)(D) of the MMPA to SOI, AES, and CPAI for these activities. Consultation will be concluded prior to NMFS making a determination on the issuance of an IHA.

VII. Implementation Process

This SEA addresses the proposed action of issuing five IHAs, as described and analyzed throughout this document. The IHAs were requested by five separate applicants, and the issuance of any IHA would be specific to that applicant. Although NMFS considers the purposes of NEPA are supported through consideration of the requested take authorization for 2008 Arctic seismic in one NEPA document, it is important to recognize that the industry actions are not dependent on each other, and separate issuance of IHAs under MMPA is the appropriate consideration and pending decision to be made by NMFS. Therefore, if the appropriate determinations under NEPA and MMPA are reached and a Biological Opinion determining no jeopardy is issued, NMFS would consider a separate FONSI and IHA for each of the five actions. The process of public comment may suggest mitigation or other measures, and those would be considered and addressed in each IHA issuance. Should these measures be considered a significant change, NMFS would consider supplementing this NEPA analysis as appropriate.

VIII. LIST OF PREPARERS AND CONTRIBUTERS

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