

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648-XD655-X

Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to an Exploration Drilling Program in the Chukchi Sea, Alaska

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Notice; issuance of an incidental harassment authorization.

SUMMARY: In accordance with the Marine Mammal Protection Act (MMPA) regulations, notification is hereby given that NMFS has issued an Incidental Harassment Authorization (IHA) to Shell Gulf of Mexico Inc. (Shell) to take marine mammals, by harassment, incidental to offshore exploration drilling on Outer Continental Shelf (OCS) leases in the Chukchi Sea, Alaska

DATES: Effective July 1, 2015, through October 31, 2015.

ADDRESSES: A copy of the issued IHA, application with associated materials, and NMFS' Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) may be obtained by writing to Jolie Harrison, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910, telephoning the contact listed below (see **FOR FURTHER INFORMATION**

CONTACT), or visiting the internet at: <http://www.nmfs.noaa.gov/pr/permits/incidental.htm>.

Documents cited in this notice may also be viewed, by appointment, during regular business hours, at the aforementioned address

FOR FURTHER INFORMATION CONTACT: Shane Guan, Office of Protected Resources, NMFS, (301) 427-8401.

SUPPLEMENTARY INFORMATION:

Background

Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 *et seq.*) direct the Secretary of Commerce to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and either regulations are issued or, if the taking is limited to harassment, a notice of a proposed authorization is provided to the public for review.

An authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant), and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such takings are set forth. 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.”

Except with respect to certain activities not pertinent here, the MMPA defines "harassment" as: any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption

of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment].

Summary of Request

On September 18, 2014, Shell submitted an application to NMFS for the taking of marine mammals incidental to exploration drilling activities in the Chukchi Sea, Alaska. After receiving comments and questions from NMFS, Shell revised its IHA application and related Marine Mammal Mitigation and Monitoring Plan (4MP) on December 17, 2014. NMFS determined that the application was adequate and complete on January 5, 2015.

NMFS published a Notice of Proposed IHA in the **Federal Register** on March 4, 2015 (80 FR 11726). That notice contained in-depth descriptions and analyses that may be summarized but are generally not repeated in this document. Only in cases where descriptions or analyses changed is that information updated here.

The proposed activity would occur between July and October 2015. The following specific aspects of the proposed activities are likely to result in the take of marine mammals: exploration drilling, supply and drilling support vessels using dynamic positioning, mudline cellar construction, anchor handling, ice management activities, and zero-offset vertical seismic profiling (ZVSP) activities.

Shell requested an authorization to take 13 marine mammal species by Level B harassment. However, the narwhal (*Monodon monoceros*) is not expected to be found in the activity area. Therefore, NMFS proposed to authorize take of 12 marine mammal species, by Level B harassment, incidental to Shell's offshore exploration drilling in the Chukchi Sea. These species are: beluga whale (*Delphinapterus leucas*); bowhead whale (*Balaena mysticetus*); gray

whale (*Eschrichtius robustus*); killer whale (*Orcinus orca*); minke whale (*Balaenoptera acutorostrata*); fin whale (*Balaenoptera physalus*); humpback whale (*Megaptera novaeangliae*); harbor porpoise (*Phocoena phocoena*); bearded seal (*Erignathus barbatus*); ringed seal (*Phoca hispida*); spotted seal (*P. largha*); and ribbon seal (*Histriophoca fasciata*).

In 2012, NMFS issued two IHAs to Shell to conduct two exploratory drilling activities at exploration wells in the Beaufort (77 FR 27284; May 9, 2012) and Chukchi (77 FR 27322; May 9, 2012) Seas, Alaska, during the 2012 Arctic open-water season (July through October). Shell's proposed 2015 exploration drilling program is similar though not identical to those conducted in 2012. (In December 2012, Shell submitted two additional IHA applications to take marine mammals incidental to its proposed exploratory drilling in Beaufort and Chukchi Seas during the 2013 open-water season. However, Shell withdrew its application in February 2013.)

Description of the Specified Activity

Overview

Shell proposes to conduct exploration drilling at up to four exploration drill sites at Shell's Burger Prospect on the OCS leases acquired from the U.S. Department of Interior, Bureau of Ocean Energy Management (BOEM). The exploration drilling planned for the 2015 season is a continuation of the Chukchi Sea exploration drilling program that began in 2012, and resulted in the completion of a partial well at the location known as Burger A.

Shell plans to use two drilling units, the drillship *Noble Discoverer* (*Discoverer*) and semi-submersible *Transocean Polar Pioneer* (*Polar Pioneer*) to drill at up to four locations on the Burger Prospect. Both drilling units will be attended to by support vessels for the purposes of ice management, anchor handling, oil spill response (OSR), refueling, support to drilling units,

and resupply. The drilling units will be accompanied by a greater number of support vessels, aircraft, and oil spill response vessels (OSRV) greater than the number deployed during the 2012 drilling season.

Dates and Duration

Shell anticipates that its exploration drilling program will occur between July 1 and approximately October 31, 2015. The drilling units will move through the Bering Strait and into the Chukchi Sea on or after July 1, 2015, and then onto the Burger Prospect as soon as ice and weather conditions allow. Exploration drilling activities will continue until about October 31, 2015, and the drilling units and support vessels will exit the Chukchi Sea at the conclusion of the exploration drilling season.

Specified Geographic Region

All drill sites at which exploration drilling would occur in 2015 will be at Shell's Burger Prospect (see Figure 1-1 on page 1-2 of Shell's IHA application). Shell has identified a total of six Chukchi Sea lease blocks on the Burger Prospect. All six drill sites are located more than 64 mi (103 km) off the Chukchi Sea coast. During 2015, the *Discoverer* and *Polar Pioneer* will be used to conduct exploration drilling activities at up to four of the six exploration drill sites (up to two at a time). As with any Arctic exploration program, weather and ice conditions will dictate actual operations.

Detailed Description of Activities

The Notice of Proposed IHA (80 FR 11726; March 4, 2015) contained a full description of Shell's planned operations. That notice describes the equipment to be used for the different operational activities, the timeframe of activities, and the sound characteristics of the associated

equipment. There is no change to Shell’s planned exploration drilling activity, therefore, the information is not repeated here. Please refer to the proposed IHA notice for the full description of the specified activity.

Comments and Responses

A Notice of Proposed IHA published in the **Federal Register** on March 4, 2015 (80 FR 11726) for public comment. During the 30-day public comment period, NMFS received 8 comment letters from the following: the Marine Mammal Commission (Commission); the Alaska Eskimo Whaling Commission (AEWC); the North Slope Borough (NSB); Shell; the Northern Alaska Environment Center (NAEC); the Environmental Investigation Agency (EIA); Oceana, Ocean Conservancy, and Audubon Alaska (collectively Oceana); and Alaska Wilderness League (AWL), Center for Biological Diversity, Earthjustice, EIA, Greenpeace, Natural Resources Defense Council, NAEC, Ocean Conservation Research, and Sierra Club (collectively “AWL”), along with a form letter signed by 180,036 private citizens (with many duplicate submissions).

All of the public comment letters received on the Notice of Proposed IHA (80 FR 11726; March 4, 2015) are available on the internet at:

<http://www.nmfs.noaa.gov/pr/permits/incidental.htm>. Following are the public comments and NMFS’ responses.

General Comments

Comment 1: The Commission notes that NMFS does not typically authorize the taking of marine mammals incidental to mudline construction and anchor handling. The Commission further recommends that if NMFS intends to authorize the taking of marine mammals incidental

to these types of activities, NMFS should provide guidance and follow a consistent approach in assessing the potential for taking by Level B harassment, including whether applicants should include requests for authorizations of such taking in their applications.

Response: NMFS has not authorized marine mammal takes by Level B harassment that result from mudline cellar construction and anchor handling because there had been no documentation that noises generated from such activities were significant enough to cause take. The noise levels of these activities were first measured during the sound source verification tests for Shell's exploration drilling activities in the Beaufort and Chukchi seas in 2012, and were reported in the 90-day reports of these activities. As detailed in the notice for the proposed IHA (80 FR 11726; March 4, 2015), the Level B harassment radii (120-dB isopleths) for mudline cellar construction and anchor handling are 8.2 and 19 km from the sources, respectively.

For determining whether impacts from sound-generating activities rise to Level B harassment of marine mammals, NMFS' current guidance is that if an animal is exposed to received noise levels higher than 160-dB for impulse source or 120-dB for non-impulse source, then it is considered a take. In the case of mudline cellar construction and anchor handling, NMFS required sound source verification (SSV) tests on these sources in the 2012 IHAs issued to Shell for its 2012 open-water exploration drilling activities. The results showed that these activities generate significant underwater noise that could result in take under NMFS' current guidance for marine mammal behavioral harassment, and NMFS considers that takes are likely from these activities for Shell's 2015 exploration drilling activity in the Chukchi Sea. As a result, impacts from these sound sources should be considered in future incidental take applications and analyses.

Comment 2: The NSB requests an extension of the 30-day comment period for the proposed IHA. The NSB states that because Shell’s Chukchi Sea Exploration Plan is incredibly detailed, yet has not yet been “deemed submitted” by the Bureau of Ocean Energy Management (BOEM), the NSB has not had the opportunity to review all the details. In addition, the NSB states that having two drill rigs operating near one another could cause major impacts, and that without evaluating the entire Exploration Plan, the NSB cannot fully evaluate how all aspects of the operation will move forward, nor can the NSB evaluate the cumulative impacts on marine mammals.

Response: NMFS received the NSB’s request on April 3, 2015, the last day of the comment period for the proposed IHA. As a practical matter an extension of the public comment period would not have been possible given the short time period left to consider the request. Section 101(a)(5)(D) of the MMPA was intended to provide a mechanism for more expedited review and issuance of marine mammal incidental take authorizations (than section 101(a)(5)(A)), assuming the required findings can be made. We complied with the 30-day public comment period specified in the statute. In this case, an extension of or an additional comment period could have delayed issuance of the IHA in the timeframe requested by Shell for it to conduct its specified activity.

Although Shell’s Exploration Plan was not “deemed submitted” by BOEM until after the closing of NMFS’ public comment period, we note that a second draft “Revision 2” of Shell’s Chukchi Sea Exploration Plan was submitted to BOEM and publicly available since August 2014. See <http://www.boem.gov/shell-chukchi/>. Further, the information provided to NMFS in Shell’s IHA application and marine mammal mitigation and monitoring plan (4MP) contained

substantial information for NMFS to analyze potential impacts to marine mammals from Shell's proposed exploration drilling. Information provided by Shell to NMFS for impact analysis included a detailed description of the acoustic footprint from two drill rigs operating near one another, and total ensonified area resulting from two different sources. Therefore, adequate information was publicly available to evaluate potential impacts to marine mammals from Shell's proposed exploration drilling activities in the Chukchi during the 2015 Arctic open-water season even before the Exploration Plan was officially deemed submitted.

Comment 3: The NSB noted that NMFS convened an independent peer review panel to review Shell's 4MP for the proposed exploration drilling in the Chukchi Sea, and that after the review process NMFS will consider all recommendations made by the panel and incorporate appropriate changes in the monitoring requirements of the IHA (if issued). The NSB states that it would be useful to the NSB to have the benefit of this feedback and proposed changes when evaluating the IHA.

Response: In evaluating potential marine mammal impacts from Shell's proposed exploration drilling program in the Chukchi Sea, NMFS published a **Federal Register** notice of proposed IHA for public comment. The **Federal Register** notice contains substantial information on Shell's proposed activities, potential impacts to marine mammals and subsistence harvest, and proposed mitigation, monitoring, and reporting measures. In addition, Shell's IHA application and 4MP are posted on NMFS' website along with the **Federal Register** for public examination and comments. Furthermore, the peer-review panel report on Shell's 4MP, along with the panel's recommendations, as well as changes made by NMFS to the monitoring and reporting measures, are available to the public in this document and will be posted on NMFS'

website. However, due to the short duration of the statutory timeframe of the IHA process (120 days), it was not possible to afford additional time for feedback on the peer-review panel reports and proposed changes. Nevertheless, NMFS believes that the IHA process allows NMFS to receive the benefit of important input from the public, subsistence users, and peer review in its decision making.

Impact Analysis

Comment 4: Shell notes that the functional hearing frequency ranges provided in the **Federal Register** notice for the proposed IHA are inconsistent with those presented in Southall *et al.* (2007), specifically, the low frequency and pinniped hearing groups. Shell states that the extension of the hearing range of low-frequency cetaceans is not supported by empirical evidence. Shell argues that there is no evidence indicating that mysticetes hear above 20-22 kHz, and there are no empirical data to support expansion to 30 kHz. Shell also notes that these ranges appear to be drawn from NMFS' draft acoustic criteria, which are still under review and have not been finalized. Shell requests NMFS provide justification for the ranges listed above including associated references.

Response: The hearing frequency ranges of functional hearing groups provided in the **Federal Register** notice is based on current data (via direct measurements [behavioral and electrophysiological]) and predictions (based on inner ear morphology, behavior, vocalizations, or taxonomy), which indicate that not all marine mammal individuals/species have equal hearing capabilities, in terms of absolute hearing sensitivity and the frequency band of hearing (Richardson *et al.* 1995; Wartzok and Ketten 1999; Southall *et al.* 2007; Au and Hastings 2008). Hearing has been directly measured in a multitude of odontocete and pinniped species (see

review in Southall *et al.* 2007). Direct measurements of mysticete hearing are lacking (e.g., there was an unsuccessful attempt to directly measure hearing in a stranded gray whale calf by Ridgway and Carder 2001). Thus, scientifically based hearing predictions for mysticetes are based on other scientific methods (e.g., anatomical studies: Houser *et al.* 2001; Parks *et al.* 2007; vocalizations: see reviews in Richardson *et al.* 1995; Wartzok and Ketten 1999; Au and Hastings 2008; taxonomy and behavioral responses to sound: Dahlheim and Ljungblad 1990; see review in Reichmuth 2007).

To more accurately reflect marine mammal hearing capabilities, Southall *et al.* (2007) recommended that marine mammals be divided into functional hearing groups based on measured or estimated functional hearing ranges. Based on additional data, NOAA modified the functional hearing groups proposed by Southall *et al.* (2007) for species relevant to this action as follows:

- *Extension of upper end of low-frequency cetacean hearing range:* NOAA extended slightly the estimated upper end of the hearing range for low-frequency cetaceans, from 22 to 25 kHz, based on data from Watkins *et al.* (1986) for numerous mysticete species (variety of mysticete species responding to sounds up to 28 kHz), Au *et al.* (2006) for humpback whales (songs having harmonics that extend beyond 24 kHz), Lucifredi and Stein (2007) for gray whales (reported potentially responding to sounds beyond 22 kHz), and an unpublished report (Ketten and Mountain 2009) and data (Tubelli *et al.* 2012) for minke whales (predicted hearing range of up to 30 kHz based on inner ear anatomy). These new data indicate that at least some mysticete species can hear above 22 kHz. Thus our current understanding of low-frequency cetaceans' hearing range

is 7 Hz – 25 kHz. As more data become available, these estimated hearing ranges may require future modification.

- *Division of pinnipeds into phocids and otariids*: NOAA subdivided pinnipeds into their two families: Phocidae and Otariidae. Based on a review of the literature, phocid species have consistently demonstrated an extended frequency range of hearing compared to otariids, especially in the higher frequency range (Hemilä *et al.* 2006; Kastelein *et al.* 2009; Reichmuth *et al.* 2013). This is believed to be because phocid ears are anatomically distinct from otariid ears in that phocids have larger, more dense middle ear ossicles, inflated auditory bulla, and larger portions of the inner ear (i.e., tympanic membrane, oval window, and round window), which make them more adapted for underwater hearing (Terhune and Ronald 1975; Kastak and Schusterman 1998; Hemilä *et al.* 2006; Mulsow *et al.* 2011; Reichmuth *et al.* 2013).

NMFS considers this classification reflects the incorporation of the best scientific information since Southall *et al.* 2007, and is considered in our effects analyses for marine mammal incidental take authorizations.

Comment 5: The Commission noted that when estimating the number of bowhead takes, Shell assumed that 50 percent of all bowheads would avoid the Level B harassment zone during exploratory drilling and related support activities. The Commission generally does not agree with using assumptions of marine mammal avoidance of certain activities when estimating takes, unless the studies supporting such assumptions were based on the same or very similar circumstances and NMFS has determined that such avoidance would not result in an abandonment or significant alteration of behavioral patterns. The Commission further states that

if NMFS intends to adjust take estimates based on assumed levels of avoidance, the Commission recommends that NMFS should provide guidance and follow a consistent approach in the adjustment of those estimates.

Response: NMFS agrees with the Commission that general avoidance by marine mammals of an ensonified area is a form of Level B harassment. Therefore, NMFS worked with Shell and revised the bowhead whale take analysis, which is provided in details below. While we agree that avoidance occurs, the revised take estimate of bowhead whales assumes that the animals that avoid the area will be taken by Level B harassment. In short, the 50% adjustment to Level B take numbers for avoidance is no longer applied.

Separately, however, NMFS also recognizes that the approach used here, which includes consideration of the number of days, results in an overestimate of takes, because it assumes a 24-hour turnover rate of bowhead whales in the ensonified area. This is not likely due to the large area of the Level B harassment zone (modelled at 22 km radius for anchor handling) and the slow migration speed of bowhead whales (Mate *et al.* 2000) and observed feeding behavior in the area. Tagging studies showed that bowhead whales moved at speeds between 1.1 and 5.8 km/h, with frequent stay at places to feed (Mocklin 2009). Although a precise quantitative assessment of the turnover rate is difficult due to large variation among individual whales, NMFS considers it reasonable yet conservative to assume an averaged 48-hour turnover rate for bowheads in the ensonified area when estimating bowhead whales that could be taken by Level B harassment.

Comment 6: Citing NMFS' impact analysis when issuing an IHA to Shell to take marine mammals incidental to exploratory drilling in the Beaufort Sea (77 FR 27284, 27288 [May 9, 2012]), Shell requests that NMFS continue to recognize the scientific evidence for avoidance of

bowhead whales from drilling related activities, and not deviate from its prior position in 2012, which asserted that avoidance does not always rise to a level that constitutes a Level B take.

Response: NMFS recognizes that some marine mammals will avoid drilling related activities to differing degrees. Further, there may be some small degree of avoidance that occurs at lower received levels that would not rise to the level of a take; however, avoidance that is expected, or modeled, within or near the 160-dB isopleth (where there are data illustrating notable avoidance responses (Richardson *et al.*, 1995)) is considered behavioral harassment. Therefore, it is inappropriate to suggest that some portion of animals that would otherwise be expected to be exposed within the 160-dB isopleth be considered *not taken* because they would avoid the area – as the avoidance itself is a form of Level B harassment. Because Shell proposed to quantitatively adjust their estimated level B take numbers in their application, it was necessary for NMFS to further interpret this issue, however, we consider this a clarification rather than a deviation from what was included in the 2012 notice.

Comment 7: NAEC, AWL, and a form letter from private citizens state that Shell's activities would harm more than small numbers of marine mammals or that the impacts will be more than negligible. EIA states that Shell's proposed ice management activities will expose an unacceptable number of belugas to harassing levels of noise.

Response: NMFS is required to authorize the take of "small numbers" of a species or stock if the taking by harassment will have a negligible impact on the affected species or stocks and will not have an unmitigable adverse impact on the availability of such species or stock for taking for subsistence purposes. See 16 U.S.C. 1371(a)(5)(D). In determining whether to authorize "small numbers" of a species or stock, NMFS determines that the taking will be small

relative to the estimated population size. With the exception of the ringed seal, less than 5.1% of each species stock or population would be taken by Level B harassment incidental to Shell's activities. The modeling results indicate that 8.4% of the ringed seal population would be taken by Level B harassment. For bowhead, gray, and beluga whales, NMFS further consulted with the National Marine Mammal Laboratory and NMFS Alaska Regional Office and revised the estimated takes using a more robust dataset. The results show that except for beluga whale, the estimated takes of bowhead and gray whales are further reduced to 5.5% and 4.4% of their population from the previous estimates of 13.2% and 13.5%, respectively. For beluga whales, the revised take estimate is 1,662 instead of 974 animals. Further breakdown of stock specific takes provide a result of 344 animals (9.3%) of the East Chukchi Sea stock and 1,318 animals (3.4%) of the Beaufort Sea stock. A detailed description of the take calculation on beluga whales is provided in section "*Estimated Takes*" below. We also note the following important factors:

(1) In all of the modeling submitted by Shell, a 1.3 dB safety factor was added to the source level of each continuous sound source prior to sound propagation modeling of areas exposed to Level B thresholds, which make the effective zones for take calculation larger than they likely will be;

(2) Shell applied binning of similar activity scenarios into a representative scenario, each of which reflected the largest exposed area for a related group of activities;

(3) Except for bowhead whale, the take estimates assume 100% daily turnover of population for all other species, which likely overestimates the number of different individuals that would be exposed, especially during non-migratory periods. Even for the bowhead whale, which is slow moving and often observed stopping to feed during its fall migration, a 50% daily

(i.e., 48-hour) turnover of population was included in take calculation; and

(4) Density estimates for some cetaceans include nearshore areas, where more individuals would be expected to occur than in the offshore Burger Prospect area (e.g., gray whales).

Based on this analysis, NMFS concluded that takes resulting from Shell's activities will constitute small numbers of marine mammals of the affected species or stocks.

In making a negligible impact determination, NMFS considers a variety of factors, including: (1) the number of anticipated mortalities; (2) the number and nature of anticipated injuries; (3) the number, nature, intensity, and duration of Level B harassment; and (4) the context in which the takes occur. NMFS has determined that Shell's activities will not result in injury or mortality of marine mammals. The proposed IHA notice analyzed the number, nature, intensity, and duration of the Level B harassment that may occur and the context in which it may occur. That analysis led us to make a negligible impact finding.

Comment 8: NAEC states that the take thresholds NMFS uses are outdated.

Response: NMFS does not agree with NAEC's statement. NMFS uses 160 dB (rms) as the exposure level for estimating Level B harassment takes for impulse noise source and 120 dB (rms) for non-impulse noise source. These thresholds were established based on measured avoidance responses observed in whales in the wild. Specifically, the 160 dB threshold was derived from data for mother-calf pairs of migrating gray whales (Malme *et al.*, 1983, 1984) and bowhead whales (Richardson *et al.*, 1985, 1986) responding to seismic airguns (e.g., impulsive sound source). While the 120 dB threshold is a more conservative threshold for non-impulse sources (e.g., drilling) given that these sources have longer duration than impulsive noises and thus most likely longer than the integration time needed for acoustic detection by an animal.

We acknowledge there is more recent information bearing on behavioral reactions to seismic airguns, but those data only illustrate how complex and context-dependent the relationship is between the two. See 75 FR 49710, 49716 (August 13, 2010) (IHA for Shell seismic survey in Alaska; response to comment 9). Accordingly, it is not a matter of merely replacing the existing threshold with a new one. NOAA is working to develop relatively more sophisticated draft guidelines for determining acoustic impacts, including information for determining Level B harassment thresholds. Due to the complexity of the task, the draft guidelines will undergo a rigorous review that includes internal agency review, public notice and comment, and external peer review before any final product is published. In the meantime, and taking into consideration the facts and available science, NMFS determined it is reasonable to use the 160 dB and 120 dB thresholds for estimating takes of marine mammals in the Chukchi Sea by Level B harassment. However, we discuss the science on this issue qualitatively in our analysis of potential effects to marine mammals.

Comment 9: EIA states that Shell’s application (1) relies on outdated beluga population data, (2) conflates resident and migratory populations, and (3) utilizes faulty beluga survey methods.

Response: NMFS does not agree with EIA’s statement. First, the beluga whale densities used to estimate potential exposure were calculated from aerial survey data collected by the National Marine Mammal Laboratory (NMML) from July through October of 2008 – 2014. These are the best scientific information available for the impact analysis. Second, there is no “resident” population of beluga whale in the Chukchi Sea as stated by the EIA’s comment. When analyzing potential impacts to beluga whales that could result from Shell’s proposed

exploration drilling activity, we reviewed the available information on stock structure, migratory behavior, and density of the beluga whale Eastern Chukchi Sea Stock and the Beaufort Sea Stock in the Chukchi Sea and made judgments based on that information.

Comment 10: EIA states that Shell's proposed noise mitigation measures fail to take into account the sensitivity of belugas to noise, particularly airgun-related noise. EIA further points out that in Shell's IHA application, belugas are not afforded the greater levels of mitigation that Shell's proposal gives larger whales. For example, upon sighting a beluga, airgun testing is not allowed to resume for 15 minutes, as opposed to the longer 30-minute pause for larger whales.

Response: The apparent sensitivity of belugas to anthropogenic sounds in certain circumstances/locations means that beluga whales are unlikely to occur within the exclusion zone around an operating airgun. Nevertheless, to be consistent with other Arctic open-water activities for which NMFS issues take authorizations, NMFS changed the IHA to require that should a beluga occur within an exclusion zone during airgun operations, the longer 30-minute pause will be required if the animal is not sighted exiting the exclusion zone.

Comment 11: The AWL states that there are large gaps in basic scientific information about both the Chukchi Sea ecosystem and marine mammal responses to noise, and that these gaps prevent adequate analysis of the potential impacts of Shell's proposed activities on wildlife.

Response: As required by NMFS' MMPA implementing regulations at 50 CFR 216.102(a), NMFS has used the best scientific information available in assessing potential impacts and whether the activity will have a negligible impact on the affected marine mammal species or stock. While NMFS agrees that there may be some gaps in information about the Chukchi Sea ecosystem and in our understanding of how some taxa respond to noise in certain

situations, at this point, results from many studies illustrate well the range of likely responses to industrial noise across a wide variety of species (Southall et al 2007; LGL et al 2014). Much of this work on the Arctic species addressed here has been conducted as part of the monitoring requirements of previous MMPA authorizations (e.g., HDR 2013; Beland et al. 2013; Reider et al. 2013). In order to issue the IHA to Shell, NMFS conducted rigorous analyses using the best available scientific information about both the Chukchi Sea ecosystem and marine mammal responses to noise, and we are confident that the content of this extensive dataset supports our findings. These analyses are provided in the **Federal Register** notice (80 FR 11726; March 4, 2015) for the proposed IHA and EA prepared by NMFS.

Industrial activities have been occurring (at varying levels) in the U.S. Arctic Ocean for decades, and the available measurable indicators do not suggest that these activities are having long-term impacts on marine mammal species/stocks in the area. For example, bowhead whales continued to increase in abundance during periods of intense seismic activity in the Chukchi Sea in the 1980s (Raftery *et al.*, 1995; Angliss and Outlaw, 2007), even without implementation of current mitigation requirements. This increase has been observed to continue to date (Givens et al. 2013). Additionally, industry has been collecting data and conducting monitoring in the region for many years and will continue to do so under this IHA. Therefore, NMFS' negligible impact finding is supported by the available facts and science.

Comment 12: The AWL states that NMFS uses outdated thresholds for acoustic impact analysis, and that the new criteria will likely increase the estimated number of bowhead whales, other cetaceans, and ice seals that could be disturbed by exploratory activities, and in some cases the increased level of disturbance could be large.

Response: The AWL did not specify in its comment whether it was referring to Level A or Level B harassment thresholds. Nevertheless, NMFS does not agree with AWL's assessment. First, for Level A takes, NMFS' proposed draft guidance for acoustic injury criteria use a different set of metrics than the current criteria, meaning that one cannot simply compare 180 dB to the numbers proposed in the draft acoustic guidance. The proposed criteria have a dual metric of both peak pressure as sound pressure level (SPL) and sound exposure level (SEL), while the current acoustic criteria use root-mean-squared (RMS) as SPL. Additionally, the draft guidance for injury also include taxa-specific filters that must be applied in order to apply the new thresholds, making it even more difficult to compare directly to the current 180-dB threshold.

Second, Shell's proposed exploration drilling will result in Level B harassment takes only, and Level B behavioral harassment thresholds are not addressed in NMFS' draft acoustic threshold guidance. As indicated elsewhere in this **Federal Register** Notice, NMFS is working to develop guidance on updated behavioral take thresholds but NMFS believes the current thresholds are still appropriate. See response to Comment 8.

Comment 13: AWL states that NMFS' uniform marine mammal harassment thresholds do not consider documented reactions of specific species in the Arctic to much lower received levels. The letter notes reactions of bowhead and gray whales to certain activities emitting impulse sounds below 160 dB and of beluga and bowhead whales and harbor porpoise reacting to other sound sources below 120 dB.

Response: For non-impulse sounds, such as those produced by drilling operations and during icebreaking activities, NMFS uses a received level of 120-dB (rms) to indicate the onset of Level B harassment. For impulsive sounds, such as those produced by the airgun array during

the ZVSP surveys, NMFS uses a received level of 160-dB (rms) to indicate the onset of Level B harassment. Therefore, while a level of 160-dB was used to estimate take for a portion of the operations that will only occur for a total of 10-14 hours for each survey, depending on how many wells are drilled, during the entire 4-month open-water season, a threshold of 120-dB was used to estimate potential takes for all species from the drilling operations and ice management/icebreaking activities.

While some published articles indicate that certain marine mammal species may avoid seismic airguns (an impulsive sound source) at levels below 160 dB, when predicting take estimates for incidental take authorizations NMFS does not consider that these exposures rise to the level of a take. While studies, such as Miller *et al.* (1999), have indicated that some bowhead whales may have started to deflect from their migratory path 21.7 mi (35 km) from the seismic source vessel, it should be pointed out that these minor course changes occurred during migration and have not been seen at other times of the year and during other activities. To show the contextual nature of this minor behavioral modification, recent monitoring studies of Canadian seismic operations indicate that feeding, non-migratory bowhead whales do not move away from a noise source at a sound pressure level (SPL) of 160 dB. For predictive purposes, NMFS therefore continues to estimate takes from impulse noises such as seismic using the 160 dB (re 1 μ Pa) threshold.

According to experts on marine mammal behavior, whether a particular stressor could potentially disrupt behavioral patterns of migration, breathing, nursing, breeding, feeding, or sheltering, etc., of a marine mammal, i.e., whether it would result in a take is complex and context specific, and it depends on several variables in addition to the received level of the sound

by the animals. These additional variables include: other source characteristics (such as frequency range, duty cycle, continuous vs. impulse vs. intermittent sounds, duration, moving vs. stationary sources, etc.); specific species, populations, and/or stocks; prior experience of the animals (naive 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). The 120-dB and 160-dB acoustic criteria are generalized thresholds based on the available data that are intended to assist in a reasonably accurate assessment of take while acknowledging that sometimes animals will respond at received levels below those levels and sometimes they will not respond in a manner considered a take at received levels above them.

Comment 14: The AWL disagree with NMFS assessment that “few seals are expected to occur in the proposed project area” and that “Shell’s proposed activities would occur at a time of year when the ice seal species found in the region are not molting, breeding or pupping.” The AWL states that these statements are not supported. AWL states that Shell’s proposed ice management and ice-breaking activities have the potential to disrupt essential ringed seal molting activities in July in a large region surrounding the drilling site, which could have harmful consequences for ringed seal survival.

Response: The breeding and pupping season for Arctic ringed seal populations occurs from late March to mid-May, well before the proposed July 1 start date and after the conclusion of operations at the end of October (Kelly *et al.* 2010). Although molting in some areas of the Arctic can extend into July, the molting period for ringed seals in the Chukchi Sea is primarily in May and June. This is evidenced by when the National Marine Mammal Laboratory conducted

aerial surveys for ringed and bearded seals in 1999 and 2000, the surveys occurred in late May and early June at the peak of the molting/basking period (Bengtson *et al.* 2005). Therefore, ice scouting and management activities in July and August, should they be necessary, will not occur during the period when most molting occurs. In addition to the fact that these activities are not expected to overlap with molting times, it is important to note that a large percentage of the anticipated takes will occur as a result of exposures that only just exceed the harassment threshold (e.g., about 67% of the takes would be as a result of exposures between 120 and 126 dB), suggesting relatively minor and shorter term impacts that would have little to no likelihood of affecting an individual's fitness. Additionally, the estimated takes represent instances of take and do not account for the fact that the same individuals may be taken on more than one day, so the numbers of takes are an overestimate of individuals.

Comment 15: The AWL states that ice management and ice-breaking activities, vessel traffic, and noise disturbance in September and October have the potential to displace large numbers of ringed seals and prevent them from occupying wintering areas and breeding areas in the offshore pack ice, with potential harm to survival.

Response: NMFS considered the potential impacts of Shell's ice management efforts to ringed seals resting on pack ice in the Notice of Proposed IHA (80 FR 11726; March 4, 2015) in the section regarding anticipated effects on marine mammal habitat. NMFS noted that use of the icebreakers would occur outside of the ringed seal breeding and pupping seasons in the Chukchi Sea, and those ringed seal activities occur more commonly on landfast ice, which will not be affected by Shell's activity. Limited ice breaking might be needed to assist the fleet in accessing/exiting the project area if large amounts of ice pose a navigational hazard. Ice seals

have variable responses to ice management activity. Alliston (1980, 1981) reported icebreaking activities did not adversely affect ringed seal abundance in the Northwest Territories and Labrador. Brueggeman *et al.* (1992) reported ringed seals and bearded seals diving into the water when an icebreaker was 0.58 mi (0.93 km) away. However, Kanik *et al.* (1980) reported that ringed seals remained on sea ice when an icebreaker was 0.62-1.24 mi (1-2 km) away.

The drill site is expected to be mostly ice-free during July, August, and September, and the need for ice management should be infrequent. The presence of an icebreaker is primarily a safety precaution to protect the drill ship from damage. Ice seals could be on isolated floes that may need to be managed for safety. Any ice seals on floes approaching the drill ship may be disturbed by ice management activities. Ringed seals on an ice floe are anticipated to enter the water before the icebreaker contacts the ice, remain in the water as the ice moves past the drill ship, and could reoccupy ice after it has moved safely past the drill ship. As was discussed in the proposed IHA notice, NMFS determined that this activity and these reactions would result in Level B harassment.

In addition, ice formation in October could begin to support haul-out of seals; however, wind and currents continually move and reshape the sea ice throughout the late-fall and early winter period. This movement of the pack ice continually opens new leads and breathing holes while closing old ones. Because the offshore pack ice continues to move and change throughout the winter and spring, breathing holes established in October, as described in shorefast ice locations, are unlikely to persist through the winter. Any disruption of newly forming sea ice in October by project vessels is not likely to cause any greater disturbance to the pack ice environment than will occur through natural processes during the remainder of the ice-covered

period.

Mitigation, Monitoring and Reporting

Comment 16: The Commission notes that Shell would be required to monitor for marine mammals for 30 minutes before and continuously during airgun operations, but no post-activity monitoring. The Commission states that post-activity monitoring is needed to ensure that marine mammals have not been taken in unexpected or unauthorized ways or in unanticipated numbers. The Commission further states that some types of taking (e.g., taking by death or serious injury) may not be observed until after the activity has ceased. Accordingly, the Commission recommends that NMFS require Shell to monitor for marine mammals for 30 minutes before airgun operations begin, while those activities are being conducted, and for 30 minutes after those operations have ceased.

Response: NMFS agrees with the Commission's recommendation and revised the proposed IHA to require post-activity marine mammal monitoring for 30 minutes after Shell ceases activities.

Comment 17: The Commission recommends that NMFS incorporate the peer review panel's recommendations into the IHA if issued.

Response: NMFS conducted a peer review process to evaluate Shell's monitoring plan in early March 2015 in Anchorage, AK. The peer review panel submitted its report to NMFS in early April and provided recommendations to Shell. The panel's major recommendation was for Shell to modify the configuration of its passive acoustic arrays to evaluate the potential for spatial displacement of marine mammals. The panel also requested that the 90-day monitoring report include sightability curves for each species observed in the study area, and report concurrent

collection of spatially overlapped visual and acoustic data to allow for a more detailed description of approximate acoustic detection ranges for the different species sighted and acoustically detected.

In addition, though not requested, the peer review panel also provided additional mitigation measures for bowhead whales or other large whale cow/calf pairs and aggregations, and during low visibility conditions; limiting the duration of mitigation gun to 30 minutes during repositioning; and turning off engines when vessels are stationary.

NMFS discussed with Shell the peer review panel report and went through a list of recommendations. As a result, Shell agrees to modify the deployment configuration of its passive acoustic monitoring to allow for evaluation of potential for spatial displacement of marine mammals. Shell also agreed to provide sightability curves and overlaying visual and acoustic detections in its 90-day report.

Regarding the mitigation measures recommended by the panel, Shell advised, and we agree, that the measures would not be practicable. For example, the VSP is planned to be conducted for just 10 – 14 hours total at different sediment depths at each site; a shutdown for cow/calf pairs and aggregation of bowhead whales and other large whales and during low visibility conditions would require Shell to restart the VSP, thus extending the duration of the VSP. In addition, the panel's recommended mitigation measures for turning off vessel engines while stationary would pose safety concerns. Therefore, these additional measures were not included in the IHA.

A detailed discussion on the peer review process and recommendations is provided in "*Monitoring Plan Peer Review*" section below.

Comment 18: The NSB requests NMFS ensure that sufficient monitoring and mitigation requirements be implemented, and their effectiveness verified, to protect subsistence species, habitat and subsistence hunters. In addition, the NSB requests NMFS ensure that appropriate acoustic and visual monitoring be required.

Response: Under the MMPA, NMFS must determine the taking from the specified activity will have a negligible impact on the species or stock(s) and will not have an unmitigable adverse impact on the availability of the species or stock(s) for taking for subsistence uses (where relevant). In addition, NMFS is required to prescribe the permissible methods of taking and other means of effecting the least practicable impact on the species or stock and their habitat and on the availability of the species or stock for taking for subsistence uses, as well as requirements pertaining to the monitoring and reporting of such takings.

Shell has worked with NMFS, as well as the affected subsistence communities, for multiple years on the continued development of its 4MP. The iterative evolution and review of the 4MP and its results indicates successful implementation by Shell, supports NMFS' impact analyses for this activity (i.e., from the information gathered, impacts are within the scope and extent of those previously estimated) and, further, has added meaningfully to our understanding of the impacts of industrial activities on marine mammals. NMFS has conducted its own rigorous review and analysis of Shell's 4MP, and also had Shell's monitoring plan peer-reviewed by an independent peer-review panel (see below). Furthermore, the effectiveness of these monitoring and mitigation measures were evaluated by NMFS from Shell's 2012 monitoring reports, and deemed to be effective to protect subsistence species, habitat, and subsistence hunters.

These processes led NMFS to conclude that sufficient monitoring and mitigation requirements are prescribed in the IHA issued to Shell to protect subsistence species, habitat, and subsistence hunters. In addition, the IHA contains appropriate acoustic and visual monitoring requirements.

Comment 19: Shell requests clarification on PSO monitoring requirement in the proposed IHA to reflect the 4MP to read:

“Utilize two, NMFS-approved vessel-based Protected Species Observers (PSOs) (except during meal times and restroom breaks, when at least one PSO will be on watch) aboard the drilling units to visually watch for and monitor marine mammals near the drilling units or support vessel during active drilling or airgun operations...day or night. At least one PSO will be aboard each support vessel to conduct watch.”

Response: NMFS made the modification to clarify the PSO monitoring requirements and updated the language in the final IHA based on Shell’s request.

Comment 20: Regarding the requirement of making ZVSP sound source verification (SSV) measurements available to NMFS in 120 hours, Shell is concerned that this proposed requirement poses considerable safety issues and operations challenges. Shell stated that some of the recorders required to measure sound threshold radii of the ZVSP airgun array must be moored to the seafloor within the anchor pattern of the drilling unit. Recovery of these recorders while the drilling unit remains anchored will be unsafe. Grappling, the most reliable method of recovery, or recovery by acoustic release of the recorders, introduce risks to the crew of the drilling unit and the recovery vessel. These risks include entanglement of grappling lines with anchor lines, and disruption or disablement of critical communications equipment from acoustic

interference. In addition, Shell states that it would conduct at most only one more ZVSP survey following measurement of the ZVSP airgun array, and the ZVSP survey is only 10-14 hours in duration.

Response: After further review of Shell's proposed specific activities and discussion with Shell, NMFS agrees with Shell's concern and removed the condition of requiring ZVSP SSV results 120 hours after the measurement. Instead, NMFS requires that ZVSP SSV results be made available in the 90-day monitoring report. NMFS further recognizes that the ZVSP acoustic footprint proposed by Shell for 2015 was modeled using JASCO's Marine Operations Noise Model, which is a reliable computation model for underwater acoustic propagation assessment. These model results were maximized over all water depths to identify the most protective 95th percentile distances to Level A thresholds, and then multiplied by 1.5 as an additional safeguard to ensure sufficient establishment of ZVSP exclusion zones for monitoring and mitigation. For these reasons, NMFS considers the modeled pre-season Level A exclusion zones adequate to protect marine mammals from injury.

Comment 21: Shell requests NMFS remove the SSV reporting condition in the proposed IHA, which requires that:

“Preliminary vessel characterization measurements will be reported in a field report to be delivered 120 hours after the recorders are retrieved and the data downloaded.”

Shell states that it did not intend to include this requirement in the IHA application. Shell argues that one of its 2015 sound source characterization (SSC) of its exploration drilling program is a comprehensive analysis of underwater sound across the entire operational season, which necessitates that recorders remain deployed as long as is practicable. Further, Shell states

that there is no connection between measurements of vessel sounds and mitigation, and Shell does not believe there is anything to be gained by reporting preliminary vessel measurements prior to a more comprehensive analysis of the data. Finally, Shell states that it will present detailed results of drilling and vessel SSCs in the 90-day report, as stated in the proposed IHA.

Response: The proposed SSC reporting measurements was initially proposed by Shell in its 4MP. However, NMFS agrees with Shell's comment that leaving these recorders deployed for the entire project duration will collect valuable acoustic data on underwater noise across the entire operational season. NMFS made revision to the SSC condition in the IHA issued to Shell that requires Shell to present detailed results of drilling and vessel SSCs in its 90-day report.

Comment 22: Shell points out that the following two proposed IHA mitigation measures regarding vessel movement seem to be contradictory:

“Avoid multiple changes in direction and speed when within 900 feet (300 yards/274 m) of whales.” (7(b) of the proposed IHA)

“When weather conditions require, such as when visibility drops, support vessels must reduce speed and change direction, as necessary (and as operationally practicable), to avoid the likelihood of injury to whales.” (7(c) of the proposed IHA)

Shell states that the first proposed requirement is sufficient to meet mitigation objectives and avoid injury to whales, and requests NMFS to remove the second proposed requirement.

Response: NMFS does not agree with Shell's assessment. The first proposed requirement (7(b) of the proposed IHA) would be in effect when a whale is sighted within 900 feet (300 yards/274 m) of a moving vessel and refers to avoiding *multiple* changes in direction in speed. In addition, 7(a) of the proposed IHA further requires all vessels to reduce speed to a

maximum of 5 knots when a whale is detected at this distance. Item 7(c) is a general requirement for vessel transiting during poor visibility. Under this condition, vessels are required to travel at a reduced speed even no whale is in sight. NMFS believes that this condition is necessary to compensate for reduced whale detectability during poor visibility, to avoid ship strike. The IHA issued to Shell includes all these requirements.

Comment 23: Shell points out that an important ZVSP mitigation measure was omitted from the proposed IHA that has been included in previous Arctic IHAs for marine seismic surveys. Shell recommends that the following mitigation measure be included in the IHA:

“If, for any reason, electrical power to the airgun array has been discontinued for a period of 10 minutes or more, ramp-up procedures shall be implemented. Only if the PSO watch has been suspended, a 30-minute clearance of the exclusion zone is required prior to commencing ramp-up. Discontinuation of airgun activity for less than 10 minutes does not require a ramp-up.”

Response: NMFS agrees and included this measure in the final IHA issued to Shell.

Comment 24: Shell states that the following language regarding PSOs is confusing:

“The Holder of this Authorization shall designate biologically-trained PSOs to be aboard the drilling units and all transiting support vessels.”

Shell states that the confusion lies between an academically degreed biologist and non-degreed biologist, both of which when properly trained can perform the duties of a PSO. Shell suggests we change the language to:

“The Holder of this Authorization shall designate trained PSOs aboard drilling units, icebreakers, and anchor handlers. All support vessels will be staffed with at least one trained

PSO.”

Response: NMFS agrees and revised the PSO language per Shell’s recommendation. “Trained” requires that PSOs attend the training session described in this **Federal Register** Notice shortly before the start of the 2015 drilling season.

Comment 25: The AWL states that the mitigation measures NMFS has proposed are inadequate for protecting marine mammals from adverse impacts. The AWL further states that NMFS has failed to analyze the full range of available mitigation measures, especially with regard to time/area restriction. The AWL specifically mentioned Hanna Shoal and migration corridors.

Response: In order to issue an incidental take authorization (ITA) under the MMPA, NMFS must, where applicable, set forth the permissible methods of taking pursuant to such activity, and other means of effecting the least practicable impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such species or stock for taking for certain subsistence uses (where relevant).

Concerning time/area closure, the IHA issued to Shell contains specific spatio-temporal requirements that Shell must follow to minimize or avoid impacts to subsistence harvest. Under the IHA issued to Shell, Shell is not permitted to enter the Chukchi Sea prior to July 1, 2015, which helps minimize impacts to the beluga hunt. In addition, Shell must finish drilling activities by October 31, 2015, which helps ensure that the drill ship and supporting vessels depart past Saint Lawrence Island before the Gambell bowhead whale harvest begins, thus minimizing potential impacts.

Regarding Hanna Shoal, we reviewed the literature and determined that although it has biological significance for walrus, a U.S. Fish and Wildlife species, there are no species under NMFS' jurisdiction for which Hanna Shoal has particular biological importance. AWL did not mention other specific time/area closures.

One new publication compiles cetacean behavioral and distributional information to identify biologically important areas that are specifically used for feeding, migrating, or reproductive uses, or where small and resident populations are limited. Part of the northeastern Chukchi Sea is recognized as a bowhead whale reproductive biologically important area (BIA) from observation of calves there in October (Clarke *et al* 2015). Additionally, bowhead whales have also been observed feeding in this area during summer and fall; however, it is not recognized as a feeding BIA due to relatively fewer feeding observations (Clarke *et al.* 2015). Additionally, in the northeastern Chukchi Sea, aerial survey sightings (Clarke & Ferguson, 2010; Clarke *et al.*, 2011, 2012, 2013), satellite telemetry (Quakenbush *et al.*, 2010a, 2010b, 2013), and passive acoustic data (Hannay *et al.*, 2013) indicate that the migration route in September and October is geographically broad (from the coast to > 400 km offshore); therefore, the northeastern Chukchi Sea does not meet the criteria for a migratory corridor BIA (Clarke *et al.* 2015).

Portions of these areas utilized by bowhead whales for calving, feeding, and migration would be ensonified by Shell's proposed exploration drilling operation, although the size of the ensonified area will vary depending on the particular activity (e.g., drilling, anchor handling, ZSVP, etc.). NMFS has considered time/area-based mitigation to reduce potential impacts to bowhead whale reproduction, feeding, and migration in regard to its BIAs. The only BIA that

overlaps with Shell's exploration drilling is the bowhead reproduction BIA in the northeast Chukchi Sea in October and NMFS has already considered and discussed the potential for some small amount of behavioral harassment of mothers and calves, should they pass nearby the comparatively small area that may be ensonified by Shell's activities. Since Shell would only be conducting exploration drilling during a short four-month period, imposing a time/area limit of one month to avoid this time when calves might pass would mean a 25% reduction of Shell's work window, and would only likely avoid a small amount of harassment of mother/calf pairs. On balance, when the limited benefits of the measure are compared against the negative impacts to Shell's activities (either not completing the needed activities, or needing to extend them into additional seasons), NMFS considers it impracticable for the company to implement.

NMFS' analysis of the potential impacts of Shell's proposed exploration drilling on marine mammals species/stocks and subsistence activities indicates that Shell's activities would be limited to a small area in the Chukchi Sea during a four-month period in the 2015 open-water season. This is relatively small in both spatial and temporal scales when considering the total area of the Chukchi used by the affected marine mammal species or stocks for various activities, including migration.

NEPA Analysis

Comment 26: The AWL states that NMFS must address cumulative, long-term effects of increased noise and other impacts from oil and gas activity properly before further activity is authorized.

Response: Section 101(a)(5)(D) of the MMPA and its implementing regulations require NMFS to consider a request for the taking of marine mammals incidental to *a specified activity*

within a specified geographical region and, assuming certain findings can be made, to authorize the taking of small numbers of marine mammals while engaged in that activity. NMFS has defined “specified activity” in 50 CFR 216.103 as “any activity, other than commercial fishing, that takes place in a specified geographical region and potentially involves the taking of small numbers of marine mammals.”

When making a negligible impact determination for an IHA, NMFS considers the total impact during each 1-year period resulting from the specified activity only and supports its determination by relying on factors such as: (1) the number of anticipated mortalities from the activity; (2) the number and nature of anticipated injuries from the activity; (3) the number, nature, intensity, and duration of Level B harassment resulting from the activity; (4) the context in which the takes occur; (5) the status of the species or stock; (6) environmental features that may significantly increase the potential severity of impacts from the proposed action; (7) effects on habitat that could affect rates of recruitment or survival; and (8) how the mitigation measures are expected to reduce the number or severity of takes or the impacts to habitat. When making its finding that there will be no unmitigable adverse impact on the availability of the affected species or stock for taking for subsistence uses, NMFS analyzes the measures contained in the applicant’s Plan of Cooperation (POC). Additionally, Shell signed the 2012 Conflict Avoidance Agreement (CAA) with the AEWC. NMFS included all necessary measures from both documents in the IHA to ensure no unmitigable adverse impacts to subsistence.

Neither the MMPA nor NMFS’ implementing regulations specify how to consider other activities and their impacts on the same populations when conducting a negligible impact analysis. However, consistent with the 1989 preamble for NMFS’ implementing regulations (54

FR 40338, September 29, 1989), the impacts from other past and ongoing anthropogenic activities are incorporated into the negligible impact analysis via their impacts on the environmental baseline (e.g., as reflected in the density/distribution and status of the species, population size and growth rate, and ambient noise). Additionally, NMFS analyzed cumulative effects in NMFS' EA for the "*Issuance of an Incidental Harassment Authorization for the Take of Marine Mammals by Harassment Incidental to Conducting an Exploration Drilling Program in the U.S. Chukchi Sea*" and other relevant data to inform its MMPA determination here. Pursuant to the National Environmental Policy Act (NEPA), those documents contained a cumulative impacts assessment, as well as an assessment of the impacts of the proposed exploratory drilling program on marine mammals and other protected resources.

NMFS considered the impacts analyses (i.e., direct, indirect, and cumulative) contained in the EA and other relevant NEPA documents cited in our response to comment 27 in reaching its conclusion that any marine mammals exposed to the sounds produced by the drillship, ice management/icebreaking vessels, support vessels and aircraft, and airguns would be disturbed for only a short period of time with no likely consequences for annual rates of recruitment or survival and would not be harmed or killed. Furthermore, the required mitigation and monitoring measures are expected to reduce the likelihood or severity of any impacts to marine mammal species or stocks or their habitats.

Moreover, NMFS gave careful consideration to a number of other issues and sources of information. In particular, NMFS relied upon a number of scientific reports, including the 2014 U.S. Alaska Marine Mammal Stock Assessment Reports (SARs), to support its findings. The SARs contain a description of each marine mammal stock, its geographic range, a minimum

population estimate, current population trends, current and maximum net productivity rates, optimum sustainable population levels and allowable removal levels, and estimates of annual human-caused mortality and serious injury through interactions with commercial fisheries and subsistence harvest data.

After careful consideration of the proposed activities, the context in which Shell's proposed activities would occur, the best available scientific information, and all effects analyses (including cumulative effects), NMFS has determined that the specified activities: (1) would not result in more than the behavioral harassment (i.e., Level B harassment) of small numbers of marine mammal species or stocks; (2) the taking by harassment would have a negligible impact on affected species or stocks; and (3) the taking by harassment would not have an unmitigable adverse impact on the availability of such species or stocks for taking for subsistence uses.

Comment 27: NAEC states there is a lack of programmatic analysis of the effects of oil and gas exploration and development in the Arctic. Oceana claims that a programmatic environmental impact statement is needed to evaluate the environmental impacts of proposed and reasonably foreseeable oil and gas exploration in the Beaufort and Chukchi Seas. Both Oceana and AWL state that NMFS should not rely on an EA to evaluate the impacts of the proposed IHA.

Response: NOAA prepared a Supplemental Draft Environmental Impact Statement on the Effects of Oil and Gas Activities in the Arctic Ocean (DEIS). The DEIS includes a broad range of potential offshore oil and gas activities in the Arctic that could affect marine mammals, other resources, and Alaska Native communities. While this EIS has not been finalized, and further considers a program including a more extensive amount of activity than is currently

occurring, NMFS considers the analyses contained therein in the cumulative impact assessment of the current EA for the activity assessed here.

NMFS prepared an EA in 2012 to consider the effects of our 2012 IHAs for drilling in the Beaufort and Chukchi Seas, pending finalization of that EIS. For this IHA we prepared an EA, under similar reasoning we used in 2012. While the Final EIS is still under development, NMFS conducted a thorough analysis of the affected environment and the environmental consequences from exploratory drilling in the Chukchi Sea in 2015 and prepared an EA specific to Shell's proposed activity. The analysis in that EA warranted a Finding of No Significant Impact for issuance of an IHA to Shell for the incidental taking of marine mammals in the Chukchi Sea in 2015

In addition, BOEM prepared a Supplemental EIS (SEIS), published in February 2015, to analyze its estimate of the highest amount of production that could reasonably result from its Lease Sale 193. Information provided in our joint DEIS and BOEM's SEIS was considered in evaluating Shell's proposed exploration drilling impacts. In short, NOAA has considered the programmatic impacts and cumulative effects of multiple oil and gas exploration activities through multiple documents and analyses, the substance and conclusions (preliminary or final) of which have been considered in the current NEPA analysis for this action.

Comment 28: While applauding NMFS for treating the no action alternative as a true no action alternative in its draft EA, and that for inclusion of two realistic alternatives that include fewer impacts than the preferred alternative, the AWL states that NMFS could explore a wider range of alternatives, including an alternative that requires the closures of particular areas.

Response: In AWL's comments, it suggested Hanna Shoal could be considered for

time/area closure. However, as discussed in Response to Comment 25, Hanna Shoal is not an important habitat for marine mammals under NMFS' jurisdiction, and the IHA contains other spatio-temporal restrictions that bound its effective dates. The alternatives NMFS considered in its draft EA are: (1) Issuance of an authorization with mitigation measures (Preferred Alternative); (2) Issuance of an IHA for a shorter time period with required mitigation, monitoring, and reporting requirements (Alternative 2); (3) Issuance of an IHA to drill one well with required mitigation, monitoring, and reporting requirements (Alternative 3); and (4) No issuance of the request IHA to Shell for its exploration drilling activities (Alternative 4 – the No Action Alternative). Other alternatives considered but rejected from further consideration include: (1) Issuance of an IHA with no required mitigation, monitoring, or reporting measures; and (2) Use of alternative technologies. Since Shell's proposed exploration drilling activities in the 2015 Arctic open-water season in Chukchi Sea occupies a small area and will have a limited noise footprint around its drill platforms and ice management and icebreaking vessels and other support vessels around the drilling vicinity, and further that footprint is not within an area of heightened importance for marine mammals (with the exception to bowhead whale reproduction in October, see *Response to Comment 25* above) or subsistence uses, NMFS does not consider the closure of a particular area would be a meaningful alternative. We also note that Alternative 3, issuance of IHA to drill one well with required mitigation, monitoring, and reporting requirements, considers a spatial limitation on the area Shell would affect.

Comment 29: AWL states that NMFS draft EA does not contain original analysis of cumulative impacts of climate change for this IHA, and that the most recent study cited in reference to climate change analysis is from 2011.

Response: As explained by the Council on Environmental Quality, an EA is a concise document and should not contain long descriptions or detailed data which the agency may have gathered. Rather, it should contain a brief discussion of the need for the proposal, alternatives to the proposal, the environmental impacts of the proposed action and alternatives, and a list of agencies and persons consulted. See NEPA's Forty Most Asked Questions, 46 FR 18026 (March 23, 1981); 40 CFR 1508.9(b). The EA prepared for this action contains a cumulative effects analysis that includes consideration of climate change and incorporates by reference several original studies on climate change (ACIA 2004; Raven et al. 2005; IPCC 2007; Fabry et al. 2009; Mathis 2011). An assessment of the IHA for Shell's drilling activity and its added contribution to cumulative impacts of climate change on the environment was conducted based on these studies. An exhaustive search of the most recent studies did not show that NMFS missed any critical information in conducting the analysis. In its comment, the AWL did not point out any additional new scientific information that NMFS should take into consideration in its climate change analysis. We also note that climate change is considered in BOEM's SEIS for Lease Sale 193 and NMFS' draft EIS for the Arctic.

Impacts on Subsistence

Comment 30: The AEWG states that the analysis in the **Federal Register** of potential impacts to subsistence uses should begin with a discussion of whether the operator has signed the Conflict Avoidance Agreement (CAA) and, if so, what the CAA includes as mitigation measures for the subsistence activities.

Response: NMFS has defined "unmitigable adverse impact" in 50 CFR 216.103 as: "an impact resulting from the specified activity: (1) That is likely to reduce the availability of the

species to a level insufficient for a harvest to meet subsistence needs by: (i) Causing the marine mammals to abandon or avoid hunting areas; (ii) Directly displacing subsistence users; or (iii) Placing physical barriers between the marine mammals and the subsistence hunters; and (2) That cannot be sufficiently mitigated by other measures to increase the availability of marine mammals to allow subsistence needs to be met. The analysis of potential impacts to subsistence uses depends on more information than solely whether the applicant has signed a CAA. Nevertheless, in our analysis, we did consider the CAA negotiation between the Shell and the Native subsistence users. Where measures outlined in the CAA are also necessary to ensure an unmitigable adverse impact to subsistence uses, NMFS includes them as required measures in the IHA. In the **Federal Register** notice for the proposed IHA, NMFS noted that Shell attended the 2012–2014 CAA negotiation meetings in support of exploration drilling, offshore surveys, and future drilling plans. In addition, Shell informed NMFS that it would do the same for the upcoming 2015 exploration drilling program, and Shell has signed the 2015 CAA.

Comment 31: The AEWG notes that the proposed IHA for Shell incorporates mitigation measures from the CAA, including the use of protected species observers (PSOs) and Inupiat Communicators, the Com-Centers and the general communications scheme, sound source verification, monitoring plans, cumulative noise impacts study, and general provisions for avoiding interference with bowhead whales or subsistence whale hunting activities. However, AEWG points out that additional mitigation measures from the CAA should also be included in the IHA, including: Standardized Log Books (CAA Section 204) and Shore-Based Service and Supply Areas (CAA Section 504). The AEWG recommends these measures be included under Section 9 of the IHA.

Response: NMFS considered whether implementing Standardized Log Books and Shore-Based Service and Supply Areas was necessary to reach a finding of no unmitigable adverse impact on availability of marine mammals for taking for subsistence or appropriate for effecting the least practicable impact on the availability of the species or stock for taking for subsistence uses, and in both cases determined they were not. The recommendation of Standardized Log Books requires that industry participants provide the Com-Centers and Marine Mammal Observer / Inupiat Communicators with identical log books to assist in the standardization of record keeping associated with communications procedures. NMFS further clarified with AEWG on this issue and understands that the log books would serve a record-keeping function at times in determining sources of disturbance by the AEWG. The AEWG would like to have a coherent record of activities and communications. The AEWG further states that as non-industry vessel traffic increases (i.e., research, commercial, and marine tourism vessels), the ability to track communications through the Com Centers and along the coast is going to become important.

NMFS has already been requiring Shell and other companies to use standardized format for marine mammal monitoring under the recommendation by peer-review panel. We again require Shell to provide detailed records of all marine mammal sightings and its activities under the IHA. In addition, Shell is required to produce a draft comprehensive report that integrates the studies into a broad based assessment of all industry activities and their impacts, which will be made available to NMFS, AEWG, and NSB for review. Furthermore, Shell is required to communicate with Com Centers for all its activities that could affect subsistence resources. Finally, as Shell already signed a CAA with AEWG, this condition prescribed in the CAA will

serve as a form of agreement between AEWG and Shell on these issues.

Regarding the Shore-Based Service and Supply Areas provision, NMFS reached out to the AEWG for clarification of this recommendation. AEWG states that this simply means that the mitigation measures run both prospect-to-shore and shore-to-prospect. Therefore, NMFS does not believe that this requirement would add additional value to NMFS determination of non-mitigable impact.

Comment 32: The AEWG requests NMFS include a condition requiring Shell to complete exit transit through the Bering Strait to a point south of 59 degrees North latitude no later than November 15, 2015. In addition, the AEWG requests NMFS require that any industry participant vessel that encounters weather or ice that will prevent compliance with the date shall coordinate its transit through the Bering Strait to a point south of 59 degrees North latitude with the appropriate Com-Centers, and that all industry participant vessels shall, weather and ice permitting, transit east of St. Lawrence Island and no closer than 10 miles from the shore of St. Lawrence Island.

Response: Shell signed the 2015 CAA with the AEWG on April 23, 2015. In the signed 2015 CAA, Shell agreed to establish Communication Centers in the Bering Sea communities and will conduct such communications in the manner laid out in the CAA and the IHA. Shell's IHA is valid for drilling operations through October 31. Therefore, demobilization and transit out of the area will begin by that date. Information shared with NMFS from hunters on St. Lawrence Island noted that the fall bowhead whale hunts typically occur the week of Thanksgiving. For example, in 2012, 1 bowhead whale was harvested on November 27 and 1 on November 30 in the community of Savoonga, and 1 bowhead was harvested on November 27 in the community of

Gambell. In 2013, 1 bowhead was harvested on December 4 and 1 on December 6 in Savoonga, and no fall whale harvest in Gambell.

In addition, vessel transit route through the Bering Strait will follow a route well east of St. Lawrence Island, placing vessels more than 60 miles and 90 miles east of the communities of Savoonga and Gambell, respectively. Furthermore, Shell will communicate with all communities via its Com Centers as vessels depart the operating area and transit into the Bering Sea to ensure that vessel transit does not interfere with any hunt.

Comment 34: The NSB states that it has repeatedly asked that industry not enter the Chukchi Sea until after July 15th, which will allow for the completion of the beluga whale hunt in Point Lay. The NSB states that this will help mitigate some of the impacts to the subsistence harvests. The NSB states that it has heard from Shell that they do not anticipate arriving until after this date; yet under the proposed IHA Shell would be permitted to move into the Chukchi Sea beginning on July 1.

Response: Shell requested take coverage beginning July 1 (Shell 2015). Upon receiving NSB's comment, NMFS further verified with Shell its intended project dates for the exploration drilling program during the 2015 Arctic open-water season, and again Shell emphasized that it is critical for Shell to enter Chukchi Sea through Bering Strait on or after July 1. This timeframe for entry has been an annual component of Shell's plans to conduct exploration drilling in the Chukchi Sea since 2009. To address subsistence impact concerns, Shell developed a robust Subsistence Advisor (SA) program within our POC, also adding a Communication Plan for direct communication and real-time avoidance of impacts to subsistence users and marine mammals. This is specifically detailed on page 12-2 of Shell's IHA application. The SA

program and Communication Plan within that program have been in place since 2009 and remain due to the proven capability of avoiding impacts to subsistence harvests regardless of the location or timing of those harvests in the Chukchi and Beaufort Seas. Again in 2015, Shell will have SAs and Community Liaisons in place and Communication Centers (Com Centers) active along the coasts of the Bering and Chukchi Seas, to carry out the POC.

Shell's general marine vessel route is approximately 54 nautical miles offshore of Pt. Lay. Vessels transiting offshore of Point Lay will generally be far outside of areas traditionally used by Pt. Lay residents for beluga whale subsistence hunting. Therefore, Shell's vessels will be positioned well offshore and it is highly unlikely that routine vessel transits will impede subsistence users' access to beluga whales or cause them to divert from their normal migratory route.

Finally, Shell is required implement a number of mitigation measures to minimize any potential adverse impacts on subsistence users. These include the use of Subsistence Advisors, Community Liaison Officers, and Com Centers, which will be established and utilized on a daily basis to coordinate and modify vessel traffic based on current or anticipated subsistence activities. Thus, given the distance of vessel traffic in relation to subsistence hunting activities, and with the implementation of appropriate mitigation measures, NMFS does not believe Shell's entering of the Chukchi Sea prior to July 15 will adversely affect beluga whale harvest in Point Lay.

Comment 35: The NSB requests NMFS require Shell to coordinate with the AEWC and other Alaska Native marine mammal user groups as appropriate, and participate in the well-established and effective Conflict Avoidance Agreement (CAA) process.

Response: Throughout the incidental take authorization processing for the 2015 Arctic open-water industry activities, NMFS has been working with stakeholders including the AEWC and other Alaska Native marine mammal user groups as appropriate to conduct its analysis on the potential impacts of the drilling program on subsistence activities. A peer-review meeting on industry's monitoring plans was held in early March 2015 in Anchorage, and NMFS invited a representative from the AEWC to observe the peer-review process.

Shell signed the 2015 CAA with the AEWC on April 23, 2015. The CAA is a document that is negotiated between and signed by the industry participant and subsistence user groups such as AEWC and the Village Whaling Captains' Associations. NMFS has no role in the development or execution of this agreement. Although the contents of a CAA may inform NMFS' no unmitigable adverse impact determination for marine mammal subsistence impacts, the signing of a CAA is not a requirement. NMFS' MMPA implementing regulations require that for an activity that will take place near a traditional Arctic hunting ground, or may affect the availability of marine mammals for subsistence uses, an applicant for MMPA authorization must either submit a Plan of Cooperation (POC) or information that identifies the measures that have been taken to minimize adverse impacts on subsistence uses. Shell submitted a POC with its IHA application, which was available during the public comment period.

NMFS (or other Federal agencies) has no authority to require agreements between third parties, and NMFS would not be able to enforce the provisions of CAAs because the Federal government is not a party to the agreements. Regarding the CAA signed with the AEWC, NMFS has reviewed that document, as well as Shell's POC. The majority of the conditions are identical between the two documents. NMFS' IHA includes measures from the 2015 CAA between Shell

and the AEWC that we believe are relevant to ensuring no unmitigable adverse impact on the availability of marine mammals for subsistence uses.

Miscellaneous

Comment 36: Shell points out that the 180 dB re 1 μ Pa rms radius for zero-offset vertical seismic profile (ZVSP) should be 1.38 km, not 1.28 km as stated on page 11773 of the **Federal Register** notice for the proposed IHA (80 FR 11726; March 4, 2015).

Response: NMFS recognizes that this is a typographic error and made the correction. This error does not affect the results of the analysis since the analysis was conducted on the correct radius of 1.38 km. NMFS has corrected the error in the IHA issued to Shell.

Comment 37: The NSB requests NMFS require Shell to use the best available technologies and best management practices for both seismic and exploratory drilling, including zero discharge.

Response: Shell's collection of drilling mud and cuttings and certain other waste streams is a voluntary decision on the part of the company for its Beaufort Sea exploratory drilling program. Shell will not be conducting such a program in the Chukchi Sea, a practice that is consistent with both the current Arctic Oil and Gas Exploration General Permit and the draft General Permit being considered by the U.S. Environmental Protection Agency. The discharge of drilling related effluents has been extensively studied in both temperate and Arctic regions (Neff, 2010) and, when employing water based muds, is generally considered to be of slight environmental impact. The removal of muds, cuttings, and other effluent streams from exploration drilling requires additional vessels, which results in additional vessel traffic and related noise (which can in turn increase the potential for vessel-marine mammal interactions and

vessel-related air emissions). Given the concerns raised with respect to the cumulative impacts of vessel traffic in the Arctic, the speculative benefits of waste stream removal do not warrant imposing such a requirement on Shell in the Chukchi Sea. Shell will, however, collect water and other samples in both seas before, during, and after the drilling programs in order to study sediment and water chemistry, the biotic community, deposition, and bioaccumulation. The collection of these samples will repeat evaluations at the localized drill sites that have been conducted as part of the Joint Industry Monitoring Program for several years. NMFS has determined that even without requiring such a measure, Shell's activities will have a negligible impact on marine mammal species or stocks and will not have an unmitigable adverse impact on the availability of marine mammals for taking for subsistence uses.

Comment 38: Several private citizens are concerned about potential oil spill from Shell's exploration drilling program in the Chukchi Sea.

Response: NMFS' Notice of Proposed IHA contained information regarding measures Shell has instituted to reduce the possibility of a major oil spill during its operations, as well as potential impacts on cetaceans and pinnipeds, their habitats, and subsistence activities (80 FR 11726; March 4, 2015). NMFS' EA also contains an analysis of the potential effects of an oil spill on marine mammals, their habitats, and subsistence activities. Much of that analysis is incorporated by reference from other NEPA documents prepared for activities in the region. There is no information regarding potential take from a release of oil because an oil spill is not a component of the "specified activity."

The Bureau of Ocean Energy Management (BOEM) and the Bureau of Safety and Environmental Enforcement (BESS) under the Department of the Interior (DOI) are the agencies

with expertise in assessing risks of an oil spill. In reviewing Shell’s Chukchi Sea Exploration Plan and Regional Oil Spill Response Plan (OSRP), BOEM and BSEE determined that the risk was low and that Shell will implement adequate measures to further minimize the risk. Shell’s OSRP identifies the company’s prevention procedures; estimates the potential discharges and describes the resources and steps that Shell would take to respond in the unlikely event of a spill; and addresses a range of spill volumes, ranging from small operational spills to the worst case discharge calculations required to account for the unlikely event of a blowout. Additionally, in 2012 NOAA’s Office of Response and Restoration reviewed Shell’s OSRP and provided input to DOI requesting changes to the plan before it should be approved. Shell incorporated NOAA’s suggested changes, which included updating the trajectory analysis and the worst case discharge scenario. Based on these revisions, NOAA’s Office of Response and Restoration determined that Shell’s plans to respond to an offshore oil spill in the U.S. Arctic Ocean are satisfactory, as stated in a 2012 memorandum provided to NMFS by the Office of Response and Restoration. Lastly, in the unlikely event of an oil spill, Shell will conduct response activities in accordance with NOAA’s Marine Mammal Oil Spill Response Guidelines

Description of Marine Mammals in the Area of the Specified Activity

The Chukchi Sea supports a diverse assemblage of marine mammals, including: bowhead, gray, beluga, killer, minke, humpback, and fin whales; harbor porpoise; ringed, ribbon, spotted, and bearded seals; narwhals; polar bears (*Ursus maritimus*); and walruses (*Odobenus rosmarus divergens*; see Table 4-1 in Shell’s application). The bowhead, humpback, and fin whales are listed as “endangered” under the Endangered Species Act (ESA) and as depleted under the MMPA. The ringed seal is listed as “threatened” under the ESA. Certain stocks or

populations of gray, beluga, and killer whales and spotted seals are listed as endangered or are proposed for listing under the ESA; however, none of those stocks or populations occur in the proposed activity area. Both the walrus and the polar bear are managed by the U.S. Fish and Wildlife Service (USFWS) and are not considered further in this IHA notice.

Of these species, 12 are expected to occur in the area of Shell's proposed operations. These species are: the bowhead, gray, humpback, minke, fin, killer, and beluga whales; harbor porpoise; and the ringed, spotted, bearded, and ribbon seals. Beluga, bowhead, and gray whales, harbor porpoise, and ringed, bearded, and spotted seals are anticipated to be encountered more than the other marine mammal species mentioned here. The marine mammal species likely to be encountered most widely (in space and time) throughout the period of the proposed drilling program is the ringed seal. Encounters with bowhead and gray whales are expected to be limited to particular seasons, as discussed later in this document. Where available, Shell used density estimates from peer-reviewed literature in the application. In cases where density estimates were not readily available in the peer-reviewed literature, Shell used other methods to derive the estimates. The explanation for those derivations and the actual density estimates are described later in this document (see the "**Estimated Take by Incidental Harassment**" section).

The narwhal occurs in Canadian waters and occasionally in the Alaskan Beaufort Sea and the Chukchi Sea, but it is considered extralimital in U.S. waters and is not expected to be encountered. There are scattered records of narwhal in Alaskan waters, including reports by subsistence hunters, where the species is considered extralimital (Reeves *et al.*, 2002). Due to the rarity of this species in the proposed project area and the remote chance it would be affected by Shell's proposed Chukchi Sea drilling activities, this species is not discussed further in this

IHA notice.

Shell’s application contains information on the status, distribution, seasonal distribution, abundance, and life history of each of the species under NMFS jurisdiction mentioned in this document. NMFS consideration of this application later took into account updated information on bowhead and beluga whale densities. See “**Estimated Take by Incidental Harassment**” section later in this notice. Additional information can also be found in the NMFS Stock Assessment Reports (SAR). The Alaska 2013 SAR is available at:

http://www.nmfs.noaa.gov/pr/sars/pdf/ak2013_final.pdf.

Table 1 lists the 12 marine mammal species or stocks under NMFS jurisdiction with confirmed or possible occurrence in the proposed project area.

Table 1. Marine mammal species and stocks with confirmed or possible occurrence in the proposed exploration drilling area.

Common Name	Scientific Name	Status	Occurrence	Seasonality	Range	Abundance
Odontocetes Beluga whale (Eastern Chukchi Sea stock)	<i>Delphinapterus leucas</i>	-	Common	Mostly spring and fall with some in summer	Russia to Canada	3,710
Beluga whale (Beaufort Sea stock)	<i>Delphinapterus leucas</i>	-	Common	Mostly spring and fall with some in summer	Russia to Canada	39,258
Killer whale	<i>Orcinus orca</i>	-	Occasional/ Extralimital	Mostly summer and early fall	California to Alaska	2,084
Harbor porpoise	<i>Phocoena phocoena</i>	-	Occasional/ Extralimital	Mostly summer and early fall	California to Alaska	48,215
Mysticetes Bowhead whale	<i>Balaena mysticetus</i>	Endangered; Depleted	Common	Mostly spring and fall with some in summer	Russia to Canada	19,534
Gray whale	<i>Eschrichtius robustus</i>	-	Somewhat common	Mostly summer	Mexico to the U.S. Arctic Ocean	19,126
Minke whale	<i>Balaenoptera</i>	-	Rare	Summer	North Pacific	810-1,003

	<i>acutorostrata</i>					
Fin whale (North Pacific stock)	<i>B. physalus</i>	Endangered; Depleted	Rare	Summer	North Pacific	1,652
Humpback whale (Central North Pacific stock)	<i>Megaptera novaeangliae</i>	Endangered; Depleted	Rare	Summer	Central to North Pacific	20,800
Pinnipeds		Candidate				
Bearded seal (Beringia distinct population segment)	<i>Erignathus barbatus</i>		Common	Spring and summer	Bering, Chukchi, and Beaufort Seas	155,000
Ringed seal (Arctic stock)	<i>Phoca hispida</i>	Threatened; Depleted	Common	Year round	Bering, Chukchi, and Beaufort Seas	300,000
Spotted seal	<i>Phoca largha</i>	-	Common	Summer	Japan to U.S. Arctic Ocean	141,479
Ribbon seal	<i>Histiophoca fasciata</i>	Species of concern	Occasional	Summer	Russia to U.S. Arctic Ocean	49,000

Potential Effects of the Specified Activity on Marine Mammals

The primary potential impacts to marine mammals and other marine species are associated with elevated sound levels produced by the exploratory drilling program (i.e. the drillship and the airguns). The proposed IHA contains a full discussion of the potential impacts to marine mammal species in the project area. No changes have been made to that discussion, except a clarification made on marine mammal functional hearing groups, which is discussed in *Response to Comment 4* above. Please refer to the proposed IHA for the full discussion of potential impacts to marine mammal (80 FR 11726, March 4, 2015). NMFS has determined that Shell's exploratory drilling program would only result in Level B behavioral harassment of marine mammals, and will not cause hearing threshold shifts, injury, and/or mortality to marine mammals exposed to noise generated from Shell's activities.

Anticipated Effects on Marine Mammal Habitat

The primary potential impacts to marine mammals and other marine species are associated with elevated sound levels produced by the exploratory drilling program (i.e. the drillship and the airguns). However, other potential impacts are also possible to the surrounding habitat from physical disturbance and an oil spill (should one occur). The proposed IHA contains a full discussion of the potential impacts to marine mammal habitat and prey species in the project area. No changes have been made to that discussion. Please refer to the proposed IHA for the full discussion of potential impacts to marine mammal habitat (80 FR 11726, March 4, 2015). NMFS has determined that Shell's exploratory drilling program is not expected to have any habitat-related effects that could cause significant or long-term consequences for marine mammals or on the food sources that they utilize.

Mitigation

In order to issue an incidental take authorization (ITA) under section 101(a)(5)(D) of the MMPA, NMFS must, where applicable, set forth the permissible methods of taking pursuant to such activity, and other means of effecting the least practicable impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such species or stock for taking for certain subsistence uses (where relevant). This section summarizes the mitigation measures Shell is required to implement under the IHA. In summary, the following changes have been made to the mitigation since the proposed IHA was published: requiring ramp-up procedure if ZVSP airgun has been discontinued for a period of 10 minutes or more, and when utilizing the mitigation airgun for position change, use a reduced duty cycle (approximately 1 shot per 5 minutes).

Vessel Based Marine Mammal Monitoring for Mitigation (and Other Purposes)

The objectives of the vessel based marine mammal monitoring are to ensure that disturbance to marine mammals and subsistence hunts is minimized, that effects on marine mammals are documented, and that data is collected on the occurrence and distribution of marine mammals in the project area.

The marine mammal monitoring will be implemented by a team of protected species observers (PSOs). The PSOs will be biologists and Alaska Native personnel trained as field observers. PSOs will be stationed on both drilling units, ice management vessels, anchor handlers and other drilling support vessels engaged in transit to and between drill sites to monitor for marine mammals. The duties of the PSOs will include: watching for and identifying marine mammals, recording their numbers, recording distances and reactions of marine mammals to exploration drilling activities, initiating mitigation measures when appropriate, and reporting results of the vessel based monitoring program, which will include the estimation of the number of marine mammal “exposures” as defined by the NMFS and stipulated in the IHA.

The vessel based work will provide:

- The basis for initiating real-time mitigation, if necessary, as required by the various permits that Shell receives;
- Information needed to estimate the number of “exposures” of marine mammals to sound levels that may result in harassment, which must be reported to NMFS;
- Data on the occurrence, distribution, and activities of marine mammals in the areas where drilling activity is conducted;
- Information to compare the distances, distributions, behavior, and movements of

marine mammals relative to the drilling unit during times with and without drilling activity occurring;

- A communication channel to coastal communities including whalers; and
- Employment and capacity building for local residents, with one objective being to develop a larger pool of experienced Alaska Native PSOs.

The vessel based monitoring will be operated and administered consistent with monitoring programs conducted during past exploration drilling activities, seismic and shallow hazards surveys, or alternative requirements stipulated in permits issued to Shell. Agreements between Shell and other agencies will also be fully incorporated. PSOs will be provided training through a program approved by the NMFS.

Mitigation Measures during the Exploration Drilling Program

Shell's planned exploration drilling activities incorporate design features and operational procedures aimed at minimizing potential impacts on marine mammals and subsistence hunts.

Some of the mitigation design features include:

- Conducting pre-season acoustic modeling to establish the appropriate exclusion and disturbance zones;
- Vessel based PSO monitoring to implement appropriate mitigation if necessary, and to determine the effects of the drilling program on marine mammals;
- Passive acoustic monitoring of drilling and vessel sounds and marine mammal vocalizations; and
- Aerial surveys with photographic equipment over operations and in coastal and nearshore waters with photographic equipment to help determine the effects of

project activities on marine mammals; and seismic activity mitigation measures during acquisition of the ZVSP surveys.

The potential impacts on marine mammals during drilling activities will be mitigated through the implementation of several vessel based mitigation measures as necessary.

(1) Exclusion and Disturbance Zones

Mitigation for NMFS' incidental take authorizations typically includes "safety radii" or "exclusion zones" for marine mammals around airgun arrays and other impulsive industrial sound sources where received levels are ≥ 180 dB re 1 μ Pa (rms) for cetaceans and ≥ 190 dB re 1 μ Pa (rms) for pinnipeds. These zones are based on a cautionary assumption that sound energy at lower received levels will not injure these animals or impair their hearing abilities, but that higher received levels might have some such effects. Disturbance or behavioral effects to marine mammals from underwater sound may occur from exposure to sound at distances greater than these zones (Richardson *et al.* 1995). The NMFS assumes that marine mammals exposed to pulsed airgun sounds with received levels ≥ 160 dB re 1 μ Pa (rms) or continuous sounds from vessel activities with received levels ≥ 120 dB re 1 μ Pa (rms) have the potential to be disturbed. These sound level thresholds are currently used by NMFS to define acoustic disturbance (harassment) criteria.

(A) Exploration Drilling Activities

The areas exposed to sounds produced by the drilling units *Discoverer* and *Polar Pioneer* were determined by measurements from drilling in 2012 or were modeled by JASCO Applied Sciences. The 2012 measurement of the distance to the 120 dB (rms) threshold for normal drilling activity by the *Discoverer* was 0.93 mi (1.5 km) while the distance of the ≥ 120 dB (rms)

radius during MLC construction was 5.1 mi (8.2 km).

Measured sound levels for the *Polar Pioneer* were not available. Its sound footprint was estimated with JASCO's Marine Operations Noise Model (MONM) using an average source level derived from a number of reported acoustic measurements of comparable semi-submersible drill units, including the Ocean Bounty (Gales, 1982), SEDCO 708 (Greene, 1986), and Ocean General (McCauley, 1998). The model yielded a propagation range of 0.22 mi (0.35 km) for rms sound pressure levels of 120 dB for the *Polar Pioneer* while drilling at the Burger Prospect.

In addition to drilling and MLC construction, numerous activities in support of exploration drilling produce continuous sounds above 120 dB (rms). These activities in direct support of the moored drilling units include ice management, anchor handling, and supply/discharge sampling vessels using DP thrusters. Detailed sound characterizations for each of these activities are presented in the 2012 Comprehensive Report for NMFS' 2012 IHA (LGL *et al.* 2013).

The source levels for exploration drilling and related support activities are not high enough to cause temporary reduction in hearing sensitivity or permanent hearing damage to marine mammals. Consequently, mitigation as described for seismic activities, including ramp ups, power downs, and shut downs, are not required for exploration drilling activities. However, Shell will use PSOs onboard the drilling units, ice management, and anchor handling vessels to monitor marine mammals and their responses to industry activities, in addition to initiating mitigation measures should in-field measurements of the activities indicate conditions that may present a risk of unanticipated impacts on marine mammals.

(B) *ZVSP Surveys*

Two sound sources have been proposed by Shell for the ZVSP surveys. The first is a small airgun array that consists of three 150 in³ (2,458 cu cm³) airguns for a total volume of 450 in³ (7,374 cm³). The second ZVSP sound source consists of two 250 in³ (4,097 cm³) airguns with a total volume of 500 in³ (8,194 cm³). Sound footprints of the ZVSP airgun array configurations were estimated using JASCO Applied Sciences' Marine Operations Noise Model (MONM). The model results were maximized over all water depths between 9.9 and 23 ft (3 and 7 m) to yield sound level isopleths as a function of range and direction from the source. The 450 in³ airgun array at a source depth of 23 ft (7 m) yielded the maximum ranges to the ≥ 190 , ≥ 180 , and ≥ 160 dB (rms) isopleths. The estimated 95th percentile distances to these thresholds were: 190 dB = 558 ft (170 m), 180 dB = 3,018 ft (920 m), and 160 dB = 39,239 ft (11,960 m). These distances were multiplied by 1.5 as a conservative measure, and the resulting radii are shown in Table 2.

PSOs on the drilling units will initially use the radii in Table 2 for monitoring and mitigation purposes during ZVSP surveys. An acoustics contractor will perform direct measurements of the received levels of underwater sound versus distance and direction from the ZVSP array using calibrated hydrophones. The mitigation measures to be implemented will include pre-ramp up watches, ramp ups, power downs and shut downs as described below.

TABLE 2. Estimated distances of the ≥ 190 , 180, and 160, dB (rms) isopleths to be used for mitigation purposes during ZVSP surveys until SSV results are available.

Threshold levels in dB re 1 μ Pa (rms)	Estimated Distance (m)
≥ 190	255
≥ 180	1,380
≥ 160	11,960

(2) Ramp Ups

A ramp up of an airgun array provides a gradual increase in sound levels, and involves a step-wise increase in the number and total volume of airguns firing until the full volume is achieved. The purpose of a ramp up (or “soft start”) is to “warn” cetaceans and pinnipeds in the vicinity of the airguns and to provide time for them to leave the area, thus avoiding any potential injury or impairment of their hearing abilities from higher levels of exposure.

Shell contact NMFS and clarified the operations of ZVSP uses and stated that during the proposed ZVSP surveys, the operator will ramp up the airgun arrays slowly. Full ramp ups (i.e., from a cold start when no airguns have been firing) will begin by firing a single airgun in the array. A full ramp up will not begin until there has been observation of the exclusion zone by PSOs for a minimum of 30 minutes to ensure that no marine mammals are present. The entire exclusion zones must be visible during the 30 minutes leading into to a full ramp up. If the entire exclusion zone is not visible, a ramp up from a cold start cannot begin. If a marine mammal is sighted within the relevant exclusion zone during the 30 minutes prior to ramp up, ramp up will be delayed until the marine mammal is sighted outside of the exclusion zone or is not sighted for at least 15-30 minutes: 15 minutes for small odontocetes and pinnipeds, or 30 minutes for baleen whales and large odontocetes.

In addition, if for any reason, use of the airgun array has been discontinued for a period of 10 minutes or more, ramp-up procedures shall be implemented. Only if the PSO watch has been suspended, a 30-minute clearance of the exclusion zone is required prior to commencing ramp-up. Discontinuation of airgun activity for less than 10 minutes does not require a ramp-up; and

Further, when utilizing the mitigation airgun during position/depth change, use a reduced duty cycle (approximately 1 shot every 5 minutes).

(3) Power Downs and Shut Downs

A power down is the immediate reduction in the number of operating energy sources from all firing to some smaller number. A shut down is the immediate cessation of firing of all energy sources. The arrays will be immediately powered down whenever a marine mammal is sighted approaching close to or within the applicable exclusion zone of the full arrays, but is outside the applicable exclusion zone of the single source. If a marine mammal is sighted within the applicable exclusion zone of the single energy source, the entire array will be shut down (i.e., no sources firing).

After a complete shutdown of the airgun due to detection of a marine mammal in the vicinity, airguns cannot be restarted until the marine mammal is visually sighted leaving the exclusion zone, or is not sighted for at least 15-30 minutes: 15 minutes for small odontocetes and pinnipeds, or 30 minutes for baleen whales and large odontocetes.

(4) Loss of Electrical Power to Airgun Array

If, for any reason, electrical power to the airgun array has been discontinued for a period of 10 minutes or more, ramp-up procedures shall be implemented. If the PSO watch has been suspended, a 30-minute clearance of the exclusion zone is required prior to commencing ramp-up. Discontinuation of airgun activity for less than 10 minutes does not require a ramp-up.

Mitigation Conclusions

NMFS has carefully evaluated the applicant's mitigation measures and considered a range of other measures in the context of ensuring that NMFS prescribes the means of effecting the least practicable impact on the affected marine mammal species and stocks and their habitat. Our evaluation of potential measures included consideration of the following factors in relation to one

another:

- The manner in which, and the degree to which, the successful implementation of the measure is expected to minimize adverse impacts to marine mammals
- The proven or likely efficacy of the specific measure to minimize adverse impacts as planned, and
- The practicability of the measure for applicant implementation.

Any mitigation measure(s) prescribed by NMFS should be able to accomplish, have a reasonable likelihood of accomplishing (based on current science), or contribute to the accomplishment of one or more of the general goals listed below:

1. Avoidance or minimization of injury or death of marine mammals wherever possible (goals 2, 3, and 4 may contribute to this goal).
2. A reduction in the numbers of marine mammals (total number or number at biologically important time or location) exposed to received levels of noises generated from exploration drilling and associated activities, or other activities expected to result in the take of marine mammals (this goal may contribute to 1, above, or to reducing harassment takes only).
3. A reduction in the number of times (total number or number at biologically important time or location) individuals would be exposed to received levels of noises generated from exploration drilling and associated activities, or other activities expected to result in the take of marine mammals (this goal may contribute to 1, above, or to reducing harassment takes only).

4. A reduction in the intensity of exposures (either total number or number at biologically important time or location) to received levels of noises generated from exploration drilling and associated activities, or other activities expected to result in the take of marine mammals (this goal may contribute to a, above, or to reducing the severity of harassment takes only).
5. Avoidance or minimization of adverse effects to marine mammal habitat, paying special attention to the food base, activities that block or limit passage to or from biologically important areas, permanent destruction of habitat, or temporary destruction/disturbance of habitat during a biologically important time.
6. For monitoring directly related to mitigation – an increase in the probability of detecting marine mammals, thus allowing for more effective implementation of the mitigation.

Based on our evaluation of the applicant’s mitigation measures, as well as other measures considered by NMFS, NMFS has determined that the prescribed mitigation measures provide the means of effecting the least practicable impact on marine mammals species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance. Mitigation to effect least practicable impact on the availability of marine mammals for taking for subsistence uses is discussed later in this document (see “*Impact on Availability of Affected Species or Stock for Taking for Subsistence Uses*” section).

Monitoring and Reporting

In order to issue an ITA for an activity, section 101(a)(5)(D) of the MMPA states that NMFS must, where applicable, set forth “requirements pertaining to the monitoring and reporting

of such taking”. The MMPA implementing regulations at 50 CFR 216.104 (a)(13) indicate that requests for ITAs must include the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present in the action area. The change made from the proposed notice for the IHA is that Shell revised the deployment design of its acoustic arrays for passive acoustic monitoring based on recommendations from the peer-review panel. This is discussed in detail in the “*Monitoring Plan Peer Review*” section below.

Monitoring measures prescribed by NMFS should accomplish one or more of the following general goals:

1. An increase in the probability of detecting marine mammals, both within the mitigation zone (thus allowing for more effective implementation of the mitigation) and in general to generate more data to contribute to the analyses mentioned below;
2. An increase in our understanding of how many marine mammals are likely to be exposed to levels of noises generated from exploration drilling and associated activities that we associate with specific adverse effects, such as behavioral harassment, TTS, or PTS;
3. An increase in our understanding of how marine mammals respond to stimuli expected to result in take and how anticipated adverse effects on individuals (in different ways and to varying degrees) may impact the population, species, or stock (specifically through effects on annual rates of recruitment or survival)

through any of the following methods:

- Behavioral observations in the presence of stimuli compared to observations in the absence of stimuli (need to be able to accurately predict received level, distance from source, and other pertinent information);
 - Physiological measurements in the presence of stimuli compared to observations in the absence of stimuli (need to be able to accurately predict received level, distance from source, and other pertinent information);
 - Distribution and/or abundance comparisons in times or areas with concentrated stimuli versus times or areas without stimuli;
4. An increased knowledge of the affected species; and
 5. An increase in our understanding of the effectiveness of certain mitigation and monitoring measures.

NMFS believes that the required measures will contribute towards these goals.

Monitoring Measures

1. Protected Species Observers

Vessel based monitoring for marine mammals will be done by trained PSOs on both drilling units and ice management and anchor handler vessels throughout the exploration drilling activities. The observers will monitor the occurrence and behavior of marine mammals near the drilling units, ice management and anchor handling vessels, during all daylight periods during the exploration drilling operation, and during most periods when exploration drilling is not being

conducted. PSO duties will include watching for and identifying marine mammals; recording their numbers, distances, and reactions to the exploration drilling activities; and documenting exposures to sound levels that may constitute harassment. PSOs also will help ensure that the vessel communicates with the Communications and Call Centers (Com Centers) in Native villages along the Chukchi Sea coast.

(A) Number of Observers

A sufficient number of PSOs will be onboard to meet the following criteria:

- 100 percent monitoring coverage during all periods of exploration drilling operations in daylight;
- Maximum of four consecutive hours on watch per PSO; and
- Maximum of approximately 12 hours on watch per day per PSO

PSO teams will consist of trained Alaska Natives and field biologist observers. An experienced field crew leader will be on every PSO team aboard the drilling units, ice management and anchor handling vessels, and other support vessels during the exploration drilling program. The total number of PSOs aboard may decrease later in the season as the duration of daylight decreases.

(B) Crew Rotation

Shell anticipates that there will be provisions for crew rotation at least every three to six weeks to avoid observer fatigue. During crew rotations detailed notes will be provided to the incoming crew leader. Other communications such as email, fax, and/or phone communication between the current and oncoming crew leaders during each rotation will also occur when necessary. In the event of an unexpected crew change Shell will facilitate such communications

to insure monitoring consistency among shifts.

(C) Observer Qualifications and Training

Crew leaders serving as PSOs will have experience from one or more projects with operators in Alaska or the Canadian Beaufort.

Crew leaders will be highly experienced with previous vessel based marine mammal monitoring projects. Resumes for those individuals will be provided to the NMFS for approval. All PSOs will be trained and familiar with the marine mammals of the area. A PSO handbook, adapted for the specifics of the planned Shell drilling program, will be prepared and distributed beforehand to all PSOs.

PSOs will also complete a two-day training and refresher session on marine mammal monitoring, to be conducted shortly before the anticipated start of the drilling season. The training sessions will be conducted by marine mammalogists with extensive crew leader experience from previous vessel based seismic monitoring programs in the Arctic.

Primary objectives of the training include:

- Review of the 4MP for this project, including any amendments adopted or specified by NMFS in the final IHA or other agreements in which Shell may elect to participate;
- Review of marine mammal sighting, identification, (photographs and videos) and distance estimation methods, including any amendments specified by NMFS in the IHA;
- Review operation of specialized equipment (e.g., reticle binoculars, big eye binoculars, night vision devices, GPS system); and

- Review of data recording and data entry systems, including procedures for recording data on mammal sightings, exploration drilling and monitoring activities, environmental conditions, and entry error control. These procedures will be implemented through use of a customized computer databases and laptop computers.

(D) PSO Handbook

A PSO Handbook will be prepared for Shell's monitoring program. The Handbook will contain maps, illustrations, and photographs as well as copies of important documents and descriptive text and are intended to provide guidance and reference information to trained individuals who will participate as PSOs. The following topics will be covered in the PSO Handbook:

- Summary overview descriptions of the project, marine mammals and underwater sound energy, the 4MP (vessel-based, aerial, acoustic measurements, special studies), the IHA and other regulations/permits/agencies, the Marine Mammal Protection Act;
- Monitoring and mitigation objectives and procedures, including initial exclusion and disturbance zones;
- Responsibilities of staff and crew regarding the 4MP;
- Instructions for staff and crew regarding the 4MP;
- Data recording procedures: codes and coding instructions, common coding mistakes, electronic database; navigational, marine physical, and drilling data recording, field data sheet;

- Use of specialized field equipment (e.g., reticle binoculars, Big-eye binoculars, NVDs, laser rangefinders);
- Reticle binocular distance scale;
- Table of wind speed, Beaufort wind force, and sea state codes;
- Data storage and backup procedures;
- List of species that might be encountered: identification, natural history;
- Safety precautions while onboard;
- Crew and/or personnel discord; conflict resolution among PSOs and crew;
- Drug and alcohol policy and testing;
- Scheduling of cruises and watches;
- Communications;
- List of field gear provided;
- Suggested list of personal items to pack;
- Suggested literature, or literature cited;
- Field reporting requirements and procedures;
- Copies of the IHA will be made available; and
- Areas where vessels need permission to operate such as the Ledyard Bay Critical Habitat Unit (LBCHU).

2. Vessel-Based Monitoring Methodology

The observer(s) will watch for marine mammals from the best available vantage point on the drilling units and support vessels 30 minutes before and during Shell's activities, and for 30 minutes after the activities are ceased. Ideally this vantage point is an elevated stable platform

from which the PSO has an unobstructed 360° view of the water. The observer(s) will scan systematically with the naked eye and 7 x 50 reticle binoculars, supplemented with Big-eye binoculars and night-vision equipment when needed. Personnel on the bridge will assist the marine mammal observer(s) in watching for pinnipeds and cetaceans. New or inexperienced PSOs will be paired with an experienced PSO or experienced field biologist so that the quality of marine mammal observations and data recording is kept consistent.

Information to be recorded by marine mammal observers will include the same types of information that were recorded during previous monitoring projects (e.g., Moulton and Lawson 2002; Reiser *et al.* 2010, 2011; Bisson *et al.* 2013). When a mammal sighting is made, the following information about the sighting will be carefully and accurately recorded:

- Species, group size, age/size/sex categories (if determinable), physical description of features that were observed or determined not to be present in the case of unknown or unidentified animals;
- Behavior when first sighted and after initial sighting;
- Heading (if consistent), bearing and distance from observer;
- Apparent reaction to activities (e.g., none, avoidance, approach, paralleling, etc.), closest point of approach, and behavioral pace;
- Time, location, speed, and activity of the vessel, sea state, ice cover, visibility, and sun glare, on support vessels the distance and bearing to the drilling unit will also be recorded; and
- Positions of other vessel(s) in the vicinity of the observer location.

The vessel's position, speed, water depth, sea state, ice cover, visibility, and sun glare

will also be recorded at the start and end of each observation watch, every 30 minutes during a watch, and whenever there is a change in any of those variables.

Distances to nearby marine mammals will be estimated with binoculars (Fujinon 7x50 binoculars) containing a reticle to measure the vertical angle of the line of sight to the animal relative to the horizon.

An electronic database will be used to record and collate data obtained from visual observations during the vessel-based study. The PSOs will enter the data into the custom data entry program installed on field laptops. The data entry program automates the data entry process and reduces data entry errors and maximizes PSO time spent looking at the water. PSOs also have voice recorders available to them. This is another tool that will allow PSOs to maximize time spent focused on the water.

PSOs will be instructed to identify animals as unknown when appropriate rather than strive to identify an animal when there is significant uncertainty. PSOs should also provide any sightings cues they used and any distinguishable features of the animal even if they are not able to identify the animal and record it as unidentified. Emphasis will also be placed on recording what was not seen, such as dorsal features.

(A) Monitoring At Night and In Poor Visibility

Night-vision equipment “Generation 3” binocular image intensifiers or equivalent units will be available for use when needed. However, past experience with night-vision devices in the Beaufort Sea and elsewhere indicates they are not nearly as effective as visual observation during daylight hours (e.g., Harris *et al.* 1997, 1998; Moulton and Lawson 2002; Hartin *et al.* 2013).

(B) Specialized Field Equipment

Shell will provide the following specialized field equipment for use by the onboard PSOs: reticle binoculars, Big-eye binoculars, GPS unit, laptop computers, night vision binoculars, and possibly digital still and digital video cameras. Big eye binoculars will be mounted and used on key monitoring vessels including the drilling units, ice management vessels and the anchor handler.

(C) Field Data-Recording, Verification, Handling, and Security

The observers on the drilling units and support vessels will record their observations directly into computers using a custom software package. The accuracy of the data entry will be verified in the field by computerized validity checks as the data are entered, and by subsequent manual checking. These procedures will allow initial summaries of data to be prepared during and shortly after the field season, and will facilitate transfer of the data to statistical, graphical or other programs for further processing. Quality control of the data will be facilitated by (1) the start-of-season training session, (2) subsequent supervision by the onboard field crew leader, and (3) ongoing data checks during the field season.

The data will be sent off of the vessel to Anchorage on a daily basis and backed up regularly onto storage devices on the vessel, and stored at separate locations on the vessel. If practicable, hand-written data sheets will be photocopied daily during the field season. Data will be secured further by having data sheets and backup data devices carried back to the Anchorage office during crew rotations.

PSOs will be able to plot sightings in near real-time for their vessel. Significant sightings from key vessels including drilling units, ice management, anchor handlers and aircraft will be relayed between platforms to keep observers aware of animals that may be in or near the area but

may not be visible to the observer at any one time. Emphasis will be placed on relaying sightings with the greatest potential to involve mitigation or reconsideration of a vessel's course (e.g., large group of bowheads).

Observer training will emphasize the use of “comments” for sightings that may be considered unique or not fully captured by standard data codes. In addition to the standard marine mammal sightings forms, a specialized form was developed for recording traditional knowledge and natural history observations. PSOs will be encouraged to use this form to capture observations related to any aspect of the arctic environment and the marine mammals found within it. Examples might include relationships between ice and marine mammal sightings, marine mammal behaviors, comparisons of observations among different years/seasons, etc. Voice recorders will also be available for observers to use during periods when large numbers of animals may be present and it is difficult to capture all of the sightings on written or digital forms. These recorders can also be used to capture traditional knowledge and natural history observations should individuals feel more comfortable using the recorders rather than writing down their comments. Copies of these records will be available to all observers for reference if they wish to prepare a statement about their observations for reporting purposes. If prepared, this statement would be included in the 90-day and final reports documenting the monitoring work.

3. Acoustic Monitoring Plan

Exploration drilling, ZVSP, and vessel noise measurements

Exploration drilling sounds are expected to vary significantly with time due to variations in the level of operations and the different types of equipment used at different times onboard the drilling units. The goals of these measurements are:

- To quantify the absolute sound levels produced by exploration drilling and to monitor their variations with time, distance and direction from the drilling unit;
- To measure the sound levels produced by vessels while operating in direct support of exploration drilling operations. These vessels will include crew change vessels, tugs, ice-management vessels, and spill response vessels not measured in 2012; and
- To measure the sound levels produced by an end-of-hole zero-offset vertical seismic profile (ZVSP) survey using a stationary sound source.

Sound characterization and measurements of all exploration drilling activities will be performed using two sets of six parallel Autonomous Multichannel Acoustic Recorders (AMAR) deployed on the seabed along the distances of 0.5, 1, 2, 4, 8 and 16 mi from each drilling unit. All 12 recording stations will sample at least at 32 kHz, providing calibrated acoustic measurements in the 5 Hz to 16 kHz frequency band. The logarithmic spacing of the recorders is designed to sample the attenuation of drilling unit sounds with distance, and also provide information on potential marine mammal displacement. The autonomous recorders will sample through completion of the first well, to provide a detailed record of sounds emitted from all activities. These recorders will be retrieved and their data analyzed and reported in the project's 90-day report.

The deployment of drilling sound monitoring equipment will occur before, or as soon as possible after the *Discoverer* and the *Polar Pioneer* are on site. Activity logs of exploration drilling operations and nearby vessel activities will be maintained to correlate with these acoustic measurements. All results, including back-propagated source levels for each operation, will be

reported in the 90-day report.

(A) Vessel Sound Characterization

Vessel sound characterizations will be performed using dedicated recorders deployed at sufficient distances from exploration drilling operations so that sound produced by those activities does not interfere. Three AMAR acoustic recorders will be deployed on and perpendicular to a sail track on which all Shell contracted vessels will transit. This geometry is designed to obtain sound level measurements as a function of distance and direction. The fore and aft directions are sampled continuously over longer distances to 3 and 6 miles (5 and 10 km) respectively, while broadside and other directions are sampled as the vessels pass closer to the recorders.

Vessel sound measurements will be processed and reported in a manner similar to that used by Shell and other operators in the Beaufort and Chukchi Seas during seismic survey operations. The measurements will further be analyzed to calculate source levels. Source directivity effects will be examined and reported. The measurements will include sound level data but not source level calculations. All vessel characterization results, including source levels, will be reported in 1/3-octave bands in the project 90-day report.

(B) Zero-Offset Vertical Seismic Profiling Sound Monitoring

Shell may conduct ZVSP at two drill sites in 2015. See the **Federal Register** Notice of proposed IHA for information on this activity.

ZVSP sound verification measurements will be performed using either the AMARs that are deployed for drilling unit sound characterizations, or by JASCO Ocean Bottom Hydrophone (OBH) recorders. The AMARs will not be retrieved until several days after the ZVSP as they are

intended to monitor during retrievals of drilling unit anchors and related support activities.

(C) Acoustic Data Analyses

Exploration drilling sound data will be analyzed to extract a record of the frequency-dependent sound levels as a function of time. These results are useful for correlating measured sound energy events with specific survey operations. The analysis provides absolute sound levels in finite frequency bands that can be tailored to match the highest-sensitivity hearing ranges for species of interest. The analyses will also consider sound level integrated through 1-hour durations (referred to as sound energy equivalent level L_{eq} (1-hour)). Similar graphs for long time periods will be generated as part of the data analysis performed for indicating drilling sound variation with time in selected frequency bands.

(D) Reporting of Results

Acoustic sound level results will be reported in the 90-day and comprehensive reports for this program. The results reported will include:

- Sound source levels for the drilling units and all drilling support vessels;
- Spectrogram and band level versus time plots computed from the continuous recordings obtained from the hydrophone systems;
- Hourly L_{eq} levels at the hydrophone locations; and
- Correlation of exploration drilling source levels with the type of exploration drilling operation being performed. These results will be obtained by observing differences in drilling sound associated with differences in drilling unit activities as indicated in detailed drilling unit logs.

Acoustic “net” array in Chukchi Sea

This section describes acoustic studies that were undertaken from 2006 through 2013 in the Chukchi Sea as part of the Joint Monitoring Program and that will be continued by Shell during exploration drilling activities. The acoustic “net” array used during the 2006–2013 field seasons in the Chukchi Sea was designed to accomplish two main objectives. The first was to collect information on the occurrence and distribution of marine mammals (including beluga whale, bowhead whale, and other species) that may be available to subsistence hunters near villages along the Chukchi Sea coast and to document their relative abundance, habitat use, and migratory patterns. The second objective was to measure the ambient soundscape throughout the eastern Chukchi Sea and to record received levels of sounds from industry and other activities further offshore in the Chukchi Sea.

A net array configuration similar to that deployed in 2007–2013 is again proposed. The basic components of this effort consist of autonomous acoustic recorders deployed widely across the U.S. Chukchi Sea during the open water season and then more limited arrays during the winter season. These calibrated systems sample at 16 kHz with 24-bit resolution, and are capable of recording marine mammal sounds and making anthropogenic noise measurements. The net array configuration will include a regional array of 23 AMAR recorders deployed July–October off the four main transect locations: Cape Lisburne, Point Lay, Wainwright and Barrow. All of these offshore systems will capture sounds associated with exploration drilling, where present, over large distances to help characterize the sound transmission properties in the Chukchi Sea. Six additional summer AMAR recorders will be deployed around the Burger drill sites to monitor directional variations and longer-range propagation of drilling-related sounds. These recorders will also be used to examine marine mammal vocalization patterns in the vicinity of

exploration drilling activities. The regional recorders will be retrieved in early October 2015; acoustic monitoring will continue through the winter with 8 AMAR recorders deployed October 2015– August 2016. The winter recorders will sample at 16 kHz on a 17% duty cycle (40 minutes every 4 hours). The winter recorders deployed in previous years have provided important information about fall and spring migrations of bowhead, beluga, walrus and several seal species.

The Chukchi acoustic net array will produce an extremely large dataset comprising several Terabytes of acoustic data. The analyses of these data require identification of marine mammal vocalizations. Because of the very large amount of data to be processed, the analysis methods will incorporate automated vocalization detection algorithms that have been developed over several years. While the hydrophones used in the net array are not directional, and therefore not capable of accurate localization of detections, the number of vocalizations detected on each of the sensors provides a measure of the relative spatial distribution of some marine mammal species, assuming that vocalization patterns are consistent within a species across the spatial and geographic distribution of the hydrophone array. These results therefore provide information such as timing of migrations and routes of migration for belugas and bowheads.

A second purpose of the Chukchi net array is to monitor the amplitude of exploration drilling sound propagation over a very large area. It is expected that sounds from exploratory drilling activities will be detectable on hydrophone systems within approximately 30 km of the drilling units when ambient sound energy conditions are low. The drilling sound levels at recorder locations will be quantified and reported.

Analysis of all acoustic data will be prioritized to address the primary questions. The

primary data analysis questions are to (a) determine when, where, and what species of animals are acoustically detected on each recorder (b) analyze data as a whole to determine offshore distributions as a function of time, (c) quantify spatial and temporal variability in the ambient sound energy, and (d) measure received levels of exploration drilling survey events and drilling unit activities. The detection data will be used to develop spatial and temporal animal detection distributions. Statistical analyses will be used to test for changes in animal detections and distributions as a function of different variables (e.g., time of day, season, environmental conditions, ambient sound energy, and drilling or vessel sound levels).

4. Chukchi Offshore Aerial Photographic Monitoring Program

Shell has been reticent to conduct manned aerial surveys in the offshore Chukchi Sea because conducting those surveys puts people at risk. There is a strong desire, however, to obtain data on marine mammal distribution in the offshore Chukchi Sea and Shell will conduct a photographic aerial survey that would put fewer people at risk as an alternative to the fully-manned aerial survey. The photographic survey would reduce the number of people on board the aircraft from six persons to two persons (the pilot and copilot) and would serve as a pilot study for future surveys that would use an Unmanned Aerial System (UAS) to capture the imagery.

Aerial photographic surveys have been used to monitor distribution and estimate densities of marine mammals in offshore areas since the mid-1980s, and before that, were used to estimate numbers of animals in large concentration areas. Digital photographs provide many advantages over observations made by people if the imagery has sufficient resolution (Koski *et al.* 2013). With photographs there is constant detectability across the imagery, whereas observations by people decline with distance from the center line of the survey area. Observations at the outer

limits of the transect can decline to 5-10% of the animals present for real-time observations by people during an aerial survey. The distance from the trackline of sightings is more accurately determined from photographs; group size can be more accurately determined; and sizes of animals can be measured, and hence much more accurately determined, in photographs. As a result of the latter capability, the presence or absence of a calf can be more accurately determined from a photograph than by in-the-moment visual observations. Another benefit of photographs over visual observations is that photographs can be reviewed by more than one independent observer allowing quantification of detection, identification and group size biases.

The proposed photographic survey will provide imagery that can be used to evaluate the ability of future studies to use the same image capturing systems in an UAS where people would not be put at risk. Although the two platforms are not the same, the slower airspeed and potentially lower flight altitude of the UAS would mean that the data quality would be better from the UAS. Initial comparisons have been made between data collected by human observers on board both the Chukchi and Beaufort aerial survey aircraft and the digital imagery collected in 2012. Overall, the imagery provided better estimates of the number of large cetaceans and pinnipeds present but fewer sightings were identified to species in the imagery than by PSOs, because the PSOs had sightings in view for a longer period of time and could use behavior to differentiate species. The comparisons indicated that some cetaceans that were not seen by PSOs were detected in the imagery; errors in identification were made by the PSOs during the survey that could be resolved from examination of the imagery; cetaceans seen by PSOs were visible in the imagery; and during periods with large numbers of sightings, the imagery provided much better estimates of numbers of sightings and group size than the PSO data.

Photographic surveys would start as soon as the ice management, anchor handler and drilling units are at or near the first drill site and would continue throughout the drilling period and until the drilling related vessels have left the exploration drilling area. Since the current plans are for vessels to enter the Chukchi Sea on or about 1 July, surveys would be initiated on or about 3 July. This start date differs from past practices of beginning five days prior to initiation of an activity and continuing until five days after cessation of the activity because the presence of vessels with helidecks in the area where overflights will occur is one of the main mitigations that will allow for safe operation of the overflight program this far offshore. The surveys will be based out of Barrow and the same aircraft will conduct the offshore surveys around the drilling units and the coastal saw-tooth pattern. The surveys of offshore areas around the drilling units will take precedence over the sawtooth survey, but if weather does not permit surveying offshore, the nearshore survey will be conducted if weather permits.

The aerial survey grids are designed to maximize coverage of the sound level fields of the drilling units during the different exploratory drilling activities. The survey grids can be modified as necessary based on weather and whether a noisy activity or quiet activity is taking place. The intensive survey design maximizes the effort over the area where sound levels are highest. The outer survey grid covers an elliptical area with a 45 km radius near the center of the ellipse. The spacing of the outer survey lines is 10 km, and the spacing between the intensive and outer lines is 5 km. The expanded survey grid covers a larger survey area, and the design is based on an elliptical area with a 50 km radius centered on the well sties. For both survey designs the main transects will be spaced 10 km apart which will allow even coverage of the survey area during a single flight if weather conditions permit completion of a survey. A random

starting point will be selected for each survey and the evenly spaced lines will be shifted NE or SW along the perimeter of the elliptical survey area based on the start point. The total length of survey lines will be about 1,000 km and the exact length will depend on the location of the randomly selected start point.

Following each survey, the imagery will be downloaded from the memory card to a portable hard drive and then backed up on a second hard drive and stored at accommodations in Barrow until the second hard drive can be transferred to Anchorage. In Anchorage, the imagery will be processed through a computer-assisted analysis program to identify where marine mammal sightings might be located among the many images obtained. A team of trained photo analysts will review the photographs identified as having potential sightings and record the appropriate data on each sighting. If time permits, a second review of some of the images will be conducted while in the field, but the sightings recorded during the second pass will be identified in the database as secondary sightings, so that biases associated with the detection in the imagery can be quantified. If time does not permit that review to be conducted while in the field, the review will be conducted by personnel in the office during or after the field season. A sample of images that are not identified by the computer-assisted analysis program will be examined in detail by the image analysts to determine if the program has missed marine mammal sightings. If the analysis program has missed mammal sightings, these data will be used to develop correction factors to account for these missed sightings among the images that were not examined.

5. Chukchi Sea Coastal Aerial Survey

Nearshore aerial surveys of marine mammals in the Chukchi Sea were conducted over coastal areas to approximately 23 miles (mi) [37 kilometers (km)] offshore in 2006–2008 and in

2010 in support of Shell's summer seismic exploration activities. In 2012 these surveys were flown when it was not possible to fly the photographic transects out over the Burger well site due to weather or rescue craft availability. These surveys provided data on the distribution and abundance of marine mammals in nearshore waters of the Chukchi Sea. Shell plans to conduct these nearshore aerial surveys in the Chukchi Sea as opportunities unfold and surveys will be similar to those conducted during previous years except that no PSOs will be onboard the aircraft. As noted above, the first priority will be to conduct photographic surveys around the offshore exploration drilling activities, but nearshore surveys will be conducted whenever weather does not permit flying offshore. As in past years, surveys in the southern part of the nearshore survey area will depend on the end of the beluga hunt near Point Lay. In past years, Point Lay has requested that aerial surveys not be conducted until after the beluga hunt has ended and so the start of surveys has been delayed until mid-July.

Alaskan Natives from villages along the east coast of the Chukchi Sea hunt marine mammals during the summer and Native communities are concerned that offshore oil and gas exploration activities may negatively impact their ability to harvest marine mammals. Of particular concern are potential impacts on the beluga harvest at Point Lay and on future bowhead harvests at Point Hope, Point Lay, Wainwright and Barrow. Other species of concern in the Chukchi Sea include the gray whale; bearded, ringed, and spotted seals. Gray whale and harbor porpoise are expected to be the most numerous cetacean species encountered during the proposed aerial survey; although harbor porpoise are abundant they are difficult to detect from aircraft because of their small size and brief surfacing. Beluga whales may occur in high numbers early in the season. The ringed seal is likely to be the most abundant pinniped species.

The current aerial survey program will be designed to collect distribution data on cetaceans but will be limited in its ability to collect similar data on pinnipeds and harbor porpoises because they are not reliably detectable during review of the collected images unless a third camera with a 50 mm or similar lens is deployed.

Transects will be flown in a saw-toothed pattern between the shore and 23 mi (37 km) offshore as well as along the coast from Point Barrow to Point Hope. This design will permit completion of the survey in one to two days and will provide representative coverage of the nearshore region. Sawtooth transects were designed by placing transect start/end points every 34 mi (55 km) along the offshore boundary of this 23 mi (37 km) wide nearshore zone, and at midpoints between those points along the coast. The transect line start/end points will be shifted along both the coast and the offshore boundary for each survey based upon a randomized starting location, but overall survey distance will not vary substantially. The coastline transect will simply follow the coastline or barrier islands. As with past surveys of the Chukchi Sea coast, coordination with coastal villages to avoid disturbance of the beluga whale subsistence hunt will be extremely important. “No-fly” zones around coastal villages or other hunting areas established during communications with village representatives will be in place until the end of the hunting season.

Standard aerial survey procedures used in previous marine mammal projects (by Shell as well as by others) will be followed. This will facilitate comparisons and (as appropriate) pooling with other data, and will minimize controversy about the chosen survey procedures. The aircraft will be flown at 110–120 knots ground speed and usually at an altitude of 1,000 ft (305 m). Aerial surveys at an altitude of 1,000 ft. (305 m) do not provide much information about seals

but are suitable for bowhead, beluga, and gray whales. The need for a 1,000+ ft (305+ m) or 1,500+ ft (454+ m) cloud ceiling will limit the dates and times when surveys can be flown. Selection of a higher altitude for surveys would result in a significant reduction in the number of days during which surveys would be possible, impairing the ability of the aerial program to meet its objectives.

The surveyed area will include waters where belugas are usually available to subsistence hunters. If large concentrations of belugas are encountered during the survey, the aircraft will climb to ~10,000 ft (3,050 m) altitude to avoid disturbing the cetaceans. If cetaceans are in offshore areas, the aircraft will climb high enough to include all cetaceans within a single photograph; typically about 3,000 ft (914 m) altitude. When in shallow water, belugas and other marine mammals are more sensitive to aircraft over flights and other forms of disturbance than when they are offshore (see Richardson *et al.* 1995 for a review). They frequently leave shallow estuaries when over flown at altitudes of 2,000–3,000 ft (610-904 m); whereas they rarely react to aircraft at 1,500 ft (457 m) when offshore in deeper water.

Monitoring Plan Peer Review

The MMPA requires that monitoring plans be independently peer reviewed “where the proposed activity may affect the availability of a species or stock for taking for subsistence uses” (16 U.S.C. 1371(a)(5)(D)(ii)(III)). NMFS’ implementing regulations state, “Upon receipt of a complete monitoring plan, and at its discretion, [NMFS] will either submit the plan to members of a peer review panel for review or within 60 days of receipt of the proposed monitoring plan, schedule a workshop to review the plan” (50 CFR 216.108(d)).

NMFS established an independent peer review panel to review Shell’s 4MP for the

proposed exploration drilling in the Chukchi Sea. The panel met in early March 2015, and provided comments and recommendations to NMFS in April 2015. The full panel report can be viewed on the Internet at: <http://www.nmfs.noaa.gov/pr/permits/incidental.htm>.

NMFS provided the panel with Shell's IHA application and monitoring plan and asked the panel to answer the following questions:

1. Will the applicant's stated objectives effectively further the understanding of the impacts of their activities on marine mammals and otherwise accomplish the goals stated above?

If not, how should the objectives be modified to better accomplish the goals above?

2. Can the applicant achieve the stated objectives based on the methods described in the plan?

3. Are there technical modifications to the proposed monitoring techniques and methodologies proposed by the applicant that should be considered to better accomplish their stated objectives?

4. Are there techniques not proposed by the applicant (i.e., additional monitoring techniques or methodologies) that should be considered for inclusion in the applicant's monitoring program to better accomplish their stated objectives?

5. What is the best way for an applicant to present their data and results (formatting, metrics, graphics, etc.) in the required reports that are to be submitted to NMFS (i.e., 90-day report and comprehensive report)?

The peer-review panel report contains recommendations that the panel members felt were applicable to the Shell' monitoring plans. The panel concluded that the proposed exclusion zones, PSO vessel-based and aerial effort described in the 4MP will further the understanding of

the impacts of the activities on marine mammals. However, the panel also pointed out that Shell's passive acoustics monitoring objectives did not include monitoring for negative effects of drilling activities such as spatial displacement. In addition, the panel concluded that the methodology described in the 4MP would only cover the stated objectives during good visibility day-light operations, where visual effort is most efficient. To compensate for these issues, the panel recommended Shell modify the deployment configuration of passive acoustic sensors to allow proper evaluation of evaluating the potential for spatial displacement of marine mammals.

The panel provided two options:

Option A: involves 4 axial deployment lines to independently evaluate effects of each drilling site; and

Option B: involves 3 axial deployment lines but reduces the capacity to tease effects from each drilling site.

In addition, the panel recommended that the aerial survey transect lines be oriented parallel to the acoustic arrays and/or the axis between the two drill sites for compatibility with acoustic data.

Furthermore, the panel also provided comments on reporting measures and requests that the 90-day monitoring report include sightability curves for each species observed in the study area, and to report concurrent collection of spatially overlapped visual and acoustic data to allow for a more detailed description of approximate acoustic detection ranges for the different species sighted and acoustically detected.

NMFS discussed these recommendations with Shell to improve its monitoring and reporting measures. As a result, Shell considered localizing arrays of the types proposed by the

peer review panel when designing its original passive acoustic monitoring plan. That analysis generated predicted detection ranges for marine mammal calls in the presence of support vessel and drilling activity sounds. It was found that detection ranges would be small (often less than 2 km) in the presence of the expected sound levels within a few kilometers of the drill sites. The panel's suggested recorder spacing is 5 km, so the effectiveness of the array would be limited. The layout of recorders close to the drilling sites as originally proposed was designed to focus on quantifying drilling source levels and ZVSP sound levels as a function of distance away from the drill sites.

Even though its localizing abilities might be limited, especially with respect to being able to examine deflections, the approximate geometry of part of the Panel's Option A can be achieved by simply reorienting Shell's drill rig sound characterization arrays. Shell therefore modified the initial layout to approximate the panel's Option A array layout.

For recommendations concerning reporting measures, Shell agrees to provide:

(1) Sightability curves by species or species group in the 90-day report, as appropriate given the data collected, and

(2) Visual and acoustic detection results overlaid in the 90-day report to the extent allowed by data collected in 2015.

Concerning the comment on orienting aerial transect lines parallel to the acoustic arrays and/or the axis between the two drill sites for compatibility with acoustic data, Shell determined that a north-south orientation that would be perpendicular to the generally east-west migration of bowheads may be advantageous to generating statistically robust density estimates. The original northwest-southeast orientation was designed to be consistent with the ASAMM survey lines that

cover the greater region.

Since the Burger aerial survey does not tie-back to the coastline, maintaining consistency with the ASAMM survey lines is less useful than orienting the lines to be perpendicular with the migration of bowheads. Therefore, Shell is considering shifting the orientation of the survey lines to be north-south. However, for safety reasons, further analysis of the overall flight time and duration of time spent on the western edge of the survey area using the north-south survey lines must be completed before the orientation and location of the lines can be finalized. Shell states that it must assess the specifics of flight times, aviation fuel requirements, and distances for which search and rescue (SAR) coverage exists, among other factors before committing to a change in the flight pattern and flight duration. If flight pattern changes as described above meet the Shell safety standards, Shell may be able to alter the flight patterns in time for the 2015 season. Shell will not alter the map of the proposed route map in the 4MP, but would reflect the change in the resulting 90-day report following the season should changes be made to the flight patterns flown. NMFS is satisfied with this explanation and approach to making the recommended change, and did not incorporate the recommendation from the panel regarding flight pattern changes.

Additionally, though not requested, the peer review panel also recommended a number of mitigation measures listed below:

- (1) If a bowhead whale or other large whale has been sighted within 2,000 m of the drilling site during the 5 days prior to the onset of ZVSP operations, airgun activity should be avoided outside good visibility day-light periods.

- (2) Implement power-down or shutdown procedures if a bowhead whale mother/calf pair

or an aggregation of 3 or more bowhead or gray whales is sighted within 2,000 m of the airgun array.

(3) Mitigation gun cannot be used for more than 30 min during repositioning, and then Shell should initiate standard ramp-up procedures prior to the use of the full airgun array.

(4) Vessels maintain quiet when stationary, i.e, vessels be anchored with engines and depth sounder off (as appropriate from a safety point of view), preferably near an acoustic mooring to allow PSOs to scan for marine mammals.

NMFS analyzed these recommendations and worked with Shell to understand the practicability of these mitigation recommendations and concluded that these measures either do not provide added value to the existing mitigation measures already prescribed and/or are impracticable due to costs for the company for the following reasons:

(1) *2,000 meter exclusion zone* – Shell has already incorporated a 50% safety margin into the proposed 1,380 m exclusion zone for ZVSP. Thus, the established safety zone is already conservative. Moreover, PSO monitoring will be more effective over this radius than an unnecessarily larger 2,000 meter radius. The ability to monitor the near-field zone more effectively is an important consideration as the potential for more significant injurious effects has a higher likelihood of occurring close to the source, where sound pressures are highest.

(2) *Power-down or shutdown* – It is impracticable for Shell (or other seismic operators) to shutdown airgun activities during low visibility or night-time conditions. ZSP is a relatively short activity that takes about 10 – 14 hours to complete; however, once it is started, any interruption would require the ZSP to be restarted, which would be impracticable and take more time for the company to complete the work. Furthermore, this would extend the survey duration

longer than needed. In standard practice, NMFS typically requires that no startup of airguns will be allowed if the exclusion zone cannot be visually cleared prior to full array ramp up. Large seismic arrays are allowed to operate at night and during inclement weather when appropriate mitigation measures are in use, e.g., operating after a ramp-up in full visibility, or operating following mitigation gun operation for limited amounts of time following power downs or brief shutdowns.

(3) *Mitigation gun* – NMFS recognizes that mitigation guns create noise underwater which, although lower than full-power seismic airguns, can adversely affect marine mammals in the nearby vicinity, and in the past several years has conditioned that mitigation guns only be used during turns for a maximum of 3 hours. While Shell’s ZVSP array is stationary, the re-positioning from one session to the next will take more than 30 minutes. Therefore, limiting the mitigation gun to be used for a maximum of 30 minutes will require Shell to ramp-up after a session, which would extend the duration of the entire ZVSP program. Furthermore, the total ZVSP operations would only last for 20-28 hours. Therefore, working through the details of an operational adjustment to address this issue, NMFS determined there would be less environmental impact to allow the mitigation gun to operate longer than 30 minutes than require ramping up after a re-positioning and operating at a rate of 5 minutes per shoot.

(4) *Vessel anchoring with engines and depth sounders off* – Although it is desirable to have less noise output from the proposed operations, NMFS also considers the safety issue as a critical factor to determine whether such proposed mitigation measures should be included. The following reasoning led NMFS to conclude, after consulting with Shell, that requiring vessels to have engines and depth sounders off while anchoring is not practicable for the industry

operations.

- Anchoring: – Vessel Masters are responsible for crew safety and operation of their vessels in the open water Chukchi Sea. Vessel masters decide, based on numerous factors, safety being paramount, how the vessel maintains its position during stand-by periods. Vessels use slow transits to be able to continuously orient themselves relative to weather and swell directions to minimize vessel motion in the open ocean. Anchoring also restricts vessel flexibility to react quickly to sea state, weather, and work requirements. With regard to how vessels will be operated in the presence of marine mammals, each vessel will be staffed with PSOs when underway or in stand-by mode. PSOs will scan the area for marine mammals and advise the Vessel Master when marine mammals are in the vicinity of the vessel.
- Positioning vessels near acoustic stations: – Vessels would need to keep their generators and other auxiliary machinery operating when anchored. Even though vessel propulsion noise would be eliminated, the auxiliary systems would continue to generate underwater noise that would significantly mask marine mammal calls on nearby recorders.
- Depth sounders: – These devices are highly directional in the downward direction. Little sound energy propagates horizontally away from the vessels to expose marine mammals to additional sounds. Turning off depth sounders is a safety concern that is not outweighed by the small potential benefit.

Reporting Measures

Two modifications were made from the proposed IHA: (1) In the final IHA issued to Shell, NMFS requires Shell to submit daily PSO logs to NMFS as reasonably practicable, and (2) we removed proposed conditions of providing ZSVP and vessel SSV reports within 120 hour after the measurements. The reason for removing 120-hour ZSVP SSV reporting is due to safety concerns of recovering acoustic recorders during drilling operations. The rationale for removing vessel SSV reporting within 120 hours is because vessel noises are not used to established exclusion zones and zones of influence, therefore, there is no need for a 120 hour quick turnaround for these reports. Both ZSVP and vessel SSVs will be reported in Shell's 90-day report.

(1) Submit daily PSO logs to NMFS as reasonably practicable;

(2) Field Reports

Throughout the exploration drilling program, the PSOs will prepare a report each day or at such other interval as required summarizing the recent results of the monitoring program. The reports will summarize the species and numbers of marine mammals sighted. These reports will be provided to NMFS as required.

(3) Technical Reports

The results of Shell's 2015 Chukchi Sea exploratory drilling monitoring program (i.e., vessel-based, aerial, and acoustic) will be presented in the "90-day" and Final Technical reports under the proposed IHA. Shell proposes that the Technical Reports will include: (1) summaries of monitoring effort (e.g., total hours, total distances, and marine mammal distribution through study period, accounting for sea state and other factors affecting visibility and detectability of marine mammals); (2) analyses of the effects of various factors influencing detectability of marine mammals (e.g., sea state, number of observers, and fog/glare); (3) species composition,

occurrence, and distribution of marine mammal sightings, including date, water depth, numbers, age/size/gender categories (if determinable), group sizes, and ice cover; (4) sighting rates of marine mammals during periods with and without drilling activities (and other variables that could affect detectability); (5) initial sighting distances versus drilling state; (6) closest point of approach versus drilling state; (7) observed behaviors and types of movements versus drilling state; (8) numbers of sightings/individuals seen versus drilling state; (9) distribution around the drilling units and support vessels versus drilling state; and (10) estimates of take by harassment. This information will be reported for both the vessel-based and aerial monitoring.

Analysis of all acoustic data will be prioritized to address the primary questions, which are to: (a) determine when, where, and what species of animals are acoustically detected on each AMAR ; (b) analyze data as a whole to determine offshore bowhead distributions as a function of time; (c) quantify spatial and temporal variability in the ambient noise; and (d) measure received levels of drilling unit activities. The detection data will be used to develop spatial and temporal animal distributions. Statistical analyses will be used to test for changes in animal detections and distributions as a function of different variables (e.g., time of day, time of season, environmental conditions, ambient noise, vessel type, operation conditions).

Finally, the 90-day report should also include sightability curves and analysis overlaying visual and acoustic detections.

The initial technical report is due to NMFS within 90 days of the completion of Shell's Chukchi Sea exploration drilling program. The "90-day" report will be subject to review and comment by NMFS. Any recommendations made by NMFS must be addressed in the final report prior to acceptance by NMFS.

(4) Notification of Injured or Dead Marine Mammals

Shell will be required to notify NMFS' Office of Protected Resources and NMFS' Stranding Network of any sighting of an injured or dead marine mammal. Based on different circumstances, Shell may or may not be required to stop operations upon such a sighting. Shell will provide NMFS with the species or description of the animal(s), the condition of the animal(s) (including carcass condition if the animal is dead), location, time of first discovery, observed behaviors (if alive), and photo or video (if available). The specific language describing what Shell must do upon sighting a dead or injured marine mammal appears in the IHA.

Estimated Take by Incidental Harassment

Except with respect to certain activities not pertinent here, the MMPA defines "harassment" as: any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment]. Only take by Level B behavioral harassment is anticipated as a result of the proposed drilling program. Noise propagation from the drilling units, associated support vessels (including during icebreaking if needed), and the airgun array are expected to harass, through behavioral disturbance, affected marine mammal species or stocks. Additional disturbance to marine mammals may result from aircraft overflights and visual disturbance of the drilling units or support vessels. However, based on the flight paths and altitude, impacts from aircraft operations are anticipated to be localized and minimal in nature. Based on new information and through section 7 consultation under the Endangered Species Act

(ESA), a few changes have been made to the underlying data and the methods used to calculate take, including: updated density estimates for bowhead, gray, and beluga whales based on new survey data, the use of anticipated turnover rates of bowhead and ringed seals within the area, removal of level B harassment reduction factor for bowhead whales based on avoidance, and calculating the stock specific takes for the East Chukchi Sea and Beaufort Sea beluga whales separately. These changes are described in greater detail below.

The full suite of potential impacts to marine mammals from various industrial activities was described in detail in the “**Potential Effects of the Specified Activity on Marine Mammals**” section in the **Federal Register** notice (80 FR 11726; March 4, 2015) for the proposed IHA. The potential effects of sound from the proposed exploratory drilling program without regard to any mitigation might include one or more of the following: tolerance; masking of natural sounds; behavioral disturbance; non-auditory physical effects; and, at least in theory, temporary or permanent hearing impairment (Richardson *et al.*, 1995a). As discussed in the **Federal Register** notice (80 FR 11726; March 4, 2015) for the proposed IHA, NMFS estimates that Shell’s activities will most likely result in behavioral disturbance, including avoidance of the ensonified area or changes in speed, direction, and/or diving profile of one or more marine mammals. For reasons discussed in the **Federal Register** notice (80 FR 11726; March 4, 2015) for the proposed IHA, hearing impairment (TTS and PTS) is highly unlikely to occur based on the fact that most of the equipment to be used during Shell’s proposed drilling program does not have source levels high enough to elicit even mild TTS and/or the fact that certain species are expected to avoid the ensonified areas close to the operations. The required monitoring and mitigation measures further reduce any potential for hearing impairment. Additionally, non-

auditory physiological effects are anticipated to be minor, if any would occur at all.

For continuous sounds, such as those produced by drilling operations and during icebreaking activities, NMFS uses a received level of 120-dB (rms) to indicate the onset of Level B harassment. For impulsive sounds, such as those produced by the airgun array during the ZVSP surveys, NMFS uses a received level of 160-dB (rms) to indicate the onset of Level B harassment. Shell provided calculations for the 120-dB isopleths produced by aggregate sources and then used those isopleths to estimate takes by harassment. Additionally, Shell provided calculations for the 160-dB isopleth produced by the airgun array and then used that isopleth to estimate takes by harassment. Shell provides a full description of the methodology used to estimate takes by harassment in its IHA application (see **ADDRESSES**), which is also provided, and revised as mentioned above, in the following sections.

Shell has requested authorization to take bowhead, gray, fin, humpback, minke, killer, and beluga whales, harbor porpoise, and ringed, spotted, bearded, and ribbon seals incidental to exploration drilling, ice management/icebreaking, and ZVSP activities. Additionally, Shell provided exposure estimates and requested takes of narwhal. However, as stated previously in this document, sightings of this species are rare, and the likelihood of occurrence of narwhals in the proposed drilling area is minimal. Therefore, NMFS is not authorizing take of this species.

Basis for Estimating “Take by Harassment”

“Take by Harassment” is described in this section and was calculated in Shell’s application by multiplying the three factors below, which provides the number of instances of take. In a couple of cases, other-species specific information is taken into consideration to help better understand the number of individuals taken. Following are the three factors:

- the expected densities of marine mammals that may occur near the exploratory drilling operations,
- the area of water likely to be exposed to continuous, non-pulse sounds ≥ 120 dB re 1 μ Pa (rms) during drilling unit operations or icebreaking activities and impulse sounds ≥ 160 dB re 1 μ Pa (rms) created by seismic airguns during ZVSP activities, and
- The number of days of the applicable activity.

Through the IHA process we determined that certain modifications to the take estimates were appropriate. Those are described in subsequent sections of this Notice (see *Marine Mammal Density Estimates* and *Estimated Takes*). The next subsection describes the estimated densities of marine mammals that may occur in the project area. The area of water that may be ensounded to the above sound levels is described further in the “*Individual Sound Sources and Level B Harassment Radii*” subsection.

Marine Mammal Density Estimates

In the **Federal Register** notice (80 FR 11726; March 4, 2015) for the proposed IHA, a detailed description was provided on the marine mammal densities in the Chukchi Sea. However, NMFS later learned that data only included sighting data from 2012 and 2013 for bowhead, gray, and beluga whales. Upon consulting with NMFS Alaska Regional Office (AKRO) under section 7 of the Endangered Species Act and the National Marine Mammal Laboratory (NMML), we determined that using sighting data covering 2008-2014 will yield more accurate density estimates of these three species. In addition, NMFS also revised the detectability bias $f(0)$ in density calculation for the bowhead whale based on Ferguson and Clarke

(2013). Therefore, NMFS is revising the take estimates of bowhead, gray, and beluga whales in this section based on these updates to the density estimates.

Marine mammal density estimates in the Chukchi Sea have been derived for two time periods, the summer period covering July and August, and the fall period including September and October. Animal densities encountered in the Chukchi Sea during both of these time periods will further depend on the habitat zone within which the activities are occurring: open water or ice margin. More ice is likely to be present in the area of activities during the July–August period, so summer ice-margin densities have been applied to 50% of the area that may be ensonified from drilling and ZVSP activities in those months. Open water densities in the summer were applied to the remaining 50 percent of the area. Less ice is likely to be present during the September–October period, so fall ice-margin densities have been applied to only 20% of the area that may be ensonified from drilling and ZVSP activities in those months. Fall open-water densities were applied to the remaining 80 percent of the area. Since ice management activities would only occur within ice-margin habitat, the entire area potentially ensonified by ice management activities has been multiplied by the ice-margin densities in both seasons.

There is some uncertainty about the representativeness of the data and assumptions used in the calculations. To provide some allowance for the uncertainties, “maximum estimates” as well as “average estimates” of the numbers of marine mammals potentially affected have been derived. For a few marine mammal species, several density estimates were available. In those cases, the mean and maximum estimates were determined from the reported densities or survey data. In other cases only one or no applicable estimate was available, so correction factors were used to arrive at “average” and “maximum” estimates. These are described in detail in the

following subsections.

Detectability bias, quantified in part by $f(0)$, is associated with diminishing sightability with increasing lateral distance from the survey trackline. Availability bias, $g(0)$, refers to the fact that there is <100% probability of sighting an animal that is present along the survey trackline. Some sources below included these correction factors in the reported densities (e.g. ringed seals in Bengtson *et al.* 2005) and the best available correction factors were applied to reported results when they had not already been included (e.g. Moore *et al.* 2000).

(1) Cetaceans

Eight species of cetaceans are known to occur in the activity area. Three of the nine species, bowhead, fin, and humpback whales, are listed as “endangered” under the ESA.

(a) Beluga Whales

Summer densities of beluga whales in offshore waters are expected to be low, with somewhat higher densities in ice-margin and nearshore areas. Past aerial surveys have recorded few belugas in the offshore Chukchi Sea during the summer months (Moore *et al.* 2000). More recent aerial surveys of the Chukchi Sea from 2008-2014 flown by the NMML as part of the COMIDA project, now part of the Aerial Surveys of Arctic Marine Mammals (ASAMM) project, reported 10 beluga sightings (22 individuals) in offshore waters during 22,154 km of on-transect effort. Larger groups of beluga whales were recorded in nearshore areas, especially in June and July during the spring migration (Clarke *et al.* 2012, 2013). Additionally, only one beluga sighting was recorded during >80,000 km of visual effort during good visibility conditions from industry vessels operating in the Chukchi Sea in September-October of 2006-2010 (Hartin *et al.* 2013). If belugas are present during the summer, they are more likely to occur in or near the ice

edge or close to shore during their northward migration. Effort and sightings reported by Clarke *et al.* (2012, 2013) were used to calculate the average open-water density estimate. The mean group size of the sightings was 2.2. A $f(0)$ value of 2.841 and $g(0)$ value of 0.58 from Harwood *et al.* (1996) were also used in the density calculation resulting in an average open-water density of 0.0010 belugas/km². The highest density from the reported survey periods (0.0030 belugas/km²) has been used as the maximum density that may occur in open-water habitat. Specific data on the relative abundance of beluga in open-water versus ice-margin habitat during the summer in the Chukchi Sea is not available. However, belugas are commonly associated with ice, so an inflation factor of four was used to estimate the ice-margin densities from the open-water densities. Very low densities observed from vessels operating in the Chukchi Sea during non-seismic periods and locations in July-August of 2006-2010 (0.0-0.0003/mi², 0.0-0.0001/km²; Hartin *et al.* 2013), also suggest the number of beluga whales likely to be present near the planned activities will not be large.

In the fall, beluga whale densities offshore in the Chukchi Sea are expected to be somewhat higher than in the summer because individuals of the eastern Chukchi Sea stock and the Beaufort Sea stock will be migrating south to their wintering grounds in the Bering Sea (Allen and Angliss 2012). Densities derived from survey results in the northern Chukchi Sea in Clarke and Ferguson and Clarke *et al.* (2012, 2013) were used as the average density for open-water season estimates. Clarke and Ferguson (in prep, cited in Shell 2014) and Clarke *et al.* (2012, 2013) reported 17 beluga sightings (28 individuals) during 22,255 km of on-transect effort in water depths 36–50 m during the months of July through September. The mean group size of those three sightings was 1.6. A $f(0)$ value of 2.841 and a $g(0)$ value of 0.58 from Harwood *et al.*

(1996) were used to calculate the average open-water density of 0.0100 belugas/km². The highest density from the reported periods (0.0420 belugas/km²) was again used as the maximum density that may occur in open-water habitat. Moore *et al.* (2000) reported lower than expected beluga sighting rates in open-water during fall surveys in the Beaufort and Chukchi seas, so an inflation value of four was used to estimate the ice-margin densities from the open-water densities. Based on the few beluga sightings from vessels operating in the Chukchi Sea during non-seismic periods and locations in September-November of 2006-2010 (Hartin *et al.* 2013), the relatively low densities shown in Table 6-2 in Shell's IHA application are consistent with what is likely to be observed from vessels during the planned exploration drilling activities.

(b) Bowhead Whales

By July, most bowhead whales are northeast of the Chukchi Sea, within or migrating toward their summer feeding grounds in the eastern Beaufort Sea. No bowheads were reported during 10,686 km of on-transect effort in the Chukchi Sea by Moore *et al.* (2000). Bowhead whales were also rarely sighted in July-August of 2006-2010 during aerial surveys of the Chukchi Sea coast (Thomas *et al.* 2011). This is consistent with movements of tagged whales (ADFG 2010), all of which moved through the Chukchi Sea by early May 2009, and tended to travel relatively close to shore, especially in the northern Chukchi Sea.

The estimate of the July-August open-water bowhead whale density in the Chukchi Sea was calculated from the three bowhead sightings (3 individuals) and 22,154 km of survey effort in waters 36-50 m deep in the Chukchi Sea during July-August reported in Clarke and Ferguson (in prep, cited in Shell 2014) and Clarke *et al.* (2012, 2013). The mean group size from those sightings was 1. The group size value, along with a $f(0)$ value of 1.15 and a $g(0)$ value of 0.07,

both from Thomas *et al.* (2002) were used to estimate a summer density of 0.0010 bowheads/km². The two sightings recorded during 4,209 km of survey effort in 2011 (Clarke *et al.* 2012) produced the highest annual bowhead density during July-August (0.0050 bowheads/km²) which was used as the maximum open-water density. Bowheads are not expected to be encountered in higher densities near ice in the summer (Moore *et al.* 2000), so the same density estimates have been used for open-water and ice-margin habitats. Densities from vessel based surveys in the Chukchi Sea during non-seismic periods and locations in July-August of 2006-2010 (Hartin *et al.* 2013) ranged from 0.0002-0.0008/km² with a maximum 95% CI of 0.0085/km².

During the fall, bowhead whales that summered in the Beaufort Sea and Amundsen Gulf migrate west and south to their wintering grounds in the Bering Sea, making it more likely those bowheads will be encountered in the Chukchi Sea at this time of year. Moore *et al.* (2000) reported 34 bowhead sightings during 44,354 km of on-transect survey effort in the Chukchi Sea during September-October. Thomas *et al.* (2011) also reported increased sightings on coastal surveys of the Chukchi Sea during October and November of 2006-2010. GPS tagging of bowheads appear to show that migration routes through the Chukchi Sea are more variable than through the Beaufort Sea (Quakenbush *et al.* 2010). Some of the routes taken by bowheads remain well north of the planned drilling activities while others have passed near to or through the area. Kernel densities estimated from GPS locations of whales suggest that bowheads do not spend much time (e.g. feeding or resting) in the north-central Chukchi Sea near the area of planned activities (Quakenbush *et al.* 2010). However, tagged whales did spend a considerable amount of time in the north-central Chukchi Sea in 2012, despite ongoing industrial activities in

the region (ADFG 2012). Clarke *et al.* (2012, 2013) reported 72 sightings (86 individuals) during 22,255 km of on-transect aerial survey effort in waters 36-50 m deep in 2008-2012, the majority of which (53 sightings) were recorded in 2012. The mean group size of the 72 sightings was 1.2. The same $f(0)$ and $g(0)$ values that were used for the summer estimates above were used for the fall estimates resulting in an average September–October estimate of 0.0230 bowheads/km². The highest density from the survey periods (0.0780 bowheads/km²) was used as the maximum open-water density during the fall period. Moore *et al.* (2000) found that bowheads were detected more often than expected in association with ice in the Chukchi Sea in September-October, so the ice-margin densities that are used are twice the open-water densities. Densities from vessel based surveys in the Chukchi Sea during non-seismic periods and locations in September-November of 2006-2010 (Hartin *et al.* 2013) ranged from 0.0003 to 0.0052/km² with a maximum 95 percent CI of 0.051/km².

(c) Gray Whales

Gray whale densities are expected to be much higher in the summer months than during the fall. Moore *et al.* (2000) found the distribution of gray whales in the planned operational area was scattered and limited to nearshore areas where most whales were observed in water less than 35 m deep. Thomas *et al.* (2011) also reported substantial declines in the sighting rates of gray whales in the fall. The average open-water summer density was calculated from 2008–2014 aerial survey effort and sightings in Clarke *et al.* (2012, 2013) for water depths 36-50 m including 98 sightings (137 individuals) during 22,154 km of on-transect effort. The average group size of those sightings was 1.4. Correction factors $f(0) = 2.49$ (Forney and Barlow 1998) and $g(0) = 0.30$ (Forney and Barlow 1998, Mallonee 1991) were used to calculate and average

open-water density of 0.0080 gray whales/km². The highest density from the survey periods reported in Clarke *et al.* (2012, 2013) was 0.0300 gray whales/km² and this was used as the maximum open-water density. Gray whales are not commonly associated with sea ice, but may be present near it, so the same densities were used for ice-margin habitat as were derived for open-water habitat during both seasons. Densities from vessel based surveys in the Chukchi Sea during non-seismic periods and locations in July-August of 2006-2010 (Hartin *et al.* 2013) ranged from 0.0008/km² to 0.0085/km² with a maximum 95 percent CI of 0.0353 km².

In the fall, gray whales may be dispersed more widely through the northern Chukchi Sea (Moore *et al.* 2000), but overall densities are likely to be decreasing as the whales begin migrating south. A density calculated from effort and sightings (46 sightings [64 individuals] during 22,255 km of on-transect effort) in water 36-50 m deep during September–October reported by Clarke and Ferguson (in prep, cited in Shell 2014) and Clarke *et al.* (2012, 2013) was used as the average estimate for the Chukchi Sea during the fall period (0.0040 gray whales/km²). The corresponding group size value of 1.39, along with the same $f(0)$ and $g(0)$ values described above were used in the calculation. The maximum density from the survey periods (0.0080 gray whales/km²) was reported in 2013 (Clarke *et al.* 2013) and used as the maximum fall open-water density. Densities from vessel based surveys in the Chukchi Sea during non-seismic periods and locations in September-November of 2006-2010 (Hartin *et al.* 2013) ranged from 0.0/km² to 0.0044/km² with a maximum 95% CI of 0.0335 km².

(d) Harbor Porpoises

Harbor Porpoise densities were estimated from industry data collected during 2006-2010 activities in the Chukchi Sea. Prior to 2006, no reliable estimates were available for the Chukchi

Sea and harbor porpoise presence was expected to be very low and limited to nearshore regions. Observers on industry vessels in 2006–2010, however, recorded sightings throughout the Chukchi Sea during the summer and early fall months. Density estimates from 2006-2010 observations during non-seismic periods and locations in July-August ranged from 0.0013/km² to 0.0029/km² with a maximum 95% CI of 0.0137/km² (Hartin *et al.* 2013). The average density from the summer season of those three years (0.0022/km²) was used as the average open-water density estimate while the high value (0.0029/km²) was used as the maximum estimate (Table 6-1 in Shell's IHA application). Harbor porpoise are not expected to be present in higher numbers near ice, so the open-water densities were used for ice-margin habitat in both seasons. Harbor porpoise densities recorded during industry operations in the fall months of 2006-2010 were slightly lower and ranged from 0.0/km² to 0.0044/km² with a maximum 95% CI of 0.0275/km². The average of those years (0.0021/km²) was again used as the average density estimate and the high value (0.0044/km²) was used as the maximum estimate (Table 6-2 in Shell's IHA application).

(e) Other Whales

The remaining five cetacean species that could be encountered in the Chukchi Sea during Shell's planned exploration drilling program include the humpback whale, killer whale, minke whale, and fin whale. Although there is evidence of the occasional occurrence of these five cetacean species in the Chukchi Sea, it is unlikely that more than a few individuals will be encountered during the planned exploration drilling program and therefore minimum densities have been assigned to these species (Tables 6-1 and 6-2 in Shell's IHA application). Clarke *et al.* (2011, 2013) and Hartin *et al.* (2013) reported humpback whale sightings; George and Suydam

(1998) reported killer whales; Brueggeman *et al.* (1990), Hartin *et al.* (2013), Clarke *et al.* (2012, 2013), and Reider *et al.* (2013) reported minke whales; and Clarke *et al.* (2011, 2013) and Hartin *et al.* (2013) reported fin whales. With regard to humpback and fin whales, NMFS (2013) recently concluded these whales occur in very low numbers in the project area, but may be regular visitors.

Of these uncommon cetacean species, minke whale has the potential to be the most common based on recent industry surveys. Reider *et al.* (2013) reported 13 minke whale sightings in the Chukchi Sea in 2013 during Shell's marine survey program. All but one minke whale sighting in 2013, however, were observed in nearshore areas despite only minimal monitoring effort in nearshore areas compared to more offshore locations near the Burger prospect (Reider *et al.* 2013).

(2) Pinnipeds

Three species of pinnipeds under NMFS jurisdiction are likely to be encountered in the Chukchi Sea during Shell's planned exploration drilling program: ringed seal, bearded seal, and spotted seal. Ringed and bearded seals are associated with both the ice margin and the nearshore area. The ice margin is considered preferred habitat (as compared to the nearshore areas) for ringed and bearded seals during most seasons. Spotted seals are often considered to be predominantly a coastal species except in the spring when they may be found in the southern margin of the retreating sea ice. However, satellite tagging has shown that they sometimes undertake long excursions into offshore waters during summer (Lowry *et al.* 1994, 1998). Ribbon seals have been reported in very small numbers within the Chukchi Sea by observers on industry vessels (Patterson *et al.* 2007, Hartin *et al.* 2013).

(a) Ringed and Bearded Seals

Ringed seal and bearded seals “average” and “maximum” summer ice-margin densities were available in Bengtson *et al.* (2005) from spring surveys in the offshore pack ice zone (zone 12P) of the northern Chukchi Sea. However, corrections for bearded seal availability, $g(0)$, based on haulout and diving patterns were not available. Densities of ringed and bearded seals in open water are expected to be somewhat lower in the summer when preferred pack ice habitat may still be present in the Chukchi Sea. Average and maximum open-water densities have been estimated as 3/4 of the ice margin densities during both seasons for both species. The fall density of ringed seals in the offshore Chukchi Sea has been estimated as 2/3 the summer densities because ringed seals begin to reoccupy nearshore fast ice areas as it forms in the fall. Bearded seals may also begin to leave the Chukchi Sea in the fall, but less is known about their movement patterns so fall densities were left unchanged from summer densities. For comparison, the ringed seal density estimates calculated from data collected during summer 2006-2010 industry operations ranged from 0.0138/km² to 0.0464/km² with a maximum 95 percent CI of 0.1581/km² (Hartin *et al.* 2013).

(b) Spotted Seals

Little information on spotted seal densities in offshore areas of the Chukchi Sea is available. Spotted seal densities in the summer were estimated by multiplying the ringed seal densities by 0.02. This was based on the ratio of the estimated Chukchi populations of the two species. Chukchi Sea spotted seal abundance was estimated by assuming that 8% of the Alaskan population of spotted seals is present in the Chukchi Sea during the summer and fall (Rugh *et al.* 1997), the Alaskan population of spotted seals is 59,214 (Allen and Angliss 2012), and that the

population of ringed seals in the Alaskan Chukchi Sea is ~208,000 animals (Bengtson *et al.* 2005). In the fall, spotted seals show increased use of coastal haulouts so densities were estimated to be 2/3 of the summer densities.

(c) Ribbon Seals

Four ribbon seal sightings were reported during industry vessel operations in the Chukchi Sea in 2006-2010 (Hartin *et al.* 2013). The resulting density estimate of 0.0007/km² was used as the average density and 4 times that was used as the maximum for both seasons and habitat zones.

Individual Sound Sources and Level B Harassment Radii

The assumed start date of Shell's exploration drilling program in the Chukchi Sea using the drilling units *Discoverer* and *Polar Pioneer* with associated support vessels is 4 July. Shell may conduct exploration drilling activities at up to four drill sites at the prospect known as Burger. Drilling activities are expected to be conducted through approximately 31 October 2015.

Previous IHA applications for offshore Arctic exploration programs estimated areas potentially ensonified to ≥ 120 or ≥ 160 dB re 1 μ Pa rms independently for each continuous or pulsed sound source, respectively (e.g., drilling, ZVSP, etc.). The primary method used in this IHA application for estimating areas ensonified to continuous sound levels ≥ 120 dB re 1 μ Pa rms by drilling-related activities involved sound propagation modeling of a variety of scenarios consisting of multiple, concurrently-operating sound sources. These "activity scenarios" consider additive acoustic effects from multiple sound sources at nearby locations, and more closely capture the nature of a dynamic acoustic environment where numerous activities are taking place simultaneously. The area ensonified to ≥ 160 dB re 1 μ Pa rms from ZVSP, a pulsed

sound source, was treated independently from the activity scenarios for continuous sound sources.

The continuous sound sources used for sound propagation modeling of activity scenarios included 1) drilling unit and drilling sounds, 2) supply and drilling support vessels using DP when tending to a drilling unit, 3) MLC construction, 4) anchor handling in support of mooring a drilling unit, and 5) ice management activities. The information used to generate sound level characteristics for each continuous sound source is summarized below to provide background on the model inputs. A “safety factor” of 1.3 dB re 1 μ Pa rms was added to the source level for each sound source prior to modeling activity scenarios to account for variability across the project area associated with received levels at different depths, geoacoustical properties, and sound-speed profiles. The addition of the 1.3 dB re 1 μ Pa rms safety factor to source levels resulted in an approximate 20 percent increase in the distance to the 120 dB re 1 μ Pa rms threshold for each continuous source.

Table 3 summarizes the 120 dB re 1 μ Pa rms radii for individual sound sources, both the “original” radii as measured in the field, and the “adjusted” values that were calculated by adding the “safety factor” of 1.3 dB re 1 μ Pa rms to each source. The adjusted source levels were then used in sound propagation modeling of activity scenarios to estimate ensonified areas and associated marine mammal exposure estimates. Additional details for each of the continuous sound sources presented in Table 3 are discussed below.

The pulsed sound sources used for sound propagation modeling of activity scenarios consisted of two small airgun arrays proposed for ZVSP activities. All possible array configurations and operating depths were modeled to identify the arrangement with the greatest

sound propagation characteristics. The resulting ≥ 160 dB re $1\mu\text{Pa}$ rms radius was multiplied by 1.5 as a conservative measure prior to estimating exposed areas, which is discussed in greater detail below.

Table 3. Measured and adjusted 120 dB re $1\mu\text{Pa}$ radii for individual, continuous sound sources

Activity / Continuous sound source	Radii of 120 dB re $1\mu\text{Pa}$ (rms) isopleth (meters)	
	Original measurement	With 1.3 dB correction factor
Drilling at 1 site	1,500	1,800
Vessel in DP	4,500	5,500
Mudline cellar construction at 1 site	8,200	9,300
Anchor handling at 1 site (assumed to be 2 vessels)	19,000	22,000
Single vessel ice management	9,600	11,000

Two sound sources have been proposed by Shell for the ZVSP surveys in 2015. The first is a small airgun array that consists of three 150 in^3 ($2,458\text{ cm}^3$) airguns for a total volume of 450 in^3 ($7,374\text{ cm}^3$). The second ZVSP sound source consists of two 250 in^3 ($4,097\text{ cm}^3$) airguns with a total volume of 500 in^3 ($8,194\text{ cm}^3$). Sound footprints for each of the two proposed ZVSP airgun array configurations were estimated using JASCO Applied Sciences' MONM. The model results were maximized over all water depths from 9.8 to 23 ft (3 to 7 m) to yield precautionary sound level isopleths as a function of range and direction from the source. The 450 in^3 airgun array at a source depth of 7 m yielded the maximum ranges to the ≥ 190 , ≥ 180 , and ≥ 160 dB re $1\mu\text{Pa}$ rms isopleths.

There are two reasons that the radii for the 450 in^3 airgun array are larger than those for the 500 in^3 array. First, the sound energy does not scale linearly with the airgun volume, rather it is proportional to the cube root of the volume. Thus, the total sound energy from three airguns is larger than the total energy from two airguns, even though the total volume is smaller. Second, larger volume airguns emit more low-frequency sound energy than smaller volume airguns, and

low-frequency airgun sound energy is strongly attenuated by interaction with the surface reflection. Thus, the sound energy for the larger-volume array experiences more reduction and results in shorter sound threshold radii.

The estimated 95th percentile distances to the following thresholds for the 450 in³ airgun array were: ≥ 190 dB re 1 μ Pa rms = 170 m, ≥ 180 dB re 1 μ Pa rms = 920 m, and ≥ 160 dB re 1 μ Pa rms = 7,970 m. The ≥ 160 dB re 1 μ Pa rms distance was multiplied by 1.5 for a distance of 11,960 m. This radius was used for estimating areas ensonified by pulsed sounds to ≥ 160 dB re 1 μ Pa rms during a single ZVSP survey. ZVSP surveys may occur at up to two different drill sites during Shell's planned 2015 exploration drilling program in the Chukchi Sea.

As noted above, previous IHA applications for Arctic offshore exploration programs estimated areas potentially ensonified to continuous sound levels ≥ 120 dB re 1 μ Pa rms independently for each sound source. This method was appropriate for assessing a small number of continuous sound sources that did not consistently overlap in time and space. However, many of the continuous sound sources described above will operate concurrently at one or more nearby locations in 2015 during Shell's planned exploration drilling program in the Chukchi Sea. It is therefore appropriate to consider the concurrent operation of numerous sound sources and the additive acoustic effects from combined sound fields when estimating areas potentially exposed to levels ≥ 120 dB re 1 μ Pa rms.

A range of potential "activity scenarios" was derived from a realistic operational timeline by considering the various combinations of different continuous sound sources that may operate at the same time at one or more locations. The total number of possible activity combinations from all sources at up to four different drill sites would not be practical to assess or present in a

meaningful way. Additionally, combinations such as concurrent drilling and anchor handling in close proximity do not add meaning to the analysis given the negligible contribution of drilling sounds to the total area ensonified by such a scenario. For these reasons, various combinations of similar activities were grouped into representative activity scenarios shown in Table 4.

Ensonified areas for these representative activity scenarios were estimated through sound propagation modeling. Activity scenarios were modeled for different drill site combinations and, as a conservative measure, the locations corresponding to the largest ensonified area were chosen to represent the given activity scenario. In other words, by binning all potential scenarios into the most conservative representative scenario, the largest possible ensonified areas for all activities were identified for analysis. A total of nine representative activity scenarios were modeled to estimate areas exposed to continuous sounds ≥ 120 dB re 1 μ Pa rms for Shell’s planned 2015 exploration drilling program in the Chukchi Sea (Table 4). A tenth scenario was included for the ZVSP activities.

Table 4. Sound propagation modeling results of representative drilling related activity scenarios and estimates of the total area potentially ensonified above threshold levels at the Burger Prospect in the Chukchi Sea, Alaska, during Shell’s proposed 2015 exploration drilling program

Activity scenario description	Threshold level (dB re 1 μ Pa rms)	Area potentially ensonified (km ²)	
		Summer	Fall
Drilling at 1 site	120	10.2	10.2
Drilling and DP vessel at 1 site	120	111.8	111.8
Drilling and DP vessel (1 site) + drilling and DP vessel (2 nd site)	120	295.5	295.5
Mudline cellar construction at 2 different sites	120	575.5	575.5
Anchor handling at 1 site	120	1,534.9	1,534.9
Drilling and DP vessel at 1 site + anchor handling at 2 nd site	120	1,759.2	1,759.2
Mudline cellar construction at 2 different sites + anchor handling at 3 rd site	120	2,046.3	2,046.3
Two-vessel ice management	120	937.4	937.4
Four-vessel ice management	120	1,926.0	1,926.0
ZVSP at 2 different sites	160	0.0	898.0

Estimated Takes

This section provides estimates of the number of individuals potentially exposed to continuous sound levels ≥ 120 dB re 1 μ Pa rms from exploration drilling related activities and pulsed sound levels ≥ 160 dB re 1 μ Pa rms by ZVSP activities. The estimates are based on a consideration of the number of exposures of marine mammals to Shells' drilling operations in the Chukchi Sea during 2015 in the anticipated area ensonified to those sound levels, as well as the duration of the activities.

To account for different densities in different habitats, Shell has assumed that more ice is likely to be present in the area of operations during the July–August period than in the September–October period, so summer ice-margin densities have been applied to 50% of the area that may be exposed to sounds from exploration drilling activities in those months. Open water densities in the summer were applied to the remaining 50% of the area.

Less ice is likely to be present during the September–October period than in the July–August period, so fall ice-margin densities have been applied to only 20% of the area that may be exposed to sounds from exploration drilling activities in those months. Fall open-water densities were applied to the remaining 80% of the area. Since icebreaking activities would only occur within ice-margin habitat, the entire area potentially ensonified by icebreaking activities has been multiplied by the ice-margin densities in both seasons.

Estimates of the numbers of marine mammals potentially exposed to continuous sounds ≥ 120 dB re 1 μ Pa rms or pulsed sounds ≥ 160 dB re 1 μ Pa rms are based on assumptions that include upward scaling of source levels for all sound sources, 100% “turnover” of individuals in ensonified areas every 24 hours (except for bowhead whales and ringed seals, as discussed below), and no decrease in the number of takes resulting from anticipated avoidance behaviors.

These estimates are likely conservative given some of the buffers Shell included in their ensonified area estimates and the fact that the estimates indicate the likely instances of take, but are expected to overestimate the numbers of individuals, since we expect that the instances include repeated exposures of some individuals (meaning the number of individuals is lower), which is not quantitatively accounted for in any species except bowheads and ringed seals.

The following sections present exposure estimates for bowhead whales and ringed seals. Estimates were generated based on an evaluation of the best available science and a consideration of the assumptions above.

It is difficult to determine an average turnover time for individual bowhead whales in a particular area of the Chukchi Sea. Reasons for this include differences in residency time between migratory and non-migratory periods, changes in distribution of food and other factors such as behavior that influence animal movement, variation among individuals, etc.

Complete turnover of individual bowhead whales in the project area each 24-hour period is possible during distinct periods within the fall migration when bowheads are traveling through the area, however, bowheads often move in pulses with one to several days between major pulses of whales (Miller *et al.* 2002). Gaps between groups of traveling whales during fall migration result in days when no bowhead whales would be expected to be present in the activity area. The absence of bowhead whales during periods of the fall migration can likely be attributed to individuals stopping to feed opportunistically when food is encountered, which is known to occur annually in an area north of Barrow (Citta *et al.* 2014). The extent of feeding by bowhead whales during fall migration across other areas of the Chukchi Sea varies greatly from year to year based on the location and abundance of prey (Shelden and Mocklin 2013). For these reasons, NMFS

believes a 24-hour turnover period for bowhead whales is unnecessarily conservative and has selected a turnover rate of 48 hours to estimate exposures. Using the projected 2015 bowhead whale population of 19,534, which is based on the Givens *et al.* (2013) bowhead whale abundance estimate of 16,892 individuals in 2011 with an annual growth rate of 3.7%, a reasonable estimate of individual exposures, as discussed above, to be associated with the assumptions of no avoidance and a 48-hour turnover period, is 2,582 individuals, or 5.5% of the projected 2015 bowhead whale population.

For ringed seals, satellite tagging data from tagging studies from a joint research by the State of Alaska Department of Fish and Game's Marine Mammals Program, the Ice Seal Committee, and interested seal hunters from villages along the west and north coasts of Alaska were used to derive a turnover rate for this species. Data from these tagged animals showed that in addition to a long distance seasonal migration, there are many instances from July through September when individual ringed seals stayed in a relatively small area (compared to their migration route) up to multiple weeks, including on and around the offshore continental shelf leased blocks. In addition, Patterson *et al.* 2014 indicate a turnover period of a week or more for individual seals near a drilling operation in the Alaskan Arctic may be more appropriate, based on the 6-24 day area occupancy described above. These results suggest that assuming 100% turnover of all individual seals around an offshore drilling operation on a daily basis is unreasonable, and a period closer to a week may be more appropriate and yet still conservative for other individuals that remained in the area for longer periods.

Thus, NMFS considers the estimate associated with 24-hour turnover and zero avoidance to be an overestimate of the numbers of individual ringed seals. We have determined a 48-hour

turnover rate to be more realistic, and still very conservative.

For beluga whales, challenges arise when one attempts to derive density and exposure estimates separately for the two stocks as they overlap in time and space in the Chukchi Sea, particularly within the specified geographic region (i.e., the lease area), and the physical characteristics of individuals from the two stocks do not allow differentiation during visual surveys.

Beluga whale densities used to estimate potential exposures were calculated from aerial survey data collected by the NMML from July through October of 2008–2014. To reflect differences in abundance between seasons, data from July and August were pooled to produce a “Summer” density and data from September and October were pooled to produce a “Fall” density. Since individuals of the two stocks cannot be distinguished visually, these data represent individuals from both stocks to the extent that both stocks are present in the Chukchi Sea during the two seasons.

Few individuals from either stock are likely to be present near the planned activities in July and August because the spring migrations of both stocks beyond the lease sale area are largely complete by early July. The spring migration of the Beaufort Sea Stock occurs much earlier in the season compared to the Chukchi Sea stock, thus, beluga whales present in the Chukchi Sea in July and August are most likely from the Eastern Chukchi Sea Stock. It is therefore assumed that the average observed Summer (July–August) density of 0.0010 individuals/km² is entirely composed of individuals from the Eastern Chukchi Sea Stock.

Since the two stocks migrate at similar times through the Chukchi Sea in the fall and one cannot distinguish them visually, the pooled September–October beluga density received from

NMML (0.0100 individuals/km²) represents the presence of both stocks. The current abundance estimate for the Eastern Chukchi Sea Stock is 3,710 individuals and the abundance estimate for the Beaufort Sea Stock is 39,258 individuals (Allen and Angliss 2014), resulting in a combined total estimate of 42,968 individuals. The Eastern Chukchi Sea Stock is, therefore, considered to represent 8.6% of the combined population and the Beaufort Sea Stock is considered to represent 91.4% of the same. Multiplying the observed density of 0.0100 individuals/km² by these percentages results in a density estimate of 0.0009 individuals/km² for the Eastern Chukchi Sea Stock and 0.0091 individuals/km² for the Beaufort Sea Stock. The Eastern Chukchi Sea Stock density estimate for the Fall period is therefore slightly lower than the density estimate for the Summer.

Based on the information above, a method was derived to calculate the takes of beluga whales by assuming that (1) all beluga whales encountered in the summer at the proposed project area are from the East Chukchi Sea population; and (2) composition of beluga whales encountered in the fall at the proposed project area reflects the relative proportion of the sizes of both stocks. Based on this method, the total number of individuals potentially exposed from the Eastern Chukchi Sea Stock would be approximately 344 (9.3% of estimated population of 3,710) while the number of individuals from the Beaufort Sea Stock would be approximately 1,318 (3.4% of the estimated population of 39,258). Table 5 presents the exposure estimates for Shell's proposed 2015 exploration drilling program in the Chukchi Sea. The table also summarizes abundance estimates for each species and the corresponding percent of each population that may be exposed to continuous sounds ≥ 120 dB re 1 μ Pa rms or pulsed sounds ≥ 160 dB re 1 μ Pa rms taking into account assigned turnover rates. With the exception of the exposure estimate for

bowhead whales and ringed seals described above, where we had additional information to inform a turnover estimate, estimates for all other species assume 100% daily turnover and no avoidance of activities or ensonified areas.

Table 5. The total number of potential exposures of marine mammals to sound levels ≥ 120 dB re 1 μ Pa rms or ≥ 160 dB re 1 μ Pa rms during the Shell’s proposed drilling activities in the Chukchi Sea, Alaska, 2015. Estimates are also shown as a percent of each population

Species	Abundance	Number potential exposure	% Estimated population
Beluga (Beaufort Sea)	42,968	1,318	3.4%
Beluga (E. Chukchi Sea)	3,710	344	9.3%
Killer whale	2,084	14	0.8%
Harbor porpoise	48,215	294	0.6%
Bowhead whale	19,534	1,083	5.5%
Fin whale	1,652	14	0.8%
Gray whale	19,126	834	4.4%
Humpback whale	20,800	14	0.1%
Minke whale	810	41	5.1%
Bearded seal	155,000	1,722	1.1%
Ribbon seal	49,000	96	0.2%
Ringed seal	300,000	25,217	8.4%
Spotted seal	141,479	1,007	0.7%

In summary, several precautionary methods were applied when calculating exposure estimates. These conservative methods and related considerations include:

- Application of a 1.3 dB re 1 μ Pa rms safety factor to the source level of each continuous sound source prior to sound propagation modeling of areas exposed to Level B harassment thresholds;
- Binning of similar activity scenarios into a representative scenario, each of which reflected the largest exposed area for a related group of activities;
- Modeling numerous iterations of each activity scenario at different drill site locations to identify the spatial arrangement with the largest exposed area for

each;

- Assuming 100 percent daily (or 24-hour) turnover of populations (except for bowhead whales and ringed seals), which likely overestimates the number of different individuals that would be exposed, especially during non-migratory periods; and
- Density estimates for some cetaceans include nearshore areas where more individuals would be expected to occur than in the offshore Burger Prospect area (e.g., gray whales).

Additionally, post-season estimates of the numbers of marine mammals exposed to Level B harassment thresholds per Shell's 90-day report from the 2012 IHA consistently support the methods used in Shell's IHA applications as precautionary. Most recently, exposure estimates reported by Reider *et al.* (2013) from Shell's 2012 exploration activities in the Chukchi Sea were considerably lower than those requested in Shell's 2012 IHA application. The above summary of the numbers of cetaceans and pinnipeds that may be exposed to sounds above Level B harassment thresholds is best interpreted as conservatively high, especially for species for which a correction factor has not been included to account for animals staying in an area for more than 24 hours at a time (e.g, other than ringed seals, bowheads). , particularly the larger number for each species that assumes a new group of individuals each day.

Analysis and Determinations

Negligible Impact

Negligible impact is "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” (50 CFR 216.103). A negligible impact finding is based on the lack of likely adverse effects on annual rates of recruitment or survival (i.e., population-level effects). An estimate of the number of Level B harassment takes, alone, is not enough information on which to base an impact determination. In addition to considering estimates of the number of marine mammals that might be “taken” through behavioral harassment, NMFS must consider other factors, such as the likely nature of any responses (their intensity, duration, etc.), the context of any responses (critical reproductive time or location, migration, etc.), as well as the number and nature of estimated Level A harassment takes, the number of estimated mortalities, effects on habitat, and the status of the species. To avoid repetition, we provide some general analysis immediately below that applies to all the species listed in Table 5, given that some of the anticipated effects (or lack thereof) of this project on marine mammals are expected to be relatively similar in nature. However, below that, we break our analysis into species, or groups of species where relevant similarities exist, to provide more specific information related to the anticipated effects on individuals or where there is information about the size, status, or structure of any species or stock that would lead to a differing assessment of the effects on the population.

Taking into account the required mitigation and related monitoring, no injuries or mortalities to any species are anticipated to occur as a result of Shell’s proposed Chukchi Sea exploratory drilling program, and none are authorized. Animals in the area are not expected to incur hearing impairment (i.e., TTS or PTS) or non-auditory physiological effects. Instead, any impact that could result from Shell’s activities is most likely to be behavioral harassment and is expected to be of limited duration. Although it is possible that some individuals may be exposed

to sounds from drilling operations more than once, during the migratory periods it is less likely that this will occur since animals will continue to move across the Chukchi Sea towards their wintering grounds. Injury, serious injury, or mortality could occur if there were a large or very large oil spill. However, as discussed previously in this document, the likelihood of a spill is extremely remote. Shell has implemented many design and operational standards to mitigate the potential for an oil spill of any size. NMFS does not authorize take from an oil spill, as it is not part of the specified activity.

Bowhead whales:

Bowhead whales are less likely to occur in the proposed project area in July and August, as they are found mostly in the Canadian Beaufort Sea at this time. The animals are more likely to occur later in the season (mid-September through October), as they head west towards Russia or south towards the Bering Sea. Additionally, while bowhead whale tagging studies revealed that animals occurred in the LS 193 area, a higher percentage of animals were found outside of the LS 193 area in the fall (Quakenbush *et al.*, 2010).

It is estimated that a maximum of 1,083 bowhead whales (5.5%) could be taken by Level B harassment. Potential impacts to bowhead whales from Shell's exploration drilling activity would be limited to brief behavioral disturbances and temporary avoidance of the ensonified areas.

In their westward migration route, bowhead whales have been observed to feed in the vicinity of Shell's leases in the Chukchi Sea. However, the closest primary feeding ground is near Point Barrow, which is more than 150 mi (241 km) east of Shell's Burger prospect (Clarke *et al.* 2015). Therefore, if bowhead whales stop to feed near Point Barrow during Shell's

proposed operations, the animals would not be exposed to continuous sounds from the drilling units or icebreaker above 120 dB or to impulsive sounds from the airguns above 160 dB, as those sound levels only propagate 1.8 km, 11 km, and 11.9 km, respectively, which includes the inflation factor.

As stated earlier, the proposed activity is located in an area where bowhead whale mother/calf pairs are sighted in the month of October (Clarke *et al.*, 2015). However, as discussed previously, noise exposure to bowhead whales is expected to be low and would in the worst case cause Level B harassment in the form of mild and temporary behavioral modification and/or avoidance. Moreover, the majority of the ensonified areas (67%) would fall between 120 and 126 dB re 1 μ Pa for non-impulse noise and 160 and 166 dB re 1 μ Pa for impulse noise, which at the low-end of the range for Level B behavioral harassment by noise exposure. Also, as noted above, the ensonified areas themselves from Shell's exploration drilling operation are small in comparison to the much larger bowhead whale reproduction BIA in October (Clarke *et al.*, 2015). The size of the ensonified area depends on the type of activities (drilling, anchor handling, ice management, ZVSP, etc.), with the worst case scenario being mudline cellar construction at 2 different sites and anchor handling at a third site (Table 4), which is expected to occur only 6 days each in summer and fall (Shell 2014). Therefore, NMFS believes that the potential adverse effects on bowhead whales cow/calf pairs while in their reproduction BIA in the northeast Chukchi Sea in October from Shell's exploration drilling activities will be limited in both number and severity, and that the potential worst case impacts would be mild and temporary behavioral reactions and/or avoidance of the affected area.

Beluga whale:

Beluga whales are less likely to occur in the proposed project area in July and August, as they are found mostly in the Canadian Beaufort Sea at this time. The animals are more likely to occur later in the season (mid-September through October), as they head west towards Russia or south towards the Bering Sea. There is limited data to differentiate beluga whales from different stock in regards to the potential takes. Regardless of these limitations, there is a substantial body of data to support the conclusion that individuals from both stocks will react to continuous and impulse sounds in a similar way (i.e., short-term behavioral disturbance) and that any ensuing effects will be negligible despite the fact that the two stocks differ in estimated abundance

It is estimated that a maximum of 1,318 whales from the Beaufort Sea stock (3.4%) and 344 whales from the East Chukchi Sea stock (9.3%) of beluga whales could be taken by Level B harassment. Potential impacts to beluga whales from Shell's exploration drilling activity include brief behavioral disturbances and temporary avoidance of the ensonified areas.

No biologically important area exists for beluga whales in the vicinity of Shell's exploration drilling activities (Clarke *et al.*, 2015).

Gray whales:

Gray whales occur in the northeastern Chukchi Sea during the summer and early fall to feed. Gray whales were often seen feeding in September and October near Hanna Shoal in the late 1980s and early 1990s (Clarke and Moore, 2002), but they have been seen there rarely during aerial surveys since 2008. Therefore, Hanna Shoal is not considered as a biologically important area for gray whale feeding (Clarke *et al.* 2013; 2015).

It is estimated that a maximum of 834 gray whales ([4.4%) could be taken by Level B harassment. Potential impacts to gray whales from Shell's exploration drilling activity will be

limited to brief behavioral disturbances and temporary avoidance of the ensonified areas.

No biologically important area exists for gray whales overlaps with Shell's exploration drilling area (the gray whale reproduction and feeding BIAs during the summer and fall are approximately 75 – 100 km from Shell's study area (Clarke *et al.* 2015)).

Other Cetaceans (Less frequently encountered species):

Other cetacean species are much rarer in the proposed project area. Killer whales, harbor porpoises, fin whales, humpback whales, and minke whales are species less frequently encountered in the vicinity of Shell's exploration drilling area. The exposure of these cetaceans to sounds produced by exploratory drilling operations (i.e., drilling units, ice management/icebreaking, and airgun operations) is not expected to result in more than Level B harassment. No biologically important areas exist for these less frequently encountered species in the vicinity of Shell's exploration drilling activities.

Ringed seals:

Ringed seals are the most abundant pinniped species to be encountered in the proposed Shell exploration drilling area. However, as stated in the **Federal Register** notice (80 FR 11726; March 4, 2015) for the proposed IHA, they appear to be more tolerant of anthropogenic sound, especially at lower received levels, than other marine mammals, such as mysticetes. Shell's proposed activities would occur at a time of year when ringed seals found in the region are not molting, breeding, or pupping. Therefore, these important life functions would not be impacted by Shell's proposed activities. The exposure of pinnipeds to sounds produced by Shell's proposed exploratory drilling operations in the Chukchi Sea is not expected to result in more than Level B harassment of individuals from ringed seals.

It is estimated that maxima of 25,217 ringed seals (8.4%) could be taken by Level B harassment. After taking into account our revised turnover rate, this is a reduction from the 16.8% estimate presented in our **Federal Register** Notice of Proposed IHA. Potential impacts to these species from Shell's exploration drilling activity include brief behavioral disturbances and temporary avoidance of the ensonified areas.

No biologically important area exists for seals in the vicinity of Shell's exploration drilling activities.

Other Pinnipeds (Less frequently encountered species):

Few other seals are expected to occur in the proposed project area, as several of the species prefer more nearshore waters. Additionally, as stated in the **Federal Register** notice (80 FR 11725; March 4, 2015) for the proposed IHA, pinnipeds appear to be more tolerant of anthropogenic sound, especially at lower received levels, than other marine mammals, such as mysticetes. Shell's proposed activities would occur at a time of year when the ice seal species found in the region are not molting, breeding, or pupping. Therefore, these important life functions would not be impacted by Shell's proposed activities. The exposure of pinnipeds to sounds produced by Shell's proposed exploratory drilling operations in the Chukchi Sea is not expected to result in more than Level B harassment of individuals from the affected species or stocks.

It is estimated that maxima of 1,722 bearded seal, 96 ribbon seals, and 1,007 spotted seals could be taken by Level B harassment. Potential impacts to these species from Shell's exploration drilling activity include brief behavioral disturbances and temporary avoidance of the ensonified areas.

No biologically important area exists for seals in the vicinity of Shell's exploration drilling activities.

Of the 12 marine mammal species or stocks likely to occur in the proposed drilling area, four are listed as endangered or threatened under the ESA: the bowhead, humpback, fin whales, and ringed seal. All four species are also designated as "depleted" under the MMPA.

Nevertheless, the Bering-Chukchi-Beaufort stock of bowheads has been increasing at a rate of 3.4% annually for nearly a decade (Allen and Angliss, 2011), even in the face of ongoing industrial activity. Additionally, during the 2001 census, 121 calves were counted, which was the highest yet recorded. The calf count provides corroborating evidence for a healthy and increasing population (Allen and Angliss, 2011). An annual increase of 4.8% was estimated for the period 1987-2003 for North Pacific fin whales. While this estimate is consistent with growth estimates for other large whale populations, it should be used with caution due to uncertainties in the initial population estimate and about population stock structure in the area (Allen and Angliss, 2011).

Zeribini *et al.* (2006, cited in Allen and Angliss, 2011) noted an increase of 6.6% for the Central North Pacific stock of humpback whales in Alaska waters. Certain stocks or populations of gray and beluga whales and spotted seals are listed as endangered or are proposed for listing under the ESA; however, none of those stocks or populations occur in the proposed activity area.

Arctic ringed seals are listed as a threatened species under the ESA and are depleted under the MMPA. NMFS also listed the Beringia bearded seal DPS as threatened, but in July 2014 the U.S. District Court for the District of Alaska vacated the listing rule and remanded the rule to NMFS to correct the deficiencies identified in the opinion. An appeal is pending; in the

interim the species is not listed under the ESA. None of the other species that may occur in the project area is listed as threatened or endangered under the ESA or designated as depleted under the MMPA. There is currently no established critical habitat in the proposed project area for any ESA-listed species. NMFS proposed critical habitat for Arctic ringed seals in December 2014, with a 90-day public comment period that was extended through March 31, 2015. No final rule has been issued.

Potential impacts to marine mammal habitat were discussed previously in this document (see the “**Anticipated Effects on Habitat**” section). Although some disturbance is possible to food sources of marine mammals, the impacts are anticipated to be minor. Based on the vast size of the Arctic Ocean where feeding by marine mammals occurs versus the localized area of the drilling program, and the absence of any known areas of particular importance in the area of Shell’s drilling activities, any missed feeding opportunities in the direct project area would be of little consequence, as marine mammals would have access to other feeding grounds.

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the monitoring and mitigation measures, NMFS finds that the taking of marine mammals from Shell’s proposed 2015 open-water exploration drilling program in the Chukchi Sea is not reasonably likely to adversely affect the species or stocks through effects on annual rates of recruitment or survival and therefore will have a negligible impact on the affected marine mammal species or stocks.

Small Numbers

The estimated takes proposed to be authorized represent less than 1% of the affected

population or stock for six of the species and less than 5.5% for five additional species. The estimated take for ringed seals is 8.4%, and the estimated take for East Chukchi Sea beluga whales is 9.3%. These estimates represent the percentage of each species or stock that could be taken by Level B behavioral harassment if each animal is taken only once.

The estimated take numbers are likely an overestimate for several reasons.

First, a 1.3 dB safety factor was applied to the source level of each continuous sound source prior to sound propagation modeling of areas exposed to Level B thresholds, which make the effective zones for take calculation larger than they likely would be. In addition, Shell applied binning of similar activity scenarios into a representative scenario, each of which reflected the largest exposed area for a related group of activities. Further, the take estimates assume 100% daily turnover of animals (with the exception of bowhead whales and ringed seals, for which a still conservative 48-hour turnover rate is assumed), which likely overestimates the number of different individuals that would be exposed, especially during non-migratory periods. Finally, density estimates for some cetaceans include nearshore areas where more individuals would be expected to occur than in the offshore Burger Prospect area (e.g., gray whales).

Based on the analysis contained herein of the estimated takes of marine mammals,, NMFS finds that small numbers of marine mammals will be taken relative to the population sizes of the affected species or stocks.

Impact on Availability of Affected Species or Stock for Taking for Subsistence Uses

Relevant Subsistence Uses

The disturbance and potential displacement of marine mammals by sounds from drilling activities are the principal concerns related to subsistence use of the area. Subsistence remains

the basis for Alaska Native culture and community. Marine mammals are legally hunted in Alaskan waters by coastal Alaska Natives. In rural Alaska, subsistence activities are often central to many aspects of human existence, including patterns of family life, artistic expression, and community religious and celebratory activities. Additionally, the animals taken for subsistence provide a significant portion of the food that will last the community throughout the year. The main species that are hunted include bowhead and beluga whales, ringed, spotted, and bearded seals. The importance of each of these species varies among the communities and is largely based on availability.

The subsistence communities in the Chukchi Sea that have the potential to be impacted by Shell's offshore drilling program include Point Hope, Point Lay, Wainwright, Barrow, and possibly Kotzebue and Kivalina (however, these two communities are much farther to the south of the proposed project area).

(1) Bowhead Whales

Sound energy and general activity associated with drilling and operation of vessels and aircraft have the potential to temporarily affect the behavior of bowhead whales. Monitoring studies (Davis 1987, Brewer *et al.* 1993, Hall *et al.* 1994) have documented temporary diversions in the swim path of migrating bowheads near drill sites; however, the whales have generally been observed to resume their initial migratory route within a distance of 6-20 mi (10-32 km).

Drilling noise has not been shown to block or impede migration even in narrow ice leads (Davis 1987, Richardson *et al.* 1991).

Behavioral effects on bowhead whales from sound energy produced by drilling, such as avoidance, deflection, and changes in surface/dive ratios, have generally been found to be limited

to areas around the drill site that are ensonified to >160 dB re 1 μ Pa rms, although effects have infrequently been observed out as far as areas ensonified to 120 dB re 1 μ Pa rms. Ensonification by drilling to levels >120 dB re 1 μ Pa rms will be limited to areas within about 0.93 mi (1.5 km) of either drilling units during Shell's exploration drilling program. Shell's proposed drill sites are located more than 64 mi (103 km) from the Chukchi Sea coastline, whereas mapping of subsistence use areas indicates bowhead hunts are conducted within about 30 mi (48 km) of shore; there is therefore little or no opportunity for the proposed exploration drilling activities to affect bowhead hunts.

Vessel traffic along planned travel corridors between the drill sites and marine support facilities in Barrow and Wainwright would traverse some areas used during bowhead harvests by Chukchi villages. Bowhead hunts by residents of Wainwright, Point Hope and Point Lay take place almost exclusively in the spring prior to the date on which Shell would commence the proposed exploration drilling program. From 1984 through 2009, all bowhead harvests by these Chukchi Sea villages occurred only between April 14 and June 24 (George and Tarpley 1986; George *et al.* 1987, 1988, 1990, 1992, 1995, 1998, 1999, 2000; Philo *et al.* 1994; Suydam *et al.* 1995, 1996, 1997, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010), and Shell will not enter the Chukchi Sea prior to July 1. However, fall whaling by some of these Chukchi Sea villages has occurred since 2010 and is likely to occur in the future, particularly if bowhead quotas are not completely filled during the spring hunt, and fall weather is accommodating. A Wainwright whaling crew harvested the first fall bowhead for these villages in 90 years or more on October 7, 2010, and another in October of 2011 (Suydam *et al.* 2011, 2012, 2013). No bowhead whales were harvested during fall in 2012, but 3 were harvested by Wainwright in fall

2013.

Barrow crews have traditionally hunted bowheads during both spring and fall; however spring whaling by Barrow crews is normally finished before the date on which Shell operations would commence. From 1984 through 2011 whales were harvested in the spring by Barrow crews only between April 23 and June 15 (George and Tarpley 1986; George *et al.* 1987, 1988, 1990, 1992, 1995, 1998, 1999, 2000; Philo *et al.* 1994; Suydam *et al.* 1995, 1996, 1997, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2103). Fall whaling by Barrow crews does take place during the time period when vessels associated with Shell's exploration drilling program would be in the Chukchi Sea. From 1984 through 2011, whales were harvested in the fall by Barrow crews between August 31 and October 30, indicating that there is potential for vessel traffic to affect these hunts. Most fall whaling by Barrow crews, however, takes place east of Barrow along the Beaufort Sea coast, therefore providing little opportunity for vessel traffic associated with Shell's exploration drilling program to affect them. For example, Suydam *et al.* (2008) reported that in the previous 35 years, Barrow whaling crews harvested almost all their whales in the Beaufort Sea to the east of Point Barrow. Shell's mitigation measures, which include a system of Subsistence Advisors (SAs), Community Liaisons, and Com Centers, will be implemented to avoid any effects from vessel traffic on fall whaling in the Chukchi Sea by Barrow and Wainwright.

Aircraft traffic (helicopters and small fixed wing airplanes) between the drill sites and facilities in Wainwright and Barrow would also traverse these subsistence areas. Flights between the drill sites and Wainwright or other shoreline locations would take place after the date on which spring bowhead whaling out of Point Hope, Point Lay, and Wainwright is typically

finished for the year; however, Wainwright has harvested bowheads in the fall since 2010 and aircraft may traverse areas sometimes utilized for these fall hunts. Aircraft overflights between the drill sites and Barrow or other shoreline locations could also occur over areas used by Barrow crews during fall whaling, but again, most fall whaling by Barrow crews takes place to the east of Barrow in the Beaufort Sea. The most commonly observed reactions of bowheads to aircraft traffic are hasty dives, but changes in orientation, dispersal, and changes in activity are sometimes noted. Such reactions could potentially affect subsistence hunts if the flights occurred near and at the same time as the hunt, but Shell has developed and proposes to implement a number of mitigation measures to avoid such impacts. These mitigation measures include minimum flight altitudes, employment of SAs, and Com Centers. Twice-daily calls are held during the exploration drilling program and are attended by operations staff, logistics staff, and SAs. Vessel movements and aircraft flights are adjusted as needed and planned in a manner that avoids potential impacts to bowhead whale hunts and other subsistence activities.

(2) Beluga Whale

Beluga whales typically do not represent a large proportion of the subsistence harvests by weight in the communities of Wainwright and Barrow, the nearest communities to Shell's planned exploration drilling program. Barrow residents hunt beluga in the spring (normally after the bowhead hunt) in leads between Point Barrow and Skull Cliffs in the Chukchi Sea, primarily in April-June and later in the summer (July-August) on both sides of the barrier island in Elson Lagoon/Beaufort Sea (Minerals Management Service [MMS] 2008), but harvest rates indicate the hunts are not frequent. Wainwright residents hunt beluga in April-June in the spring lead system, but this hunt typically occurs only if there are no bowheads in the area. Communal hunts

for beluga are conducted along the coastal lagoon system later in July-August.

Belugas typically represent a much greater proportion of the subsistence harvest in Point Lay and Point Hope. Point Lay's primary beluga hunt occurs from mid-June through mid-July, but can sometimes continue into August if early success is not sufficient. Point Hope residents hunt beluga primarily in the lead system during the spring (late March to early June) bowhead hunt, but also in open water along the coastline in July and August. Belugas are harvested in coastal waters near these villages, generally within a few miles from shore. Shell's proposed drill sites are located more than 60 mi (97 km) offshore, therefore proposed exploration drilling in the Burger Prospect would have no or minimal impacts on beluga hunts. Aircraft and vessel traffic between the drill sites and support facilities in Wainwright, and aircraft traffic between the drill sites and air support facilities in Barrow, would traverse areas that are sometimes used for subsistence hunting of belugas.

Disturbance associated with vessel and aircraft traffic could therefore potentially affect beluga hunts. However, all of the beluga hunt by Barrow residents in the Chukchi Sea, and much of the hunt by Wainwright residents, would likely be completed before Shell activities commence. Additionally, vessel and aircraft traffic associated with Shell's planned exploration drilling program will be restricted under normal conditions to designated corridors that remain onshore or proceed directly offshore thereby minimizing the amount of traffic in coastal waters where beluga hunts take place. The designated vessel and aircraft traffic corridors do not traverse areas indicated in recent mapping as utilized by Point Lay or Point Hope for beluga hunts, and avoids important beluga hunting areas in Kasegaluk Lagoon that are used by Wainwright. Shell has developed a number of mitigation measures, e.g., PSOs on board vessels,

minimum flight altitudes, and the SA and Com Center programs, to ensure that there is no impact on the availability of the beluga whale as a subsistence resource.

(3) Pinnipeds

Seals are an important subsistence resource and ringed seals make up the bulk of the seal harvest. Most ringed and bearded seals are harvested in the winter or in the spring before Shell's exploration drilling program would commence, but some harvest continues during open water and could possibly be affected by Shell's planned activities. Spotted seals are also harvested during the summer. Most seals are harvested in coastal waters, with available maps of recent and past subsistence use areas indicating seal harvests have occurred only within 30-40 mi (48-64 km) of the coastline. Shell's planned drill sites are located more than 64 statute mi (103 km) offshore, so activities within the Burger Prospect, such as drilling, would have no impact on subsistence hunting for seals. Helicopter traffic between land and the offshore exploration drilling operations could potentially disturb seals and, therefore, subsistence hunts for seals, but any such effects would be minor and temporary lasting only minutes after the flight has passed due to the small number of flights and the altitude at which they typically fly, and the fact that most seal hunting is done during the winter and spring when the exploration drilling program is not operational. Mitigation measures to be implemented by Shell include minimum flight altitudes, employment of subsistence advisors in the villages, and operation of Com Centers.

Potential Impacts to Subsistence Uses

NMFS has defined "unmitigable adverse impact" in 50 CFR 216.103 as: "an impact resulting from the specified activity: (1) That is likely to reduce the availability of the species to a level insufficient for a harvest to meet subsistence needs by: (i) Causing the marine mammals to

abandon or avoid hunting areas; (ii) Directly displacing subsistence users; or (iii) Placing physical barriers between the marine mammals and the subsistence hunters; and (2) That cannot be sufficiently mitigated by other measures to increase the availability of marine mammals to allow subsistence needs to be met.

Noise and general activity during Shell's proposed drilling program have the potential to impact marine mammals hunted by Native Alaskans. In the case of cetaceans, the most common reaction to anthropogenic sounds (as noted previously in this document) is avoidance of the ensonified area. In the case of bowhead whales, this often means that the animals divert from their normal migratory path by several kilometers. Helicopter activity also has the potential to disturb cetaceans and pinnipeds by causing them to vacate the area. Additionally, general vessel presence in the vicinity of traditional hunting areas could negatively impact a hunt. Native knowledge indicates that bowhead whales become increasingly "skittish" in the presence of seismic noise. Whales are more wary around the hunters and tend to expose a much smaller portion of their back when surfacing (which makes harvesting more difficult). Additionally, Native Alaskans report that bowheads exhibit angry behaviors in the presence of seismic activity, such as tail-slapping, which translates to danger for nearby subsistence harvesters. However, only limited seismic activity is planned in the vicinity of the drill units in 2015.

Plan of Cooperation or Measures to Minimize Impacts to Subsistence Hunts

Regulations at 50 CFR 216.104(a)(12) require IHA applicants for activities that take place in Arctic waters to provide a Plan of Cooperation (POC) or information that identifies what measures have been taken and/or will be taken to minimize adverse effects on the availability of marine mammals for subsistence purposes.

Shell prepared and will implement a POC under the MMPA, which requires that all exploration operations be conducted in a manner that prevents unreasonable conflicts between oil and gas activities and the subsistence activities and resources of residents of the North Slope. This stipulation also requires adherence to USFWS and NMFS regulations, which require an operator to implement a POC to mitigate the potential for conflicts between the proposed activity and traditional subsistence activities (50 CFR 18.124(c)(4) and 50 CFR 216.104(a)(12)). A POC was prepared and submitted with the initial Chukchi Sea EP that was submitted to BOEM in May 2009, and approved on 7 December 2009. Subsequent POC Addendums were submitted in May 2011 with a revised Chukchi Sea EP and the IHA application for the 2012 exploration drilling program. For this IHA application, Shell again updated the POC Addendum. The POC Addendum was updated to include documentation of meetings undertaken to specifically gather feedback from stakeholder communities on Shell's implementation of the Chukchi Sea exploration drilling program during 2012, plus inform and obtain their input regarding the continuation of the program with the addition of a second drilling unit, additional vessels and aircraft.

The POC Addendum identifies the measures that Shell has developed in consultation with North Slope subsistence communities to minimize any adverse effects on the availability of marine mammals for subsistence uses and will implement during its planned Chukchi Sea exploration drilling program for the summer of 2015. In addition, the POC Addendum details Shell's communications and consultations with local subsistence communities concerning its planned exploration drilling program, potential conflicts with subsistence activities, and means of resolving any such conflicts (50 CFR 18.128(d) and 50 CFR 216.104(a) (12) (i), (ii), (iv)). Shell

has documented its contacts with the North Slope subsistence communities, as well as the substance of its communications with subsistence stakeholder groups.

The POC Addendum report (Attachment C of the IHA application) provides a list of public meetings attended by Shell since 2012 to develop the POC and the POC Addendum. The POC Addendum will be updated through July 2015, and includes sign-in sheets and presentation materials used at the POC meetings held in 2014 to present the 2015 Chukchi Sea exploration drilling information. Comment analysis tables for numerous meetings held during 2014 summarize feedback from the communities on Shell's 2015 exploration drilling and planned activities beginning in the summer of 2015. All comments from the communities were addressed in Shell's final POC.

The following mitigation measures, plans and programs, are integral to this POC and were developed during Shell's consultation with potentially affected subsistence groups and communities. These measures, plans, and programs to monitor and mitigate potential impacts to subsistence users and resources will be implemented by Shell during its exploration drilling operations in the Chukchi Sea. The mitigation measures Shell has adopted and will implement during its Chukchi Sea exploration drilling operations are listed and discussed below. These mitigation measures reflect Shell's experience conducting exploration activities in the Alaska Arctic OCS since the 1980s and its ongoing efforts to engage with local subsistence communities to better understand their concerns and develop appropriate and effective mitigation measures to address those concerns. This most recent version of Shell's planned mitigation measures was presented to community leaders and subsistence user groups starting in January 2009 and has evolved since in response to information learned during the consultation process.

To minimize any cultural or resource impacts from its exploration operations, Shell will continue to implement the following additional measures to ensure coordination of its activities with local subsistence users to minimize further the risk of impacting marine mammals and interfering with the subsistence hunt:

(1) Communications

- Shell has developed a Communication Plan and will implement this plan before initiating exploration drilling operations to coordinate activities with local subsistence users, as well as Village Whaling Captains' Associations, to minimize the risk of interfering with subsistence hunting activities, and keep current as to the timing and status of the bowhead whale hunt and other subsistence hunts. The Communication Plan includes procedures for coordination with Com Centers to be located in coastal villages along the Chukchi Sea during Shell's proposed exploration drilling activities.
- Shell will employ local SAs from the Chukchi Sea villages that are potentially impacted by Shell's exploration drilling activities. The SAs will provide consultation and guidance regarding the whale migration and subsistence activities. There will be one per village, working approximately 8-hr per day and 40-hr per week during each drilling season. The subsistence advisor will use local knowledge (Traditional Knowledge) to gather data on subsistence lifestyle within the community and provide advice on ways to minimize and mitigate potential negative impacts to subsistence resources during each drilling season. Responsibilities include reporting any subsistence concerns or conflicts;

coordinating with subsistence users; reporting subsistence-related comments, concerns, and information; coordinating with the Com and Call Center personnel; and advising how to avoid subsistence conflicts.

(2) Aircraft Travel

- Aircraft over land or sea shall not operate below 1,500 ft. (457 m) altitude unless engaged in marine mammal monitoring, approaching, landing or taking off, in poor weather (fog or low ceilings), or in an emergency situation.
- Aircraft engaged in marine mammal monitoring shall not operate below 1,500 ft. (457 m) in areas of active whaling; such areas to be identified through communications with the Com Centers.

(3) Vessel Travel

- The drilling unit(s) and support vessels will enter the Chukchi Sea through the Bering Strait on or after 1 July, minimizing effects on marine mammals and birds that frequent open leads and minimizing effects on spring and early summer bowhead whale hunting.
- The transit route for the drilling unit(s) and drilling support fleets will avoid known fragile ecosystems and the Ledyard Bay Critical Habitat Unit (LBCHU) (for spectacled eiders), and will include coordination through Com Centers.
- PSOs will be aboard the drilling unit(s) and transiting support vessels.
- When within 900 ft (274 m) of whales, vessels will reduce speed, avoid separating members from a group and avoid multiple changes of direction.
- Vessel speed will be reduced during inclement weather conditions in order to

avoid collisions with marine mammals.

- Shell will communicate and coordinate with the Com Centers regarding all vessel transit.

(4) ZVSP

- Airgun arrays will be ramped up slowly during ZVSPs to warn cetaceans and pinnipeds in the vicinity of the airguns and provide time for them to leave the area and avoid potential injury or impairment of their hearing abilities. Ramp ups from a cold start when no airguns have been firing will begin by firing a single airgun in the array. A ramp up to the required airgun array volume will not begin until there has been a minimum of 30 min of observation of the safety zone by PSOs to assure that no marine mammals are present. The safety zone is the extent of the 180 dB radius for cetaceans and 190 dB re 1 μ Pa rms for pinnipeds. The entire safety zone must be visible during the 30-min lead-in to an array ramp up. If a marine mammal(s) is sighted within the safety zone during the 30-min watch prior to ramp up, ramp up will be delayed until the marine mammal(s) is sighted outside of the safety zone or the animal(s) is not sighted for at least 15-30 min: 15 min for small odontocetes and pinnipeds, or 30 min for baleen whales and large odontocetes.

(5) Ice Management

- Real time ice and weather forecasting will be from SIWAC

(6) Oil Spill Response

- Pre-booming is required for all fuel transfers between vessels

The potentially affected subsistence communities, identified in BOEM Lease Sale, that were consulted regarding Shell's exploration drilling activities include: Barrow, Wainwright, Point Lay Point Hope, Kotzebue, and Deering. Additionally, Shell has met with subsistence groups including the Alaska Eskimo Whaling Commission (AEWC), Inupiat Community of the Arctic Slope (ICAS), and the Native Village of Barrow, and presented information regarding the proposed activities to the North Slope Borough (NSB) and Northwest Arctic Borough (NWAB) Assemblies, and NSB and NWAB Planning Commissions during 2014. In July 2014, Shell conducted POC meetings in Chukchi villages to present information on the proposed 2015 drilling season. Shell supplemented the IHA application with a POC addendum to incorporate these POC visits. Throughout 2014 and 2015 Shell anticipates continued engagement with the marine mammal commissions and committees active in the subsistence harvests and marine mammal research.

Shell continues to meet each year with the commissioners and committee heads of AEWC, Alaska Beluga Whale Committee, the Nanuuq Commission, Eskimo Walrus Commission, and Ice Seal Committee jointly in co-management meetings. Shell held individual consultation meetings with representatives from the various marine mammal commissions to discuss the planned Chukchi exploration drilling program. Following the drilling season, Shell will have a post-season co-management meeting with the commissioners and committee heads to discuss results of mitigation measures and outcomes of the preceding season. The goal of the post-season meeting is to build upon the knowledge base, discuss successful or unsuccessful outcomes of mitigation measures, and possibly refine plans or mitigation measures if necessary.

Shell attended the 2012-2014 Conflict Avoidance Agreement (CAA) negotiation

meetings in support of exploration drilling, offshore surveys, and future drilling plans. Shell will do the same for the upcoming 2015 exploration drilling program. Finally, Shell signed the CAA in April 2015.

Unmitigable Adverse Impact Analysis and Determination

NMFS considers that these mitigation measures including measures to reduce overall impacts to marine mammals in the vicinity of the proposed exploration drilling area and measures to mitigate any potential adverse effects on subsistence use of marine mammals are adequate to ensure subsistence use of marine mammals in the vicinity of Shell's proposed exploration drilling program in the Chukchi Sea.

Based on the description of the specified activity, the measures described to minimize adverse effects on the availability of marine mammals for subsistence purposes, and the mitigation and monitoring measures, NMFS has determined that there will not be an unmitigable adverse impact on the availability of marine mammals for taking for subsistence uses from Shell's proposed activities.

Endangered Species Act (ESA)

There are four marine mammal species listed under the ESA with confirmed or possible occurrence in the proposed project area: the bowhead, humpback, and fin whales, and ringed seals. NMFS' Permits and Conservation Division initiated consultation with NMFS Alaska Regional Office (AKRO) under section 7 of the ESA on the issuance of an IHA to Shell under section 101(a)(5)(D) of the MMPA for this activity. In June 2015, NMFS finished conducting its section 7 consultation and issued a Biological Opinion, and concluded that the issuance of the IHA associated with Shell's 2015 Chukchi Sea drilling program is not likely to jeopardize the

continued existence of the endangered bowhead, humpback, and fin whale, and the threatened Arctic sub-species of ringed seal. No critical habitat has been designated for these species, therefore none will be affected.

National Environmental Policy Act (NEPA)

NMFS prepared an EA that includes an analysis of potential environmental effects associated with NMFS' issuance of an IHA to Shell to take marine mammals incidental to conducting an exploration drilling program in the Chukchi Sea, Alaska. NMFS has finalized the EA and prepared a Finding of No Significant Impact for this action. Therefore, preparation of an Environmental Impact Statement is not necessary. NMFS' draft EA was available to the public for a 30-day comment period before it was finalized.

Authorization

As a result of these determinations, NMFS has issued an IHA to Shell for the take of marine mammals, by Level B harassment, incidental to conducting an offshore exploration drilling program in the Chukchi Sea during the 2015 open-water season, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated.

Dated: **JUN 12 2015**



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