DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648–XE403

Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to Geophysical and Geotechnical Survey in Cook Inlet, Alaska

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

ACTION: Notice; proposed incidental harassment authorization; request for comments.

SUMMARY: NMFS has received an application from ExxonMobil Alaska LNG LLC (EMALL) for an Incidental Harassment Authorization (IHA) to take marine mammals, by harassment, incidental to a geophysical and geotechnical survey in Cook Inlet, Alaska. This action is proposed to occur for 16 weeks. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is requesting comments on its proposal to issue an IHA to EMALL to incidentally take, by Level B Harassment only, marine mammals during the specified activity.

DATES: Comments and information must be received no later than March 7, 2016.

ADDRESSES: Comments on the application should be addressed to Jolie Harrison, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910. The mailbox address for providing email comments is *itp.young@noaa.gov.* Comments sent via email, including all attachments, must not exceed a 25-megabyte file size. NMFS is not responsible for comments sent to addresses other than those provided here.

Instructions: All comments received are a part of the public record and will generally be posted to *http://www.nmfs.noaa.gov/pr/permits/incidental.htm* without change. All Personal Identifying Information (for example, name, address, etc.) voluntarily submitted by the commenter may be publicly accessible. Do not submit Confidential Business Information or otherwise sensitive or protected information.

An electronic copy of the application may be obtained by writing to the address specified above, telephoning the contact listed below (see **FOR FURTHER INFORMATION CONTACT**), or visiting the internet at: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm.* The following associated documents are also available at the same internet address: Draft Environmental Assessment.

FOR FURTHER INFORMATION CONTACT: Sara Young, Office of Protected Resources, NMFS, (301) 427–8484.

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 October 5, 2015, NMFS received an application from EMALL for the taking of marine mammals incidental to a geotechnical and geophysical survey in Cook Inlet, Alaska. NMFS determined that the application was adequate and complete on December 22, 2015.

EMALL proposes to conduct a geophysical and geotechnical survey in Cook Inlet to investigate the technical suitability of a pipeline study corridor across Cook Inlet and potential marine terminal locations near Nikiski. The proposed activity would occur for 16 weeks during the 2016 open water season beginning on March 1, 2016. The following specific aspects of the proposed activities are likely to result in the take of marine mammals: Use of a seismic airgun, sub-bottom profiler (chirp and boomer), and a vibracore. Take, by Level B Harassment only, of individuals of four species of marine mammals is anticipated to result from the specified activities.

EMALL received an Authorization for 2015 to conduct a similar suite of activities using the same technologies. The Authorization was issued for 84 days beginning August 14, 2015 (80 FR 50989).

Description of the Specified Activity

Overview

The planned geophysical surveys involve remote sensors including single beam echo sounder, multibeam echo sounder, sub-bottom profiler (chirp and boomer), 0.983 L (60 in^3) airgun array, side scan sonar, geophysical resistivity meters, and magnetometer to characterize the bottom surface and subsurface. The planned shallow geotechnical investigations include vibracoring, sediment grab sampling, and piezo-cone penetration testing (PCPT) to directly evaluate seabed features and soil conditions. Geotechnical borings are planned at potential shoreline crossings and in the terminal boring subarea within the Marine Terminal survey area, and will be used to collect information on the mechanical properties of in-situ soils to support feasibility studies for construction crossing techniques and decisions on siting and design of pilings, dolphins, and other marine structures. Geophysical resistivity imaging will be conducted at the potential shoreline crossings. Shear wave velocity profiles (downhole geophysics) will be conducted within some of the boreholes. Further details of the planned operations are provided below.

Dates and Duration

EMALL expects operations to occur 102 days during the 2016 open-water season between March 2016 and November 2016. Operations in the pipeline survey area would occur for approximately 46 days, and operations in the marine facilities survey area and

LNG carrier (LNGC) approach survey area would occur for a total of approximately 56 days. Approximately 100 km (62 mi) of transect line (the linear distance traveled by the survey vessel) would be surveyed on an average day. The use of an air gun from a stationary platform would occur over an estimated 24 days in the marine facilities survey area. Vibracoring would occur approximately 120 times (estimated 60 days) during the 2016 open-water season between March 2016 and November 2016. It is expected that on average, two vibracores would be conducted each day depending on tides and currents, with the sound source operating for a few minutes each time the equipment is deployed. The survey days may not be consecutive, given operational limitations including but not limited to tides, currents, hours of daylight, vessel resupply, personnel fatigue days, weather, and simultaneous operations. The activities would be scheduled in such a manner as to minimize potential effects to marine mammals, subsistence activities, and other users of the Cook Inlet. EMALL will engage with NMFS should the program require additional time to complete.

Specified Geographic Region

Three separate areas will be surveyed in Cook Inlet. The survey areas are shown in Figure 1 of the application. The survey areas were sized to provide siting flexibility for future infrastructure to avoid existing hazards.

The pipeline survey area (Figure 2 in the application) extends in the marine waters of Cook Inlet from the northwest shoreline of Upper Cook Inlet near the communities of Tyonek and Beluga to the southeast shoreline of Upper Cook Inlet near Boulder Point on the Kenai Peninsula. This survey area is approximately 47 km (29 mi) in length and averages approximately 16 km (10 mi) wide. The pipeline survey area is 795 km^2 (307 mi^2).

The marine facilities survey area and LNGC approach survey areas (Figure 3 in the application) are located in the marine waters of Cook Inlet near the eastern shoreline of what is defined as the northern region of Lower Cook Inlet, south of the Forelands and adjacent to Nikiski on the Kenai Peninsula. The marine facilities survey area encompasses 109 km^2 (42 mi^2) and the LNGC approach survey area encompasses 79 km^2 (30 mi^2).

In the LNGC approach survey area, the chirp and boomer sub-bottom profilers will be operated simultaneously. The marine facilities survey area will be surveyed twice: Once with the chirp and boomer sub-bottom profilers operated simultaneously, and once with the air gun and chirp subbottom profiler operated simultaneously. The pipeline survey area will also be surveyed twice: Once with the chirp and boomer sub-bottom profilers operated simultaneously and once with the boomer sub-bottom profiler and air gun operated simultaneously. Use of an air gun from a stationary platform will be conducted only in the marine facilities survey area. Vibracoring may be conducted throughout all of the survey areas.

Detailed Description of Activities

The details of this activity are broken down into two categories for further description and analysis: Geophysical surveys and geotechnical surveys.

Geophysical Surveys

The types of acoustical geophysical equipment planned for use in the Cook Inlet 2016 G&G Program are indicated in Table 1 in the application. The equipment includes: Sub-bottom profilers (chirp and boomer), 0.983 L (60 in^3) airgun, and vibracore.

Downhole geophysics is included in the table as a sound source, but is not considered further in this assessment as the energy source will not generate significant sound energy within the water column since the equipment will be located downhole within the geotechnical boreholes. The transmitter (source) and receiver are both housed within the same probe or tool that is lowered into the hole on a wireline. The suspension log transmitter is an electromechanical device. It consists of a metallic barrel (the hammer) disposed horizontally in the tool and actuated by an electromagnet (solenoid) to hit the inside of tool body (the plate). The fundamental H1 mode is at about 4.5 KHz, and H2 is at 9 KHz. An extra resonance (unknown) mode is also present at about 15 Khz. An analysis performed to estimate the expected sound level of the proposed borehole logging equipment scaled the sound produced by a steel pile driven by a hammer (given that both are cylindrical noise sources and produce impulsive sounds) and concluded that the sound level produced at 25 m by the borehole logging equipment would be less than 142 dB. This is not considering the confining effect of the borehole which would lower the sound level even further (I&R, 2015).

The other types of geophysical equipment proposed for the 2015 program will generate impulsive sound in the water column and are described below Information on the acoustic characteristics of geophysical and geotechnical sound sources is also summarized in Table 2 in the application, followed by a corresponding description of each piece of equipment to be used.

Sub-Bottom Profiler—Chirp

The chirp sub-bottom profiler planned for use in this program is a precisely controlled ''chirp'' system that emits high-energy sounds with a resolution of one millisecond (ms) and is used to penetrate and profile the shallow sediments near the sea floor. At operating frequencies of 2 to 16 kHz (Table 2 in application), this system will be operating at the lower end of the hearing range of beluga whales and well below the most sensitive hearing range of beluga whales (45–80 kHz, Castellote *et al.* 2014), killer whales (18–42 kHz; Szymanski *et al.* 1999) and harbor porpoises (16–140 kHz; Kastelein *et al.* 2002). The source level is estimated at 202 dB re 1 μPa-m (rms). The beam width is 24 degrees and pointed downward. The chirp will be used in combination with the boomer, and separately in combination with the air gun.

Sub-Bottom Profiler—Boomer

A boomer sub-bottom profiling system with a penetration depth of up to 600 ms and resolution of 2 to 10 ms will be used to penetrate and profile the Cook Inlet sediments to an intermediate depth. The system will be towed behind the vessel. With a sound energy source level of about 205 dB re 1 μPa-m (rms) at frequencies of 0.5 to 6 kHz (Table 2 in application), most of the sound energy generated by the boomer will be at frequencies that are well below peak hearing sensitivities of beluga whales (45–80 kHz; Castellote *et al.* 2014), but would still be detectable by these animals. The boomer is pointed downward but the equipment is omni-directional so the physical orientation is irrelevant.

Airgun

A 0.983 L (60 in^3) airgun or airgun array of equal or lesser volume will be used to gather high resolution profiling at greater depths below the seafloor. The published source level from Sercel (the manufacturer) for a 0.983 L (60 in^3) airgun is 216 dB re 1 μPa-m (equating to about 206 dB re 1 μPa-m (rms). These airguns typically produce sound levels at frequencies of less than 1 kHz (Richardson *et al.* 1995, Zykov and Carr 2012), or below the most sensitive hearing of beluga whales (45–80 kHz; Castellote *et al.* 2014), but within the functional hearing of these animals (>75 Hz; Southall *et al.* 2007). The airgun will only be used during geophysical surveys conducted in the Marine Facilities area (Lower Inlet).

Geotechnical Surveys

Shallow Geotechnical Investigations—Vibracores

Vibracoring is conducted to obtain cores of the seafloor sediment from the surface down to a depth of about 6.1 m (20 ft). The cores are later analyzed in the laboratory for moisture, organic and carbonate content, shear strength, and grain size. Vibracore samplers consist of a 10-cm (4.0-in) diameter core barrel and a vibratory driving mechanism mounted on a four-legged frame, which is lowered to the seafloor. The electric motor driving mechanism oscillates the core barrel into the sediment where a core sample is then extracted. The duration of the operation varies with substrate type, but generally the sound source (driving mechanism) is operable for only the one or two minutes it takes to complete the 6.1-m (20-ft) bore and the entire setup process often takes less than one hour.

Chorney *et al.* (2011) conducted sound measurements on an operating vibracorer in Alaska and found that it emitted a sound pressure level at 1-m source of 187.4 dB re 1 µPa-m (rms), with a frequency range of between 10 Hz and 20 kHz (Table 2). Vibracoring will result in the largest zone of influence (ZOI; area ensonified by sound energy greater than the 120 dB threshold) among the continuous sound sources. Vibracoring would also have a very small effect on the benthic habitat. Vibracoring will be conducted approximately 120 times over 60 days.

Because of the very brief duration within a day (each event lasting 1 or 2-minute periods) of this continuous, non-impulsive sound, combined with the small number of days the source will be used overall, NMFS does not believe that the vibracore operations will result in the take of marine mammals. However, because the applicant requested take from this source and included a quantitative analysis in their application, that analysis will be included here for reference and opportunity for public comment.

Vessels

Vessels used in the program will be approximately 15–42 m (50–140 ft) in length and 4.5–15 m (15–50 ft) in width (beam) with approximately 750–1500 horsepower. When used in combination, the air gun and chirp and boomer sub-bottom profilers will typically be deployed from the same survey vessel. Vibracoring may be conducted from a separate survey vessel. The air gun may also be used from a stationary platform or barge.

Description of Marine Mammals in the Area of the Specified Activity

Marine mammals that regularly inhabit upper Cook Inlet and Nikiski activity areas are the beluga whale (*Delphinapterus leucas*), harbor porpoise (*Phocoena phocoena*), and harbor seal (*Phoca vitulina*) (Table 6). However, these species are found there in relatively low numbers, and generally only during the summer fish runs (Nemeth *et al.* 2007, Boveng *et al.* 2012). Killer whales (*Orcinus orca*) are occasionally observed in upper Cook Inlet where they have been observed attempting to prey on beluga whales (Shelden *et al.* 2003). Based on a number of factors, Shelden *et al.* (2003) concluded that the killer whales found in upper Cook Inlet to date are the transient type, while resident types occasionally enter lower Cook Inlet. Marine mammals occasionally found in lower Cook Inlet include humpback whales (*Megaptera novaeangliae*), gray whales (*Eschrichtius robustus*), minke whales (*Balaenoptera acutorostrata*), Dall's porpoise (*Phocoena dalli*), and Steller sea lion (*Eumetopias jubatus).* Background information of species found in Upper Cook Inlet is detailed in Table 1 below.

TABLE 1—MARINE MAMMALS INHABITING THE COOK INLET ACTION AREA

Species	Stock	ESA/MMPA status[1]; strategic (Y/N)	Stock abundance (CV, N_{min}, most recent abundance survey)[2]	Relative occurrence in Cook Inlet; season of occurrence
Killer whale	Alaska Resident	–;N	2,347 (N/A; 2,084; 2009)	Occasionally sighted in Lower Cook Inlet.
	Alaska Transient	–:N	345 (N/A; 303; 2003)	
Beluga whale	Cook Inlet	E/D;Y	312 (0.10; 280; 2012)	Use upper Inlet in summer and lower in winter: Annual.
Harbor porpoise	Gulf of Alaska	–;Y	31,046 (0.214; 25,987; 1998)	Widespread in the Inlet: Annual (less in winter).
Harbor seal	Cook Inlet/Shelikof	–;N	22,900 (0.053; 21,896; 2006)	Frequently found in upper and lower inlet; annual (more in northern Inlet in summer).

[1] ESA status: Endangered (E), Threatened (T)/MMPA status: Depleted (D). A dash (–) indicates that the species is not listed under the ESA or designated as depleted under the MMPA. Under the MMPA, a strategic stock is one for which the level of direct human-caused mortality exceeds PBR (see footnote 3) or which is determined to be declining and likely to be listed under the ESA within the foreseeable future. Any species or stock listed under the ESA is automatically designated under the MMPA as depleted and as a strategic stock.

[2] CV is coefficient of variation; N_{min} is the minimum estimate of stock abundance. In some cases, CV is not applicable. For certain stocks, abundance estimates are actual counts of animals and there is no associated CV. The most recent abundance survey that is reflected in the abundance estimate is presented; there may be more recent surveys that have not yet been incorporated into the estimate.

Beluga Whale (Delphinapterus leucas)

The Cook Inlet beluga whale Distinct Population Segment (DPS) is a small geographically isolated population that is separated from other beluga populations by the Alaska Peninsula. The population is genetically (mtDNA) distinct from other Alaska populations, suggesting that the Peninsula is an effective barrier to genetic exchange (O'Corry-Crowe *et al.* 1997) and that these whales may have been separated from other stocks at least since the last ice age. Laidre *et al.* (2000) examined data from over 20 marine mammal surveys conducted in the northern Gulf of Alaska and found that sightings of belugas outside Cook Inlet were exceedingly rare, and these were composed of a few stragglers from the Cook Inlet DPS observed at Kodiak Island, Prince William Sound, and Yakutat Bay. Several marine mammal surveys specific to Cook Inlet (Laidre *et al.* 2000, Speckman and Piatt 2000), including those that concentrated on beluga whales (Rugh *et al.* 2000, 2005a), clearly indicate that this stock largely confines itself to Cook Inlet. There is no indication that these whales make forays into the Bering Sea where they might intermix with other Alaskan stocks.

The Cook Inlet beluga DPS was originally estimated at 1,300 whales in 1979 (Calkins 1989) and has been the focus of management concerns since experiencing a dramatic decline in the 1990s. Between 1994 and 1998 the stock declined 47%, which has been attributed to overharvesting by subsistence hunting. During that period, subsistence hunting was estimated to have annually removed 10–15% of the population. Only five belugas have been harvested since 1999, yet the population has continued to decline (Allen and Angliss 2014), with the most recent estimate at only 312 animals (Allen and Angliss 2014). The NMFS listed the population as ''depleted'' in 2000 as a consequence of the decline, and as ''endangered'' under the ESA in 2008 when the population failed to recover following a moratorium on subsistence harvest. In April 2011, the NMFS designated critical habitat for the Cook Inlet beluga whale under the ESA (Figure 2 in the application).

Prior to the decline, this DPS was believed to range throughout Cook Inlet and occasionally into Prince William Sound and Yakutat (Nemeth *et al.* 2007). However, the range has contracted coincident with the population reduction (Speckman and Piatt 2000). During the summer and fall, beluga whales are concentrated near the Susitna River mouth, Knik Arm, Turnagain Arm, and Chickaloon Bay (Nemeth *et al.* 2007) where they feed on migrating eulachon (*Thaleichthys pacificus*) and salmon (Onchorhynchus spp.) (Moore *et al.* 2000). The limits of Critical Habitat Area 1 reflect the summer distribution (Figure 4 in the application). During the winter, beluga whales concentrate in deeper waters in the mid-inlet to Kalgin Island, and in the shallow waters along the west shore of Cook Inlet to Kamishak Bay. The limits of Critical Habitat Area 2 reflect the winter distribution. Some whales may also winter in and near Kachemak Bay.

Goetz *et al.* (2012) modeled beluga use in Cook Inlet based on the NMFS aerial surveys conducted between 1994 and 2008. The combined model results shown in Figure 3 in the application indicate a very clumped distribution of summering beluga whales, and that lower densities of belugas are expected to occur in most of the pipeline survey area (but not necessarily specific G&G survey locations; see Section 6.3 in the application) and the vicinity of the proposed Marine Terminal. However, Cook Inlet beluga whales begin moving into Knik Arm around August 15 where they spend about a month feeding on Eagle River salmon. The area between Nikiski, Kenai, and Kalgin Island provides important wintering habitat for Cook Inlet beluga whales. Use of this area would be expected between fall and spring, with animals largely absent during the summer months when G&G surveys would occur (Goetz *et al.* 2012).

Killer Whale (Orcinus orca)

Two different stocks of killer whales inhabit the Cook Inlet region of Alaska: The Alaska Resident Stock and the Gulf of Alaska, Aleutian Islands, Bering Sea Transient Stock (Allen and Angliss 2014). The Alaska Resident killer whale stock is estimated at 2,347 animals and occurs from Southeast Alaska to the Bering Sea (Allen and Angliss 2014). Resident killer whales feed exclusively on fish and are genetically distinct from transient whales (Saulitis *et al.* 2000).

The transient killer whales feed primarily on marine mammals (Saulitis *et al.* 2000). The transient population inhabiting the Gulf of Alaska shares mitochondrial DNA haplotypes with whales found along the Aleutian Islands and the Bering Sea, suggesting a common stock, although there appears to be some subpopulation genetic structuring occurring to suggest the gene flow between groups is limited (see Allen and Angliss 2014). For the three regions combined, the transient population has been estimated at 587 animals (Allen and Angliss 2014).

Killer whales are occasionally observed in lower Cook Inlet, especially near Homer and Port Graham (Shelden *et al.* 2003, Rugh *et al.* 2005a). The few whales that have been photographically identified in lower Cook Inlet belong to resident groups more commonly found in nearby Kenai Fjords and Prince William Sound (Shelden *et al.* 2003). Prior to the 1980s, killer whale sightings in upper Cook Inlet were very rare. During aerial surveys conducted between 1993 and 2004, killer whales were observed on only three flights, all in the Kachemak and English Bay area (Rugh *et al.* 2005a). However, anecdotal reports of killer whales feeding on belugas in upper Cook Inlet began increasing in the 1990s, possibly in response to declines in sea lion and harbor seal prey elsewhere (Shelden *et al.* 2003). These sporadic ventures of transient killer whales into beluga summering grounds have been implicated as a possible contributor to the decline of Cook Inlet belugas in the 1990s, although the number of confirmed mortalities from killer whales is small (Shelden *et al.* 2003). If killer whales were to venture into upper Cook Inlet in 2015, they might be encountered during the G&G Program.

Harbor Porpoise (Phocoena phocoena)

Harbor porpoise are small (approximately 1.2 m [4 ft] in length), relatively inconspicuous toothed whales. The Gulf of Alaska Stock is distributed from Cape Suckling to Unimak Pass and was most recently estimated at 31,046 animals (Allen and Angliss 2014). They are found primarily in coastal waters less than 100 m (328 ft) deep (Hobbs and Waite 2010) where they feed on Pacific herring (*Clupea pallasii*), other schooling fishes, and cephalopods.

Although they have been frequently observed during aerial surveys in Cook Inlet, most sightings of harbor porpoise are of single animals, and are concentrated at Chinitna and Tuxedni bays on the west side of lower Cook Inlet (Rugh *et al.* 2005a). Dahlheim *et al.* (2000) estimated the 1991 Cook Inlet-wide population at only 136 animals. Also, during marine mammal monitoring efforts conducted in upper Cook Inlet by Apache from 2012 to 2014, harbor porpoise represented less than 2% of all marine mammal sightings. However, they are one of the three marine mammals (besides belugas and harbor seals) regularly seen in upper Cook Inlet (Nemeth *et al.* 2007), especially during spring eulachon and summer salmon runs. Because harbor porpoise have been observed throughout Cook Inlet during the summer months, including mid-inlet waters, they represent species that might be encountered during G&G Program surveys in upper Cook Inlet.

Harbor Seal (Phoca vitulina)

At over 150,000 animals state-wide (Allen and Angliss 2014), harbor seals are one of the more common marine mammal species in Alaskan waters. They are most commonly seen hauled out at tidal flats and rocky areas. Harbor seals feed largely on schooling fish such as Alaska Pollock, Pacific cod, salmon, Pacific herring, eulachon, and squid. Although harbor seals may make seasonal movements in response to prey, they are resident to Alaska and do not migrate.

The Cook Inlet/Shelikof Stock, ranging from approximately Anchorage down along the south side of the Alaska Peninsula to Unimak Pass, has been recently estimated at a stable 22,900 (Allen and Angliss 2014). Large numbers concentrate at the river mouths and embayments of lower Cook Inlet, including the Fox River mouth in Kachemak Bay (Rugh *et al.* 2005a). Montgomery *et al.* (2007) recorded over 200 haulout sites in lower Cook Inlet alone. However, only a few dozen to a couple hundred seals seasonally occur in upper Cook Inlet (Rugh *et al.* 2005a), mostly at the mouth of the Susitna River where their numbers vary with the spring eulachon and summer salmon runs (Nemeth *et al.* 2007, Boveng *et al.* 2012). Review of NMFS aerial survey data collected from 1993–2012 (Shelden *et al.* 2013) finds that the annual high counts of seals hauled out in Cook Inlet ranged from about 100–380, with most of these animals hauling out at the mouths of the Theodore and Lewis Rivers. There are certainly thousands of harbor seals occurring in lower Cook Inlet, but no references have been found showing more than about 400 harbor seals occurring seasonally in upper Cook Inlet. In 2012, up to 100 harbor seals were observed hauled out at the mouths of the Theodore and Lewis rivers (located about 16 km [10 mi] northeast of the pipeline survey area) during monitoring activity associated with Apache's 2012 Cook Inlet seismic program, and harbor seals constituted 60 percent of all marine mammal sightings by Apache observers during 2012 to 2014 survey and monitoring efforts (L. Parker, Apache, pers. comm.). Montgomery *et al.* (2007) also found that seals elsewhere in Cook Inlet move in response to local steelhead (*Onchorhynchus mykiss*) and salmon runs. Harbor seals may be encountered during G&G surveys in Cook Inlet.

Humpback Whale (Megaptera novaeangliae)

Although there is considerable distributional overlap in the humpback whale stocks that use Alaska, the whales seasonally found in lower Cook Inlet are probably of the Central North Pacific stock. Listed as endangered under the ESA, this stock has recently been estimated at 7,469, with the portion of the stock that feeds in the Gulf of Alaska estimated at 2,845 animals (Allen and Angliss 2014). The Central North Pacific stock winters in Hawaii and summers from British Columbia to the Aleutian Islands (Calambokidis *et al.* 1997), including Cook Inlet.

Humpback use of Cook Inlet is largely confined to lower Cook Inlet. They have been regularly seen near Kachemak Bay during the summer months (Rugh *et al.* 2005a), and there is a whale-watching venture in Homer capitalizing on this seasonal event. There are anecdotal observations of humpback whales as far north as Anchor Point, with recent summer observations extending to Cape Starichkof (Owl Ridge 2014). Because of the southern distribution of humpbacks in Cook Inlet, it is unlikely that they will be encountered during this activity in close enough proximity to cause Level B harassment. Therefore, no take is authorized for humpback whales.

Gray Whale (Eschrichtius robustus)

Each spring, the Eastern North Pacific stock of gray whale migrates 8,000 kilometers (5,000 miles) northward from breeding lagoons in Baja California to feeding grounds in the Bering and Chukchi seas, reversing their travel again in the fall (Rice and Wolman 1971). Their migration route is for the most part coastal until they reach the feeding grounds. A small portion of whales do not annually complete the full circuit, as small numbers can be found in the summer feeding along the Oregon, Washington, British Columbia, and Alaskan coasts (Rice *et al.* 1984, Moore *et al.* 2007).

Human exploitation reduced this stock to an estimated ''few thousand'' animals (Jones and Schwartz 2002). However, by the late 1980s, the stock was appearing to reach carrying capacity and estimated to be at 26,600 animals (Jones and Schwartz 2002). By 2002, that stock had been reduced to about 16,000 animals, especially following unusually high mortality events in 1999 and 2000 (Allen and Angliss 2014). The stock has continued to grow since then and is currently estimated at 19,126 animals with a minimum estimate of 18,017 (Carretta *et al.* 2013).

Most gray whales migrate past the mouth of Cook Inlet to and from northern feeding grounds. However, small numbers of summering gray whales have been noted by fisherman near Kachemak Bay and north of Anchor Point. Further, summering gray whales were seen offshore of Cape Starichkof by marine mammal observers monitoring Buccaneer's Cosmopolitan drilling program in 2013 (Owl Ridge 2014). Regardless, gray whales are not expected to be encountered in upper Cook Inlet, where the activity is concentrated, north of Kachemak Bay. Therefore, it is unlikely that they will be encountered during this activity in close enough proximity to cause Level B harassment and are not considered further in this final Authorization notice.

Minke Whale (Balaenoptera acutorostrata)

Minke whales are the smallest of the rorqual group of baleen whales reaching lengths of up to 35 feet. They are also the most common of the baleen whales, although there are no population estimates for the North Pacific, although estimates have been made for some portions of Alaska. Zerbini *et al.* (2006) estimated the coastal population between Kenai Fjords and the Aleutian Islands at 1,233 animals.

During Cook Inlet-wide aerial surveys conducted from 1993 to 2004, minke whales were encountered only twice (1998, 1999), both times off Anchor Point 16 miles northwest of Homer. Recently, several minke whales were recorded off Cape Starichkof in early summer 2013 during exploratory drilling conducted there (Owl Ridge 2014). There are no records north of Cape Starichkof, and this species is unlikely to be seen in upper Cook Inlet. There is little chance of encountering a minke whale during these activities. Therefore, no take of minke whales is authorized.

Dall's Porpoise (Phocoenoides dalli)

Dall's porpoise are widely distributed throughout the North Pacific Ocean including Alaska, although they are not found in upper Cook Inlet and the shallower waters of the Bering, Chukchi, and Beaufort Seas (Allen and Angliss 2014). Compared to harbor porpoise, Dall's porpoise prefer the deep offshore and shelf slope waters. The Alaskan population has been estimated at 83,400 animals (Allen and Angliss 2014), making it one of the more common cetaceans in the state. Dall's porpoise have been observed in lower Cook Inlet, including Kachemak Bay and near Anchor Point (Owl Ridge 2014), but sightings there are rare. The concentration of sightings of Dall's porpoise in a southerly part of the Inlet suggest it is unlikely they will be encountered during EMALL's activities. Therefore, no take of Dall's porpoise is authorized.

Steller Sea Lion (Eumetopias jubatus)

The Western Stock of the Steller sea lion is defined as all populations west of longitude 144°W to the western end of the Aleutian Islands. The most recent estimate for this stock is 45,649 animals (Allen and Angliss 2014), considerably less than that estimated 140,000 animals in the 1950s (Merrick *et al.* 1987). Because of this dramatic decline, the stock was listed under the ESA as a threatened DPS in 1990, and relisted as endangered in 1997. Critical habitat was designated in 1993, and is defined as a 20-nautical-mile radius around all major rookeries and haulout sites. The 20-nautical-mile buffer was established based on telemetry data that indicated these sea lions concentrated their summer foraging effort within this distance of rookeries and haul outs.

Steller sea lions inhabit lower Cook Inlet, especially in the vicinity of Shaw Island and Elizabeth Island (Nagahut Rocks) haulout sites (Rugh *et al.* 2005a), but are rarely seen in upper Cook Inlet (Nemeth *et al.* 2007). Of the 42 Steller sea lion groups recorded during Cook Inlet aerial surveys between 1993 and 2004, none were recorded north of Anchor Point and only one in the vicinity of Kachemak Bay (Rugh *et al.* 2005a). Marine mammal observers associated with Buccaneer's drilling project off Cape Starichkof did observe seven Steller sea lions during the summer of 2013 (Owl Ridge 2014).

The upper reaches of Cook Inlet may not provide adequate foraging conditions for sea lions for establishing a major haul out presence. Steller sea lions feed largely on walleye pollock, salmon and arrowtooth flounder during the summer, and walleye pollock and Pacific cod during the winter (Sinclair and Zeppelin 2002), none of which, except for salmon, are found in abundance in upper Cook Inlet (Nemeth *et al.* 2007). Steller sea lions are unlikely to be encountered during operations in upper Cook Inlet, as they are primarily encountered along the Kenai Peninsula, especially closer to Anchor Point. Therefore, no take of Steller sea lion is authorized.

Potential Effects of the Specified Activity on Marine Mammals

This section includes a summary and discussion of the ways that components (seismic airgun operations, sub-bottom profiler chirper and boomer, vibracore) of the specified activity may impact marine mammals. The ''Estimated Take by Incidental Harassment'' section later in this document will include a quantitative analysis of the number of individuals that NMFS expects to be taken by this activity. The ''Negligible Impact Analysis'' section will include the analysis of how this specific proposed activity would impact marine mammals and will consider the content of this section, the ''Estimated Take by Incidental Harassment'' section, the ''Mitigation'' section, and the ''Anticipated Effects on Marine Mammal Habitat'' section to draw conclusions regarding the likely impacts of this activity on the reproductive success or survivorship of individuals and from that on the affected marine mammal populations or stocks.

NMFS intends to provide a background of potential effects of EMALL's activities in this section. Operating active acoustic sources have the potential for adverse effects on marine mammals. The majority of anticipated impacts would be from the use of active acoustic sources.

Acoustic Impacts

When considering the influence of various kinds of sound on the marine environment, it is necessary to understand that different kinds of marine life are sensitive to different frequencies of sound. Current data indicate that not all marine mammal species have equal hearing capabilities (Richardson *et al.,* 1995; Southall *et al.,* 1997; Wartzok and Ketten, 1999; Au and Hastings, 2008).

Southall *et al.* (2007) designated ''Functional hearing groups'' for marine mammals based on available behavioral data; audiograms derived from auditory evoked potentials; anatomical modeling; and other data. Southall *et al.* (2007) also estimated the lower and upper frequencies of functional hearing for each group. However, animals are less sensitive to sounds at the outer edges of their functional hearing range and are more sensitive to a range of frequencies within the middle of their functional hearing range.

The functional groups and the associated frequencies are:

- Low frequency cetaceans (13 species of mysticetes): Functional hearing estimates occur between approximately 7 Hertz (Hz) and 25 kHz (extended from 22 kHz based on data indicating that some mysticetes can hear above 22 kHz; Au *et al.,* 2006; Lucifredi and Stein, 2007; Ketten and Mountain, 2009; Tubelli *et al.,* 2012);
- Mid-frequency cetaceans (32 species of dolphins, six species of larger toothed whales, and 19 species of beaked and bottlenose whales): Functional hearing estimates occur between approximately 150 Hz and 160 kHz;
- High-frequency cetaceans (eight species of true porpoises, six species of river dolphins, *Kogia,* the franciscana, and four species of *cephalorhynchids*): Functional hearing estimates occur between approximately 200 Hz and 180 kHz; and
- Pinnipeds in Water: Phocid (true seals) functional hearing estimates occur between approximately 75 Hz and 100 kHz (Hemila *et al.,* 2006; Mulsow *et al.,* 2011; Reichmuth *et al.,* 2013) and otariid (seals and sea lions) functional hearing estimates occur between approximately 100 Hz to 40 kHz.

As mentioned previously in this document, Cook Inlet beluga whales, harbor porpoise, killer whales, and harbor seals (3 odontocetes and 1 phocid) would likely occur in the action area. Table 2 presents the classification of these species into their respective functional hearing group. NMFS consider a species' functional hearing group when analyzing the effects of exposure to sound on marine mammals.

TABLE 2—CLASSIFICATION OF MARINE MAMMALS THAT COULD POTENTIALLY OCCUR IN THE PROPOSED ACTIVITY AREA IN COOK INLET, 2015 BY FUNCTIONAL HEARING GROUP

[Southall *et al.,* 2007]

Mid-Frequency Hearing Range.	Beluga whale, killer whale.
High Frequency Hearing Range.	Harbor porpoise.
Pinnipeds in Water Hearing Range.	Harbor seal.

1. Potential Effects of Airgun Sounds on Marine Mammals

The effects of sounds from airgun operations might include one or more of the following: Tolerance, masking of natural sounds, behavioral disturbance, temporary or permanent impairment, or non-auditory physical or physiological effects (Richardson *et al.,* 1995; Gordon *et al.,* 2003; Nowacek *et al.,* 2007; Southall *et al.,* 2007). The effects of noise on marine mammals are highly variable, often depending on species and contextual factors (based on Richardson *et al.,* 1995).

Tolerance

Studies on marine mammals' tolerance to sound in the natural environment are relatively rare. Richardson *et al.* (1995) defined tolerance as the occurrence of marine mammals in areas where they are exposed to human activities or manmade noise. In many cases, tolerance develops by the animal habituating to the stimulus (*i.e.,* the gradual waning of responses to a repeated or ongoing stimulus) (Richardson, *et al.,* 1995), but because of ecological or physiological requirements, many marine animals may need to remain in areas where they are exposed to chronic stimuli (Richardson, *et al.,* 1995).

Numerous studies have shown that pulsed sounds from airguns are often readily detectable in the water at distances of many kilometers. Several studies have also shown that marine mammals at distances of more than a few kilometers from operating seismic vessels often show no apparent response. That is often true even in cases when the pulsed sounds must be readily audible to the animals based on measured received levels and the hearing sensitivity of the marine mammal group. Although various baleen whales and toothed whales, and (less frequently) pinnipeds have been shown to react behaviorally to airgun pulses under some conditions, at other times marine mammals of all three types have shown no overt reactions (Stone, 2003; Stone and Tasker, 2006; Moulton *et al.* 2005, 2006) and (MacLean and Koski, 2005; Bain and Williams, 2006).

Weir (2008) observed marine mammal responses to seismic pulses from a 24 airgun array firing a total volume of either 5,085 in^3 or 3,147 in^3 in Angolan waters between August 2004 and May 2005. Weir (2008) recorded a total of 207 sightings of humpback whales (n = 66), sperm whales (n = 124), and Atlantic spotted dolphins (n = 17) and reported that there were no significant differences in encounter rates (sightings per hour) for humpback and sperm whales according to the airgun array's operational status (*i.e.,* active versus silent).

Bain and Williams (2006) examined the effects of a large airgun array (maximum total discharge volume of 1,100 in^3) on six species in shallow waters off British Columbia and Washington: harbor seal, California sea lion, Steller sea lion, gray whale, Dall's porpoise, and harbor porpoise. Harbor porpoises showed reactions at received levels less than 155 dB re: 1 μPa at a distance of greater than 70 km (43 mi) from the seismic source (Bain and Williams, 2006). However, the tendency for greater responsiveness by harbor porpoise is consistent with their relative responsiveness to boat traffic and some other acoustic sources (Richardson, *et al.,* 1995; Southall, *et al.,* 2007). In contrast, the authors reported that gray whales seemed to tolerate exposures to sound up to approximately 170 dB re: 1 μPa (Bain and Williams, 2006) and Dall's porpoises occupied and tolerated areas receiving exposures of 170–180 dB re: 1 μPa (Bain and Williams, 2006; Parsons, *et al.,* 2009). The authors observed several gray whales that moved away from the airguns toward deeper water where sound levels were higher due to propagation effects resulting in higher noise exposures (Bain and Williams, 2006). However, it is unclear whether their movements reflected a response to the sounds (Bain and Williams, 2006). Thus, the authors surmised that the lack of gray whale responses to higher received sound levels were ambiguous at best because one expects the species to be the most sensitive to the low-frequency sound emanating from the airguns (Bain and Williams, 2006).

Pirotta *et al.* (2014) observed short-term responses of harbor porpoises to a two-dimensional (2–D) seismic survey in an enclosed bay in northeast Scotland which did not result in broad-scale displacement. The harbor porpoises that remained in the enclosed bay area reduced their buzzing activity by 15 percent during the seismic survey (Pirotta, *et al.,* 2014). Thus, the authors suggest that animals exposed to anthropogenic disturbance may make trade-offs between perceived risks and the cost of leaving disturbed areas (Pirotta, *et al.,* 2014).

Masking

Marine mammals use acoustic signals for a variety of purposes, which differ among species, but include communication between individuals, navigation, foraging, reproduction, avoiding predators, and learning about their environment (Erbe and Farmer, 2000; Tyack, 2000).

The term masking refers to the inability of an animal to recognize the occurrence of an acoustic stimulus because of interference of another acoustic stimulus (Clark *et al.,* 2009). Thus, masking is the obscuring of sounds of interest by other sounds, often at similar frequencies. It is a phenomenon that affects animals that are trying to receive acoustic information about their environment, including sounds from other members of their species, predators, prey, and sounds that allow them to orient in their environment. Masking these acoustic signals can disturb the behavior of individual animals, groups of animals, or entire populations in certain circumstances.

Introduced underwater sound may, through masking, reduce the effective communication distance of a marine mammal species if the frequency of the source is close to that used as a signal by the marine mammal, and if the anthropogenic sound is present for a significant fraction of the time (Richardson *et al.,* 1995).

Marine mammals are thought to be able to compensate for masking by adjusting their acoustic behavior through shifting call frequencies, increasing call volume, and increasing vocalization rates. For example in one study, blue whales increased call rates when exposed to noise from seismic surveys in the St. Lawrence Estuary (Di Iorio and Clark, 2010). Other studies reported that some North Atlantic right whales exposed to high shipping noise increased call frequency (Parks *et al.,* 2007) and some humpback whales responded to low-frequency active sonar playbacks by increasing song length (Miller *et al.,* 2000). Additionally, beluga whales change their vocalizations in the presence of high background noise possibly to avoid masking calls (Au *et al.,* 1985; Lesage *et al.,* 1999; Scheifele *et al.,* 2005).

Studies have shown that some baleen and toothed whales continue calling in the presence of seismic pulses, and some researchers have heard these calls between the seismic pulses (*e.g.,* McDonald *et al.,* 1995; Greene *et al.,* 1999; Nieukirk *et al.,* 2004; Smultea *et al.,* 2004; Holst *et al.,* 2005a, 2005b, 2006; and Dunn and Hernandez, 2009).

In contrast, Clark and Gagnon (2006) reported that fin whales in the northeast Pacific Ocean went silent for an extended period starting soon after the onset of a seismic survey in the area. Similarly, NMFS is aware of one report that observed sperm whales ceased calls when exposed to pulses from a very distant seismic ship (Bowles *et al.,* 1994). However, more recent studies have found that sperm whales continued calling in the presence of seismic pulses (Madsen *et al.,* 2002; Tyack *et al.,* 2003; Smultea *et al.,* 2004; Holst *et al.,* 2006; and Jochens *et al.,* 2008).

Risch *et al.* (2012) documented reductions in humpback whale vocalizations in the Stellwagen Bank National Marine Sanctuary concurrent with transmissions of the Ocean Acoustic Waveguide Remote Sensing (OAWRS) low-frequency fish sensor system at distances of 200 km (124 mi) from the source. The recorded OAWRS produced series of frequency modulated pulses and the signal received levels ranged from 88 to 110 dB re: 1 μPa (Risch, *et al.,* 2012). The authors hypothesized that individuals did not leave the area but instead ceased singing and noted that the duration and frequency range of the OAWRS signals (a novel sound to the whales) were similar to those of natural humpback whale song components used during mating (Risch *et al.,* 2012). Thus, the novelty of the sound to humpback whales in the study area provided a compelling contextual probability for the observed effects (Risch *et al.,* 2012). However, the authors did not state or imply that these changes had long-term effects on individual animals or populations (Risch *et al.,* 2012).

Several studies have also reported hearing dolphins and porpoises calling while airguns were operating (*e.g.,* Gordon *et al.,* 2004; Smultea *et al.,* 2004; Holst *et al.,* 2005a, b; and Potter *et al.,* 2007). The sounds important to small odontocetes are predominantly at much higher frequencies than the dominant components of airgun sounds, thus limiting the potential for masking in those species.

Although some degree of masking is inevitable when high levels of manmade broadband sounds are present in the sea, marine mammals have evolved systems and behavior that function to reduce the impacts of masking. Odontocete conspecifics may readily detect structured signals, such as the echolocation click sequences of small toothed whales even in the presence of strong background noise because their frequency content and temporal features usually differ strongly from those of the background noise (Au and Moore, 1988, 1990). The components of background noise that are similar in frequency to the sound signal in question primarily determine the degree of masking of that signal.

Redundancy and context can also facilitate detection of weak signals. These phenomena may help marine mammals detect weak sounds in the presence of natural or manmade noise. Most masking studies in marine mammals present the test signal and the masking noise from the same direction. The sound localization abilities of marine mammals suggest that, if signal and noise come from different directions, masking would not be as severe as the usual types of masking studies might suggest (Richardson *et al.,* 1995). The dominant background noise may be highly directional if it comes from a particular anthropogenic source such as a ship or industrial site. Directional hearing may significantly reduce the masking effects of these sounds by improving the effective signal-to-noise ratio. In the cases of higher frequency hearing by the bottlenose dolphin, beluga whale, and killer whale, empirical evidence confirms that masking depends strongly on the relative directions of arrival of sound signals and the masking noise (Penner *et al.,* 1986; Dubrovskiy, 1990; Bain *et al.,* 1993; Bain and Dahlheim, 1994). Toothed whales and probably other marine mammals as well, have additional capabilities besides directional hearing that can facilitate detection of sounds in the presence of background noise. There is evidence that some toothed whales can shift the dominant frequencies of their echolocation signals from a frequency range with a lot of ambient noise toward frequencies with less noise (Au *et al.,* 1974, 1985; Moore and Pawloski, 1990; Thomas and Turl, 1990; Romanenko and Kitain, 1992; Lesage *et al.,* 1999). A few marine mammal species increase the source levels or alter the frequency of their calls in the presence of elevated sound levels (Dahlheim, 1987; Au, 1993; Lesage *et al.,* 1993, 1999; Terhune, 1999; Foote *et al.,* 2004; Parks *et al.,* 2007, 2009; Di Iorio and Clark, 2010; Holt *et al.,* 2009).

These data demonstrating adaptations for reduced masking pertain mainly to the very high frequency echolocation signals of toothed whales. There is less information about the existence of corresponding mechanisms at moderate or low frequencies or in other types of marine mammals. For example, Zaitseva *et al.* (1980) found that, for the bottlenose dolphin, the angular separation between a sound source and a masking noise source had little effect on the degree of masking when the sound frequency was 18 kHz, in contrast to the pronounced effect at higher frequencies. Studies have noted directional hearing at frequencies as low as 0.5–2 kHz in several marine mammals, including killer whales (Richardson *et al.,* 1995a). This ability may be useful in reducing masking at these frequencies. In summary, high levels of sound generated by anthropogenic activities may act to mask the detection of weaker biologically important sounds by some marine mammals. This masking may be more prominent for lower frequencies. For higher frequencies, such as that used in echolocation by toothed whales, several mechanisms are available that may allow them to reduce the effects of such masking.

Behavioral Disturbance

Marine mammals may behaviorally react to sound when exposed to anthropogenic noise. Reactions to sound, if any, depend on species, state of maturity, experience, current activity, reproductive state, time of day, and many other factors (Richardson *et al.,* 1995; D'Spain & Wartzok, 2004; Southall *et al.,* 2007; Weilgart, 2007).

Types of behavioral reactions can include the following: Changing durations of surfacing and dives, number of blows per surfacing, or moving direction and/or speed; reduced/increased vocal activities; changing/cessation of certain behavioral activities (such as socializing or feeding); visible startle response or aggressive behavior (such as tail/fluke slapping or jaw clapping); avoidance of areas where noise sources are located; and/or flight responses (*e.g.,* pinnipeds flushing into water from haulouts or rookeries).

The biological significance of many of these behavioral disturbances is difficult to predict, especially if the detected disturbances appear minor. However, one could expect the consequences of behavioral modification to be biologically significant if the change affects growth, survival, and/or reproduction (*e.g.,* Lusseau and Bejder, 2007; Weilgart, 2007). Examples of behavioral modifications that could impact growth, survival, or reproduction include:

- Drastic changes in diving/surfacing patterns (such as those associated with beaked whale stranding related to exposure to military mid-frequency tactical sonar);
- Permanent habitat abandonment due to loss of desirable acoustic environment; and
- Disruption of feeding or social interaction resulting in significant energetic costs, inhibited breeding, or cow-calf separation.

The onset of behavioral disturbance from anthropogenic noise depends on both external factors (characteristics of noise sources and their paths) and the receiving animals (hearing, motivation, experience, demography) and is also difficult to predict (Richardson *et al.,* 1995; Southall *et al.,* 2007). Many studies have also shown that marine mammals at distances more than a few kilometers away often show no apparent response when exposed to seismic activities (*e.g.,* Madsen & Mohl, 2000 for sperm whales; Malme *et al.,* 1983, 1984 for gray whales; and Richardson *et al.,* 1986 for bowhead whales). Other studies have shown that marine mammals continue important behaviors in the presence of seismic pulses (*e.g.,* Dunn & Hernandez, 2009 for blue whales; Greene Jr. *et al.,* 1999 for bowhead whales; Holst and Beland, 2010; Holst and Smultea, 2008; Holst *et al.,* 2005; Nieukirk *et al.,* 2004; Richardson, *et al.,* 1986; Smultea *et al.,* 2004).

Baleen Whales: Studies have shown that underwater sounds from seismic activities are often readily detectable by baleen whales in the water at distances of many kilometers (Castellote *et al.,* 2012 for fin whales).

Observers have seen various species of *Balaenoptera* (blue, sei, fin, and minke whales) in areas ensonified by airgun pulses (Stone, 2003; MacLean and Haley, 2004; Stone and Tasker, 2006), and have localized calls from blue and fin whales in areas with airgun operations (*e.g.,* McDonald *et al.,* 1995; Dunn and Hernandez, 2009; Castellote *et al.,* 2010). Sightings by observers on seismic vessels off the United Kingdom from 1997 to 2000 suggest that, during times of good visibility, sighting rates for mysticetes (mainly fin and sei whales) were similar when large arrays of airguns were shooting versus silent (Stone, 2003; Stone and Tasker, 2006). However, these whales tended to exhibit localized avoidance, remaining significantly further (on average) from the airgun array during seismic operations compared with non-seismic periods (Stone and Tasker, 2006).

Ship-based monitoring studies of baleen whales (including blue, fin, sei, minke, and humpback whales) in the northwest Atlantic found that overall, this group had lower sighting rates during seismic versus non-seismic periods (Moulton and Holst, 2010). The authors observed that baleen whales as a group were significantly farther from the vessel during seismic compared with non-seismic periods. Moreover, the authors observed that the whales swam away more often from the operating seismic vessel (Moulton and Holst, 2010). Initial sightings of blue and minke whales were significantly farther from the vessel during seismic operations compared to non-seismic periods and the authors observed the same trend for fin whales (Moulton and Holst, 2010). Also, the authors observed that minke whales most often swam away from the vessel when seismic operations were underway (Moulton and Holst, 2010).

Toothed Whales: Few systematic data are available describing reactions of toothed whales to noise pulses. However, systematic work on sperm whales is underway (*e.g.,* Gordon *et al.,* 2006; Madsen *et al.,* 2006; Winsor and Mate, 2006; Jochens *et al.,* 2008; Miller *et al.,* 2009) and there is an increasing amount of information about responses of various odontocetes, including killer whales and belugas, to seismic surveys based on monitoring studies (*e.g.,* Stone, 2003; Smultea *et al.,* 2004; Moulton and Miller, 2005; Bain and Williams, 2006; Holst *et al.,* 2006; Stone and Tasker, 2006; Potter *et al.,* 2007; Hauser *et al.,* 2008; Holst and Smultea, 2008; Weir, 2008; Barkaszi *et al.,* 2009; Richardson *et al.,* 2009; Moulton and Holst, 2010). Reactions of toothed whales to large arrays of airguns are variable and, at least for delphinids, seem to be confined to a smaller radius than has been observed for mysticetes.

Observers stationed on seismic vessels operating off the United Kingdom from 1997–2000 have provided data on the occurrence and behavior of various toothed whales exposed to seismic pulses (Stone, 2003; Gordon *et al.,* 2004). The studies note that killer whales were significantly farther from large airgun arrays during periods of active airgun operations compared with periods of silence. The displacement of the median distance from the array was approximately 0.5 km (0.3 mi) or more. Killer whales also appear to be more tolerant of seismic shooting in deeper water (Stone, 2003; Gordon *et al.,* 2004).

The beluga may be a species that (at least in certain geographic areas) shows long-distance avoidance of seismic vessels. Aerial surveys during seismic operations in the southeastern Beaufort Sea recorded much lower sighting rates of beluga whales within 10–20 km (6.2–12.4 mi) of an active seismic vessel. These results were consistent with the low number of beluga sightings reported by observers aboard the seismic vessel, suggesting that some belugas might have been avoiding the seismic operations at distances of 10–20 km (6.2–12.4 mi) (Miller *et al.,* 2005).

Delphinids

Seismic operators and protected species observers (observers) on seismic vessels regularly see dolphins and other small toothed whales near operating airgun arrays, but in general there is a tendency for most delphinids to show some avoidance of operating seismic vessels (*e.g.,* Goold, 1996a,b,c; Calambokidis and Osmek, 1998; Stone, 2003; Moulton and Miller, 2005; Holst *et al.,* 2006; Stone and Tasker, 2006; Weir, 2008; Richardson *et al.,* 2009; Barkaszi *et al.,* 2009; Moulton and Holst, 2010). Some dolphins seem to be attracted to the seismic vessel and floats, and some ride the bow wave of the seismic vessel even when large arrays of airguns are firing (*e.g.,* Moulton and Miller, 2005). Nonetheless, there have been indications that small toothed whales sometimes move away or maintain a somewhat greater distance from the vessel when a large array of airguns is operating than when it is silent (*e.g.,* Goold, 1996a,b,c; Stone and Tasker, 2006; Weir, 2008; Moulton and Holst, 2010). In most cases, the avoidance radii for delphinids appear to be small, on the order of one km or less, and some individuals show no apparent avoidance.

Captive bottlenose dolphins exhibited changes in behavior when exposed to strong pulsed sounds similar in duration to those typically used in seismic surveys (Finneran *et al.,* 2000, 2002, 2005). However, the animals tolerated high received levels of sound (pk–pk level >200 dB re 1 μPa) before exhibiting aversive behaviors.

Porpoises

Results for porpoises depend upon the species. The limited available data suggest that harbor porpoises show stronger avoidance of seismic operations than do Dall's porpoises (Stone, 2003; MacLean and Koski, 2005; Bain and Williams, 2006; Stone and Tasker, 2006). Dall's porpoises seem relatively tolerant of airgun operations (MacLean and Koski, 2005; Bain and Williams, 2006), although they too have been observed to avoid large arrays of operating airguns (Calambokidis and Osmek, 1998; Bain and Williams, 2006). This apparent difference in responsiveness of these two porpoise species is consistent with their relative responsiveness to boat traffic and some other acoustic sources (Richardson *et al.,* 1995; Southall *et al.,* 2007).

Pinnipeds

Pinnipeds are not likely to show a strong avoidance reaction to the airgun sources proposed for use. Visual monitoring from seismic vessels has shown only slight (if any) avoidance of airguns by pinnipeds and only slight (if any) changes in behavior. Monitoring work in the Alaskan Beaufort Sea during 1996–2001 provided considerable information regarding the behavior of Arctic ice seals exposed to seismic pulses (Harris *et al.,* 2001; Moulton and Lawson, 2002). These seismic projects usually involved arrays of 6 to 16 airguns with total volumes of 560 to 1,500 in^3. The combined results suggest that some seals avoid the immediate area around seismic vessels. In most survey years, ringed seal (*Phoca hispida*) sightings tended to be farther away from the seismic vessel when the airguns were operating than when they were not (Moulton and Lawson, 2002). However, these avoidance movements were relatively small, on the order of 100 m (328 ft) to a few hundreds of meters, and many seals remained within 100–200 m (328–656 ft) of the trackline as the operating airgun array passed by the animals. Seal sighting rates at the water surface were lower during airgun array operations than during no-airgun periods in each survey year except 1997. Similarly, seals are often very tolerant of pulsed sounds from seal-scaring devices (Mate and Harvey, 1987; Jefferson and Curry, 1994; Richardson *et al.,* 1995). However, initial telemetry work suggests that avoidance and other behavioral reactions by two other species of seals to small airgun sources may at times be stronger than evident to date from visual studies of pinniped reactions to airguns (Thompson *et al.,* 1998).

Hearing Impairment

Exposure to high intensity sound for a sufficient duration may result in auditory effects such as a noise-induced threshold shift—an increase in the auditory threshold after exposure to noise (Finneran *et al.,* 2005). Factors that influence the amount of threshold shift include the amplitude, duration, frequency content, temporal pattern, and energy distribution of noise exposure. The magnitude of hearing threshold shift normally decreases over time following cessation of the noise exposure. The amount of threshold shift just after exposure is the initial threshold shift. If the threshold shift eventually returns to zero (*i.e.,* the threshold returns to the pre-exposure value), it is a temporary threshold shift (Southall *et al.,* 2007).

Threshold Shift (noise-induced loss of hearing)—When animals exhibit reduced hearing sensitivity (*i.e.,* sounds must be louder for an animal to detect them) following exposure to an intense sound or sound for long duration, it is referred to as a noise-induced threshold shift (TS). An animal can experience temporary threshold shift (TTS) or permanent threshold shift (PTS). TTS can last from minutes or hours to days (*i.e.,* there is complete recovery), can occur in specific frequency ranges (*i.e.,* an animal might only have a temporary loss of hearing sensitivity between the frequencies of 1 and 10 kHz), and can be of varying amounts (for example, an animal's hearing sensitivity might be reduced initially by only 6 dB or reduced by 30 dB). PTS is permanent, but some recovery is possible. PTS can also occur in a specific frequency range and amount as mentioned above for TTS.

The following physiological mechanisms are thought to play a role in inducing auditory TS: Effects to sensory hair cells in the inner ear that reduce their sensitivity, modification of the chemical environment within the sensory cells, residual muscular activity in the middle ear, displacement of certain inner ear membranes, increased blood flow, and post-stimulatory reduction in both efferent and sensory neural output (Southall *et al.,* 2007). The amplitude, duration, frequency, temporal pattern, and energy distribution of sound exposure all can affect the amount of associated TS and the frequency range in which it occurs. As amplitude and duration of sound exposure increase, so, generally, does the amount of TS, along with the recovery time. For intermittent sounds, less TS could occur than compared to a continuous exposure with the same energy (some recovery could occur between intermittent exposures depending on the duty cycle between sounds) (Kryter *et al.,* 1966; Ward, 1997). For example, one short but loud (higher SPL) sound exposure may induce the same impairment as one longer but softer sound, which in turn may cause more impairment than a series of several intermittent softer sounds with the same total energy (Ward, 1997). Additionally, though TTS is temporary, prolonged exposure to sounds strong enough to elicit TTS, or shorter-term exposure to sound levels well above the TTS threshold, can cause PTS, at least in terrestrial mammals (Kryter, 1985). Although in the case of EMALL's survey, NMFS does not expect that animals would experience levels high enough or durations long enough to result in PTS given that the airgun is a very low volume airgun, and the use of the airgun will be restricted to seven days in a small geographic area.

PTS is considered auditory injury (Southall *et al.,* 2007). Irreparable damage to the inner or outer cochlear hair cells may cause PTS; however, other mechanisms are also involved, such as exceeding the elastic limits of certain tissues and membranes in the middle and inner ears and resultant changes in the chemical composition of the inner ear fluids (Southall *et al.,* 2007).

Although the published body of scientific literature contains numerous theoretical studies and discussion papers on hearing impairments that can occur with exposure to a loud sound, only a few studies provide empirical information on the levels at which noise-induced loss in hearing sensitivity occurs in non-human animals.

Recent studies by Kujawa and Liberman (2009) and Lin *et al.* (2011) found that despite completely reversible threshold shifts that leave cochlear sensory cells intact, large threshold shifts could cause synaptic level changes and delayed cochlear nerve degeneration in mice and guinea pigs, respectively. NMFS notes that the high level of TTS that led to the synaptic changes shown in these studies is in the range of the high degree of TTS that Southall *et al.* (2007) used to calculate PTS levels. It is unknown whether smaller levels of TTS would lead to similar changes. NMFS, however, acknowledges the complexity of noise exposure on the nervous system, and will re-examine this issue as more data become available.

For marine mammals, published data are limited to the captive bottlenose dolphin, beluga, harbor porpoise, and Yangtze finless porpoise (Finneran *et al.,* 2000, 2002, 2003, 2005, 2007, 2010a, 2010b; Finneran and Schlundt, 2010; Lucke *et al.,* 2009; Mooney *et al.,* 2009a, 2009b; Popov *et al.,* 2011a, 2011b; Kastelein *et al.,* 2012a; Schlundt *et al.,* 2000; Nachtigall *et al.,* 2003, 2004). For pinnipeds in water, data are limited to measurements of TTS in harbor seals, an elephant seal, and California sea lions (Kastak *et al.,* 1999, 2005; Kastelein *et al.,* 2012b).

Lucke *et al.* (2009) found a threshold shift (TS) of a harbor porpoise after exposing it to airgun noise with a received sound pressure level (SPL) at 200.2 dB (peak-to-peak) re: 1 μPa, which corresponds to a sound exposure level of 164.5 dB re: 1 μPa2 s after integrating exposure. NMFS currently uses the root-mean-square (rms) of received SPL at 180 dB and 190 dB re: 1 μPa as the threshold above which permanent threshold shift (PTS) could occur for cetaceans and pinnipeds, respectively. Because the airgun noise is a broadband impulse, one cannot directly determine the equivalent of rms SPL from the reported peak-to-peak SPLs. However, applying a conservative conversion factor of 16 dB for broadband signals from seismic surveys (McCauley, *et al.,* 2000) to correct for the difference between peak-to-peak levels reported in Lucke *et al.* (2009) and rms SPLs, the rms SPL for TTS would be approximately 184 dB re: 1 μPa, and the received levels associated with PTS (Level A harassment) would be higher. This is still above NMFS' current 180 dB rms re: 1 μPa threshold for injury. However, NMFS recognizes that TTS of harbor porpoises is lower than other cetacean species empirically tested (Finneran & Schlundt, 2010; Finneran *et al.,* 2002; Kastelein and Jennings, 2012).

A recent study on bottlenose dolphins (Schlundt, *et al.,* 2013) measured hearing thresholds at multiple frequencies to determine the amount of TTS induced before and after exposure to a sequence of impulses produced by a seismic air gun. The air gun volume and operating pressure varied from 40–150 in^3 and 1000–2000 psi, respectively. After three years and 180 sessions, the authors observed no significant TTS at any test frequency, for any combinations of air gun volume, pressure, or proximity to the dolphin during behavioral tests (Schlundt, *et al.,* 2013). Schlundt *et al.* (2013) suggest that the potential for airguns to cause hearing loss in dolphins is lower than previously predicted, perhaps as a result of the low-frequency content of air gun impulses compared to the high-frequency hearing ability of dolphins.

Marine mammal hearing plays a critical role in communication with conspecifics, and interpretation of environmental cues for purposes such as predator avoidance and prey capture. Depending on the degree (elevation of threshold in dB), duration (*i.e.,* recovery time), and frequency range of TTS, and the context in which it is experienced, TTS can have effects on marine mammals ranging from discountable to serious (similar to those discussed in auditory masking, below). For example, a marine mammal may be able to readily compensate for a brief, relatively small amount of TTS in a non-critical frequency range that occurs during a time where ambient noise is lower and there are not as many competing sounds present. Alternatively, a larger amount and longer duration of TTS sustained during time when communication is critical for successful mother/calf interactions could have more serious impacts. Also, depending on the degree and frequency range, the effects of PTS on an animal could range in severity, although it is considered generally more serious because it is a permanent condition. Of note, reduced hearing sensitivity as a simple function of aging has been observed in marine mammals, as well as humans and other taxa (Southall *et al.,* 2007), so one can infer that strategies exist for coping with this condition to some degree, though likely not without cost.

Given the higher level of sound necessary to cause PTS as compared with TTS, it is considerably less likely that PTS would occur during the survey; TTS is also unlikely. Cetaceans generally avoid the immediate area around operating seismic vessels, as do some other marine mammals. Some pinnipeds show avoidance reactions to airguns, but their avoidance reactions are generally not as strong or consistent compared to cetacean reactions.

Non-auditory Physical Effects: Non-auditory physical effects might occur in marine mammals exposed to strong underwater pulsed sound. Possible types of non-auditory physiological effects or injuries that theoretically might occur in mammals close to a strong sound source include stress, neurological effects, bubble formation, and other types of organ or tissue damage. Some marine mammal species (*i.e.,* beaked whales) may be especially susceptible to injury and/or stranding when exposed to strong pulsed sounds.

Classic stress responses begin when an animal's central nervous system perceives a potential threat to its homeostasis. That perception triggers stress responses regardless of whether a stimulus actually threatens the animal; the mere perception of a threat is sufficient to trigger a stress response (Moberg, 2000; Sapolsky *et al.,* 2005; Seyle, 1950). Once an animal's central nervous system perceives a threat, it mounts a biological response or defense that consists of a combination of the four general biological defense responses: Behavioral responses; autonomic nervous system responses; neuroendocrine responses; or immune responses.

In the case of many stressors, an animal's first and most economical (in terms of biotic costs) response is behavioral avoidance of the potential stressor or avoidance of continued exposure to a stressor. An animal's second line of defense to stressors involves the sympathetic part of the autonomic nervous system and the classical ''fight or flight'' response, which includes the cardiovascular system, the gastrointestinal system, the exocrine glands, and the adrenal medulla to produce changes in heart rate, blood pressure, and gastrointestinal activity that humans commonly associate with stress. These responses have a relatively short duration and may or may not have significant long-term effects on an animal's welfare.

An animal's third line of defense to stressors involves its neuroendocrine or sympathetic nervous systems; the system that has received the most study has been the hypothalmus-pituitary-adrenal (HPA) system (also known as the HPA axis in mammals or the hypothalamus-pituitary-interrenal axis in fish and some reptiles). Unlike stress responses associated with the autonomic nervous system, the pituitary hormones regulate virtually all neuroendocrine functions affected by stress—including immune competence, reproduction, metabolism, and behavior. Stress-induced changes in the secretion of pituitary hormones have been implicated in failed reproduction (Moberg, 1987; Rivier, 1995), altered metabolism (Elasser *et al.,* 2000), and reduced immune competence (Blecha, 2000). Increases in the circulation of glucocorticosteroids (cortisol, corticosterone, and aldosterone in marine mammals; see Romano *et al.,* 2004) have been equated with stress for many years.

The primary distinction between stress (which is adaptive and does not normally place an animal at risk) and distress is the biotic cost of the response. During a stress response, an animal uses glycogen stores that the body quickly replenishes after alleviation of the stressor. In such circumstances, the cost of the stress response would not pose a risk to the animal's welfare. However, when an animal does not have sufficient energy reserves to satisfy the energetic costs of a stress response, it diverts energy resources from other biotic functions, which impair those functions that experience the diversion. For example, when mounting a stress response diverts energy away from growth in young animals, those animals may experience stunted growth (McEwen and Wingfield, 2003). When mounting a stress response diverts energy from a fetus, an animal's reproductive success and fitness will suffer. In these cases, the animals will have entered a pre-pathological or pathological state called ''distress'' (*sensu* Seyle, 1950) or ''allostatic loading'' (*sensu* McEwen and Wingfield, 2003). This pathological state will last until the animal replenishes its biotic reserves sufficient to restore normal function. Note that these examples involved a long-term (days or weeks) stress response exposure to stimuli.

Relationships between these physiological mechanisms, animal behavior, and the costs of stress responses have also been documented fairly well through controlled experiment; because this physiology exists in every vertebrate that has been studied, it is not surprising that stress responses and their costs have been documented in both laboratory and free-living animals (for examples see, Holberton *et al.,* 1996; Hood *et al.,* 1998; Jessop *et al.,* 2003; Krausman *et al.,* 2004; Lankford *et al.,* 2005; Reneerkens *et al.,* 2002; Thompson and Hamer, 2000). Although no information has been collected on the physiological responses of marine mammals to anthropogenic sound exposure, studies of other marine animals and terrestrial animals would lead us to expect some marine mammals to experience physiological stress responses and, perhaps, physiological responses that would be classified as ''distress'' upon exposure to anthropogenic sounds.

For example, Jansen (1998) reported on the relationship between acoustic exposures and physiological responses that are indicative of stress responses in humans (*e.g.,* elevated respiration and increased heart rates). Jones (1998) reported on reductions in human performance when faced with acute, repetitive exposures to acoustic disturbance. Trimper *et al.* (1998) reported on the physiological stress responses of osprey to low-level aircraft noise while Krausman *et al.* (2004) reported on the auditory and physiology stress responses of endangered Sonoran pronghorn to military overflights. Smith *et al.* (2004a, 2004b) identified noise-induced physiological transient stress responses in hearing-specialist fish (*i.e.,* goldfish) that accompanied short- and long-term hearing losses. Welch and Welch (1970) reported physiological and behavioral stress responses that accompanied damage to the inner ears of fish and several mammals.

Hearing is one of the primary senses marine mammals use to gather information about their environment and communicate with conspecifics. Although empirical information on the relationship between sensory impairment (TTS, PTS, and acoustic masking) on marine mammals remains limited, we assume that reducing a marine mammal's ability to gather information about its environment and communicate with other members of its species would induce stress, based on data that terrestrial animals exhibit those responses under similar conditions (NRC, 2003) and because marine mammals use hearing as their primary sensory mechanism. Therefore, NMFS assumes that acoustic exposures sufficient to trigger onset PTS or TTS would be accompanied by physiological stress responses. More importantly, marine mammals might experience stress responses at received levels lower than those necessary to trigger onset TTS. Based on empirical studies of the time required to recover from stress responses (Moberg, 2000), NMFS also assumes that stress responses could persist beyond the time interval required for animals to recover from TTS and might result in pathological and pre-pathological states that would be as significant as behavioral responses to TTS.

Resonance effects (Gentry, 2002) and direct noise-induced bubble formations (Crum *et al.,* 2005) are implausible in the case of exposure to an impulsive broadband source like an airgun array. If seismic surveys disrupt diving patterns of deep-diving species, this might result in bubble formation and a form of the bends, as speculated to occur in beaked whales exposed to sonar. However, there is no specific evidence of this upon exposure to airgun pulses.

In general, there are few data about the potential for strong, anthropogenic underwater sounds to cause non-auditory physical effects in marine mammals. Such effects, if they occur at all, would presumably be limited to short distances and to activities that extend over a prolonged period. The available data do not allow identification of a specific exposure level above which non-auditory effects can be expected (Southall *et al.,* 2007) or any meaningful quantitative predictions of the numbers (if any) of marine mammals that might be affected in those ways. There is no definitive evidence that any of these effects occur even for marine mammals in close proximity to large arrays of airguns. In addition, marine mammals that show behavioral avoidance of seismic vessels, including some pinnipeds, are unlikely to incur non-auditory impairment or other physical effects. The low volume of the airgun proposed for this activity combined with the limited scope of use makes non-auditory physical effects from airgun use, including stress, unlikely. Therefore, we do not anticipate such effects would occur given the brief duration of exposure during the survey.

Stranding and Mortality

When a living or dead marine mammal swims or floats onto shore and becomes ''beached'' or incapable of returning to sea, the event is a ''stranding'' (Geraci *et al.,* 1999; Perrin and Geraci, 2002; Geraci and Lounsbury, 2005; NMFS, 2007). The legal definition for a stranding under the MMPA is that ''(A) a marine mammal is dead and is (i) on a beach or shore of the United States; or (ii) in waters under the jurisdiction of the United States (including any navigable waters); or (B) a marine mammal is alive and is (i) on a beach or shore of the United States and is unable to return to the water; (ii) on a beach or shore of the United States and, although able to return to the water, is in need of apparent medical attention; or (iii) in the waters under the jurisdiction of the United States (including any navigable waters), but is unable to return to its natural habitat under its own power or without assistance.''

Marine mammals strand for a variety of reasons, such as infectious agents, biotoxicosis, starvation, fishery interaction, ship strike, unusual oceanographic or weather events, sound exposure, or combinations of these stressors sustained concurrently or in series. However, the cause or causes of most strandings are unknown (Geraci *et al.,* 1976; Eaton, 1979; Odell *et al.,* 1980; Best, 1982). Numerous studies suggest that the physiology, behavior, habitat relationships, age, or condition of cetaceans may cause them to strand or might pre-dispose them to strand when exposed to another phenomenon. These suggestions are consistent with the conclusions of numerous other studies that have demonstrated that combinations of dissimilar stressors commonly combine to kill an animal or dramatically reduce its fitness, even though one exposure without the other does not produce the same result (Chroussos, 2000; Creel, 2005; DeVries *et al.,* 2003; Fair and Becker, 2000; Foley *et al.,* 2001; Moberg, 2000; Relyea, 2005a; 2005b, Romero, 2004; Sih *et al.,* 2004). Given the low volume and source level of the proposed airgun, standing and mortality are not anticipated due to use of the airgun proposed for this activity.

2. Potential Effects of Other Acoustic Devices

Sub-Bottom Profiler

EMALL would also operate a sub-bottom profiler chirp and boomer from the source vessel during the proposed survey. The chirp's sounds are very short pulses, occurring for one ms, six times per second. Most of the energy in the sound pulses emitted by the profiler is at 2–6 kHz, and the beam is directed downward. The chirp has a maximum source level of 202 dB re: 1 μPa, with a tilt angle of 90 degrees below horizontal and a beam width of 24 degrees. The sub-bottom profiler boomer will shoot approximately every 3.125 m, with shots lasting 1.5 to 2 seconds. Most of the energy in the sound pulses emitted by the boomer is concentrated between 0.5 and 6 kHz, with a source level of 205 dB re: 1 μPa. The tilt of the boomer is 90 degrees below horizontal, but the emission is omnidirectional. Kremser *et al.* (2005) noted that the probability of a cetacean swimming through the area of exposure when a bottom profiler emits a pulse is small—because if the animal was in the area, it would have to pass the transducer at close range in order to be subjected to sound levels that could cause temporary threshold shift and would likely exhibit avoidance behavior to the area near the transducer rather than swim through at such a close range.

Masking: Both the chirper and boomer sub-bottom profilers produce impulsive sound exceeding 160 dB re: 1 μPa-m (rms). The louder boomer operates at a source value of 205 dB re: 1 μPa-m (rms), but with a frequency between 0.5 and 6 kHz, which is lower than the maximum sensitivity hearing range of any the local species (belugas—40–130 kHz;, killer whales—7–30 kHz; harbor porpoise—100–140 kHz; and harbor seals—10–30 kHz; Wartzok and Ketten 1999, Southall *et al.* 2007, Kastelein *et al.* 2002). While the chirper is not as loud (202 dB re 1 μPa-m [rms]), it does operate at a higher frequency range (2–16 kHz), and within the maximum sensitive range of all of the local species except beluga whales.

Marine mammal communications would not likely be masked appreciably by the profiler's signals given the directionality of the signal and the brief period when an individual mammal is likely to be within its beam. Furthermore, despite the fact that the profiler overlaps with hearing ranges of many marine mammal species in the area, the profiler's signals do not overlap with the predominant frequencies in the calls, which would avoid significant masking.

Behavioral Responses: Responses to the profiler are likely to be similar to the other pulsed sources discussed earlier if received at the same levels. The behavioral response of local marine mammals to the operation of the sub-bottom profilers is expected to be similar to that of the small airgun. The odontocetes are likely to avoid the sub-bottom profiler activity, especially the naturally shy harbor porpoise, while the harbor seals might be attracted to them out of curiosity. However, because the sub-bottom profilers operate from a moving vessel, and the maximum radius to the 160 dB harassment threshold is only 263 m (863 ft), the area and time that this equipment would be affecting a given location is very small.

Hearing Impairment and Other Physical Effects: It is unlikely that the sub-bottom profilers produce sound levels strong enough to cause hearing impairment or other physical injuries even in an animal that is (briefly) in a position near the source (Wood et al. 2012). The likelihood of marine mammals moving away from the source make if further unlikely that a marine mammal would be able to approach close to the transducers.

Animals may avoid the area around the survey vessels, thereby reducing exposure. Any disturbance to marine mammals is likely to be in the form of temporary avoidance or alteration of opportunistic foraging behavior near the survey location.

Vibracore

EMALL would conduct vibracoring in a portion of Cook Inlet for a total of 120 vibracoring occurrences. While duration is dependent on sediment type, the driving mechanism, which emits sound at a source level of 187dB re: 1 μPa, will only bore for 1 to 2 minutes. The sound is emitted at a frequency of 10 Hz to 20 kHz.

Masking: It is unlikely that masking will occur due to vibracore operations. Chorney *et al.* (2011) conducted sound measurements on an operating vibracorer in Alaska and found that it emitted a sound pressure level at 1-m source of 188 dB re 1 μPa-m (rms), with a frequency range of between 10 Hz and 20 kHz. While the frequency range overlaps the lower ends of the maximum sensitivity hearing ranges of harbor porpoises, killer whales, and harbor seals, and the continuous sound extends 2.54 km (1.6 mi) to the 120 dB threshold, the vibracorer will operate about the one or two minutes it takes to drive the core pipe 7 m (20 ft) into the sediment, and approximately twice per day. Therefore, there is very little opportunity for this activity to mask the communication of local marine mammals.

Behavioral Response: It is unlikely that vibracoring will elicit behavioral responses that rise to the level of a take from marine mammal species in the area. A review of similar survey activity in New Zealand by their Department of Conservation classified the likely effects from vibracore and similar activity to be some habitat degradation and prey species effects, but primarily behavioral responses, although the species in the analyzed area were different to those found in Cook Inlet (Thompson, 2012). The category of behavioral responses covered a suite of behaviors including altered respiration and dive patterns, disruption of foraging or nursing, and temporary displacement from particular habitats.

There are no data on the behavioral response to vibracore activity of marine mammals in Cook Inlet. The closest analog to vibracoring might be exploratory drilling, although there is a notable difference in magnitude between an oil and gas drilling operation and collecting sediment samples with a vibracorer. Thomas *et al.* (1990) played back drilling sound to four captive beluga whales and found no statistical difference in swim patterns, social groups, respiration and dive rates, or stress hormone levels before and during playbacks. There is no reason to believe that beluga whales or any other marine mammal exposed to vibracoring sound would behave any differently, especially since vibracoring occurs for only one or two minutes.

Hearing Impairment and Other Physical Effects: The vibracorer operates for only one or two minutes at a time with a 1-m source of 187.4 dB re 1 μPa-m (rms). It is neither loud enough nor does it operate for a long enough duration to induce either TTS or PTS.

Stranding and Mortality

Stress, Stranding, and Mortality Safety zones will be established to prevent acoustical injury to local marine mammals, especially injury that could indirectly lead to mortality. Also, G&G sound is not expected to cause resonate effects to gas-filled spaces or airspaces in marine mammals based on the research of Finneran (2003) on beluga whales showing that the tissue and other body masses dampen any potential effects of resonance on ear cavities, lungs, and intestines. Chronic exposure to sound could lead to physiological stress eventually causing hormonal imbalances (NRC 2005). If survival demands are already high, and/or additional stressors are present, the ability of the animal to cope decreases, leading to pathological conditions or death (NRC 2005). Potential effects may be greatest where sound disturbance can disrupt feeding patterns including displacement from critical feeding grounds. However, all G&G exposure to marine mammals would be of duration measured in minutes.

Specific sound-related processes that lead to strandings and mortality are not well documented, but may include (1) swimming in avoidance of a sound into shallow water; (2) a change in behavior (such as a change in diving behavior) that might contribute to tissue damage, gas bubble formation, hypoxia, cardiac arrhythmia, hypertensive hemorrhage, or other forms of trauma; (3) a physiological change such as a vestibular response leading to a behavioral change or stress-induced hemorrhagic diathesis, leading in turn to tissue damage; and, (4) tissue damage directly from sound exposure, such as through acoustically mediated bubble formation and growth or acoustic resonance of tissues (Wood *et al.* 2012). Some of these mechanisms are unlikely to apply in the case of impulse G&G sounds, especially since airguns and sub-bottom profilers produce broadband sound with low pressure rise. Strandings to date which have been attributed to sound exposure related to date from military exercises using narrowband mid-frequency sonar with a much greater likelihood to cause physical damage (Balcomb and Claridge 2001, NOAA and USN, 2001, Hildebrand 2005).

The low intensity, low frequency, broadband sound associated with airguns and sub-bottom profilers, combined with the shutdown safety zone mitigation measure for the airgun would prevent physical damage to marine mammals. The vibracoring would also be unlikely to have the capability of causing physical damage to marine mammals because of its low intensity and short duration.

3. Potential Effects of Vessel Movement and Collisions

Vessel movement in the vicinity of marine mammals has the potential to result in either a behavioral response or a direct physical interaction. We discuss both scenarios here.

Behavioral Responses to Vessel Movement: There are limited data concerning marine mammal behavioral responses to vessel traffic and vessel noise, and a lack of consensus among scientists with respect to what these responses mean or whether they result in short-term or long-term adverse effects. In those cases where there is a busy shipping lane or where there is a large amount of vessel traffic, marine mammals may experience acoustic masking (Hildebrand, 2005) if they are present in the area (*e.g.,* killer whales in Puget Sound; Foote *et al.,* 2004; Holt *et al.,* 2008). In cases where vessels actively approach marine mammals (*e.g.,* whale watching or dolphin watching boats), scientists have documented that animals exhibit altered behavior such as increased swimming speed, erratic movement, and active avoidance behavior (Bursk, 1983; Acevedo, 1991; Baker and MacGibbon, 1991; Trites and Bain, 2000; Williams *et al.,* 2002; Constantine *et al.,* 2003), reduced blow interval (Ritcher *et al.,* 2003), disruption of normal social behaviors (Lusseau, 2003; 2006), and the shift of behavioral activities which may increase energetic costs (Constantine *et al.,* 2003; 2004). A detailed review of marine mammal reactions to ships and boats is available in Richardson *et al.* (1995). For each of the marine mammal taxonomy groups, Richardson *et al.* (1995) provides the following assessment regarding reactions to vessel traffic:

Pinnipeds: Reactions by pinnipeds to vessel disturbance largely involve relocation. Harbor seals hauled out on mud flats have been documented returning to the water in response to nearing boat traffic. Vessels that approach haulouts slowly may also elicit alert reactions without flushing from the haulout. Small boats with slow, constant speed elicit the least noticeable reactions. However, in Alaska specifically, harbor seals are documented to tolerate fishing vessels with no discernable reactions, and habituation is common (Burns in Johnson *et al.,* 1989).

Porpoises: Harbor porpoises are often seen changing direction in the presence of vessel traffic. Avoidance has been documented up to 1km away from an approaching vessel, but the avoidance response is strengthened in closer proximity to vessels (Barlow, 1998; Palka, 1993). This avoidance behavior is not consistent across all porpoises, as Dall's porpoises have been observed approaching boats.

Toothed whales: In summary, toothed whales sometimes show no avoidance reaction to vessels, or even approach them. However, avoidance can occur, especially in response to vessels of types used to chase or hunt the animals. This may cause temporary displacement, but we know of no clear evidence that toothed whales have abandoned significant parts of their range because of vessel traffic.

Behavioral responses to stimuli are complex and influenced to varying degrees by a number of factors, such as species, behavioral contexts, geographical regions, source characteristics (moving or stationary, speed, direction, etc.), prior experience of the animal and physical status of the animal. For example, studies have shown that beluga whales' reactions varied when exposed to vessel noise and traffic. In some cases, naive beluga whales exhibited rapid swimming from ice-breaking vessels up to 80 km (49.7 mi) away, and showed changes in surfacing, breathing, diving, and group composition in the Canadian high Arctic where vessel traffic is rare (Finley *et al.,* 1990). In other cases, beluga whales were more tolerant of vessels, but responded differentially to certain vessels and operating characteristics by reducing their calling rates (especially older animals) in the St. Lawrence River where vessel traffic is common (Blane and Jaakson, 1994). In Bristol Bay, Alaska, beluga whales continued to feed when surrounded by fishing vessels and resisted dispersal even when purposefully harassed (Fish and Vania, 1971).

In reviewing more than 25 years of whale observation data, Watkins (1986) concluded that whale reactions to vessel traffic were ''modified by their previous experience and current activity: Habituation often occurred rapidly, attention to other stimuli or preoccupation with other activities sometimes overcame their interest or wariness of stimuli.'' Watkins noticed that over the years of exposure to ships in the Cape Cod area, minke whales changed from frequent positive interest (*e.g.,* approaching vessels) to generally uninterested reactions; fin whales changed from mostly negative (*e.g.,* avoidance) to uninterested reactions; right whales apparently continued the same variety of responses (negative, uninterested, and positive responses) with little change; and humpbacks dramatically changed from mixed responses that were often negative to reactions that were often strongly positive. Watkins (1986) summarized that ''whales near shore, even in regions with low vessel traffic, generally have become less wary of boats and their noises, and they have appeared to be less easily disturbed than previously. In particular locations with intense shipping and repeated approaches by boats (such as the whale-watching areas of Stellwagen Bank), more and more whales had positive reactions to familiar vessels, and they also occasionally approached other boats and yachts in the same ways.''

Vessel Strike

Ship strikes of cetaceans can cause major wounds, which may lead to the death of the animal. An animal at the surface could be struck directly by a vessel, a surfacing animal could hit the bottom of a vessel, or a vessel's propeller could injure an animal just below the surface. The severity of injuries typically depends on the size and speed of the vessel (Knowlton and Kraus, 2001; Laist *et al.,* 2001; Vanderlaan and Taggart, 2007).

The most vulnerable marine mammals are those that spend extended periods of time at the surface in order to restore oxygen levels within their tissues after deep dives (*e.g.,* the sperm whale). In addition, some baleen whales, such as the North Atlantic right whale, seem generally unresponsive to vessel sound, making them more susceptible to vessel collisions (Nowacek *et al.,* 2004). These species are primarily large, slow moving whales. Smaller marine mammals (*e.g.,* bottlenose dolphin) move quickly through the water column and are often seen riding the bow wave of large ships. Marine mammal responses to vessels may include avoidance and changes in dive pattern (NRC, 2003).

An examination of all known ship strikes from all shipping sources (civilian and military) indicates vessel speed is a principal factor in whether a vessel strike results in death (Knowlton and Kraus, 2001; Laist *et al.,* 2001; Jensen and Silber, 2003; Vanderlaan and Taggart, 2007). In assessing records with known vessel speeds, Laist *et al.* (2001) found a direct relationship between the occurrence of a whale strike and the speed of the vessel involved in the collision. The authors concluded that most deaths occurred when a vessel was traveling in excess of 24.1 km/h (14.9 mph; 13 kts). Given the slow vessel speeds necessary for data acquisition, ship strike is unlikely to occur during this survey.

Entanglement

Entanglement can occur if wildlife becomes immobilized in survey lines, cables, nets, or other equipment that is moving through the water column. The proposed survey would require towing approximately 150 ft of cables. This size of the array generally carries a lower risk of entanglement for marine mammals. Wildlife, especially slow moving individuals, such as large whales, have a low probability of entanglement due to the low amount of slack in the lines, slow speed of the survey vessel, and onboard monitoring. Pinnipeds and porpoises are the least likely to entangle in equipment, as most documented cases of entanglement involve fishing gear and prey species (Gales *et al.,* 2003). There are no reported cases of entanglement from geophysical equipment in the Cook Inlet area.

Anticipated Effects on Marine Mammal Habitat

The G&G Program survey areas are within upper Cook Inlet, primarily north of the Forelands although the Marine Terminal survey area is located near Nikiski just south of the East Foreland, which includes habitat for prey species of marine mammals, including fish as well as invertebrates eaten by Cook Inlet beluga whales. This area contains Critical Habitat for Cook Inlet belugas, is near the breeding grounds for the local harbor seal population, and serves as an occasional feeding ground for killer whales and harbor porpoises. Cook Inlet is a large subarctic estuary roughly 299 km (186 mi) in length and averaging 96 km (60 mi) in width. It extends from the city of Anchorage at its northern end and flows into the Gulf of Alaska at its southernmost end. For descriptive purposes, Cook Inlet is separated into unique upper and lower sections, divided at the East and West Forelands, where the opposing peninsulas create a natural waistline in the length of the waterway, measuring approximately 16 km (10 mi) across (Mulherin *et al.,* 2001).

Potential effects on beluga habitat would be limited to noise effects on prey; direct impact to benthic habitat from jack-up platform leg placement, and sampling with grabs, coring, and boring; and small discharges of drill cuttings and drilling mud associated with the borings. Portions of the survey areas include waters of Cook Inlet that are <9.1 m (30 ft) in depth and within 8.0 km (5.0 mi) of anadromous streams. Several anadromous streams (Three-mile Creek, Indian Creek, and two unnamed streams) enter the Cook Inlet within the survey areas. Other anadromous streams are located within 8.0 km (5.0 mi) of the survey areas. The survey program will not prevent beluga access to the mouths of these streams and will result in no short-term or long-term loss of intertidal or subtidal waters that are <9.1 m (30 ft) in depth and within 8.0 km (5.0 mi) of anadromous streams. Minor seafloor impacts will occur in these areas from grab samples, PCPTs, vibracores, or geotechnical borings but will have no effect on the area as beluga habitat once the vessel or jack-up platform has left. The survey program will have no effect on this habitat.

Cook Inlet beluga whales may avoid areas ensonified by the geophysical or geotechnical activities that generate sound with frequencies within the beluga hearing range and at levels above threshold values. This includes the chirp sub-bottom profiler with a radius of 631 m, the boomer sub-bottom profiler with a radius of 1 km, the airgun with a radius of 300 m and the vibracore with a radius of 6.2 m. The sub-bottom profilers and the airgun will be operated from a vessel moving at speeds of about 4 kt. The chirp may also be operated concurrently with an airgun. The airgun may also be used as a stationary source in the Marine Facilities area. The operation of a vibracore has a duration of approximately 1–2 minutes. All of these activities will be conducted in relatively open areas of the Cook Inlet within Critical Habitat Area 2. Given the size and openness of the Cook Inlet in the survey areas, and the relatively small area and mobile/temporary nature of the zones of ensonification, the generation of sound by the G&G activities is not expected to result in any restriction of passage of belugas within or between critical habitat areas. The jack-up platform from which the geotechnical borings will be conducted will be attached to the seafloor with legs, and will be in place at a given location for up to 4–5 days, but given its small size (Table 4 in the application) would not result in any obstruction of passage by belugas.

Upper Cook Inlet comprises the area between Point Campbell (Anchorage) down to the Forelands, and is roughly 95 km (59 mi) in length and 24.9 km (15.5 mi) in width (Mulherin *et al.,* 2001). Five major rivers (Knik, Matanuska, Susitna, Little Susitna, and Beluga) deliver freshwater to upper Cook Inlet, carrying a heavy annual sediment load of over 40 million tons of eroded materials and glacial silt (Brabets 1999). As a result, upper Cook Inlet is relatively shallow, averaging 18.3 m (60 ft) in depth. It is characterized by shoals, mudflats, and a wide coastal shelf, less than 17.9 m (59 ft) deep, extending from the eastern shore. A deep trough exists between Trading Bay and the Middle Ground Shoal, ranging from 35 to 77 m (114–253 ft) deep (NOAA Nautical Chart 16660). The substrate consists of a mixture of coarse gravels, cobbles, pebbles, sand, clay, and silt (Bouma *et al.* 1978, Rappeport 1982).

Upper Cook Inlet experiences some of the most extreme tides in the world, demonstrated by a mean tidal range from 4.0 m (13 ft) at the Gulf of Alaska end to 8.8 m (29 ft) near Anchorage (U.S. Army Corps of Engineers 2013). Tidal currents reach 3.9 kts per second (Mulherin *et al.,* 2001) in upper Cook Inlet, increasing to 5.7–7.7 kts per second near the Forelands where the inlet is constricted. Each tidal cycle creates significant turbulence and vertical mixing of the water column in the upper inlet (U.S. Army Corps of Engineers 2013), and are reversing, meaning that they are marked by a period of slack tide followed an acceleration in the opposite direction (Mulherin *et al,.* 2001).

Because of scouring, mixing, and sediment transport from these currents, the marine invertebrate community is very limited (Pentec 2005). Of the 50 stations sampled by Saupe *et al.* 2005 for marine invertebrates in Southcentral Alaska, their upper Cook Inlet station had by far the lowest abundance and diversity. Further, the fish community of upper Cook Inlet is characterized largely by migratory fish—eulachon and Pacific salmon—returning to spawning rivers, or outmigrating salmon smolts. Moulton (1997) documented only 18 fish species in upper Cook Inlet compared to at least 50 species found in lower Cook Inlet (Robards *et al.* 1999).

Lower Cook Inlet extends from the Forelands southwest to the inlet mouth demarked by an approximate line between Cape Douglas and English Bay. Water circulation in lower Cook Inlet is dominated by the Alaska Coastal Current (ACC) that flows northward along the shores of the Kenai Peninsula until it turns westward and is mixed by the combined influences of freshwater input from upper Cook Inlet, wind, topography, tidal surges, and the coriolis effect (Field and Walker 2003, MMS 1996). Upwelling by the ACC brings nutrient-rich waters to lower Cook Inlet and contributes to a biologically rich and productive ecology (Sambrotto and Lorenzen 1986). Tidal currents average 2–3 kt per second and are rotary in that they do not completely go slack before rotating around into an opposite direction (Gatto 1976, Mulherin *et al.* 2001). Depths in the central portion of lower Cook Inlet are 60–80 m (197–262 ft) and decrease steadily toward the shores (Muench 1981). Bottom sediments in the lower inlet are coarse gravel and sand that grade to finer sand and mud toward the south (Bouma 1978).

Coarser substrate support a wide variety of invertebrates and fish including Pacific halibut, Dungeness crab, tanner crab, pandalid shrimp, Pacific cod, and rock sole, while the soft-bottom sand and silt communities are dominated by polychaetes, bivalves and other flatfish (Field and Walker

2003). These species constitute prey species for several marine mammals in Cook Inlet, including pinnipeds and Cook Inlet belugas. Sea urchins and sea cucumbers are important otter prey and are found in shell debris communities. Razor clams are found all along the beaches of the Kenai Peninsula. In general, the lower Cook Inlet marine invertebrate community is of low abundance, dominated by polychaetes, until reaching the mouth of the inlet (Saupe *et al.* 2005). Overall, the lower Cook Inlet marine ecosystem is fed by midwater communities of phytoplankton and zooplankton, with the latter composed mostly of copepods and barnacle and crab larvae (Damkaer 1977, English 1980).

G&G Program activities that could potentially impact marine mammal habitats include sediment sampling (vibracore, boring, grab sampling) on the sea bottom, placement of the jack-up platform spud cans, and acoustical injury of prey resources. However, there are few benthic resources in the survey area that could be impacted by collection of the small samples (Saupe *et al.* 2005). These activities are temporary in nature and for short durations.

Acoustical effects to marine mammal prey resources are also limited. Christian *et al.* (2004) studied seismic energy impacts on male snow crabs and found no significant increases in physiological stress due to exposure to high sound pressure levels. No acoustical impact studies have been conducted to date on the above fish species, but studies have been conducted on Atlantic cod and sardine. Davis *et al.* (1998) cited various studies that found no effects to Atlantic cod eggs, larvae, and fry when received levels were 222 dB. Effects found were to larval fish within about 5.0 m (16 ft), and from air guns with volumes between 49,661 and 65,548 cm3 (3,000 and 4,000 in^3). Similarly, effects to sardine were greatest on eggs and 2-day larvae, but these effects were greatest at 0.5 m (1.6 ft), and again confined to 5.0 m (16 ft). Further, Greenlaw *et al.* (1988) found no evidence of gross histological damage to eggs and larvae of northern anchovy exposed to seismic air guns, and concluded that noticeable effects would result only from multiple, close exposures. Based on these results, much lower energy impulsive geophysical equipment planned for this program would not damage larval fish or any other marine mammal prey resource.

Potential damage to the Cook Inlet benthic community will be limited to the actual surface area of the four spud cans that form the ''foot'' of each 0.762-m (30-in) diameter leg, the 42 0.1524-m (6-in) diameter borings, and the 55 0.0762-m (3-in) diameter vibracore samplings (plus several grab and PCPT samples). Collectively, these samples would temporarily damage about a hundred square meters of benthic habitat relative to the size (nearly 21,000 km2/8,108 mi2) of Cook Inlet. Overall, sediment sampling and acoustical effects on prey resources will have a negligible effect at most on the marine mammal habitat within the G&G Program survey area. Some prey resources might be temporarily displaced, but no long-term effects are expected.

The Cook Inlet 2015 G&G Program will result in a number of minor discharges to the waters of Cook Inlet. Discharges associated with the geotechnical borings will include: (1) The discharge of drill cuttings and drilling fluids and (2) the discharge of deck drainage (runoff of precipitation and deck wash water) from the geotechnical drilling platform. Other vessels associated with the G&G surveys will discharge wastewaters that are normally associated with the operation of vessels in transit including deck drainage, ballast water, bilge water, non-contact cooling water, and gray water.

The discharges of drill cuttings, drilling fluids, and deck drainage associated with the geotechnical borings will be within limitations authorized by the Alaska Department of Environmental Conservation under the Alaska Pollutant Discharge Elimination System. The drill cuttings consist of natural geologic materials of the seafloor sediments brought to the surface via the drill bit/drill stem of the rotary drilling operation, will be relatively minor in volume, and deposit over a very small area of Cook Inlet seafloor. The drilling fluids which are used to lubricate the bit, stabilize the hole, and viscosify the slurry for transport of the solids to the surface will consist of seawater and guar gum. Guar gum is a high-molecular weight polysaccharide (galactose and mannose units) derived from the ground seeds of the plant *Cyampsis gonolobus.* It is a non-toxic fluid also used as a food additive in soups, drinks, breads, and meat products.

Vessel discharges will be authorized under the U.S. Environmental Protection Agency's (EPA's) National Pollutant Discharge Elimination System (NPDES) Vessel General Permit (VGP) for Discharges Incidental to the Normal Operation of Vessels. Each vessel will have obtained authorization under the VGP and will discharge according to the conditions and limitations mandated by the permit. As required by statute and regulation, the EPA has made a determination that such discharges will not result in any unreasonable degradation of the marine environment, including:

- Significant adverse changes in ecosystem diversity, productivity and stability of the biological community within the area of discharge and surrounding biological communities,
- Threat to human health through direct exposure to pollutants or through consumption of exposed aquatic organisms, or
- Loss of aesthetic, recreational, scientific or economic values which is unreasonable in relation to the benefit derived from the discharge.

Proposed Mitigation

In order to issue an incidental take authorization under section 101(a)(5)(D) of the MMPA, NMFS must set forth the permissible methods of taking pursuant to such activity, and other means of effecting the least practicable adverse 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).

EMALL has proposed the following mitigation measures. To mitigate potential acoustical impacts to local marine mammals, Protected Species Observers (PSOs) will operate aboard the vessels from which the chirper, boomer, airgun, and vibracorer will be deployed. The PSOs will implement the mitigation measures described in the Marine Mammal Monitoring and Mitigation Plan (Appendix A of the application). These mitigations include: (1) Establishing safety zones to ensure marine mammals are not injured by sound pressure levels exceeding Level A injury thresholds; (2) shutting down the airgun when required to avoid harassment of beluga whales approaching the 160–dB disturbance zone; and (3) timing survey activity to avoid concentrations of beluga whales on a seasonal basis.

Before chirper, boomer, airgun, and vibracoring operations begin each day and before restarting operations after a shutdown of 15 minutes or greater, the PSOs will ''clear'' both the Level A and Level B Zones of Influence (ZOIs—area from the source to the 160dB or 180/190dB isopleths) of marine mammals by intensively surveying these ZOIs prior to activity to confirm that marine mammals are not seen in the applicable area. All three geophysical activities (boomer, chirp, airgun) will be shut down in mid-operation at the approach to any marine mammal to the Level A safety zone, and at the approach of an ESA-listed beluga whale to the Level B harassment zone for these sources. The geotechnical vibracoring lasts only one or two minutes and shutdowns are likely impossible. Finally, the G&G Program will be planned to avoid high beluga whale density areas. This would be achieved by conducting surveys at the Marine Terminal and the southern end of the pipeline survey area when beluga whales are farther north, feeding near the Susitna Delta, and completing activities in the northern portion of the pipeline survey area when the Cook Inlet beluga whales have begun to disperse from the Susitna Delta and other summer concentration areas.

Vessel-Based Visual Mitigation Monitoring

EMALL will hire qualified and NMFS-approved PSOs. These PSOs will be stationed aboard the geophysical survey source or support vessels during sub-bottom profiling, air gun, and vibracoring operations. A single senior PSO will be assigned to oversee all Marine Mammal Mitigation and Monitoring Program mandates and function as the on-site person-in-chargeimplementing the 4MP.

Generally, two PSOs will work on a rotational basis during daylight hours with shifts of 4 to 6 hours, and one PSO on duty on each source vessel at all times. Work days for an individual PSO will not exceed 12 hours in duration. Sufficient numbers of PSOs will be available and provided to meet requirements.

Roles and responsibilities of all PSOs include the following:

- Accurately observe and record sensitive marine mammal species;
- Follow monitoring and data collection procedures; and
- Ensure mitigation measures are followed.

PSOs will be stationed at the best available vantage point on the source vessels. PSOs will scan systematically with the unaided eye and 7x50 reticle binoculars. As necessary, new PSOs will be paired with experienced PSOs to ensure that the quality of marine mammal observations and data recording are consistent.

All field data collected will be entered by the end of the day into a custom database using a notebook computer. Weather data relative to viewing conditions will be collected hourly, on rotation, and when sightings occur and include the following:

- Sea state;
- Wind speed and direction;
- Sun position; and
- Percent glare.

The following data will be collected for all marine mammal sightings:

- Bearing and distance to the sighting;
- Species identification;
- Behavior at the time of sighting (*e.g.,* travel, spy-hop, breach, etc.);
- Direction and speed relative to vessel;
- Reaction to activities—changes in behavior (*e.g.,* none, avoidance, approach, paralleling, etc.);
- Group size;
- Orientation when sighted (*e.g.,* toward, away, parallel, etc.);
- Closest point of approach;
- Sighting cue (*e.g.,* animal, splash, birds, etc.);
- Physical description of features that were observed or determined not to be present in the case of unknown or unidentified animals;
- Time of sighting;
- Location, speed, and activity of the source and mitigation vessels, sea state, ice cover, visibility, and sun glare; and positions of other vessel(s) in the vicinity, and
- Mitigation measure taken—if any.

All observations and shut downs will be recorded in a standardized format and data entered into a custom database using a notebook computer. Accuracy of all data will be verified daily by the person in charge (PIC) or designated PSO by a manual verification. These procedures will reduce errors, allow the preparation of short-term data summaries, and facilitate transfer of the data to statistical, graphical, or other programs for further processing and archiving. PSOs will conduct monitoring during daylight periods (weather permitting) during G&G activities, and during most daylight periods when G&G activities are temporarily suspended.

Shutdown Procedures

If any marine mammal is seen approaching the Level A injury zone for the air gun, chirp, or boomer, these sources will be shut down. If ESA-listed marine mammals (*e.g.,* beluga whales) are observed approaching the Level B harassment zone for the air gun, chirp, or boomer, these sources will be shut down. The PSOs will ensure that the harassment zone is clear of marine mammal activity before vibracoring will occur, using observers near the vibracore as well as PSOs from a monitoring vessel. Given that vibracoring lasts only about a minute or two, shutdown actions are not practicable.

Resuming Airgun Operations After a Shutdown

A full ramp-up after a shutdown will not begin until there has been a minimum of 30 minutes of observation of the applicable exclusion zone by PSOs to assure that no marine mammals are present. The entire exclusion zone must be visible during the 30-minute lead-in to a full ramp up. If the entire exclusion zone is not visible, then ramp-up from a cold start cannot begin. If a marine mammal(s) is sighted within the injury exclusion zone during the 30-minute watch prior to ramp-up, ramp-up will be delayed until the marine mammal(s) is sighted outside of the zone or the animal(s) is not sighted for at least 15–30 minutes: 15 Minutes for small odontocetes and pinnipeds (*e.g.* harbor porpoises, harbor seals), or 30 minutes for large odontocetes (*e.g.,* killer whales and beluga whales).

Speed and Course Alterations

If a marine mammal is detected outside the Level A injury exclusion zone and, based on its position and the relative motion, is likely to enter that zone, the vessel's speed and/or direct course may, when practical and safe, be changed to also minimize the effect on the survey program. The marine mammal activities and movements relative to the sound source and support vessels will be closely monitored to ensure that the marine mammal does not approach within the applicable exclusion radius. If the mammal appears likely to enter the exclusion radius, further mitigative actions will be taken, *i.e.,* either further course alterations or shut down of the active sound sources considered in this Authorization.

Mitigation Proposed by NMFS

Special Procedures for Situations or Species of Concern

The following additional protective measures for beluga whales and groups of five or more killer whales and harbor porpoises are required. Specifically, a 160-dB vessel monitoring zone would be established and monitored in Cook Inlet during all seismic surveys. If a beluga whale or groups of five or more killer whales and/or harbor porpoises are visually sighted approaching or within the 160-dB disturbance zone, survey activity would not commence until the animals are no longer present within the 160-dB disturbance zone. Whenever Cook Inlet beluga whales or groups of five or more killer whales and/or harbor porpoises are detected approaching or within the 160-dB disturbance zone, the boomer, chirp, and airgun may be powered down before the animal is within the 160-dB disturbance zone, as an alternative to a complete shutdown. If the PSO determines a power down is not sufficient, the sound source(s) shall be shut-down until the animals are no longer present within the 160-dB zone.

Mitigation Exclusion Zones

NMFS requires that EMALL will not operate the chirp, boomer, vibracore, or airgun within 10 miles (16 km) of the mean higher high water (MHHW) line of the Susitna Delta (Beluga River to the Little Susitna River) between April 15 and October 15. The purpose of this mitigation measure is to protect beluga whales in the designated critical habitat in this area that is important for beluga whale feeding and calving during the spring and fall months. The range of the setback required by NMFS was designated to protect this important habitat area and also to create an effective buffer where sound does not encroach on this habitat. This seasonal exclusion will be in effect from April 15th to October 15th annually. Activities can occur within this area from October 16th–April 14th.

Passive Acoustic Monitoring

To allow the use of vibracoring in low-light and nighttime conditions, NMFS would require use of passive acoustic monitoring to acoustically ''clear'' the relevant 120 or 160-dB disturbance zone. A specifically trained Passive Acoustic Monitoring (PAM) operator will deploy the hydrophone and listen for vocalizations of marine mammals. If no vocalizations are detected in 30 minutes of listening, the area can be considered clear and operations can ramp up.

Mitigation Conclusions

NMFS has carefully evaluated EMALL's mitigation measures and considered additional measures in the context of ensuring that we prescribe 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 here:

- Avoidance or minimization of injury or death of marine mammals wherever possible (goals 2, 3, and 4 may contribute to this goal).
- A reduction in the numbers of marine mammals (total number or number at biologically important time or location) exposed to sub-bottom profiler or airgun operations that we expect to result in the take of marine mammals (this goal may contribute to 1, above, or to reducing harassment takes only).
- A reduction in the number of times (total number or number at biologically important time or location) individuals would be exposed to sub-bottom profiler or airgun operations that we expect to result in the take of marine mammals (this goal may contribute to 1, above, or to reducing harassment takes only).
- A reduction in the intensity of exposures (either total number or number at biologically important time or location) to airgun operations that we expect to result in the take of marine mammals (this goal may contribute to a, above, or to reducing the severity of harassment takes only).
- 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.
- 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 the evaluation of EMALL's measures, as well as other measures required by NMFS, NMFS has determined that the mitigation measures provide the means of effecting the least practicable impact on marine mammal species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance. Measures to ensure availability of such species or stock for taking for certain subsistence uses are discussed later in this document (see ''Impact on Availability of Affected Species or Stock for Taking for Subsistence Uses'' section).

Proposed Monitoring and Reporting

In order to issue an IHA for an activity, section 101(a)(5)(D) of the MMPA states that NMFS must 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 incidental take authorizations 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 proposed action area.

Any monitoring requirement we prescribe should improve our understanding of one or more of the following:

- Occurrence of marine mammal species in action area (*e.g.,* presence, abundance, distribution, density).
- Nature, scope, or context of likely marine mammal exposure to potential stressors/impacts (individual or cumulative, acute or chronic), through better understanding of: (1) Action or environment (*e.g.,* source characterization, propagation, ambient noise); (2) Affected species (*e.g.,* life history, dive patterns); (3) Co-occurrence of marine mammal species with the action; or (4) Biological or behavioral context of exposure (*e.g.,* age, calving, breeding, or feeding areas).
- Individual responses to acute stressors, or impacts of chronic exposures (behavioral or physiological).
- How anticipated responses to stressors impact either: (1) Long-term fitness and survival of an individual; or (2) Population, species, or stock.
- Effects on marine mammal habitat and resultant impacts to marine mammals.
- Mitigation and monitoring effectiveness.

EMALL submitted a marine mammal monitoring plan as part of the IHA application. It can be found in Appendix A. The plan may be modified or supplemented based on comments or new information received from the public during the public comment period.

Weekly Field Reports

Weekly reports will be submitted to NMFS no later than the close of business (Alaska Time) each Thursday during the weeks when in-water G&G activities take place. The reports will cover information collected from Wednesday of the previous week through Tuesday of the current week. The field reports will summarize species detected, in-water activity occurring at the time of the sighting, behavioral reactions to in-water activities, and the number of marine mammals exposed to harassment level noise. The weekly reports will also contain information about which km^2 grid cells that EMALL has operated in that week, along with the corresponding densities from the Goetz *et al.* 2012 model to indicate how many belugas may have been taken by these operations. The weekly report will also include the number of belugas that may have been taken from previous weeks to track when EMALL is approaching their cap of 34 belugas.

Monthly Field Reports

Monthly reports will be submitted to NMFS for all months during which in-water G&G activities take place. The reports will be submitted to NMFS no later than five business days after the end of the month. The monthly report will contain and summarize the following information:

- Dates, times, locations, heading, speed, weather, sea conditions (including Beaufort Sea state and wind force), and associated activities during the G&G Program and marine mammal sightings.
- Species, number, location, distance from the vessel, and behavior of any sighted marine mammals, as well as associated G&G activity (number of shut downs), observed throughout all monitoring activities.
- An estimate of the number (by species) of: (i) Pinnipeds that have been exposed to the authorized geophysical or geotechnical activity (based on visual observation) at received levels greater than or equal to 160 dB re 1 μPa (rms) and/or 190 dB re 1 μPa (rms) with a discussion of any specific behaviors those individuals exhibited; and (ii) cetaceans that have been exposed to the geophysical activity (based on visual observation) at received levels greater than or equal to 160 dB re 1 μPa (rms) and/or 180 dB re 1 μPa (rms) with a discussion of any specific behaviors those individuals exhibited.
- An estimate of the number (by species) of pinnipeds and cetaceans that have been exposed to the geotechnical activity (based on visual observation) at received levels greater than or equal to 120 dB re 1 μPa (rms) with a discussion of any specific behaviors those individuals exhibited.
- A description of the implementation and effectiveness of the: (i) Terms and conditions of the Biological Opinion's Incidental Take Statement; and (ii) mitigation measures of the IHA. For the Biological Opinion, the report shall confirm the implementation of each Term and Condition, as well as any conservation recommendations, and describe their effectiveness, for minimizing the adverse effects of the action on ESA-listed marine mammals.

90-Day Technical Report

A report will be submitted to NMFS within 90 days after the end of the project or at least 60 days before the request for another IHA for the next open water season to enable NMFS to incorporate observation data into the next Authorization. The report will summarize all activities and monitoring results (*i.e.,* vessel-based visual monitoring) conducted during in-water G&G surveys. The Technical Report will include the following:

- Summaries of monitoring effort (*e.g.,* total hours, total distances, and marine mammal distribution through the study period, accounting for sea state and other factors affecting visibility and detectability of marine mammals).
- Analyses of the effects of various factors influencing detectability of marine mammals (*e.g.,* sea state, number of observers, and fog/glare).
- 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.
- Analyses of the effects of survey operations.
- Sighting rates of marine mammals during periods with and without G&G survey activities (and other variables that could affect detectability), such as: (i) Initial sighting distances versus survey activity state; (ii) closest point of approach versus survey activity state; (iii) observed behaviors and types of movements versus survey activity state; (iv) numbers of sightings/individuals seen versus survey activity state; (v) distribution around the source vessels versus survey activity state; and (vi) estimates of Level B harassment based on presence in the 120 or 160 dB harassment zone.

Notification of Injured or Dead Marine Mammals

In the unanticipated event that the specified activity leads to an injury of a marine mammal (Level A harassment) or mortality (*e.g.,* ship-strike, gear interaction, and/or entanglement), EMALL would immediately cease the specified activities and immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, and the Alaska Regional Stranding Coordinators at NMFS. The report would include the following information:

- Time, date, and location (latitude/longitude) of the incident;
- Name and type of vessel involved;
- Vessel's speed during and leading up to the incident;
- Description of the incident;
- Status of all sound source use in the 24 hours preceding the incident;
- Water depth;
- Environmental conditions (*e.g.,* wind speed and direction, Beaufort sea state, cloud cover, and visibility);
- Description of all marine mammal observations in the 24 hours preceding the incident;
- Species identification or description of the animal(s) involved;
- Fate of the animal(s); and
- Photographs or video footage of the animal(s) (if equipment is available).

Activities would not resume until NMFS is able to review the circumstances of the event. EMALL would work with NMFS to minimize reoccurrence of such an event in the future. The G&G Program would not resume activities until formally notified by NMFS via letter, email, or telephone.

In the event that the G&G Program discovers an injured or dead marine mammal, and the lead PSO determines that the cause of the injury or death is unknown and the death is relatively recent (*i.e.,* in less than a moderate state of decomposition as described in the next paragraph), the Applicant would immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, and the NMFS Alaska Stranding Hotline and/or by email to the Alaska Regional Stranding Coordinators. The report would include the same information identified in the paragraph above. Activities would be able to continue while NMFS reviews the circumstances of the incident. NMFS would work with the Applicant to determine if modifications in the activities are appropriate.

In the event that the G&G Program discovers an injured or dead marine mammal, and the lead PSO determines that the injury or death is not associated with or related to the activities authorized in the IHA (*e.g.,* previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), EMALL would report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, and the NMFS Alaska Stranding Hotline and/or by email to the Alaska Regional Stranding Coordinators, within 24 hours of the discovery. EMALL would provide photographs or video footage (if available) or other documentation of the stranded animal sighting to NMFS and the Marine Mammal Stranding Network.

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].

Acoustic stimuli (*i.e.,* increased underwater sound) generated during the operation of the airgun or the sub-bottom profiler have the potential to result in the behavioral disturbance of some marine mammals. NMFS believes that take from the operation of the vibracore is unlikely but possible and is issuing take at the request of the applicant. Thus, NMFS proposes to authorize take by Level B harassment resulting from the operation of the sound sources for the proposed survey based upon the current acoustic exposure criteria shown in Table 3.

TABLE 3—NMFS' CURRENT ACOUSTIC EXPOSURE CRITERIA

Criterion	Criterion definition	Threshold
Level A Harassment (Injury)	Permanent Threshold Shift (PTS) (Any level above that which is known to cause TTS).	180 dB re 1 microPa-m (cetaceans)/190 dB re 1 microPa-m (pinnipeds) root mean square (rms).
Level B Harassment	Behavioral Disruption (for impulse noises)	160 dB re 1 microPa-m (rms).
	Behavioral Disruption (for continuous noises)	120 dB re 1 microPa-m (rms).

NMFS' practice is to apply the 120 or 160 dB re: 1 μPa received level threshold (whichever is appropriate) for underwater impulse sound levels to determine whether take by Level B harassment is likely to occur.

All four types of survey equipment addressed in the application will be operated from the geophysical source vessels that will either be moving steadily across the ocean surface (chirper, boomer, airgun), or from station to station (airgun, vibracoring). The numbers of marine mammals that might be exposed to sound pressure levels exceeding NMFS Level B harassment threshold levels due to G&G surveys, without mitigation, were determined by multiplying the average raw density for each species by the daily ensonified area, and then multiplying that figure by the number of days each sound source is estimated to be in use. The chirp is always used simultaneously with either the boomer or the airgun and therefore was removed from calculation because they will be operating concurrently, using the daily ensonified area of the boomer or airgun, as it is a slightly larger isopleth. The exposure estimates for each activity were then summed to provide total exposures for the duration of the project. The exposure estimates for the activity are detailed below. Although NMFS believes that take of marine mammals from vibracore is extremely unlikely, it has been included in this authorization out of an abundance of caution and at the request of the applicant.

Ensonified Area

The ZOI is the area ensonified by a particular sound source greater than threshold levels (120 dB for continuous and 160 dB for impulsive). The radius of the ZOI for airguns was determined by applying the source sound pressure levels described in Table 6 of the application to Collins *et al.*'s (2007) attenuation model of 18.4 Log(r)—0.00188 derived from Cook Inlet. For the boomer and vibracore, which are less studied sound sources, the geometric spreading model of 15 Log(r) was used. For those equipment generating loud underwater sound within the audible hearing range of marine mammals (<200 kHz), the distance to threshold ranges between 44 m and 1 km (Table 4).

TABLE 4—SUMMARY OF DISTANCES TO THE NMFS THRESHOLDS AND ASSOCIATED ZOIS

Survey equipment	Distance to 160/120 dB isopleth [1] Km^2	160/120 dB ZOI km^2
Sub-bottom Profiler (Chirp)	0.631(160 dB)	127 (160 dB)
Sub-bottom Profiler (Boomer)	1.00 (160 dB)	203(160 dB)
Airgun	0.3 (160 dB)	60 (160 dB)
Vibracore	20.57 (120 dB)	1328.61 (120 dB)

[1] Calculated by applying Collins et al. (2007) spreading formula or geometrical spreading to source levels in Table 2.

Marine Mammal Densities

Density estimates were derived for harbor porpoises, killer whales, and harbor seals from NMFS 2002–2012 Cook Inlet survey data as described below in Section 6.1.2.1 and shown in Table 8. The beluga whale densities were extracted from Goetz et al. (2012) as described in Section 6.1.2.2 of the application.

Harbor Porpoise, Killer Whale, Harbor Seal

Density estimates were calculated for all marine mammals (except beluga whales) by using aerial survey data collected by NMFS in Cook Inlet between 2002 and 2012 (Rugh *et al.* 2002, 2003, 2004a, 2004b, 2005a, 2005b, 2005c, 2006, 2007; Shelden et al. 2008, 2009, 2010; Hobbs *et al.* 2011, Shelden *et al.* 2012) and compiled by Apache, Inc. (Apache IHA application 2014). To estimate the average raw densities of marine mammals, the total number of animals for each species observed over the 11-year survey period was divided by the total area of 65,889 km2 (25,540 mi2) surveyed over the 11 years. The aerial survey marine mammal sightings, survey effort (area), and derived average raw densities are provided in Table 5.

TABLE 5—RAW DENSITY ESTIMATES FOR COOK INLET MARINE MAMMALS BASED ON NMFS AERIAL SURVEYS

Species	Number of animals	NMFS survey area km² (mi²)	Mean raw density animals/km² (animals/mi²)
Harbor Porpoise	249	65,889 (25,440)	0.0033 (0.0098)
Killer Whale [1]	42	65,889 (25,440)	0.0008 (0.0017)
Harbor Seal	16,117	65,889 (25,440)	0.28 (0.6335)

[1] Density is for all killer whales regardless of the stock although all killer whales in the upper Cook Inlet are thought to be transient.

These raw densities were not corrected for animals missed during the aerial surveys as no accurate correction factors are currently available for these species; however, observer error may be limited as the NMFS surveyors often circled marine mammal groups to get an accurate count of group size. The harbor seal densities are probably biased upwards given that a large number of the animals recorded were of large groups hauled out at river mouths, and do not represent the distribution in the waters where the G&G activity will actually occur. However, these data are the most comprehensive available for Cook Inlet harbor seals and therefore constitute the best available science.

Beluga Whale

Goetz *et al.* (2012) modeled aerial survey data collected by the NMFS between 1993 and 2008 and developed specific beluga summer densities for each 1-km² cell of Cook Inlet. The results provide a more precise estimate of beluga density at a given location than simply multiplying all aerial observations by the total survey effort given the clumped distribution of beluga whales during the summer months. To develop a density estimate associated with planned action areas (*i.e.,* Marine Terminal and pipeline survey areas), the ensonified area associated with each activity was overlain a map of the 1-km density cells, the cells falling within each ensonified area were quantified, and an average cell density was calculated. The summary of the density results is found in Table 9 in the application. The associated ensonified areas and beluga density contours relative to the action areas are shown in Table 6.

TABLE 6—MEAN RAW DENSITIES OF BELUGA WHALES WITHIN THE ACTION AREAS BASED ON GOETZ ET AL. (2012) COOK INLET BELUGA WHALE DISTRIBUTION MODELING

Action area	Number of cells	Mean density (animals/km²)	Density range (animals/km²)
Marine Facilities Area	141	0.00014	0.00002–0.00069
LNGC Approach Area	95	.00016	0.00003–0.00052
Pipeline Survey Area	880	0.0139	0.00028–0.15672

Activity Duration

The Cook Inlet 2015 G&G Program is expected to require approximately 16 weeks (102 days) to complete. Table 7 below outlines which technologies will be used and for how many days.

TABLE 7—ESTIMATED ACTIVITY DURATIONS FOR 2016 G&G PROGRAM

		Survey area			
Survey equipment	Unit	Marine facilities	LNGC Approach	Pipeline	Total
Sub-bottom profiler—boomer	Days	28	14	30	72
Air gun	Days	14	0	16	30
Subtotal	Days	42	14	46	102
Vibracore	Days	30	10	20	60
Air gun (stationary)	Days	24	0	0	24

In the 46 days of activity in the pipeline area, the chirp and boomer will operate concurrently for 30 days while the chirp and airgun will operate concurrently for 16 days. In the 42 days of activity in the Marine Facilities area, the chirp and boom will operate concurrently for 28 days and the chirp will operate concurrently with the airgun for 14 days. In the 14 days of operation in the LNGC approach area, the chirp and boom will operate concurrently for all days.

Exposure Calculations

The numbers of marine mammals that might be exposed to sound pressure levels exceeding NMFS Level B harassment threshold levels due to G&G surveys, without mitigation, were determined by multiplying the average raw density for each species by the daily ensonified area, then multiplying by the number of days each sound source is estimated to be in use. While this method produces a good estimate of the number of instances of take, it is likely an overestimate of the number of individual marine mammals taken because it assumes that entirely new individuals are taken on subsequent days and that no animals are taken more than once. The chirp and boomer activities were combined to calculate exposure from days of activities in the Upper Cook Inlet area and the Lower Cook Inlet area because they will be operating concurrently. The exposure estimates for each activity were then summed to provide total exposures for the duration of the project. The exposure estimates for the activity are detailed below.

TABLE 8—EXPOSURE ESTIMATES FOR ACTIVITY IN INSTANCES, NOT NUMBER OF INDIVIDUALS

[Also not accounting for management of total beluga takes]

Total exposures	Boomer			Airgun			Stationary airgun	Total
	Marine facilities	LNGC	Pipeline	Marine facilities	LNGC	Pipeline		
Harbor porpoise	18.71	9.36	20.05	2.78	0.00	3.17	0.02	54.09
Harbor seal	1606.15	803.08	1720.88	238.32	0.00	272.36	1.92	4642.81
Killer whale	4.66	2.33	5.00	0.69	0.00	0.79	0.01	13.48
Beluga	0.80	0.46	80.38	0.12	0.00	12.72	0.00	[1] 94.48

* Vibracore totals are not proposed to be authorized because NMFS has determined take due to vibracoring is unlikely to occur.

[1] This calculation of beluga takes is from the ensonified area and densities of those areas, and does not incorporate mitigation. NMFS will require a cap of 34 takes on the activity and would not authorize this number of takes.

NMFS recognizes that in addition to what was mentioned above, there are other factors that contribute to an overestimate of exposures *e.g.*, the fact that many of these technologies will be operating simultaneously, and not exposing animals in separate instances for the duration of the survey period. Additionally, the beamwidth and tilt angle of the sub-bottom profiler are not factored into the characterization of the sound field, making it conservative and large, creating additional overestimates in take estimation.

NMFS calculated the exposures from vibracore and found they would increase take by 580 percent and recognizes that the take calculated for vibracore is high when compared to take calculated from other portions of the activity. It is unlikely that many instances of take will occur from an activity with a source level of 187.4 dB for a duration of 60–90 seconds. This is largely attributed to the size of the isopleth (20 km) due to the use of geometrical spreading to model the ZOI. The vibracore produces noise of a much shorter duration than those sources used to determine the 120dB threshold,. NMFS believes implementation of the mitigation and monitoring measures mentioned in the above section, in combination with the short duration of the sound, will not result in take by Level B harassment.

The possibility of Level A exposure was analyzed, however the distances to 180 dB/190 dB isopleths are incredibly small, ranging from 3 to 47 meters. The number of exposures, without accounting for mitigation or likely avoidance of louder sounds, is small for these zones, and with mitigation and the likelihood of detecting marine mammals within this small area combined with the likelihood of avoidance, it is likely these takes can be avoided. The only technology that would not shutdown is the vibracore, which has a distance to Level A isopleth (180 dB) of 3 meters. Therefore, authorization of Level A take is not necessary.

NMFS recognizes that the calculations of take by Level B harassment of beluga whales for the entire activity is higher than NMFS would issue for an endangered population that is not recovering despite the moratorium on subsistence hunting. Given that the factors contributing to the lack of recovery remain unknown, NMFS proposes to limit the number of Level B takes of Cook Inlet beluga to 34, or 10 percent of the population. This cap can be implemented in a method similar to that used in SAE's 2015 IHA or the Apache proposed rulemaking.

In order to estimate when 34 individuals is reached, EMALL will use a formula based on the total potential area of each survey project zone (including the 160 dB buffer) and the average density of beluga whales for each zone. Daily take is calculated as the product of the daily ensonified area times the beluga density in that area, as extracted from the Goetz et al 2012 model. Then daily take is summed across all the days of the survey until the survey approaches 34 takes.

EMALL will limit surveying in the seismic survey area as not to exceed a maximum of 34 beluga takes during the open water season. In order to ensure that EMALL does not exceed 34 beluga whale takes, the following equation is being used:

$$\text{Equation 1: } d_1A_1 + d_2A_{2\ldots\ldots} \leq 34 \text{ Beluga Takes}$$

$$* \; d_x = \frac{\text{Expected Beluga Density from the NMML model in Zone X}}{\text{Total Area of Zone X including 160 dB buffer}}$$

$$* \; A_x = \text{Actual Area Surveyed (km}^2\text{) including 160 dB buffer in Zone X}$$

This formula also allows EMALL to have flexibility to prioritize survey locations in response to local weather, ice, and operational constraints. EMALL may choose to survey portions of a zone or a zone in its entirety, and the analysis in this Authorization takes this into account.

Operations are required to cease once EMALL has conducted seismic data acquisition in an area where multiplying the applicable density by the total ensonified area out to the 160-dB isopleth equaled 34 beluga whales, using the equation provided above. If 34 belugas are visually observed within the ZOI before the calculation reaches 34 belugas, EMALL is also required to cease survey activity.

NMFS proposes to authorize the following takes by Level B harassment:

TABLE 9—PROPOSED TAKE AUTHORIZATION

Species	Exposure estimate	Take authorized	Percent of stock or population	Population trend
Beluga	94.48	34	10	Decreasing.
Killer whale	13.48	13	3.77 transient	Transient—Stable.
Harbor seal	4,642.81	4,643	20.27	Stable.
Harbor porpoise	54.09	54	0.17	No reliable info.

Analysis and Preliminary 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). The lack of likely adverse effects on annual rates of recruitment or survival (*i.e.,* population level effects) forms the basis of a negligible impact finding. Thus, an estimate of the number of 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, except where otherwise identified, the discussion of our analyses applies to all the species listed in Table 8, given that the anticipated effects of this project on marine mammals are expected to be relatively similar in nature. Where there is information about specific impacts to, or about the size, status, or structure of, any species or stock that would lead to a different analysis for this activity, species-specific factors are identified and analyzed.

In making a negligible impact determination, NMFS considers:

- The number of anticipated injuries, serious injuries, or mortalities;
- The number, nature, and intensity, and duration of Level B harassment; and
- The context in which the takes occur (*e.g.*, impacts to areas of significance, impacts to local populations, and cumulative impacts when taking into account successive/contemporaneous actions when added to baseline data);
- The status of stock or species of marine mammals (*i.e.*, depleted, not depleted, decreasing, increasing, stable, impact relative to the size of the population);
- Impacts on habitat affecting rates of recruitment/survival; and
- The effectiveness of monitoring and mitigation measures to reduce the number or severity of incidental take.

As discussed in the Potential Effects section, temporary or permanent threshold shift, non-auditory physical or physiological effects, ship strike, entanglement are not expected to occur. Given the required mitigation and related monitoring, no injuries or mortalities are anticipated to occur to any species as a result of EMALL's proposed survey in Cook Inlet, 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 due to low source levels and the fact that most marine mammals would more likely avoid a loud sound source rather than swim in such close proximity as to result in TTS or PTS. The most likely effect from the proposed action is localized, short-term behavioral disturbance from active acoustic sources. The number of takes that are anticipated and authorized are expected to be limited to short-term Level B behavioral harassment for all stocks for which take is authorized. This is largely due to the short time scale of the proposed activity, the low source levels for many of the technologies proposed to be used, as well as the required mitigation. The technologies do not operate continuously over a 24-hour period. Rather, airguns are operational for a few hours at a time for 30 days, with the sub-bottom profiler boomer operating for 72 days, and the vibracore operating over 60 days.

The addition of five vessels, and noise due to vessel operations associated with the survey, would not be outside the present experience of marine mammals in Cook Inlet, although levels may increase locally. 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 enough as to not affect annual rates of recruitment or survival of marine mammals in the area. Based on the size of Cook Inlet where feeding by marine mammals occurs versus the localized area of the marine survey activities, any missed feeding opportunities in the direct project area would be minor based on the fact that other feeding areas exist elsewhere.

Taking into account the mitigation measures that are planned, effects on cetaceans are generally expected to be restricted to avoidance of a limited area around the survey operation and short-term changes in behavior, falling within the MMPA definition of ''Level B harassment.'' Shut-downs are required for belugas and groups of killer whales or harbor porpoises when they approach the 160dB disturbance zone, to further reduce potential impacts to these populations. Visual observation by trained PSOs is also implemented to reduce the impact of the proposed activity by informing operators of marine mammals approaching the relevant disturbance or injury zones. Animals are not expected to permanently abandon any area that is surveyed, and any behaviors that are interrupted during the activity are expected to resume once the activity ceases. Only a small portion of marine mammal habitat will be affected at any time, and other areas within Cook Inlet will be available for necessary biological functions.

Odontocete (including Cook Inlet beluga whales, killer whales, and harbor porpoises) reactions to seismic energy pulses are usually assumed to be limited to shorter distances from the airgun(s) than are those of mysticetes, in part because odontocete low-frequency hearing is assumed to be less sensitive than that of mysticetes. This information supports the idea that the numerated takes for odonotocetes are likely on the lower end of severity in the terms of responses that rise to the level of a take.

Beluga Whales

Cook Inlet beluga whales are listed as endangered under the ESA. This stock is also considered depleted under the MMPA. The estimated annual rate of decline for Cook Inlet beluga whales was 0.6 percent between 2002 and 2012. The authorization of take by Level B harassment of 34 Cook Inlet beluga whales represents 10 percent of the population.

Belugas in the Canadian Beaufort Sea in summer appear to be fairly responsive to seismic energy, with few being sighted within 10–20 km (6–12 mi) of seismic vessels during aerial surveys (Miller *et al.*, 2005). However, as noted above, Cook Inlet belugas are more accustomed to anthropogenic sound than beluga whales in the Beaufort Sea. Therefore, the results from the Beaufort Sea surveys are not necessarily applicable to potential reactions of Cook Inlet beluga whales. Also, due to the dispersed distribution of beluga whales in Cook Inlet during winter and the concentration of beluga whales in upper Cook Inlet from late April through early fall, belugas would likely occur in small numbers in the majority of EMALL's proposed survey area during the majority of EMALL's annual operational timeframe of March through December. For the same reason, as well as the mitigation measure that requires shutting down for belugas seen approaching the 160 dB disturbance zone, and the likelihood of avoidance at high levels, it is unlikely that animals would be exposed to received levels capable of causing injury.

Given the large number of vessels in Cook Inlet and the apparent habituation to vessels by Cook Inlet beluga whales and the other marine mammals that may occur in the area, vessel activity from the two source vessels, tug and jack-up rig and associated vessel noise is not expected to have effects that could cause significant or long-term consequences for individual marine mammals or their populations, given that vessels will operate for a maximum of 102 days.

In addition, NMFS has seasonally restricted survey operations in the area known to be important for beluga whale feeding, calving, or nursing. The primary location for these biological life functions occurs in the Susitna Delta region of upper Cook Inlet. NMFS required EMALL to implement a 16 km (10 mi) seasonal exclusion from survey operations in this region from April 15–October 15. The highest concentrations of belugas are typically found in this area from early May through September each year. NMFS has incorporated a 2-week buffer on each end of this seasonal use timeframe to account for any anomalies in distribution and marine mammal usage.

Killer Whales

The authorization of take by Level B harassment of 13 killer whales represents only 3.77 percent of the population. Killer whales are not encountered as frequently in Cook Inlet as some of the other species in this analysis, however when sighted they are usually in groups. The addition of a mitigation measure to shutdown if a group of 5 or more killer whales is seen approaching the 160 dB zone is intended to minimize any impact to an aggregation of killer whales if encountered. The killer whales in the survey area are also thought to be transient killer whales and therefore rely on the habitat in the EMALL survey area less than other resident species.

Harbor Porpoise

The authorization of take by Level B harassment for 54 harbor porpoises represents only 0.17 percent of the population. Harbor porpoises are among the most sensitive marine mammal species with regard to behavioral response and anthropogenic noise. They are known to exhibit behavioral responses to operation of seismic airguns, pingers, and other technologies at low thresholds. However, they are abundant in Cook Inlet and therefore the authorized take is unlikely to affect recruitment or status of the population in any way. In addition, mitigation measures include shutdowns for groups of more than 5 harbor porpoises that will minimize the amount of take to the local harbor porpoise population. This mitigation as well as the short duration and low source levels of the proposed activity will reduce the impact to the harbor porpoises found in Cook Inlet.

Harbor Seal

The authorization of take by Level B harassment for 4,643 harbor seals represents 20.27 percent of a stable population. Observations during other anthropogenic activities in Cook Inlet have reported large congregations of harbor seals hauling out in upper Cook Inlet. However, mitigation measures, such as vessel speed, course alteration, and visual monitoring, and time-area restrictions will be implemented to help reduce impacts to the animals. Additionally, this activity does not encompass a large number of known harbor seal haulouts, particularly as this activity proposes operations traversing across the Inlet, as opposed to entirely nearshore activities. While some harbor seals will likely be exposed, the required mitigation along with their smaller aggregations in water than on shore should minimize impacts to the harbor seal population. Additionally, the short duration of the survey, and the use of visual observers to inform shutdowns and ramp up delays should further reduce the severity of behavioral reactions to Cook Inlet harbor seals. Therefore, the exposure of pinnipeds to sounds produced by this phase of EMALL's proposed survey is not anticipated to have an effect on annual rates of recruitment or survival on those species or stocks.

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 required monitoring and mitigation measures, NMFS finds that the total annual marine mammal take from EMALL's proposed survey will have a negligible impact on the affected marine mammal species or stocks (see Table 8).

Although NMFS believes it is unlikely the operation of the vibracore would result in the take of marine mammals and does not propose to authorize take by vibracore in the **Federal Register**, the analysis has been included in this document for public comment. The vibracoring activity is proposed to occur at 60 locations across the Inlet from the Forelands, north to the upper end of Cook Inlet. However, the actual noise-producing activity will only occur for only 90 seconds at a time, during which PSOs will be observing for marine mammals and passive acoustic monitoring will be required during nighttime vibracoring. The limited scope and duration of vibracoring makes it extremely unlikely that take by Level B harassment would occur during the vibracore portion of the operation. Nonetheless, we included the potential take from vibracore in our analysis above.

Small Numbers Analysis

The requested takes authorized annually represent 10 percent of the Cook Inlet beluga whale population of approximately 340 animals (Shelden *et al.*, 2015), 3.77 percent of the Gulf of Alaska, Aleutian Island and Bering Sea stock of killer whales (345 transients), and 0.17 percent of the Gulf of Alaska stock of approximately 31,046 harbor porpoises. The take requests presented for harbor seals represent 20.27 percent of the Cook Inlet/Shelikof stock of approximately 22,900 animals. These take estimates represent small numbers relative to the affected species or stock sizes as shown in Table 8.

In addition to the quantitative methods used to estimate take, NMFS also considered qualitative factors that further support the ''small numbers'' determination, including: (1) The seasonal distribution and habitat use patterns of Cook Inlet beluga whales, which suggest that for much of the time only a small portion of the population would be accessible to impacts from EMALL's activity, as most animals are found in the Susitna Delta region of Upper Cook Inlet from early May through September; (2) other cetacean species are not common in the survey area; (3) the required mitigation requirements, which provide spatio-temporal limitations that avoid impacts to large numbers of belugas feeding and calving in the Susitna Delta; (4) the required monitoring requirements and mitigation measures described earlier in this document for all marine mammal species that will reduce the amount of takes; and (5) monitoring results from previous activities that indicated low numbers of beluga whale sightings within the Level B disturbance exclusion zone and low levels of Level B harassment takes of other marine mammals. Therefore, NMFS determined that the numbers of animals likely to be taken are small.

Impact on Availability of Affected Species for Taking for Subsistence Uses

Relevant Subsistence Uses

The subsistence harvest of marine mammals transcends the nutritional and economic values attributed to the animal and is an integral part of the cultural identity of the region's Alaska Native communities. Inedible parts of the whale provide Native artisans with materials for cultural handicrafts, and the hunting itself perpetuates Native traditions by transmitting traditional skills and knowledge to younger generations (NOAA, 2007).

The Cook Inlet beluga whale has traditionally been hunted by Alaska Natives for subsistence purposes. For several decades prior to the 1980s, the Native Village of Tyonek residents were the primary subsistence hunters of Cook Inlet beluga whales. During the 1980s and 1990s, Alaska Natives from villages in the western, northwestern, and North Slope regions of Alaska either moved to or visited the south central region and participated in the yearly subsistence harvest (Stanek, 1994). From 1994 to 1998, NMFS estimated 65 whales per year (range 21–123) were taken in this harvest, including those successfully taken for food and those struck and lost. NMFS concluded that this number was high enough to account for the estimated 14 percent annual decline in the population during this time (Hobbs *et al.*, 2008). Actual mortality may have been higher, given the difficulty of estimating the number of whales struck and lost during the hunts. In 1999, a moratorium was enacted (Pub. L. 106–31) prohibiting the subsistence take of Cook Inlet beluga whales except through a cooperative agreement between NMFS and the affected Alaska Native organizations. Since the Cook Inlet beluga whale harvest was regulated in 1999 requiring cooperative agreements, five beluga whales have been struck and harvested. Those beluga whales were harvested in 2001 (one animal), 2002 (one animal), 2003 (one animal), and 2005 (two animals). The Native Village of Tyonek agreed not to hunt or request a hunt in 2007, when no co-management agreement was to be signed (NMFS, 2008a).

On October 15, 2008, NMFS published a final rule that established long-term harvest limits on Cook Inlet beluga whales that may be taken by Alaska Natives for subsistence purposes (73 FR 60976). That rule prohibits harvest for a 5-year interval period if the average stock abundance of Cook Inlet beluga whales over the prior five-year interval is below 350 whales. Harvest levels for the current 5-year planning interval (2013–2017) are zero because the average stock abundance for the previous five-year period (2008–2012) was below 350 whales. Based on the average abundance over the 2002–2007 period, no hunt occurred between 2008 and 2012 (NMFS, 2008a). The Cook Inlet Marine Mammal Council, which managed the Alaska Native Subsistence fishery with NMFS, was disbanded by a unanimous vote of the Tribes' representatives on June 20, 2012. At this time, no harvest is expected in 2015 or, likely, in 2016.

Data on the harvest of other marine mammals in Cook Inlet are lacking. Some data are available on the subsistence harvest of harbor seals, harbor porpoises, and killer whales in Alaska in the marine mammal stock assessments. However, these numbers are for the Gulf of Alaska including Cook Inlet, and they are not indicative of the harvest in Cook Inlet.

There is a low level of subsistence hunting for harbor seals in Cook Inlet. Seal hunting occurs opportunistically among Alaska Natives who may be fishing or travelling in the upper Inlet near the mouths of the Susitna River, Beluga River, and Little Susitna. Some detailed information on the subsistence harvest of harbor seals is available from past studies conducted by the Alaska Department of Fish & Game (Wolfe *et al.*, 2009). In 2008, 33 harbor seals were taken for harvest in the Upper Kenai-Cook Inlet area. In the same study, reports from hunters stated that harbor seal populations in the area were increasing (28.6%) or remaining stable (71.4%). The specific hunting regions identified were Anchorage, Homer, Kenai, and Tyonek, and hunting generally peaks in March, September, and November (Wolfe *et al.*, 2009).

Potential Impacts on Availability for Subsistence Uses

Section 101(a)(5)(D) also requires NMFS to determine that the taking will not have an unmitigable adverse effect on the availability of marine mammal species or stocks for subsistence use. 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 primary concern is the disturbance of marine mammals through the introduction of anthropogenic sound into the marine environment during the proposed survey. Marine mammals could be behaviorally harassed and either become more difficult to hunt or temporarily abandon traditional hunting grounds. However, the proposed survey will not have any impacts to beluga harvests as none currently occur in Cook Inlet. Additionally, subsistence harvests of other marine mammal species are limited in Cook Inlet.

Plan of Cooperation or Measures To Minimize Impacts to Subsistence Hunts

50 CFR 216.04(a)(12) requires IHA applicants for activities that take place in Arctic waters to provide Plan of Cooperation 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 uses. The entire upper Cook unit and a portion of the lower Cook unit falls north of 60° N, or within the region NMFS has designated as an Arctic subsistence use area. EMALL provided detailed information in Section 8 of their application regarding their plan to cooperate with local subsistence users and stakeholders regarding the potential effects of their proposed activity. There are several villages in EMALL's proposed project area that have traditionally hunted marine mammals,

primarily harbor seals. Tyonek is the only tribal village in upper Cook Inlet with a tradition of hunting marine mammals, in this case harbor seals and beluga whales. However, for either species the annual recorded harvest since the 1980s has averaged about one or fewer of either species (Fall *et al.* 1984, Wolfe *et al.* 2009, SRBA and HC 2011), and there is currently a moratorium on subsistence harvest of belugas. Further, many of the seals that are harvested are done incidentally to salmon fishing or moose hunting (Fall *et al.* 1984, Merrill and Orpheim 2013), often near the mouths of the Susitna Delta rivers (Fall *et al.* 1984) north of EMALL's proposed seismic survey area.

Villages in lower Cook Inlet adjacent to EMALL's proposed survey area (Kenai, Salamatof, and Nikiski) have either not traditionally hunted beluga whales, or at least not in recent years, and rarely do they harvest sea lions. These villages more commonly harvest harbor seals, with Kenai reporting an average of about 13 per year between 1992 and 2008 (Wolfe *et al.* 2009). According to Fall *et al.* (1984), many of the seals harvested by hunters from these villages were taken on the west side of the inlet during hunting excursions for moose and black bears.

Although marine mammals remain an important subsistence resource in Cook Inlet, the number of animals annually harvested is low, and are primarily harbor seals. Much of the harbor seal harvest occurs incidental to other fishing and hunting activities, and at areas outside of the EMALL's proposed survey areas such as the Susitna Delta or the west side of lower Cook Inlet. Also, EMALL is unlikely to conduct activity in the vicinity of any of the river mouths where large numbers of seals haul out.

EMALL and NMFS recognize the importance of ensuring that Alaska Natives and federally recognized tribes are informed, engaged, and involved during the permitting process and will continue to work with the Alaska Natives and tribes to discuss operations and activities.

Prior to offshore activities EMALL will to consult with nearby communities such as Tyonek, Salamatof, and the Kenaitze Indian Tribe to attend and present the program description prior to operations within those areas.

If a conflict does occur with project activities involving subsistence or fishing, the project manager will immediately contact the affected party to resolve the conflict.

Unmitigable Adverse Impact Analysis and Determination

The project will not have any effect on beluga whale harvests because no beluga harvest will take place in 2016. Additionally, the proposed seismic survey area is not an important native subsistence site for other subsistence species of marine mammals thus, the number harvested is expected to be extremely low. The timing and location of subsistence harvest of Cook Inlet harbor seals may coincide with EMALL's project, but because this subsistence hunt is conducted opportunistically and at such a low level (NMFS, 2013c), EMALL's program is not expected to have an impact on the subsistence use of harbor seals. Moreover, the proposed survey would result in only temporary disturbances. Accordingly, the specified activity would not impact the availability of these other marine mammal species for subsistence uses.

NMFS anticipates that any effects from EMALL's proposed survey on marine mammals, especially harbor seals and Cook Inlet beluga whales, which are or have been taken for subsistence uses, would be short-term, site specific, and limited to inconsequential changes in behavior and mild stress responses. NMFS does not anticipate that the authorized taking of affected species or stocks will reduce the availability of the species to a level insufficient for a harvest to meet subsistence needs by: (1) Causing the marine mammals to abandon or avoid hunting areas; (2) directly displacing subsistence users; or (3) placing physical barriers between the marine mammals and the subsistence hunters; and that cannot be sufficiently mitigated by other measures to increase the availability of marine mammals to allow subsistence needs to be met. 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 required mitigation and monitoring measures, NMFS has determined that there will not be an unmitigable adverse impact on subsistence uses from EMALL's proposed activities.

Endangered Species Act

There is one marine mammal species listed as endangered under the ESA with confirmed or possible occurrence in the proposed project area: The Cook Inlet beluga whale. In addition, the proposed action could occur within 10 miles of designated critical habitat for the Cook Inlet beluga whale. NMFS's Permits and Conservation Division has initiated consultation with NMFS' Alaska Region Protected Resources Division under section 7 of the ESA. This consultation will be concluded prior to issuing any final authorization.

National Environmental Policy Act

NMFS has prepared a Draft Environmental Assessment (EA) for the take of marine mammals incidental to issuance of IHAs for the proposed oil and gas activities in Cook Inlet. The Draft EA has been made available for public comment concurrently with this proposed authorization (see **ADDRESSES**). NMFS will finalize the EA and either conclude with a finding of no significant impact (FONSI) or prepare an Environmental Impact Statement prior to issuance of the final authorization (if issued).

Proposed Authorization

As a result of these preliminary determinations, we propose to issue an IHA to EMALL for taking marine mammals incidental to a geophysical and geotechnical survey in Cook Inlet, Alaska, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated. The proposed IHA language is provided next.

This section contains a draft of the IHA itself. The wording contained in this section is proposed for inclusion in the IHA (if issued).

Incidental Harassment Authorization

Exxon Mobil Alaska LNG LLC (EMALL), 3201 C Street; Suite 506, Anchorage, Alaska 99501, is hereby authorized under section 101(a)(5)(D) of the Marine Mammal Protection Act (MMPA; 16 U.S.C. 1371(a)(5)(D)), to harass small numbers of marine mammals incidental to specified activities associated with a marine geophysical and geotechnical survey in Cook Inlet, Alaska, contingent upon the following conditions:

1. This Authorization is valid from March 1, 2016, through December 31, 2016.

2. This Authorization is valid only for EMALL's activities associated with survey operations that shall occur within the areas denoted as Marine Terminal Survey Area and Pipeline Survey Area as depicted in the attached Figure 1 of EMALL's October 2015 application to the National Marine Fisheries Service.

3. *Species Authorized and Level of Take*

(a) The incidental taking of marine mammals, by Level B harassment only, is limited to the following species in the waters of Cook Inlet:

(i) Odontocetes: see Table 1 (attached) for authorized species and take numbers.

(ii) Pinnipeds: see Table 1 (attached) for authorized species and take numbers.

(iii) If any marine mammal species are encountered during activities that are not listed in Table 1 (attached) for authorized taking and are likely to be exposed to sound pressure levels (SPLs) greater than or equal to 160 dB re 1 μPa (rms) for impulsive sound of 120 dB re 1μPa (rms), then the Holder of this Authorization must alter speed or course or shut-down the sound source to avoid take.

(b) The taking by injury (Level A harassment), serious injury, or death of any of the species listed in Table 1 or the taking of any other species of marine mammal is prohibited and may result in the modification, suspension or revocation of this Authorization.

(c) If the number of detected takes of any marine mammal species listed in Table 1 is met or exceeded, EMALL shall immediately cease survey operations involving the use of active sound sources (*e.g.,* airguns, profilers etc.) and notify NMFS.

4. The authorization for taking by harassment is limited to the following acoustic sources (or sources with comparable frequency and intensity) absent an amendment to this Authorization:

(a) EdgeTech3200 Sub-bottom profiler chirp;

(b) Applied Acoustics AA301 Sub-bottom profiler boomer;

(c) A 60 in^3 airgun;

5. The taking of any marine mammal in a manner prohibited under this Authorization must be reported immediately to the Chief, Permits and Conservation Division, Office of Protected Resources, NMFS or her designee at (301) 427–8401.

6. The holder of this Authorization must notify the Chief of the Permits and Conservation Division, Office of Protected Resources, or her designee at least 48 hours prior to the start of survey activities (unless constrained by the date of issuance of this Authorization in which case notification shall be made as soon as possible) at 301–427–8484 or to *Sara.Young@noaa.gov.*

7. *Mitigation and Monitoring Requirements:* The Holder of this Authorization is required to implement the following mitigation and monitoring requirements when conducting the specified activities to achieve the least practicable impact on affected marine mammal species or stocks:

(a) Utilize a minimum of two NMFS-qualified PSOs per source vessel (one on duty and one off-duty) to visually watch for and monitor marine mammals near the seismic source vessels during daytime operations (from nautical twilight-dawn to nautical twilight-dusk) and before and during start-ups of sound sources day or night. Two PSVOs will be on each source vessel, and two PSVOs will be on a support vessel to observe the exclusion and disturbance zones. PSVOs shall have access to reticle binoculars (7x50) and long-range binoculars (40x80). PSVO shifts shall last no longer than 4 hours at a time. PSVOs shall also make observations during daytime periods when the sound sources are not operating for comparison of animal abundance and behavior, when feasible. When practicable, as an additional means of visual observation, EMALL's vessel crew may also assist in detecting marine mammals.

(b) Record the following information when a marine mammal is sighted:

(i) Species, group size, age/size/sex categories (if determinable), behavior when first sighted and after initial sighting, heading (if consistent), bearing and distance from seismic vessel, sighting cue, apparent reaction to the airguns or vessel (*e.g.,* none, avoidance, approach, paralleling, etc.), and behavioral pace;

(ii) Time, location, heading, speed, activity of the vessel (including type of equipment operating), Beaufort sea state and wind force, visibility, and sun glare; and

(iii) The data listed under Condition 7(d)(ii) shall also be recorded at the start and end of each observation watch and during a watch whenever there is a change in one or more of the variables.

(c) Establish a 160 dB re 1 μPa (rms) ''disturbance zone'' for belugas, and groups of five or more harbor porpoises and killer whales as well as a 180 dB re 1 μPa (rms) and 190 dB re 1 μPa (rms) ''exclusion zone'' (EZ) for cetaceans and pinnipeds respectively before equipment is in operation.

(d) Visually observe the entire extent of the EZ (180 dB re 1 μPa [rms] for cetaceans and 190 dB re 1 μPa [rms] for pinnipeds) using NMFS-qualified PSVOs, for at least 30 minutes (min) prior to starting the survey (day or night). If the PSVO finds a marine mammal within the EZ, EMALL must delay the seismic survey until the marine mammal(s) has left the area. If the PSVO sees a marine mammal that surfaces, then dives below the surface, the PSVO shall wait 30 min. If the PSVO sees no marine mammals during that time, they should assume that the animal has moved beyond the EZ. If for any reason the entire radius cannot be seen for the entire 30 min (*i.e.,* rough seas, fog, darkness), or if marine mammals are near, approaching, or in the EZ, the sound sources may not be started.

(e) Alter speed or course during survey operations if a marine mammal, based on its position and relative motion, appears likely to enter the relevant EZ. If speed or course alteration is not safe or practicable, or if after alteration the marine mammal still appears likely to enter the EZ, further mitigation measures, such as a shutdown, shall be taken.

(f) Shutdown the sound source(s) if a marine mammal is detected within, approaches, or enters the relevant EZ. A shutdown means all operating sound sources are shut down (*i.e.,* turned off).

(g) Survey activity shall not resume until the PSVO has visually observed the marine mammal(s) exiting the EZ and is not likely to return, or has not been seen within the EZ for 15 min for species with shorter dive durations (small odontocetes and pinnipeds) or 30 min for species with longer dive durations (large odontocetes, including killer whales and beluga whales).

(h) Marine geophysical surveys may continue into night and low-light hours if such segment(s) of the survey is initiated when the entire relevant EZs can be effectively monitored visually (*i.e.,* PSVO(s) must be able to see the extent of the entire relevant EZ).

(i) No initiation of survey operations involving the use of sound sources is permitted from a shutdown position at night or during low-light hours (such as in dense fog or heavy rain).

(j) If a beluga whale is visually sighted approaching or within the relevant160dB disturbance zone, survey activity will not commence or the sound source(s) shall be shut down until the animals are no longer present within the 160-dB zone.

(h) Whenever aggregations or groups of killer whales and/or harbor porpoises are detected approaching or within the 160-dB disturbance zone, survey activity will not commence or the sound source(s) shall be shut-down until the animals are no longer present within the 160-dB zone. An aggregation or group of whales/porpoises shall consist of five or more individuals of any age/sex class.

(i) EMALL must not operate within 10 miles (16 km) of the mean higher high water (MHHW) line of the Susitna Delta (Beluga River to the Little Susitna River) between April 15 and October 15 (to avoid any effects to belugas in an important feeding and breeding area).

(j) Survey operations involving the use of airguns, sub-bottom profiler, or vibracore must cease if takes of any marine mammal are met or exceeded.

8. *Reporting Requirements:* The Holder of this Authorization is required to:

(a) Submit a weekly field report, no later than close of business (Alaska time) each Thursday during the weeks when in-water survey activities take place. The field reports will summarize species detected, in-water activity occurring at the time of the sighting, behavioral reactions to in-water activities, and the number of marine mammals taken. The weekly reports will also contain information about which km^2 grid cells that EMALL has operated in that week, along with the corresponding densities from the Goetz et al 2012 model to indicate how many belugas may have been taken by these operations. The weekly report will also include the number of belugas that may have been taken from previous weeks to track when EMALL is approaching their cap of 34 belugas.

(b) Submit a monthly report, no later than the 15th of each month, to NMFS' Permits and Conservation Division for all months during which in-water seismic survey activities occur. These reports must contain and summarize the following information:

(i) Dates, times, locations, heading, speed, weather, sea conditions (including Beaufort sea state and wind force), and associated activities during all operations and marine mammal sightings;

(ii) Species, number, location, distance from the vessel, and behavior of any marine mammals, as well as associated activity (type of equipment in use and number of shutdowns), observed throughout all monitoring activities;

(iii) An estimate of the number (by species) of: (A) pinnipeds that have been exposed to the activity (based on visual observation) at received levels greater than or equal to 160 dB re 1 µPa (rms) and/or 190 dB re 1 µPa (rms) with a discussion of any specific behaviors those individuals exhibited; and (B) cetaceans that have been exposed to the activity (based on visual observation) at received levels greater than or equal to 120 dB or 160 dB re 1 µPa (rms) and/or 180 dB re 1 µPa (rms) with a discussion of any specific behaviors those individuals exhibited.

(iv) A description of the implementation and effectiveness of the: (A) terms and conditions of the Biological Opinion's Incidental Take Statement (ITS); and (B) mitigation measures of this Authorization. For the Biological Opinion, the report shall confirm the implementation of each Term and Condition, as well as any conservation recommendations, and describe their effectiveness, for minimizing the adverse effects of the action on Endangered Species Act-listed marine mammals.

(c) Submit a draft Technical Report on all activities and monitoring results to NMFS' Permits and Conservation Division within 90 days of the completion of the seismic survey. The Technical Report will include the following information:

(i) Summaries of monitoring effort (*e.g.*, total hours, total distances, and marine mammal distribution through the study period, accounting for sea state and other factors affecting visibility and detectability of marine mammals);

(ii) Analyses of the effects of various factors influencing detectability of marine mammals (*e.g.*, sea state, number of observers, and fog/glare);

(iii) 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;

(iv) Analyses of the effects of survey operations; and

(v) Sighting rates of marine mammals during periods with and without survey activities (and other variables that could affect detectability), such as: (A) initial sighting distances versus survey activity state; (B) closest point of approach versus survey activity state; (C) observed behaviors and types of movements versus survey activity state; (D) numbers of sightings/individuals seen versus survey activity state; (E) distribution around the source vessels versus survey activity state; and (F) estimates of take by Level B harassment based on presence in the relevant 120 dB or 160 dB harassment zone.

(d) Submit a final report to the Chief, Permits and Conservation Division, Office of Protected Resources, NMFS, within 30 days after receiving comments from NMFS on the draft report. If NMFS decides that the draft report needs no comments, the draft report shall be considered to be the final report.

(e) EMALL must immediately report to NMFS if 25 belugas are detected within the relevant 120 dB or 160 dB re 1 µPa (rms) disturbance zone during survey operations to allow NMFS to consider making necessary adjustments to monitoring and mitigation.

9. (a) In the unanticipated event that the specified activity clearly causes the take of a marine mammal in a manner prohibited by this Authorization, such as an injury (Level A harassment), serious injury or mortality (*e.g.*, ship-strike, gear interaction, and/or entanglement), EMALL shall immediately cease the specified activities and immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, or her designees by phone or email (telephone: 301–427–8401 or *Sara.Young@noaa.gov*), the Alaska Regional Office (telephone: 907–271–1332 or *Barbara.Mahoney@noaa.gov*), and the Alaska Regional Stranding Coordinators (telephone: 907–586–7248 or *Aleria.Jensen@noaa.gov* or *Barbara.Mahoney@noaa.gov*). The report must include the following information:

(i) Time, date, and location (latitude/longitude) of the incident;

(ii) The name and type of vessel involved;

(iii) The vessel's speed during and leading up to the incident;

(iv) Description of the incident;

(v) Status of all sound source use in the 24 hours preceding the incident;

(vi) Water depth;

(vii) Environmental conditions (*e.g.*, wind speed and direction, Beaufort sea state, cloud cover, and visibility);

(viii) Description of marine mammal observations in the 24 hours preceding the incident;

(ix) Species identification or description of the animal(s) involved;

(x) The fate of the animal(s); and

(xi) Photographs or video footage of the animal (if equipment is available).

Activities shall not resume until NMFS is able to review the circumstances of the prohibited take. NMFS shall work with EMALL to determine what is necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. EMALL may not resume their activities until notified by NMFS via letter or email, or telephone.

(b) In the event that EMALL discovers an injured or dead marine mammal, and the lead PSO determines that the cause of the injury or death is unknown and the death is relatively recent (*i.e.*, in less than a moderate state of decomposition as described in the next paragraph), EMALL will immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, her designees, and the NMFS Alaska Stranding Hotline (see contact information in Condition 9(a)). The report must include the same information identified in the Condition 9(a) above. Activities may continue while NMFS reviews the circumstances of the incident. NMFS will work with EMALL to determine whether modifications in the activities are appropriate.

(c) In the event that EMALL discovers an injured or dead marine mammal, and the lead PSO determines that the injury or death is not associated with or related to the activities authorized in Condition 2 of this Authorization (*e.g.*, previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), EMALL shall report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, her designees, the NMFS Alaska Stranding Hotline (1–877–925–7773), and the Alaska Regional Stranding Coordinators within 24 hours of the discovery (see contact information in Condition 9(a)). EMALL shall provide photographs or video footage (if available) or other documentation of the stranded animal sighting to NMFS and the Marine Mammal Stranding Network. Activities may continue while NMFS reviews the circumstances of the incident.

10. EMALL is required to comply with the Reasonable and Prudent Measures and Terms and Conditions of the ITS corresponding to NMFS' Biological Opinion issued to both U.S. Army Corps of Engineers and NMFS' Office of Protected Resources.

11. A copy of this Authorization and the ITS must be in the possession of all contractors and PSOs operating under the authority of this Incidental Harassment Authorization.

12. Penalties and Permit Sanctions: Any person who violates any provision of this Incidental Harassment Authorization is subject to civil and criminal penalties, permit sanctions, and forfeiture as authorized under the MMPA.

13. This Authorization may be modified, suspended or withdrawn if the Holder fails to abide by the conditions prescribed herein or if the authorized taking is having more than a negligible impact on the species or stock of affected marine mammals, or if there is an unmitigable adverse impact on the availability of such species or stocks for subsistence uses.

TABLE 1—AUTHORIZED TAKE NUMBERS FOR EACH MARINE MAMMAL SPECIES IN COOK INLET

Species	Authorized take in the Cook Inlet action area
Odontocetes	
Beluga whale (*Delphinapterus leucas*)	34
Killer whale (*Orcinus orca*)	13
Harbor porpoise (*Phocoena phocoena*)	54
Pinnipeds	
Harbor seal (*Phoca vitulina richardsi*)	4,643

Request for Public Comments

We request comment on our analysis, the draft authorization, and any other aspect of the Notice of Proposed IHA for EMALL. Please include with your comments any supporting data or literature citations to help inform our final decision on EMALL's request for an MMPA authorization.

Dated: January 29, 2016.

Perry F. Gayaldo,

Deputy Director, Office of Protected Resources, National Marine Fisheries Service.

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