Request for the Taking of Marine Mammals Incidental to Site Characterization Survey for the Empire Wind Project

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ACRONYMS AND ABBREVIATIONS

Applicant	Statoil Wind US LLC
BOEM	Bureau of Ocean Energy Management
CeTAP	Cetacean and Turtles Assessment Program
CFR	Code of Federal Regulations
CPT	Cone Penetration Test
dB	decibel
DP	dynamic positioning
DPS	distinct population segments

ESA	Endangered Species Act
ft	foot
GPS	global positioning system
HF	high-frequency
HRG	high-resolution geophysical
Hz	hertz
IHA	Incidental Harassment Authorization
kHz	kilohertz
km	kilometer
km/hr	kilometers per hour
knot	nautical mile per hour
Lease Area	OCS-A 0512
LF	Low-frequency
m	meter
m/s	meters per second
MF	Mid-frequency
mi	mile
MMPA	Marine Mammal Protection Act
ms	millisecond
nm	nautical mile
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NUWC	Naval Undersea Warfare Center
OCS	Outer Continental Shelf
OPAREA	Operations Area
PAM	Passive Acoustic Monitoring
PSO	Protected Species Observer
PTS	permanent threshold shift
RMS	root mean square
SELcum	cumulative sound exposure level
SMA	Seasonal Management Area
SPUE	sightings per unit effort
TTS	temporary threshold shift
USBL	ultra-short baseline positioning system
ZOI	Zone of Influence
μPa	microPascal

1.0 DESCRIPTION OF SPECIFIED ACTIVITY

Statoil Wind US LLC (the Applicant) is proposing to conduct marine site characterization surveys off the coast of New York as part of the Empire Wind Project in the area of the Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (OCS-A 0512) and coastal waters where one or more cable route corridors will be established prior to conducting the survey (Figure 1). The Applicant submits this request for Incidental Harassment Authorization (IHA) pursuant to Section 101(a)(5) of the Marine Mammal Protection Act (MMPA) and 50 Code of Federal Regulations (CFR) § 216 Subpart I to allow for the incidental harassment of small numbers of marine mammals resulting from the execution of marine site characterization surveys specifically associated with the operation of high-resolution geophysical (HRG) and geotechnical survey equipment during upcoming field activities. Both the National Oceanic and Atmospheric Administration (NOAA) and the Bureau of Ocean Energy Management (BOEM) have advised that sound-producing survey equipment operating below 200 kilohertz (kHz) (e.g., sub-bottom profilers) has the potential to cause acoustic harassment to marine species, in particular marine mammals. This request is being submitted to specifically address survey sound-producing data acquisition equipment that operate below 200 kHz.

The regulations set forth in Section 101(a) (5) of the MMPA and 50 CFR § 216 Subpart I allow for the incidental taking of marine mammals by a specific activity if the activity is found to have a negligible impact on the species or stock(s) of marine mammals and will not result in immitigable adverse impact on the availability of the marine mammal species or stock(s) for certain subsistence uses. In order for the National Marine Fisheries Service (NMFS) to consider authorizing the taking by U.S. citizens of small numbers of marine mammals incidental to a specified activity (other than commercial fishing), or to make a finding that incidental take is unlikely to occur, a written request must be submitted to the Assistant Administrator. Such a request is detailed in the following sections.

1.1 Survey Activities

The Applicant will conduct HRG surveys in the marine environment of the approximately 79,350-acre Lease Area located approximately 11.5 nautical miles (nm) from Jones Beach, New York (see Figure 1). Additionally, one or more cable route corridors will be established between the Lease Area and New York, identified as the Cable Route Area in Figure 1. Cable route corridors are anticipated to be 152 meters (m, 500 feet [ft]) wide and may have an overall length of as much as 135 nautical miles. For the purpose of this application, the survey area is designated as the Lease Area and cable route corridors that will be established in advance of conducting the HRG survey activity.

Water depths across the Lease Area range from approximately 22 to 41 m (72 to 135 ft) and the cable route corridors will extend to shallow water areas near landfall locations. The purpose of the marine site characterization surveys are to:

- Support the siting, design, and deployment of up to three meteorological data buoy deployment areas; and
- Obtain a baseline assessment of seabed/sub-surface soil conditions in the Lease Area and cable route corridors to support the siting of the proposed wind farm.

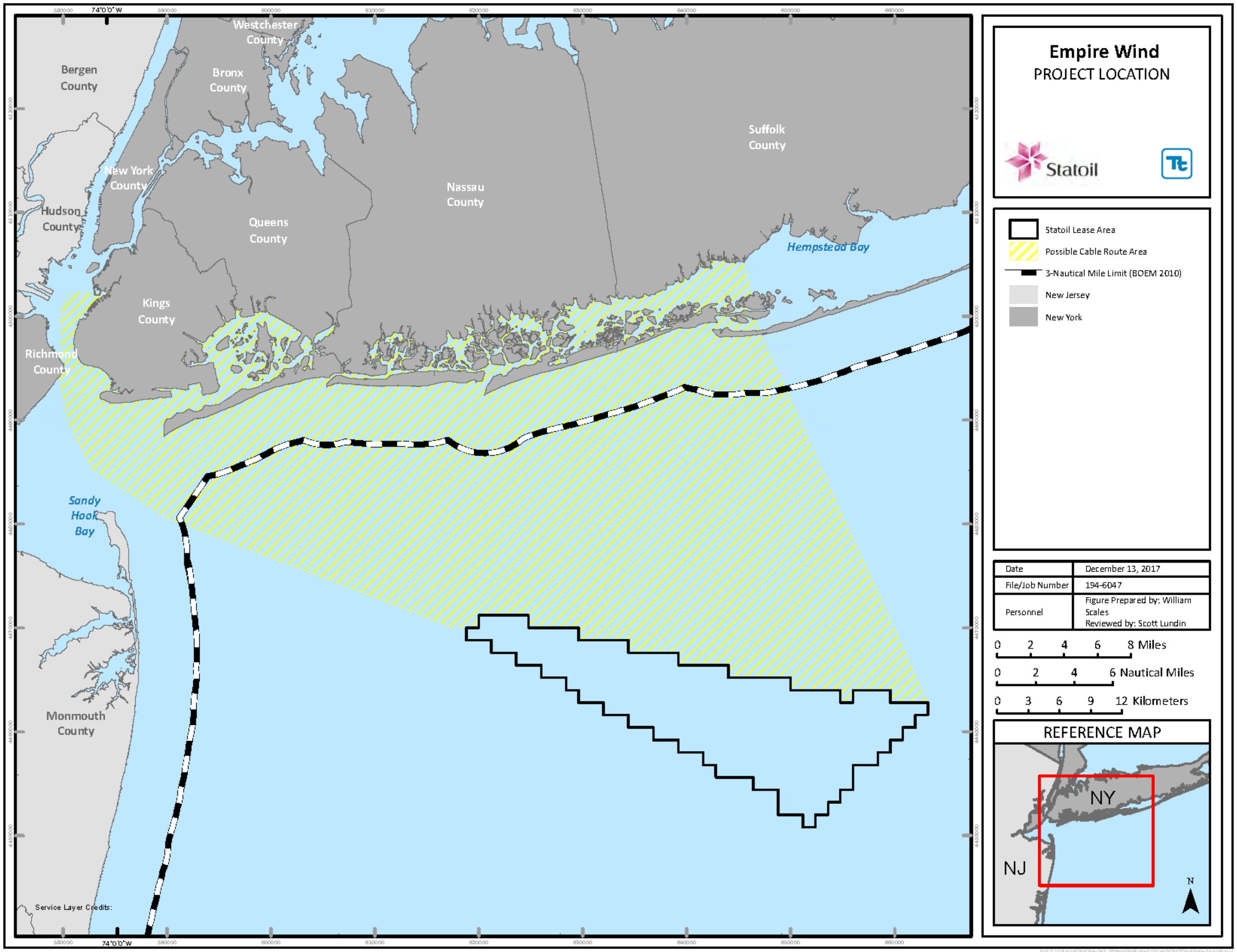

Figure 1. Project Location

The HRG survey activities will include the following:

- Depth sounding (multibeam echosounder) to determine site bathymetry and elevations;
- Magnetic intensity measurements for detecting local variations in regional magnetic field from geological strata and potential ferrous objects on and below the bottom;
- Seafloor imaging (sidescan sonar survey) for seabed sediment classification purposes, to identify natural and man-made acoustic targets resting on the bottom as well as any anomalous features;
- Shallow penetration sub-bottom profiler (pinger/chirp) to map the near surface stratigraphy (top 0 to 5 m [0 to 16 ft] of soils below seabed); and
- Medium penetration sub-bottom profiler (sparker) to map deeper subsurface stratigraphy as needed (soils down to 75 to 100 m [246 to 328 ft] below seabed).

Geotechnical survey activities throughout the survey area (see Figure 1) will include:

- Vibracores will be taken to determine the geological and geotechnical characteristics of the sediments; and
- Cone Penetration Testing (CPT) will be performed to determine stratigraphy and in-situ conditions of the sediments.

1.1.1 HRG Survey

The HRG surveys are scheduled to begin no earlier than March 1st of 2018. The survey equipment will be equivalent to the representative survey equipment identified in Table 1. The make and model of the listed HRG equipment may vary depending on availability, but will be finalized as part of the survey preparations and contract negotiations with the survey contractor.

A recent technical report conducted by the Naval Undersea Warfare Center (NUWC), through support from BOEM and United States Geological Survey, published measurement data from the sounds emitted during HRG surveys (Crocker and Fratantonio, 2016). The equipment was tested at wide range of settings with different acoustic levels measured. As a conservative measure, the loudest sound levels for each piece of equipment selected. Representative equipment and source level characteristics are listed in Table 1. Operational levels will likely use lower than the worst case levels during the survey.

Table 1. Measured Source Levels of Proposed HRG Survey Data Acquisition Equipment

HRG System	Representative HRG Survey Equipment	Operating Frequencies	Peak Source Level	RMS Source Level	Pulse Duration (ms)
Subsea Positioning / USBL	Sonardyne Ranger 2 USBL[a]	35-50 kHz[a]	200 dB_{peak}[a]	188 dB_{RMS}[a]	1[a]
Sidescan Sonar	Klein 3900 Sidescan Sonar	445 kHz/ 900 kHz	226 dB_{peak}	220 dB_{RMS}	0.016 to 0.100
Shallow penetration sub-bottom profiler	EdgeTech 512i	0.4 to 12 kHz	186 dBpeak	179 BRMS	1.8 to 65.8
Medium penetration sub-bottom profiler	SIG ELC 820 Sparker	0.9 to 1.4 kHz	215 dB_{peak}	206 dB_{RMS}	0.8
Multibeam Echo Sounder	Reson T20-P	200/300/400 kHz	227 dB_{peak}	221 dB_{RMS}	2 to 6

Note:
[a]: Equipment information not provided in Crocker and Fratantonio, 2016. Details provided are based on manufacturer specifications.

The survey activities will be supported by a vessel approximately 30 to 55 m (98 to 180 ft) in length and capable of maintaining course and a survey speed of approximately 4 nautical miles per hour (knots, 7.4 kilometers per hour [km/hr]) while transiting survey lines.

Surveys will be conducted along tracklines spaced 30 m (98 ft) apart, with tie-lines spaced every 500 m (1640 ft). The multichannel array subbottom system will be operated on 150-m (492-ft) spaced primary lines, while the single channel array subbottom system will be operated on 30-m (98-ft) line spacing to meet BOEM requirements as set out in the March 2017 *Guidelines for Providing Geophysical, Geotechnical, and Geohazard Information Pursuant and Archeological and Historic Property Information to 30 CFR Part 585*.

To minimize cost, the duration of survey activities, and the period of potential impact on marine species while surveying, the Applicant has proposed conducting continuous HRG survey operations 24 hours per day. Based on 24-hour operations, the estimated duration of the HRG survey activities would be approximately 142 days (including estimated weather down time).

As noted previously, both NOAA and BOEM have advised that the deployment of HRG survey equipment including the use of sound-producing equipment operating below 200 kHz (e.g., sub-bottom profilers) has the potential to cause acoustic harassment to marine species, in particular marine mammals. Based on the frequency ranges of the potential equipment to be used in support of the HRG survey activities (Table 1); the ultra-short baseline (USBL) positioning system and the sub-bottom profilers (shallow and medium penetration) operate within the established marine mammal hearing ranges and have the potential to result in Level B Harassment of marine mammals.

1.1.2 Geotechnical Survey

The geotechnical survey is scheduled to begin no earlier than March 1, 2018. It is anticipated that vibracore samples and CPT will alternate along the selected cable route corridors every km, such that intervals for each vibracore and CPT location will be approximately 2 km. Furthermore, the investigation activities are anticipated to be conducted from a drill ship equipped with dynamic positioning (DP) thrusters.

Field studies conducted off the coast of Virginia (Tetra Tech, 2014) to determine the underwater noise produced by borehole drilling and CPTs confirm that these activities (including vibracore sampling) do not result in underwater noise levels that are harmful or harassing to marine mammals (i.e., do not exceed NOAA current Level A and Level B harassment thresholds for marine mammals).

NMFS has recently indicated that sound produced through use of DP thrusters is similar to that produced by transiting vessels and thus it does not anticipate the need for an MMPA incidental harassment authorization for the use of DP thrusters (personal communication, 2017).

Given the recent communications with NOAA on the applicability of IHAs for normal operations of vessels and the lack of acoustic impact from vibracore sampling and CPT, these activities do not warrant further discussion and will not be carried forward in this assessment.

1.2 Survey Activities Resulting in the Potential Incidental Taking of Marine Mammals

The potential effects of underwater noise resulting in takes on marine mammals are federally managed by NOAA under the MMPA to minimize the potential for both harm and harassment. Under the MMPA, Level A harassment is statutorily defined as any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild; however, the actionable sound pressure level is not identified in the statute. Level B harassment is defined as any act of pursuit, torment, or annoyance that 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.

According to the Technical Guidance for Assessing the Effect of Anthropogenic Sound on Marine Mammals (July, 2016); Level A harassment is said to occur as a result of exposure to high noise levels and at the onset of permanent hearing sensitivity loss, known as a permanent threshold shift (PTS). This revision to earlier NMFS guidelines is based on findings published by the Noise Criteria Group (Southall et al., 2007). For transient and continuous sounds, it was concluded that the potential for injury is not just related to the level of the underwater sound and the hearing bandwidth of the animal, but is also influenced by the duration of exposure. The evaluation of the onset of PTS and temporary threshold shift (TTS) provides additional species-specific insight on the potential for affect that is not captured by evaluations completed using the previous NMFS thresholds for Level A and Level B harassment alone.

Frequency weighting provides a sound level referenced to an animal's hearing ability either for individual species or classes of species, and therefore a measure of the potential of the sound to cause an effect. The measure that is obtained represents the perceived level of the sound for that animal. This is an important consideration because even apparently loud underwater sound may not effect an animal if it is at frequencies outside the animal's hearing range. In the NMFS final Guidance document, there are five hearing groups: Low-frequency (LF) cetaceans (baleen whales), Mid-frequency (MF) cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales), High-frequency (HF) cetaceans (true porpoises, Kogia, river dolphins, cephalorhynchid, Lagenorhynchus cruciger and L. australis), Phocid pinnipeds (true seals), and Otariid pinnipeds (sea lions and fur seals). It should be noted that Otariid pinnipeds do not occur in the survey area.

There are specific hearing criteria thresholds provided by NMFS for each of group. These criteria apply hearing adjustment curves for each animal group known as M-weighting (Table 2).

Table 2. M-Weighted PTS and TTS Criteria and Functional Hearing Range for Maine Mammals

Functional Hearing Group	PTS Onset Impulsive	PTS Onset Non-Impulsive	TTS Onset Impulsive	TTS Onset Non-Impulsive	Functional Hearing Range
LF cetaceans	219 dB_{peak} & 183 dB SEL_{cum}	199 dB SEL_{cum}	213 dB_{peak} & 168 dB SEL_{cum}	179 dB SEL_{cum}	7 Hz to 35 kHz
MF cetaceans	230 dB_{pea}k & 185 dB SEL_{cum}	198 dB SEL_{cum}	224 dB_{peak} & 170 dB SEL_{cum}	178 dB SEL_{cum}	150 Hz to 160 kHz
HF cetaceans	202 dB_{peak} & 155 dB SEL_{cum}	173 dB SEL_{cum}	196 dB_{pea}k & 140 dB SEL_{cum}	153 dB SEL_{cum}	275 Hz to 160 kHz
Phocid pinnipeds	218 dB_{peak} & 185 dB SEL_{cum}	201 dB SEL_{cum}	212 dB_{peak} & 170 dB SEL_{cum}	181 dB SEL_{cum}	50 Hz to 86 kHz
Otariid pinnipeds	232 dB_{peak} & 203 dB SEL_{cum}	219 dB SEL_{cum}	226 dB_{peak} & 188 dB SEL_{cum}	199 dB SEL_{cum}	60 Hz to 39 kHz

NOAA has defined the threshold level for Level B harassment at 120 Decibels (dB) Root Mean Squared (RMS) acoustic pressure referenced at 1 micropascal (re 1 µPa) for continuous noise and 160 $dB_{RMS\ 90\%}$ re 1 µPa for impulse noise. Within this zone, the sound produced by the site investigation equipment may approach or exceed ambient sound levels (i.e., threshold of perception or zone of audibility); however, actual perceptibility will be dependent on the hearing thresholds of the species under consideration and the inherent masking effects of ambient sound levels. The Level B harassment threshold was not updated with the July 2016 technical guidance.

In accordance with current NMFS guidelines, the Applicant's survey activities that could result in the incidental take of marine mammals are limited to Level A harassment of high frequency cetaceans (harbor porpoise) and Level B harassment caused by the generation of underwater noise from operation of the HRG survey sub-bottom profiler, as described in Section 1.1 above.

2.0 DATES, DURATION, AND SPECIFIC GEOGRAPHIC REGION

2.1 Dates and Duration

HRG Surveys are anticipated to commence no earlier than March 1, 2018 and will last for approximately 18 weeks (4.5 months). This survey schedule is based on 24-hour operations and includes estimated weather down time.

2.2 Specific Geographic Region

The Applicant's survey activities will occur in the approximately 79,350-acre Empire Wind Project Lease Area and along three cable route corridors to be established within the cable route area identified in Figure 1. Each survey corridor is anticipated to be 152 m (500 ft) wide and extend from the lease area to landfall locations to be determined.

3.0 SPECIES AND NUMBERS OF MARINE MAMMALS

The Environmental Assessment (BOEM, 2016) reports 39 species of marine mammals (whales, dolphins, porpoise, and seals) in the Northwest Atlantic Outer Continental Shelf (OCS) region of the Mid-Atlantic that are protected by the MMPA, 5 of which are listed under the Endangered Species Act (ESA) and are known to be present, at least seasonally, in the survey area (see Table 3). A description of the status and distribution of these species are discussed in detail in Section 4.

4.0 AFFECTED SPECIES STATUS AND DISTRIBUTION

As described in Section 3.0, there are up to 39 marine mammal species (whales, dolphins, porpoise, and seals) which are known to be present (some year–round, and some seasonally) in the Northwest Atlantic OCS region. The marine mammal species with potential to occur in the survey area are noted in Table 3. All 39 marine mammal species identified in Table 3 are protected by the MMPA and some are also listed under the ESA. The non-listed cetacean species considered most common and most likely to occur in the survey area include humpback whales, minke whales, harbor porpoises, common dolphins, Atlantic white-sided dolphins, and bottlenose dolphins (BOEM, 2016; unpublished findings, NY DEC 2017b). The five ESA-listed marine mammal species known to be present year round or seasonally in the waters of the Mid-Atlantic are the sperm whale, North Atlantic right whale, fin whale, blue whale, and sei whale (BOEM, 2016). Of those five species, the North Atlantic right whale and the fin whale are most likely to occur in the survey area (BOEM, 2016). Sperm whales are known to occur adjacent to the Lease Area based on recent survey data (unpublished findings, NY DEC 2017b), however they are most likely to be found on continental shelf waters outside of the survey area. The remaining species listed in Table 3 are not expected to be in the area because they would be expected to occur further offshore as they prefer deeper water, or range further north/south during the season of the survey, therefore, these species will not be described further in this analysis.

Table 3. Marine Mammals Known to Occur in the Marine Waters of the Northwest-Atlantic

Common Name	Scientific Name	Fed. Status	NY Status	Estimated Population[1]	Stock	NY Bight Occurrence Likelihood	Seasonal Occurrence	Known NY Bight Distribution
Toothed Whales (Odontoceti)								
Atlantic spotted dolphin	*Stenella frontalis*	N/A	N/A	44,715	W. North Atlantic	Common[5]	Seasonal[5]	Primarily deeper waters[5]
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	N/A	N/A	48,819	W. North Atlantic	Common[5]	Seasonal[5]	On continental shelf and slope[5]
Blainville's beaked whale	*Mesoplodon densirostris*	N/A	N/A	7,092	W. North Atlantic	Common[5]	Seasonal[5]	Deep ocean waters[5]
Bottlenose dolphin[a)]	*Tursiops truncatus*	N/A	N/A	11,548	W. North Atlantic	Common[5]	Year-round[5]	Coastal and offshore[1]
Common dolphin	*Delphinus spp.*	N/A	N/A	70,184	W. North Atlantic	Common[5]	Year-round[5]	Coastal and offshore[1]
Cuvier's beaked whale	*Ziphius cavirostris*	N/A	N/A	6,532	W. North Atlantic	Common[5]	Seasonal[5]	Deep ocean waters[5]
Harbor porpoise	*Phocoena*	N/A	SC	79,833	Gulf of Maine / Bay of Fundy	Common[5]	Seasonal[3]	Great South Bay[3]
Long-finned pilot whale	*Globicephala melas*	N/A	N/A	5,636	W. North Atlantic	Common[5]	Year-round[5]	Over continental shelf to slope[5]
Pantropical spotted dolphin	*Stenella attenuata*	N/A	N/A	3,333	W. North Atlantic	Common[5]	Seasonal[5]	Primarily deeper waters [5]
Risso's dolphin	*Grampus griseus*	N/A	N/A	18,250	W. North Atlantic	Common[5]	Year-round[5]	Along continental slope[5]
Sowerby's beaked whale	*Mesoplodon bidens*	N/A	N/A	7,092[c/]	W. North Atlantic	Common[5]	Seasonal[5]	Deep ocean waters[5]
Sperm whale	*Physeter macrocephalus*	E	E	2,288	North Atlantic	Common[4]	Unknown[4]	Along and over continental shelf[3,4]; around Montauk Point[4]; Deep ocean waters[4]
Striped dolphin	*Stenella coeruleoalba*	N/A	N/A	54,807	W. North Atlantic	Common[5]	Seasonal[5]	Over continental slope[5]
True's beaked whale	*Mesoplodon mirus*	N/A	N/A	7,092	W. North Atlantic	Common[5]	Seasonal[5]	Deep ocean waters[5]
False killer whale	*Pseudorca crassidens*	N/A	N/A	442	W. North Atlantic	Extralimital[5]	N/A	Deep ocean waters[5]
Clymene dolphin	*Stenella clymene*	N/A	N/A	Unknown	W. North Atlantic	Extralimital[5]	N/A	Deep ocean waters[5]
Rough-toothed dolphin	*Steno bredanensis*	N/A	N/A	271	W. North Atlantic	Extralimital[5]	N/A	Deep ocean waters[5]
Dwarf sperm whale	*Kogia sima*	N/A	N/A	3,785	W. North Atlantic	Rare[5]	N/A	Over outer continental shelf[5]
Gervais' beaked whale	*Mesoplodon europaeus*	N/A	N/A	7,092	W. North Atlantic	Rare[5]	N/A	Deep ocean waters[5]
Killer whale	*Orcinus orca*	E	N/A	Unknown	W. North Atlantic	Rare[5]	N/A	Over continental shelf and rise[5]; Open sea and offshore waters[4]
Northern bottlenose whale	*Hyperoodon ampullatus*	N/A	N/A	Unknown	W. North Atlantic	Rare[5]	N/A	Deep ocean waters[5]
Pygmy killer whale	*Feresa attenuata*	N/A	N/A	Unknown	W. North Atlantic	Rare[5]	N/A	Deep ocean waters[5]
Pygmy sperm whale	*Kogia breviceps*	N/A	N/A	3,785	W. North Atlantic	Rare[5]	N/A	Over continental slope[5]
Short-finned pilot whale	*Globicephala macrorhynchus*	N/A	N/A	21,515	W. North Atlantic	Rare[5]	N/A	Over continental shelf to slope[5]

Table 3. Marine Mammals Known to Occur in the Marine Waters of the Northwest-Atlantic

Common Name	Scientific Name	Fed. Status	NY Status	Estimated Population[1]	Stock	NY Bight Occurrence Likelihood	Seasonal Occurrence	Known NY Bight Distribution
Spinner dolphin	*Stenella longirostris*	N/A	N/A	Unknown	W. North Atlantic	Rare[5]	N/A	Deep ocean waters[5]
White-beaked dolphin	*Lagenorhynchus albirostris*	N/A	N/A	2,003	W. North Atlantic	Rare[5]	N/A	On and over continental shelf[5]
Baleen Whales (Mysticeti)								
Minke whale	*Balaenoptera acutorostrata*	N/A	N/A	2,591	Canadian East Coast	Common[1]	Seasonal[1]	On and over continental shelf[5]
North Atlantic Right whale	*Eubalaena glacialis*	E / CE	E	440	W. North Atlantic	Common[4]	Seasonal[4]	Primarily coastal[4]
Humpback whale	*Megaptera novaeangliae*	N/A	E	7,698	W. North Atlantic	Common[4]	Seasonal[4]	Becoming more coastal[4]; may be in inlets[4]
Fin whale	*Balaenoptera physalus*	E	E	1,618	North Atlantic	Common[4]	Year-round[4]	Throughout[4]
Blue whale	*Balaenoptera musculus*	E	E	Unknown	W. North Atlantic	Rare[4]	N/A	Not well known[4]; primarily deep waters[4]
Sei whale	*Balaenoptera borealis*	E	E	357	Nova Scotia	Rare[4]	N/A	Continental shelf and slope waters[5]; throughout[4]
Pinnipeds (Pinnipedia)								
Gray seal	*Halichoerus grypus*	N/A	N/A	Unknown	W. North Atlantic	Common[5]	Seasonal[5]	Coastal and continental shelf waters[5]
Harbor seal	*Phoca vitulina*	N/A	N/A	75,834	W. North Atlantic	Common[5]	Seasonal[5]	Coastal, bays, estuaries, inlets[5]
Ringed Seal	*Pusa hispida*			-	-	Extralimital[5]	N/A	Pack ice[6]
Walrus	*Odobenus rosmarus*			-	-	Extralimital[5]	N/A	Shallow, coastal areas[6]
Harp seal	*Cystophora cristata*	N/A	N/A	Unknown	W. North Atlantic	Rare[5]	N/A	Continental shelf with pack ice[5]
Hooded seal	*Phoca groenlandica*	N/A	N/A	Unknown	W. North Atlantic	Rare[5]	N/A	Deep ocean water at edge of continental shelf with pack ice[5]
Sirenians								
West Indian manatee	*Trichechus manatus*	E	N/A	-	-	Extralimital[5]	N/A	Freshwater, estuarine, and extremely nearshore coastal areas[5]

Notes
[a] Northern migratory stock species.

Sources
[1.] Hayes et al. 2017; [2.] NYSDEC, 2017a; [3.] NYSDEC 2012; [4.] Schlesinger and Bonacci 2014; [5.] Department of the Navy 2005; [6.] Lowry 2016

The humpback whale was recently delisted from the endangered species list. These large whale species are generally migratory and typically do not spend extended periods of time in a localized area however they are known to commonly occur and have been recently sighted across multiple winter and spring months in the survey area (unpublished findings, NY DEC 2017b). The waters of the Mid-Atlantic (including the Lease Area) are used by some of the larger whales known from this area either seasonally to feed, or as habitat during seasonal movements between the more northward feeding areas and southern hemisphere breeding grounds typically used by some of the large whale species (though some winter breeding areas exist further offshore vs. in the southerly latitudes). The mid-sized whale species (e.g. minke) and other large baleen whales are present year-round in the continental shelf and slope waters of the Lease Area. Their presence typically varies with prey availability and other habitat factors. The fin and right whales have the greater potential to occur within the survey area than the other large baleen whales (blue or sei). They are known to occur adjacent to Lease Area based on recent survey data (unpublished findings, NY DEC 2017b). Blue whales and sei whales may occur but are not considered likely to occur in the survey area. Because the potential for the blue whale and sei whale to occur within the survey area during the marine survey period is the least likely, these species will not be described further in this analysis. While the presence of sperm whales in the survey location would be unlikely, species density data, as reported in Roberts et al. (2016), indicates the possibility of minimal project interaction with this species. This same dataset indicates that for other deep-diving marine mammal species, such as kogia and beaked whales, species density approaches zero along the continental shelf landward of slope waters. Sightings data for these species are also almost exclusively along the continental shelf edge and slope areas (Warring et al. 2014). Therefore, these other deep-diving whale species were discounted.

Stranding data from 1980 to 2013 indicate that gray seals, harbor seals, and harp and hooded seals have the potential to occur within the New York Bight (BOEM 2016). Of these, harbor seals are the most common in the survey area. Northeast Navy Operations Area (OPAREA) Density Estimates indicate that data for gray seals in the Mid-Atlantic are lacking so density estimates for this species are not possible (DoN 2007) however they are considered potentially common. The Environmental Assessment indicates that the presence of hooded seals would not be likely (BOEM 2016); both harp and hooded seals are considered extralimital for this Area.

The following subsections provide additional information on the biology, habitat use, abundance, distribution, and the existing threats to the non-endangered or threatened and endangered marine mammals that are both common in the waters of the OCS east of New York and have the likelihood of occurring, at least seasonally, in the survey area. The remaining marine mammal species listed in Table 3 either typically occur outside the survey area (usually in more pelagic waters) or are less common.

4.1 Toothed Whales (*Odontonceti*)

4.1.1 Sperm Whale (*Physeter macrocephalus*) – Endangered

Currently, there is no reliable estimate for the total number of sperm whales worldwide. The best estimate is that there are between 300,000 and 450,000 sperm whales, based on extrapolations from only a few areas that have useful estimates (NMFS 2015). Estimates show about 1,665 in the northern Gulf of Mexico, 14,000 in the North Atlantic, 80,000 in the North Pacific, and 9,500 in the Antarctic (NMFS 2006; Waring et al. 2009). For the North Atlantic, the minimum population size estimate is 1,815 individuals (Hayes et al. 2017).

Sperm whales are highly social, with a basic social unit consisting of 20 to 40 adult females, calves, and some juveniles (Rice 1989; Whitehead 2008). During their prime breeding period and old age, male sperm whales are essentially solitary. Males rejoin or find nursery groups during prime breeding season. While foraging, the whales typically gather in small clusters. Between diving bouts, sperm whales are known to raft together at the surface. Adult males often forage alone. Groups of females may spread out over distances greater than 0.5 nm (0.9 km)

when foraging. When socializing, they generally gather into larger surface-active groups (Jefferson et al. 2008; Whitehead 2003). In the Northern Hemisphere, the peak breeding season for sperm whales occurs between March and June, and in the Southern Hemisphere, the peak breeding season occurs between October and December (NMFS 2009). Sperm whale hearing is in the mid-frequency range (Southall et al. 2007).

This species primarily preys on squid and octopus and are also known to prey on fish, such as lumpsuckers and redfish. Although sperm whales are generalists in terms of prey, specialization does appear to occur in a few places. The main sperm whale feeding grounds are correlated with increased primary productivity caused by upwelling.

The sperm whale is thought to have a more extensive distribution than any other marine mammal, except possibly the killer whale. This species is found in polar to tropical waters in all oceans, from approximately 70° N to 70° S (Rice 1989; Whitehead 2003). It ranges throughout all deep oceans of the world, essentially from equatorial zones to the edges of the polar pack ice. In the Atlantic, sperm whales are found throughout the Gulf Stream and North Central Atlantic Gyre. The current abundance estimate for this species in the North Atlantic is 2,288 individuals (Waring et al. 2016). The species is listed as Endangered (Hayes et al. 2017).

Sperm whales show a strong preference for deep waters (Rice 1989; Whitehead 2003). Sperm whale concentrations near drop-offs and areas with strong currents and steep topography are correlated with high prey productivity. These whales occur almost exclusively at the shelf break, regardless of season (NYDOS 2013). Sperm whales are somewhat migratory; however, their migrations are not as specifically tied to seasons as seen in large baleen whale species. In the North Atlantic, there appears to be a general shift northward during the summer, but there is no clear migration in some temperate areas (Rice 1989; Whitehead 2003).

Their distribution is typically associated with waters over the continental shelf break and the continental slope and into deeper waters (Jefferson et al. 2008; Whitehead et al. 1992). They have been recently sighted here in recent surveys in various seasons (unpublished findings, NY DEC 2017b). These waters are adjacent to but outside of the Lease Area and export cable route.

4.1.2 Harbor Porpoise (*Phocoena phocoena*) – Non-Strategic

The harbor porpoise inhabits shallow, coastal waters, often found in bays, estuaries, and harbors. In the western Atlantic, they are found from Cape Hatteras north to Greenland. They are likely to occur frequently in Mid-Atlantic waters from fall through spring, reaching their highest densities in spring when migration brings them toward the Gulf of Maine feeding grounds from their wintering areas offshore and in the mid-Atlantic (Kenney and Vigness-Raposa 2009; Navy 2007). After April, they migrate north towards the Gulf of Maine and Bay of Fundy. Harbor porpoises are the smallest North Atlantic cetacean, measuring at only 1.4 to 1.9 m (4.6 to 6.2 ft), and feed primarily on fish, but also prey on squid and crustaceans (Reeves and Read 2003; Kenney and Vigness-Raposa 2009). Sighting records from the 1978 to 1981 Cetacean and Turtle Assessment Program (CeTAP) surveys showed porpoises in spring exhibited highest densities in the southwestern Gulf of Maine in proximity to the Nantucket Shoals and western Georges Bank, with presence throughout the southern New England shelf and Gulf of Maine (CeTAP 1982). While strandings have occurred throughout the south shore of Long Island and coastal Rhode Island, many sightings have occurred offshore in the OCS area (Kenney and Vigness-Raposa 2009). The North Atlantic harbor porpoise population is likely to be over 500,000 (Kenney and Vigness-Raposa 2009). The current population estimate for harbor porpoise for the Gulf of Maine/Bay of Fundy stock is 79,833 (Hayes et al. 2017). Its hearing is in the high-frequency range (Southall et al. 2007).

The most common threat to the harbor porpoise is from incidental mortality from fishing activities, especially from bottom-set gillnets. It has been demonstrated that the porpoise echolocation system is capable of

detecting net fibers, but they either must not have the "system activated" or else they fail to recognize the nets (Reeves et al. 2002). Roughly 437 harbor porpoises are killed by human-related activities in U.S. and Canadian waters each year (Hayes et al. 2017). In 1999, a Take Reduction Plan to reduce harbor porpoise bycatch in U.S. Atlantic gillnets was implemented. The plan, that pertains to the Gulf of Maine, focuses on sink gillnets and other gillnets that can catch groundfish in New England waters. The ruling implements time and area closures, some of which are complete closures, as well as requiring pingers on multispecies gillnets. In 2001, the harbor porpoise was removed from the candidate species list for the ESA; a review of the biological status of the stock indicated that a classification of "Threatened" was not warranted (Waring et al. 2009). This species has been listed as "non-strategic" because average annual human-related mortality and injury does not exceed the potential biological removal (Waring et al. 2016).

4.1.3 Atlantic White-Sided Dolphin (*Lagenorhynchus acutus*) – Non-Strategic

The Atlantic white-sided dolphin is typically found at a depth of 100 m (330 ft) in the cool temperate and subpolar waters of the North Atlantic, generally along the continental shelf between the Gulf Stream and the Labrador current to as far south as North Carolina (Bulloch 1993; Reeves et al. 2002; Jefferson et al. 2008). They are the most abundant dolphin in the Gulf of Maine and the Gulf of St. Lawrence, but seem relatively rare along the North Atlantic coast of Nova Scotia (Kenney and Vigness-Raposa 2009).

Atlantic white-sided dolphins range between 2.5 m and 2.8 m (8.2 and 9.2 ft) in length, with females being approximately 20 centimeters (shorter than males (Kenney and Vigness-Raposa 2009). Their hearing is in the mid-frequency range (Southall et al. 2007). This species is highly social and is commonly seen feeding with fin whales (NOAA 1993). White-sided dolphins feed on a variety of small species, such as herring, hake, smelt, capelin, cod, and squid, with regional and seasonal changes in the species consumed (Kenney and Vigness-Raposa 2009). Sand lance is an important prey species for these dolphins in the Gulf of Maine during the spring. Other fish prey include mackerel, silver hake, herring, smelt, and several other varieties of gadoids (Kenney and Vigness-Raposa 2009). There are seasonal shifts in the distribution of Atlantic white-sided dolphins off the northeastern U.S. coast, with low abundance in winter between Georges Basin and Jeffrey's Ledge and very high abundance in the Gulf of Maine during spring. During the summer, Atlantic white-sided dolphins are most abundant between Cape Cod and the lower Bay of Fundy. During the fall, the distribution of Atlantic white-sided dolphins is similar to that in the summer, although they are less abundant (DoN 2005). Recent population estimates for Atlantic white-sided dolphins in the Western North Atlantic Ocean places this species at 48,819 individuals (Hayes et al. 2017). This species may be found off the coast of southern New England during all seasons of the year, but is usually most numerous in areas farther offshore at depth range of 100 m (330 ft) (Kenney and Vigness-Raposa 2009; Bulloch 1993; Reeves et al. 2002). This species has been sighted in the vicinity of the survey area in recent surveys (unpublished findings, NY DEC 2017b).

The biggest human-induced threat to the Atlantic white-sided dolphin is bycatch, because they are occasionally caught in fishing gillnets and trawling equipment. An estimated average of 328 dolphins each year were killed by fishery-related activities during 2003 to 2007 (Waring et al. 2010). From 2008 through 2012, an estimated annual average of 116 dolphins per year were killed (Waring et al. 2015), and from 2010 through 2014, the estimate decreased to 74 individuals annually (Hayes et al. 2017). Average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NMFS considers this species as "non-strategic" (Waring et al. 2011; 2015).

4.1.4 Bottlenose Dolphin (*Tursiops truncatus*) – Non-Strategic

The bottlenose dolphin is a light- to slate-gray dolphin, roughly 2.4 to 3.7 m (8 to 12 ft) long with a short, stubby beak. Because this species occupies a wide variety of habitats, it is regarded as possibly the most

adaptable cetacean (Reeves et al. 2002). It occurs in oceans and peripheral seas at both tropical and temperate latitudes. In North America, bottlenose dolphins are found in surface waters with temperatures ranging from 10 to 32°C (50 to 90°F). Its hearing is in the mid-frequency range (Southall et al. 2007).

There are two distinct bottlenose dolphin morphotypes: coastal and migratory. The coastal morphotype resides along the inner continental shelf (within 7.5 km [4.5 miles {mi}] of shore) and around islands and is subdivided into 7 stocks based largely upon spatial distribution (Waring et al. 2016). These animals often move into or reside in bays, estuaries, and the lower reaches of rivers (Reeves et al. 2002). Generally, the offshore migratory morphotype is found exclusively seaward of 34 km (21 mi) and in waters deeper than 34 m (112 ft)(Hayes et al., 2017). This offshore population extends along the entire continental shelf-break from Georges Bank to Florida during the spring and summer months, and has been observed in the Gulf of Maine during the late summer and fall. However, south of Cape Hatteras, these morphotype ranges overlap to some degree. NMFS species stock assessment report estimates the population of western North Atlantic offshore bottlenose dolphin stock at approximately 77,532 individuals (Hayes et al. 2017). This species has been sighted in the vicinity of the survey area in recent surveys (unpublished findings, NY DEC 2017b).

Bottlenose dolphins feed on a large variety of organisms, depending on their habitat. The coastal, shallow population tends to feed on benthic fish and invertebrates, while deepwater populations consume pelagic or mesopelagic fish such as croakers, sea trout, mackerel, mullet, and squid (Reeves et al. 2002). Bottlenose dolphins appear to be active both during the day and night. Their activities are influenced by the seasons, time of day, tidal state, and physiological factors such as reproductive seasonality (Wells and Scott 2002).

The biggest threat to the population is bycatch because they are frequently caught in fishing gear, gillnets, purse seines, and shrimp trawls (Waring et al. 2016). They have also been adversely impacted by pollution, habitat alteration, boat collisions, human disturbance, and are subject to bioaccumulation of toxins. Scientists have found a strong correlation between dolphins with elevated levels of PCBs and illness, indicating certain pollutants may weaken their immune system (ACSonline 2004). In the U.S., the mortality and serious injury rate for the species is considered insignificant because the rate is less than 10 percent of the calculated potential biological removal (Hayes et al., 2017).

4.1.5 Short-Beaked Common Dolphin (*Delphinus delphis*) – Non-Strategic

The short-beaked dolphin is one of the most widely distributed cetaceans and occurs in temperate, tropical, and subtropical regions (Jefferson et al. 2008). Short-beaked dolphins feed on squids and small fish, including species that school in proximity to surface waters as well as mesopelagic species found near the surface at night (IUCN 2010; NatureServe 2010). They have been known to feed on fish escaping from fishermen's nets or fish that are discarded from boats (NOAA 1993). This species is found between Cape Hatteras and Georges Bank from mid-January to May, although they migrate onto Georges Bank and the Scotian Shelf between mid-summer and fall, where large aggregations occur on Georges Bank in fall (Waring et al. 2007; 2016). These dolphins can gather in schools of hundreds or thousands, although the schools generally consist of smaller groups of 30 or fewer. They are eager bow riders and are active at the surface (Reeves et al. 2002). The short-beaked common dolphin feeds on small schooling fish and squid. While this dolphin species can occupy a variety of habitats, short-beaked common dolphins occur in greatest abundance within a broad band of the northeast edge of Georges Bank in the fall (Kenney and Vigness-Raposa 2009). According to the species stock report, the best population estimate for the western North Atlantic common dolphin is approximately 70,184 individuals (Hayes et al. 2017). Its hearing is in the mid-frequency range (Southall et al. 2007).

Short-beaked common dolphins can be found either along the 200- to 2,000-m (650- to 6,500-ft isobaths over the continental shelf and in pelagic waters of the Atlantic and Pacific Oceans. They are present in the western

Atlantic from Newfoundland to Florida. The short-beaked common dolphin is especially common along shelf edges and in areas with sharp bottom relief such as seamounts and escarpments (Reeves et al. 2002). They show a strong affinity for areas with warm, saline surface waters. Off the coast of the eastern United States, they are particularly abundant in continental slope waters from Georges Bank southward to about 35 degrees north (Reeves et al. 2002) and usually inhabit tropical, subtropical, and warm-temperate waters (Waring et al. 2009; 2016). This species has been sighted in the vicinity of the survey area in recent surveys (unpublished findings, NY DEC 2017b).

The short-beaked common dolphin is also subject to bycatch. It has been caught in gillnets, pelagic trawls, and during longline fishery activities. During 2008 to 2012, it was estimated that on average approximately 289 dolphins were killed each year by human activities (Waring et al. 2015). This number increased to 409 dolphins during 2010 to 2014 (Hayes et al. 2017), and again from 2009 to 2013 where the number was estimated at 363 (Waring et al. 2016). This species is also the most common dolphin species to be stranded along the southern New England Coast (Kenney and Vigness-Raposa 2009). Average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NMFS considers this species as "non-strategic" (Waring et al. 2009; 2010; 2015; 2016).

4.2 Baleen Whales (*Mysticeti*)

4.2.1 North Atlantic Right Whale (*Eubalaena glacialis*) – Endangered

The North Atlantic right whale was listed as a federal endangered species in 1970. The North Atlantic right whale has seen a nominal 2 percent recovery rate since it was listed as a protected species (NOAA 2015a). This is a drastic difference from the stock found in the Southern Hemisphere, which has increased at a rate of 7 to 8 percent (Knowlton and Kraus 2001). Right whales are considered grazers as they swim slowly with their mouths open. They are the slowest swimming whales and can only reach speeds up to 10 miles (mi) (16 km) per hour. They can dive at least 1,000 ft (300 m) and stay submerged for typically 10 to 15 minutes, feeding on their prey below the surface (ACSonline 2004). Right whales' hearing is in the low-frequency range (Southall et al. 2007).

The right whale is a strongly migratory species that moves annually between high-latitude feeding grounds and low-latitude calving and breeding grounds. The present range of the western North Atlantic right whale population extends from the southeastern United States, which is utilized for wintering and calving, to summer feeding and nursery grounds between New England and the Bay of Fundy and the Gulf of St. Lawrence (Kenney 2002; Waring et al. 2011). The winter distribution of North Atlantic right whales is largely unknown, although offshore surveys have reported 1 to 13 detections annually in northeastern Florida and southeastern Georgia (Waring et al. 2013). A few events of right whale calving have been documented from shallow coastal areas and bays (Kenney 2002). Some evidence provided through acoustic monitoring suggests that not all individuals of the population participate in annual migrations, with a continuous presence of right whales occupying their entire habitat range throughout the year, particularly north of Cape Hatteras (Davis et al. 2017). These data also recognize changes in population distribution throughout the right whale habitat range that could be due to environmental or anthropogenic effects, a response to short-term changes in the environment, or a longer-term shift in the right whale distribution cycle (Davis et al. 2017).

Observations in December 2008 noted congregations of more than 40 individual right whales in the Jordan Basin area of the Gulf of Maine, leading researchers to believe this may be a wintering ground (NOAA 2008). A right whale satellite tracking study within the northeast Atlantic (Baumgartner and Mate 2005) reported that this species often visited waters exhibiting low bottom water temperatures, high surface salinity, and high surface stratification, most likely for higher food densities. The winter distribution of North Atlantic right

whales is largely unknown, although offshore surveys have reported between one and 13 detections annually in northeastern Florida and southeastern Georgia (Waring et al. 2007). A few documented events of right whale calving have been from shallow coastal areas and bays (Kenney 2002). North Atlantic right whales may be found in feeding grounds within New England waters between February and May, with peak abundance in late March (NOAA 2005). While in New England, right whales feed mostly on copepods belonging to the *Calanus* and *Pseudocalanus* genus (Waring et al. 2007).

The North Atlantic right whale was the first species targeted during commercial whaling operations and was the first species to be greatly depleted as a result of whaling operations (Kenney 2002). North Atlantic right whales were hunted in southern New England until the early twentieth century. Shore-based whaling in Long Island involved catches of right whales year-round, with peak catches in spring during the northbound migration from calving grounds off the southeastern United States to feeding grounds in the Gulf of Maine (Kenney and Vigness-Raposa 2009). Abundance estimates for the North Atlantic right whale population vary. From the 2003 United States Atlantic and Gulf of Mexico Marine Mammal Stock Assessments, there were only 291 North Atlantic right whales in existence, which is less than what was reported in the Northern Right Whale Recovery Plan written in 1991 (NMFS 1991a; Waring et al. 2004). This is a tremendous difference from pre-exploitation numbers, which are thought to be around 1,000 individuals. When the right whale was finally protected in the 1930s, it is believed that the North Atlantic right whale population was roughly 100 individuals (Waring et al. 2004). In 2015, the Western North Atlantic population size was estimated to be at least 476 individuals (Waring et al. 2016). That population size estimate decreased to 440 individuals in 2017 (Hayes et al. 2017). Additional information provided by Pace et al. (2017), confirms that the probability that the North Atlantic right whale population has declined since 2010 is 99.99 percent. Data indicates that the number of adult females dropped from 200 in 2010 down to 186 in 2015 while males dropped from 283 to 272 in the same timeframe. Also cause for concern is the confirmed mortality of 14 individuals so far in 2017 alone (Pace et al. 2017).

Contemporary anthropogenic threats to right whale populations include fishery entanglements and vessel strikes, although habitat loss, pollution, anthropogenic noise, and intense commercial fishing may also negatively impact their populations (Kenney 2002). Entanglements can represent a significant energy expenditure for large whales, leading to injury or death if disentanglement efforts are not successful within a critical time period (van der Hoop et al. 2017; van der Hoop et al. 2016). Such energy expenditures can have significant subleathal impacts to right whales, particularly reproductive females where time for reproduction could be delayed for months or years (van der Hoop et al. 2016). Recovery from entanglements and subsequent energy losses resulting in physiological stress could limit reproductive success and contribute to fluctuations in population growth (van der Hoop et al. 2016). Unfortunately, evidence suggests that recent efforts to reduce entanglement through fishing gear modification have not resulted in decline of frequencies of entanglement or serious injury due to entanglement (Pace et al. 2014). Between 2002 and 2006, a study of marine mammal stranding and human-induced interactions reported that right whales in the western Atlantic were subject to the highest proportion of entanglements (25 of 145 confirmed events) and ship strikes (16 of 43 confirmed occurrences) of any marine mammal studied (Glass et al. 2008). Bycatch of North Atlantic right whale has also been reported in pelagic drift gillnet operations by the Northeast Fisheries Observer Program, however, no mortalities have been reported (Glass et al. 2008). From 2010 through 2014, the minimum rate of annual human-caused mortality and serious injury to this species from fishing entanglements averaged 5.66 per year, while ship strikes averaged 1.01 whales per year (Haye et al. 2017). Environmental fluctuations and anthropogenic disturbance may be contributing to a decline in overall health of individual North Atlantic right whales that has been occurring for the last 3 decades (Rolland et al. 2016). The NOAA marine mammal stock assessment for 2015 reports that the low annual reproductive rate of right whales, coupled with small population size, suggests anthropogenic mortality may have a greater impact on population growth rates for the species

than for other whales and that any single mortality or serious injury can be considered significant (Waring et al. 2016).

Ship strikes of individuals can impact northern right whales on a population level due to the intrinsically small remnant population that persists in the North Atlantic (Laist et al. 2001). Most ship strikes are fatal to the North Atlantic right whales (Jensen and Silber 2004). Right whales have difficulty maneuvering around boats and spend most of their time at the surface, feeding, resting, mating, and nursing, increasing their vulnerability to collisions. Mariners should assume that North Atlantic right whales will not move out of their way nor will they be easy to detect from the bow of a ship for they are dark in color and maintain a low profile while swimming (World Wildlife Fund 2005). To address potential for ship strike, NMFS designated the nearshore waters of the Mid-Atlantic Bight as the Mid-Atlantic U.S. Seasonal Management Area (SMA) for right whales in December 2008. NMFS require that all vessels 19.8 m (65 ft) or longer must travel at 10 knots (18.5 km/hr) or less within the right whale SMA from November 1 through April 30 when right whales are most likely to pass through these waters (NOAA 2010). The most recent stock assessment report noted that studies by van der Hoop et al. (2015) have concluded large whale vessel strike mortalities decreased inside active SMAs but have increased outside inactive SMAs.

Right whales have been observed in or near waters south of New England during all four seasons; however, they are most common in the spring when they are migrating north and in the fall during their southbound migration (Kenney and Vigness-Raposa 2009). This species has been sighted in the vicinity of the survey area during recent surveys (unpublished findings, NY DEC 2017b).

4.2.2 Humpback Whale (*Megaptera novaeangliae*) – Strategic/Non-Endangered for West Indies Distinct Population Segment

The humpback whale was listed as endangered in 1970 due to population decrease resulting from overharvesting; however, this species was delisted as threatened or endangered as of September 8, 2016 (81 FR 62259). In September 2016, NMFS revised the ESA listing for the humpback whale to identify 14 Distinct Population Segments (DPSs) based on breeding populations: West Indies, Cape Verde Islands/Northwest Africa, Hawaii, Mexico, Central America, Brazil, Gabon/Southwest Africa, Southeast Africa/Madagascar, West Australia; East Australia, Oceania, Southeastern Pacific, and Arabian Sea (81 FR 62259). Under this new final rule, humpback whales are considered endangered in the Cape Verde Islands/Northwest Africa, Western North Pacific, Central America, and Arabian Sea DPSs and are considered threatened in the Mexico DPS. For all the remaining DPSs, including the West Indies DPS, to which humpback whales along the east coast of the United States belong, humpback whales are no longer listed as endangered or threatened.

Humpback whales feed on small prey that is often found in large concentrations, including krill and fish such as herring and sand lance (Waring et al. 2007; Kenney and Vigness-Raposa 2009). Humpback whales are thought to feed mainly while migrating and in summer feeding areas; little feeding is known to occur in their wintering grounds. Humpbacks feed over the continental shelf in the North Atlantic between New Jersey and Greenland, consuming roughly 95 percent small schooling fish and 5 percent zooplankton (i.e., krill), and they will migrate throughout their summer habitat to locate prey (Kenney and Winn 1986). They swim below the thermocline to pursue their prey, so even though the surface temperatures might be warm, they are frequently swimming in cold water (NMFS 1991b). Humpback whales from all of the North Atlantic migrate to the Caribbean in winter, where calves are born between January and March (Blaylock et al. 1995). Their hearing is in the low-frequency range (Southall et al. 2007).

Humpbacks occur off southern New England in all four seasons, with peak abundance in spring and summer. The whales exhibit consistent fidelity to feeding areas within the northern hemisphere (Stevick et al. 2006). In

winter, whales from waters off New England, Canada, Greenland, Iceland, and Norway migrate to mate and calve primarily in the West Indies (including the Antilles, the Dominican Republic, the Virgin Islands and Puerto Rico), where spatial and genetic mixing among these groups occurs (Waring et al. 2015). While migrating, humpback whales utilize the mid-Atlantic as a migration pathway between calving/mating grounds to the south and feeding grounds in the north (Waring et al. 2007). Since 1989, observations of juvenile humpbacks in the Mid-Atlantic have been increasing during the winter months, peaking January through March (Swingle et al. 1993). Biologists theorize that non-reproductive animals may be establishing a winter feeding range in the Mid-Atlantic since they are not participating in reproductive behavior in the Caribbean. Swingle et al. (1993) identified a shift in distribution of juvenile humpback whales in the nearshore waters of Virginia, primarily in winter months. This species has been sighted in the vicinity of the survey area in recent surveys (unpublished findings, NY DEC 2017b).

Humpback whales were hunted as early as the seventeenth century, with most whaling operations having occurred in the nineteenth century (Kenney and Vigness-Raposa 2009). Before whaling activities, it was thought that the abundance of whales in the North Atlantic stock was in excess of 15,000 (Nowak 2002). By 1932, commercial hunting within the North Atlantic may have reduced the humpback whale population to as little as 700 individuals (Breiwick et al. 1983). Humpback whales were commercially exploited by whalers throughout their whole range until they were protected in the North Atlantic in 1955 by the International Whaling Commission ban. Humpback whaling ended worldwide in 1966 (NatureServe 2010). Contemporary anthropogenic threats to humpback whales include fishery entanglements and vessel strikes. Glass et al. (2008) reported that between 2002 and 2006, humpback whales belonging to the Gulf of Maine population were involved in 77 confirmed entanglements with fishery equipment and 9 confirmed ship strikes. Humpback whales that were entangled exhibited the highest number of serious injury events of the six species of whale studied by Glass et al. (2008). A whale mortality and serious injury study conducted by Nelson et al. (2007) reported that the minimum annual rate of anthropogenic mortality and serious injury to humpback whales occupying the Gulf of Maine was 4.2 individuals per year. During this study period, humpback whales were involved in 70 reported entanglements and 12 vessel strikes, and were the most common dead species reported. This number has increased to 9.05 animals per year between 2010 and 2014 (Hayes et al. 2017). The humpback whale population within the North Atlantic has been estimated to include approximately 11,570 individuals (Waring et al. 2015; 2016). Through photographic population estimates, humpback whales within the Gulf of Maine (the only region where these whales summer in the United States) have been estimated to consist of 600 individuals in 1979 (NMFS 1991b). According to the latest species stock assessment report, the best estimate of abundance for the Gulf of Maine stock of humpback whales is, at a minimum, 823 individuals (Hayes et al. 2017).

4.2.3 Fin Whale (*Balaenoptera physalus*) – Endangered

The fin whale was listed as federally endangered in 1970. Fin whales' range in the North Atlantic extends from the Gulf of Mexico, Caribbean Sea, and Mediterranean Sea in the south to Greenland, Iceland, and Norway in the north (Jonsgård 1966; Gambell 1985a). They are the most commonly sighted large whales in continental shelf waters from the Mid-Atlantic coast of the United States to Nova Scotia (Sergeant 1977; Sutcliffe and Brodie 1977; CETAP 1982; Hain et al. 1992; Waring et al. 2008). Fin whales, much like humpback whales, seem to exhibit habitat fidelity (Waring et al. 2007; 2016; Kenney and Vigness-Raposa 2009). However, fin whales habitat use has shifted in the southern Gulf of Maine, most likely due to changes in the abundance of sand lance and herring, both of which are major prey species along with squid, krill, and copepods (Kenney and Vigness-Raposa 2009). While fin whales typically feed in the Gulf of Maine and the waters surrounding New England, mating and calving (and general wintering) areas are still largely unknown (Waring et al. 2007; 2016). The overall pattern of fin whale movement is complex, consisting of a less obvious north-south pattern of

migration than that of right and humpback whales. Based on acoustic recordings from hydrophone arrays, Clark (1995) reported a general southward flow pattern of fin whales in the fall from the Labrador/Newfoundland region, past Bermuda, and into the West Indies. The overall distribution may be based on prey availability, as this species preys opportunistically on both invertebrates and fish (Watkins et al. 1984). Fin whale abundance off the coast of the northeastern United States is highest between spring and fall, with some individuals remaining during the winter (Hain et al. 1992). Past estimates of fin whale abundance conducted between Georges Bank and the Gulf of St. Lawrence during the feeding season in August 2006 places the western North Atlantic fin whale populations at 2,269 individuals (Waring et al. 2007). More recent estimates indicate the western North Atlantic fin whale population is 1,618 individuals (Waring et al. 2016). Fin whales are the second largest living whale species on the planet (Kenney and Vigness-Raposa 2009). The gestation period for fin whales is approximately 11 months and calve births occur between late fall and winter. Females can give birth every two to three years. Their hearing is in the low-frequency range (Southall et al. 2007). This species has been sighted in the vicinity of the survey area in recent surveys (unpublished findings, NY DEC 2017b).

Present threats to fin whales are similar to other whale species, namely fishery entanglements and vessel strikes. Fin whales seem less likely to become entangled than other whale species. Glass et al. (2008) reported that between 2002 and 2006, fin whales belonging to the Gulf of Maine population were involved in only eight confirmed entanglements with fishery equipment. Furthermore, Nelson et al. (2007) reported that fin whales exhibited a low proportion of entanglements (eight reported events) during their 2001 to 2005 study along the western Atlantic. On the other hand, vessel strikes may be a more serious threat to fin whales. Eight and ten confirmed vessel strikes with fin whales were reported by Glass et al. (2008) and Nelson et al. (2007), respectively. This level of incidence was similar to that exhibited by the other whales studied. Conversely, a study compiling whale/vessel strike reports from historical accounts, recent whale strandings, and anecdotal records by Laist et al. (2001) reported that of the 11 great whale species studied, fin whales were involved in collisions most frequently (31 in the United States and 16 in France). From 2008 to 2012, the minimum annual rate of mortality for the North Atlantic stock from anthropogenic causes was approximately 3.35 per year (Waring et al. 2015) while from 2010 to 2014, this number has increased to 3.8 (Hayes et al. 2017). Increase in ambient noise has also impacted fin whales, for whales in the Mediterranean have demonstrated at least two different avoidance strategies after being disturbed by tracking vessels (Jahoda et al. 2003). The best abundance estimate available for the western North Atlantic fin whale stock is 1,618 (Hayes et al. 2017).

Fin whales are present in waters south of New England waters during all four seasons. In spring, summer, and fall, the main center of their distribution is in the Great South Channel area to the east of Cape Cod, which is a well-known feeding ground (Kenney and Winn 1986). Winter is the season of lowest overall abundance, but they do not depart the area entirely. Fin whales are the most common large whale encountered in continental shelf waters. They are the whales most often encountered by local whale-watching operations in most years and are likely to occur in the vicinity of the survey area. The species is listed as Endangered due to the depletion of its population from whaling (Reeves et al. 1998). A recovery plan has been written and is available from NMFS for review (Waring et al. 2010; 2011).

4.2.4 Minke Whale (*Balaenoptera acutorostrata*) – Non-Strategic

Minke whales are among the most widely distributed of all the baleen whales. They occur in the North Atlantic and North Pacific, from tropical to polar waters. Common minke whales range between 6 and 9 m (20 and 30 ft) with maximum lengths of 9 to 10 m (30 to 33 ft) and are the smallest of the North Atlantic baleen whales (Jefferson et al. 1993; Wynne and Schwartz 1999; Kenney and Vigness-Raposa 2009). The primary prey species for minke whales are most likely sand lance, clupeids, gadoids, and mackerel (Kenney and Vigness-Raposa 2009). These whales basically feed below the surface of the water, and calves are usually not seen in adult

feeding areas. Minke whales are almost absent from OCS waters off the western Atlantic in winter; however, they are common in the fall and abundant in spring and summer (CeTAP 1982; Kenney and Vigness-Raposa 2009). In the 2015 stock assessment, the estimate for minke whales in the Canadian East Coast stock was 20,741 (Waring et al. 2016). This population estimate substantially decreased to 2,591 individuals in the most recent stock assessment because estimates older than eight years were excluded from the newest estimate (Hayes et al., 2017). This new estimate should not be interpreted as a decline in abundance of this stock, as previous estimates are not directly comparable (Hayes et al., 2017). Minke whales have been observed south of New England during all four seasons; however, widespread abundance is highest in spring through fall (Waring et al. 2016). Their hearing is in the low-frequency range (Southall et al. 2007). This species has been sighted in the vicinity of the survey area in recent surveys (unpublished findings, NY DEC 2017b).

As is typical of the baleen whales, minke whales are usually seen either alone or in small groups, although large aggregations sometimes occur in feeding areas (Reeves et al. 2002). Minke populations are often segregated by sex, age, or reproductive condition. Known for their curiosity, minke whales often approach boats.

Minke whales are impacted by ship strikes and bycatch from bottom trawls, lobster trap/pot, gillnet, and purse seine fisheries. From 2008 to 2012, the minimum annual rate of mortality for the North Atlantic stock from anthropogenic causes was approximately 9.9 per year (Waring et al. 2015), while from 2010 to 2014 this decreased to 8.25 per year (Hayes et al. 2017). In addition, hunting for Minke whales continues today, by Norway in the northeastern North Atlantic and by Japan in the North Pacific and Antarctic (Reeves et al. 2002). International trade in the species is currently banned. The best recent abundance estimate for the Canadian East Coast stock is 20,741 individuals from 2007 (Waring et al. 2016). Average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NMFS considers this species as "non-strategic" (Waring et al. 2010; 2011; 2015; 2016).

4.3 Earless Seals (*Phocidae*)

4.3.1 Harbor Seal (*Phoca vitulina*) – Non-Strategic

Harbor seals are the most abundant seals in eastern United States waters and are commonly found in all nearshore waters of the Atlantic Ocean and adjoining seas above northern Florida; however, their "normal" range is probably only south to New Jersey. While harbor seals occur year-round north of Cape Cod, they only occur during winter migration, typically September through May, south of Cape Cod (Southern New England to New Jersey) (Hayes et al., 2017; Waring et al. 2015; Kenney and Vigness-Raposa 2009). During the summer, most harbor seals can be found north of New York, within the coastal waters of central and northern Maine, as well as the Bay of Fundy (DoN 2005). Harbor seals are relatively small pinnipeds, with adults ranging between 1.7 and 1.9 m (5.6 and 6.2 ft) in length, with females being slightly smaller than males (Jefferson et al. 1993; Wynne and Schwartz 1999; Kenney and Vigness-Raposa 2009). Their hearing ranges from 100 Hz to 12 kHz (Southall et al. 2007)

Harbor seals prey upon small to medium-sized fish, followed by octopus and squid, and lastly by shrimp and crabs (Kenney and Vigness-Raposa 2009). Fish eaten by harbor seals include commercially important species such as mackerel, herring, cod, hake, smelt, shad, sardines, anchovy, capelin, salmon, rockfish, sculpins, sand lance, trout, and flounders (Kenney and Vigness-Raposa 2009). They spend about 85 percent of the day diving, and much of the diving is presumed to be active foraging in the water column or on the seabed. They dive to depths of about 10 to 150 m (30 to 500 ft), depending on location. Harbor seals forage in a variety of marine habitats, including deep fjords, coastal lagoons and estuaries, and high-energy, rocky coastal areas. They may also forage at the mouths of freshwater rivers and streams, occasionally traveling several hundred miles

upstream (Reeves et al. 2002). They haul out on sandy and pebble beaches, intertidal rocks and ledges, and sandbars, and occasionally on ice floes in bays near calving glaciers.

Except for a strong bond between mothers and pups, harbor seals are generally intolerant of close contact with other seals. Nonetheless, they are gregarious, especially during the molting season, which occurs between spring and autumn, depending on geographic location. They may haul out to molt at a tide bar, sandy or cobble beach, or exposed intertidal reef. During this haul out period, they spend most of their time sleeping, scratching, yawning, and scanning for potential predators such as humans, foxes, coyotes, bears, and raptors (Reeves et al. 2002). In late autumn and winter, harbor seals may be at sea continuously for several weeks or more, presumably feeding to recover body mass lost during the reproductive and molting seasons and to fatten up for the next breeding season (Reeves et al. 2002).

Historically, these seals have been hunted for several hundred to several thousand years. Harbor seals are still killed legally in Canada, Norway, and the United Kingdom to protect fish farms or local fisheries (Reeves et al. 2002). From 2010 to 2014, the average rate of mortality for the Western North Atlantic harbor seal stock from anthropogenic causes was approximately 389 per year (Hayes et al. 2017). Currently, the best abundance estimate for harbor seals is approximately 75,834 for the Western North Atlantic stock (Hayes et al. 2017). Average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NMFS considers this species as "non-strategic" (Waring et al. 2016).

4.3.2 Gray Seal (Halichoerus grypus) – Non-Strategic

The gray seal occurs in cold temperate to sub-arctic waters in the North Atlantic, and is partitioned into three major populations occurring in eastern Canada, northwestern Europe, and the Baltic Sea (Jefferson et al. 2008; Kenney and Vigness-Raposa 2009). The western North Atlantic stock is considered to be the same population as the one found in eastern Canada, and ranges between New England and Labrador (Waring et al. 2007). As exhibited in harbor seal populations, gray seals occur most often in the waters off of Maine during winter and spring, and spend summer and fall off northern Maine and in Canadian waters (DoN 2005). Gray seals exhibit sexual dimorphism, with adult males reaching 7.5 ft (2.3 m) long and females reaching 6.6 ft (2.0 m) (Jefferson et al. 1993; Wynne and Schwartz 1999; Kenney and Vigness-Raposa 2009). The gray seal is primarily found in coastal waters and forages in OCS regions (Lesage and Hammill 2001).

Gray seals are gregarious, gathering to breed, molt, and rest in groups of several hundred or more at island coasts and beaches or on land-fast ice and pack-ice floes. They are thought to be solitary when feeding and telemetry data indicates that some seals may forage seasonally in waters close to colonies, while others may migrate long distances from their breeding areas to feed in pelagic waters between the breeding and molting seasons (Reeves et al. 2002). Gray seals molt in late spring or early summer and may spend several weeks ashore during this time. When feeding, most seals remain within 45 mi (72 km) of their haulout sites. Gray seals feed on numerous fish species and cephalopods (Kenney and Vigness-Raposa 2009). Gray seal scat samples from Muskeget Island, Massachusetts, included species such as sand lance, skates, flounder, silver hake, and gadids (Kenney and Vigness-Raposa 2009).

Gray seals form colonies on rocky island or mainland beaches, though some seals give birth in sea caves or on sea ice, especially in the Baltic Sea. Gray seals prefer haulout and breeding sites that are surrounded by rough seas and riptides where boating is hazardous. Pupping colonies have been identified at Muskeget Island (Nantucket Sound), Monomoy National Wildlife Refuge, and in eastern Maine (Rough 1995). Total western Atlantic gray seal population estimates are not currently available (Hayes et al. 2017). However, the gray seal colony of Massachusetts has more than 5,600 seals total and there are more than 1,700 individuals in Maine (Waring et al. 2007). This species has been reported with greater frequency in waters south of Cape Cod in

recent years, likely due to a population rebound in southern New England and the mid-Atlantic (Kenney and Vigness-Raposa 2009); however, most gray seals present are juveniles dispersing in the spring. The only consistent haul-out locations within the vicinity of the Lease Area are along the sandy shoals around Monomoy and Nantucket in Massachusetts (Kenney and Vigness-Raposa 2009).

The biggest threats to gray seals are entanglements in gillnets or plastic debris (Waring et al. 2004). From 2006 to 2010, the total estimated human-caused mortality to gray seals was approximately 5,253 per year, which includes the removal of nuisance animals in Canada (Waring et al. 2015). For the period 2010 through 2014, the average annual mortality estimate decreased to 4,937 gray seals per year (Hayes et al. 2017). Average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NMFS considers this species as "non-strategic" (Waring et al. 2015).

5.0 TYPE OF INCIDENTAL TAKING REQUESTED

The Applicant is requesting the authorization for potential non-lethal "taking" of small numbers of marine mammals to allow for incidental harassment resulting from the marine site characterization surveys. The request is based upon projected HRG survey activities during the anticipated survey schedule as stated in Section 2.1.

The noise levels of HRG survey equipment were evaluated against the criteria prescribed in the Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammals (NMFS 2016). The acoustic thresholds are presented using dual metrics of cumulative sound exposure level (SELcum) and peak sound level. The cumulative PTS criteria was applied to the formulaic spreadsheet provided by NMFS (see Table 4). This spreadsheet incorporates the different hearing abilities of marine mammal groups (also see Appendix A). The instantaneous peak criteria was calculated by applying a practical spreading model to the peak source levels in Table 1. No M-weighting correction is applied during evaluation of the peak criteria.

Table 4. Distances to Regulatory Level A Thresholds

Marine Mammal Group	PTS Onset SEL_{cum} Criteria	NMFS Spreadsheet (m)	PTS Onset Peak Criteria	Peak Criteria
USBL Positioning System				
LF cetaceans	183 dB SEL_{cum}	n/a a/	219 dB_{peak}	n/a a
MF cetaceans	185 dB SEL_{cum}	n/a a/	230 dB_{peak}	n/a a
HF cetaceans	155 dB SEL_{cum}	1.5	202 dB_{peak}	n/a a
Phocid pinnipeds	185 dB SEL_{cum}	n/a a/	218 dB_{peak}	n/a a
Shallow Penetration Sub-bottom Profiler				
LF cetaceans	183 dB SEL_{cum}	n/a a/	219 dB_{peak}	n/a a
MF cetaceans	185 dB SEL_{cum}	n/a a/	230 dB_{peak}	n/a a
HF cetaceans	155 dB SEL_{cum}	1.7	202 dB_{peak}	2.9
Phocid pinnipeds	185 dB SEL_{cum}	n/a a/	218 dB_{peak}	n/a a
Medium Penetration Sub-bottom Profiler				
LF cetaceans	183 dB SEL_{cum}	0.6	219 dB_{peak}	n/a a
MF cetaceans	185 dB SEL_{cum}	n/a	230 dB_{peak}	n/a a
HF cetaceans	155 dB SEL_{cum}	0.2	202 dB_{peak}	7.3
Phocid pinnipeds	185 dB SEL_{cum}	0.2	218 dB_{peak}	n/a a

Note:
a/ Indicates that the detection distance is below the stated thresholds

Modeling parameters were entered into the formulaic NMFS spreadsheet, and modelled as impulsive-mobile sources. The USBL was modelled applying the following parameters: source level of 188 dB RMS, vessel speed of 2.05 meters per second (m/s), pulse duration of 1 millisecond (ms), repetition rate of 0.5 seconds and a weighting factor adjustment of 50 kHz based on manufacturer specifications. The resultant distances for the USBL were minimal. The shallow penetration sub-bottom profiler was modelled with the following conditions: source level at 179 dB RMS, vessel velocity of 2.05 m/s, repetition rate of 0.25, pulse duration of 65.8 ms and a weighting factor adjustments of 12 kHz based on data within the NUWC study. The Level A distance to HF cetaceans was the worst case scenario at 1.7 m (5.5 ft). The medium penetration sub-bottom profiler was modelled with the following conditions: source level at 206 dB RMS, vessel velocity of 2.05 m/s, repetition rate of 0.25, pulse duration of 8 ms and a weighting factor adjustment of 1.4 based on the data within the NUWC study. The maximum distance was 7.3 m (24 ft) for HF cetaceans based on the peak PTS criteria. Of all the scenarios, the 7.3 m (24 ft) distance for consideration of Level A harassment for HF cetaceans represents the worst case scenario.

The distances to the 160 dB RMS re 1 µPa isopleth for Level B harassment are presented in Table 5. The 1,166 m distance to the medium penetration sub-bottom profiler represents the largest distance.

Table 5. Distances to Regulatory Level B Thresholds for Relevant HRG Equipment

HRG System	Representative HRG Survey Equipment	Marine Mammal Level B Harassment 160 dBRMS90% re 1 µPa (m)
Subsea Positioning / USBL	Sonardyne Ranger 2 USBL	74
Shallow penetration sub-bottom profiler	EdgeTech 512i	18
Medium penetration sub-bottom profiler	SIG ELC 820 Sparker	1,166

To ensure that the potential for take by Level A and B harassment is avoided and/or minimized to the maximum extent possible, the Applicant has committed to the mitigation measures as outlined in Sections 11.0 and 13.0, which have been successfully implemented during similar activities in the North Atlantic.

As detailed in Section 1.2, HRG equipment use would generate underwater noise with sounds exceeding the 160 $dB_{RMS90\%}$ re 1 µPa threshold for Level B harassment for impulsive sound. The Applicant is requesting the authorization for the incidental take by harassment, of small numbers of marine mammals pursuant to Section 101 (a) (5) of the MMPA and in accordance with 50 CFR § 216 Subpart I, in support of the Applicant's survey activities. Both NOAA and BOEM have advised that some sound-producing survey equipment operating below 200 kHz (e.g., sub-bottom profilers) have the potential to cause acoustic harassment to marine species, in particular marine mammals. This request is being submitted to specifically address survey sound-producing data acquisition equipment that operate below 200 kHz, in support of the Applicant's survey activities as further detailed in Section 6.

6.0 TAKE ESTIMATES FOR MARINE MAMMALS

The Applicant seeks authorization for potential "taking" of small numbers of marine mammals under the jurisdiction of NMFS in the proposed region of activity. Anticipated impacts to marine mammals from the proposed survey activities will be associated with noise propagation from the use of specific survey equipment. It should be noted that the estimates of exposure for marine mammals as presented in this section are conservative. Based on the review of protected species observer sightings reports for similar surveys conducted along the Atlantic coast, data suggests that with the application of the mitigation and monitoring actions as

proposed in Section 11.0, that exposure of marine mammals to harassing level acoustic levels during survey activities can be effectively minimized (ESS 2013; Dominion 2013 and 2014).

6.1 Basis for Estimating Numbers of Marine Mammals that Might be "Taken by Harassment"

Marine animals can perceive underwater sounds over a broad range of frequencies from about 10 hertz (Hz) to more than 10,000 Hz (10 kHz). Many of the dolphins and porpoises use even higher frequency sound for echolocation and perceive these high frequency sounds with high acuity. Marine mammals respond to low-frequency sounds with broadband intensities of more than about 120 dB re 1 µPa, or about 10 to 20 dB above natural ambient noise at the same frequencies (Richardson et al. 1991). The functional hearing ranges for the marine mammals in this evaluation have a potential for acoustic take by Level B harassment, and high frequency cetaceans (harbor porpoise) have a potential for acoustic take by Level A harassment, at the time of the proposed surveys (see Table 2 for hearing ranges by functional hearing groups).

Sound is important to marine mammals for communication, individual recognition, predator avoidance, prey capture, orientation, navigation, mate selection, and mother-offspring bonding. Potential effects of anthropogenic sounds to marine mammals can include physical injury (e.g., temporary or permanent loss of hearing sensitivity), behavioral modification (e.g., changes in foraging or habitat-use patterns), and masking (the prevention of marine mammals from hearing important sounds).

The basis for the HRG survey take estimate is the number of marine mammals that would be exposed to sound levels in excess of Level B harassment criteria for impulsive noise (160 $dB_{RMS90\%}$ re 1 µPa) and Level A harassment criteria for impulsive noise (202 dBpeak & 155 dB SELcum). Typically this is determined by multiplying the Zone of Influence (ZOI) out to the Level B harassment criteria isopleth by local marine mammal density estimates, and then correcting for seasonal use by marine mammals, seasonal duration of project-specific noise-generating activities, and estimated duration of individual activities when the maximum noise-generating activities are intermittent or occasional. In the absence of any part of this information, it becomes prudent to take a conservative approach to ensure the potential number of takes is not greatly underestimated.

Distances for noise thresholds are calculated using the conservative practical spreading model. As noted in Table 1, the Sig ELC 820 Sparker is the loudest sound source and therefore governs the Level B ZOI determination for the survey, which is considered 1,166 m (3,825 ft). The distance to the Level B harassment threshold is 74 m (243 ft) for the USBL system, 18 m (59 ft) for the shallow penetration sub-bottom profiler, and 1,166 m (3,825 ft) for the medium penetration sub-bottom profiler. Likewise, the the Sig ELC 820 Sparker governs the Level A ZOI determination for the survey, which is considered 7.3 m (24 ft). As a conservative measure to account for some of the potential variation of operating conditions, the maximum distance to the harassment thresholds is used to determine estimated exposure for HRG survey equipment (i.e. 1,166 m for Level B and 7.3 for Level A).

The estimated distance of the daily vessel trackline was determined using the estimated average speed of the vessel (4 knots) and the 24 hour operational period. Using the maximum distance to the Level B harassment threshold of 1,166 m (3,825 ft) and estimated daily vessel track of approximately 177.8 km (110.5 mi), estimates of take by survey equipment has been based on an ensonified area around the survey equipment of 418.9 km^2 (161.7 mi^2) per day over a projected survey period of 142 days for the entire survey (see Table 6). For high frequency cetaceans,uUsing the maximum distance to the Level A harassment threshold of 7.3 m (24 ft) and estimated daily vessel track of approximately 177.8 km (110.5 mi), estimates of take by survey equipment has

been based on an ensonified area around the survey equipment of 2.6 km^2 (1.0 mi^2) per day over a projected survey period of 142 days for the entire survey (see Table 6).

Table 6. Survey Segment ZOIs by Harassment Criteria

Survey Segment	Number of Active Survey Days	Estimated distances per day (km)	Calculated ZOI per day (km^2)
Level B Harassment			
Lease Area	123	177.8	418.9
Cable Route Corridors	19	177.8	418.9
Level A Harassment			
Lease Area	123	177.8	2.6
Cable Route Corridors	19	177.8	2.6

6.2 Estimate of Numbers of Marine Mammals that Might be "Taken by Harassment"

Estimates of take are computed according to the following formula as provided by NOAA (Personal Communication, November 24, 2015):

$$\textit{Estimated Take} = D \times ZOI \times (d)$$

Where:

D = average highest species density (number per m^2)
ZOI = maximum ensonified area to MMPA thresholds for impulsive noise (160 dBRMS90% re 1 µPa); and
d = number of days

Per new NOAA guidance for mobile sound sources, the ZOI was calculated according to the following formula (Personal Communication, November 24, 2015):

ZOI = maximum ensonified area around the sound source × the line miles traveled over a 24-hr period.

It should be noted however, that this calculation will result in an over-conservative ZOI as it assumes that once an area along a survey trackline is ensonified by the sound source that the area will remain ensonified at a level that will result in Level B acoustic take (160 $dB_{RMS90\%}$ re 1 µPa) and Level A take for high frequency cetaceans (202 dBpeak & 155 dB SELcum) throughout the entire 24-hr period. As summarized in Section 1.2, the only time survey activities could result in take by Level A or Level B acoustic harassment is if a marine mammal were to enter into the ensonified area associated with the HRG survey equipment being operated.

The data used as the basis for estimating cetacean density ("D") for the survey area are sightings per unit effort (SPUE) derived by Duke University (Roberts et al. 2016). For pinnipeds, the only available comprehensive data for seal abundance continues to be the Northeast Navy OPAREA Density Estimates (DoN 2007). SPUE (or, the relative abundance of species) is derived by using a measure of survey effort and number of individual cetaceans sighted. SPUE allows for comparison between discrete units of time (i.e. seasons) and space within a project area (Shoop and Kenney, 1992). The Duke University (Roberts et al. 2016) cetacean density data represent models derived from aggregating line-transect surveys conducted over 23 years by five institutions (NOAA NMFS Northeast Fisheries Science Center, New Jersey Department of Environmental Protection, NOAA NMFS Southeast Fisheries Science Center, University of North Carolina Wilmington, and Virginia Aquarium & Marine Science Center), the results of which are freely available online at the Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP) repository.

Monthly mean density values within the survey area were averaged by season (Winter [December, January, February], Spring [March, April, May], Summer [June, July, August], Fall [September, October, November]) to provide seasonal density estimates. The highest seasonal density estimates during the proposed 18-week survey schedule were used to estimate take. All cetacean species analyzed had associated monthly abundance data as reported by Roberts et al (2016). The OPAREA Density Estimates (DoN 2007) used for pinniped densities were based on data collected through NMFS Northeast Fisheries Science Center aerial surveys conducted between 1998 and 2005.

Due to the spatial distribution and transient nature of marine mammal species identified in the survey area; the relatively short duration of the activities, and the implementation of the mitigation measures as described in Section 11.0, these activities are not expected to result in Level A Harassment of high frequency cetaceans (harbor porpoise) only, and Level B harassment only on the nine species identified in Section 6.0. The take estimates as provided in Section 6.2.1 are based on an overly conservative ZOI and therefore are likely a significant overestimate of the actual potential for take by Level A and Level B acoustic harassment.

6.2.1 Estimate of Potential Project Survey Takes by Harassment

The parameters in Table 6 were used to estimate take for the survey area. Density data from Roberts et al. (2016) were mapped within the boundary of the survey area for each segment (Figure 1) using geographic information systems. For the Lease Area, the highest average seasonal density as reported by Roberts et al. (2016) was used based on the proposed survey schedule (March through July 2018). For the cable route area, take calculations were based on the average spring seasonal species density within the maximum survey area, given the survey start date and duration. Mid-Atlantic OPAREA Density Estimates (DoN 2007) as reported for the spring and summer season were used to estimate pinniped densities. Results of the take calculations by survey segment are provided in Table 7.

Table 7. Marine Mammal Density and Estimated Acoustic Harassment Take Numbers during Survey Activities

Species	Lease Area		Cable Route Corridor		Totals	
	Average Seasonal Density [a/] (No./100 km²)	Calculated Take (No.)	Average Seasonal Density [a/] (No./100 km²)	Calculated Take (No.)	Total Take Authorization (No.)	Percent of Population
Level B Harassment						
North Atlantic right whale	0.03	13.14	0.04	2.95	16	3.66
Humpback whale	0.04	19.22	0.02	1.96	21	2.57
Fin whale	0.17	85.68	0.10	7.72	93	5.77
Sperm whale	0.01	5.79	0.01	0.62	6	0.28
Minke whale	0.07	34.46	0.03	2.78	37	1.44
Bottlenose dolphin	1.53	789.69	9.65	768.37	1558	13.49
Short beaked common dolphin	3.06	1576.86	1.42	113.25	1690	2.41
Atlantic white-sided dolphin	0.78	403.23	0.32	25.37	429	0.88
Harbor porpoise	4.09	2106.42	0.43	152.01	2258	2.83
Harbor seal [b/]	4.87	2509.92	4.87	77.54	2587	3.41
Gray seal [c/]	4.87	2509.92	4.87	77.54	2587	0.74
Level A Harassment						
Harbor porpoise	4.09	13.05	0.43	0.94	14	0.02

Notes:
a/ Density values from Duke University (Roberts et al. 2016)
b/ Because the SAR-based density estimate for harbor seals is recognized as a gross overestimate, data from Barlas (1999) was used to estimate this density (DoN 2007).
c/ Gray seal estimates based on harbor seal estimates as per recommendation by NMFS on January 2, 2018.

7.0 ANTICIPATED IMPACTS OF THE ACTIVITY

Consideration of negligible impact is required for NMFS to authorize the incidental take of marine mammals. In 50 CFR § 216.103, NMFS defines negligible impact to be "an impact resulting from a specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stocks [of marine mammals] through effects on annual rates of recruitment or survival." Based upon best available data regarding the marine mammal species (including density, status, and distribution) that are likely to occur in the survey area, the Applicant concludes that exposure to marine mammal species and stocks during marine site characterization surveys would result in short-term minimal effects and would not affect the overall annual recruitment or survival for the following reasons:

- As detailed in Section 1.2, potential acoustic exposures from survey activities are within the non-injurious behavioral effects zone (Level B harassment);
- The potential for take as estimated in Section 6.2 represents a highly conservative estimate of harassment based upon typical HRG survey operations utilizing an overly conservative ZOI and without taking into consideration the effects of standard mitigation and monitoring measures; and
- The protective measures as described in Section 11.0 are designed to avoid and/or minimize the potential for interactions with and exposure to marine mammals.

Marine mammals are mobile free-ranging animals and have the capacity to exit an area when noise-producing survey activities are initiated. Based on the conservative take estimations, survey activities may disturb more than one individual for some species (mainly dolphins), but in conjunction with other aforementioned factors

we conclude the short-term survey activities are not expected to result in population-level effects and that individuals will return to normal behavioral patterns after activities have ceased or after the animal has left the area under survey.

8.0 ANTICIPATED IMPACTS ON SUBSISTENCE USES

There are no traditional subsistence hunting areas in the survey area.

9.0 ANTICIPATED IMPACTS ON HABITAT

Bottom disturbance associated with the HRG activities may include grab sampling to validate the seabed classification obtained from the multibeam echosounder/sidescan sonar data. This will typically be accomplished using a Mini-Harmon Grab with 0.1 m^2 sample area or the slightly larger Harmon Grab with a 0.2 m^2 sample area. The temporary and localized impact of the ZOI in relation to the comparatively vast area of surrounding open ocean would render any potential impacts to prey availability or potential avoidance by marine mammals insignificant and not likely to affect marine mammal species. The HRG survey equipment will not contact the seafloor and would not be a source of air or water pollution. Impact to prey species is expected to be limited to avoidance of the area around the HRG survey activities and short-term changes in behavior. Such impacts are not expected to result in population-level effects on prey species (BOEM 2016). Individuals disturbed by a survey would likely return to normal behavioral patterns after the survey has ceased or after the animal has left the survey area.

Impact on marine mammal habitat from these activities will be negligible.

10.0 ANTICIPATED EFFECTS OF HABITAT IMPACTS ON MARINE MAMMALS

As stated in Section 9.0, the effects to marine mammals from loss or modification of habitat from the proposed survey activities will be insignificant and discountable.

11.0 MITIGATION MEASURES

The Applicant commits to engaging in ongoing consultations with NMFS. The mitigation procedures outlined in this section are based on protocols and procedures that have been successfully implemented and resulted in no take of marine mammals for similar offshore projects and previously approved by NMFS (ESS 2013; Dominion 2013 and 2014).

11.1 Vessel Strike Avoidance Procedures

The Applicant will ensure that vessel operators and crew maintain a vigilant watch for cetaceans and pinnipeds by slowing down or stopping their vessels to avoid striking these protected species. Survey vessel crew members responsible for navigation duties will receive site-specific training on marine mammal sighting/reporting and vessel strike avoidance measures. Vessel strike avoidance measures will include, but are not limited to, the following, except under extraordinary circumstances when complying with these requirements would put the safety of the vessel or crew at risk:

- All vessel operators and crew will maintain vigilant watch for cetaceans and pinnipeds, and slow down or stop their vessel to avoid striking these protected species;
- All vessel operators will comply with 10 knot (18.5 km/hr) or less speed restrictions in any SMA per NOAA guidance. This applies to all vessels operating from November 1 through July 31;

- All vessel operators will reduce vessel speed to 10 knots (18.5 km/hr) or less when any large whale, any mother/calf pairs, whale or dolphin pods, or larger assemblages of non-delphinoid cetaceans are observed near (within 100 m [330 ft]) an underway vessel;
- All survey vessels will maintain a separation distance of 500 m (1640 ft) or greater from any sighted North Atlantic right whale;
- If underway, vessels must steer a course away from any sited North Atlantic right whale at 10 knots (18.5 km/hr) or less until the 500 m (1640 ft) minimum separation distance has been established. If a North Atlantic right whale is sited in a vessel's path, or within 100 m (330 ft) to an underway vessel, the underway vessel must reduce speed and shift the engine to neutral. Engines will not be engaged until the North Atlantic right whale has moved outside of the vessel's path and beyond 100 m. If stationary, the vessel must not engage engines until the North Atlantic right whale has moved beyond 100 m;
- All vessels will maintain a separation distance of 100 m (330 ft) or greater from any sighted non-delphinoid cetacean. If sighted, the vessel underway must reduce speed and shift the engine to neutral, and must not engage the engines until the non-delphinoid cetacean has moved outside of the vessel's path and beyond 100 m. If a survey vessel is stationary, the vessel will not engage engines until the non-delphinoid cetacean has moved out of the vessel's path and beyond 100 m;
- All vessels will maintain a separation distance of 50 m (164 ft) or greater from any sighted delphinoid cetacean. Any vessel underway remain parallel to a sighted delphinoid cetacean's course whenever possible, and avoid excessive speed or abrupt changes in direction. Any vessel underway reduces vessel speed to 10 knots (18.5 km/hr) or less when pods (including mother/calf pairs) or large assemblages of delphinoid cetaceans are observed. Vessels may not adjust course and speed until the delphinoid cetaceans have moved beyond 50 m and/or the abeam of the underway vessel;
- All vessels underway will not divert or alter course in order to approach any whale, delphinoid cetacean, or pinniped. Any vessel underway will avoid excessive speed or abrupt changes in direction to avoid injury to the sighted cetacean or pinniped; and
- All vessels will maintain a separation distance of 50 m (164 ft) or greater from any sighted pinniped.

The training program will be provided to NMFS for review and approval prior to the start of surveys. Confirmation of the training and understanding of the requirements will be documented on a training course log sheet. Signing the log sheet will certify that the crew members understand and will comply with the necessary requirements throughout the survey event.

11.2 Seasonal Operating Requirements

Between watch shifts, members of the monitoring team will consult NMFS North Atlantic right whale reporting systems for the presence of North Atlantic right whales throughout survey operations. However, the proposed survey activities will occur outside of the SMA located off the coasts of New Jersey and New York.

11.3 Exclusion and Monitoring Zone Implementation

An exclusion zone will be established and continuously monitored to minimize impacts to marine mammals. The exclusion zone will be established to ensure marine mammals do not encounter Level A harassment sound levels. The Lease establishes a default exclusion zone of 200 m (656 ft), however modeling results presented in Table 4 indicate that the maximum distance to the Level A harassment threshold is 7.3 m (24 ft) for HF cetaceans and negligible for LF and MF cetaceans as well as for Phocid pinnipeds. The exclusion zone will be established based upon a field verification of sound levels associated with the survey equipment operating at frequencies below 200 kHz. The proposed field verification plan is provided in Appendix B. In the event that field verification results indicate the Level A harassment threshold is less than 200 m (656 ft) from the survey

vessel, the Applicant intends to request a smaller exclusion zone from NMFS and BOEM in accordance with stipulation 4.4.6.3 of Appendix C to Lease OCS-A-0512.

A monitoring zone will be established and continuously monitored to implement vessel strike avoidance measures outlined above and to document any marine mammals exposed to Level B harassment sound levels. Based on modeling results presented in Section 6.1, the Level B zone is currently understood to be within 1,166 m (3,825 ft) of the survey vessel. This distance will be field verified prior to the start of the survey program and the monitoring zone will be increased or decreased (as appropriate) to encompass the entire Level B zone.

11.4 Visual Monitoring Program

Visual monitoring of the established exclusion and monitoring zone will be performed by qualified and NMFS-approved Protected Species Observers (PSOs).

Observer qualifications will include direct field experience on a marine mammal observation vessel and/or aerial surveys in the Atlantic Ocean/Gulf of Mexico. An observer team comprising a minimum of four NMFS-approved PSOs and two certified Passive Acoustic Monitoring (PAM) operators, operating in shifts, will be stationed aboard either the survey vessel or a dedicated PSO-vessel. PSOs and PAM operators will work in shifts such that no one monitor will work more than 4 consecutive hours without a 2 hour break or longer than 12 hours during any 24-hour period. During daylight hours the PSOs will rotate in shifts of 1 on and 3 off, and while during nighttime operations PSOs will work in pairs. The PAM operators will also be on call as necessary during daytime operations should visual observations become impaired. Each PSO will monitor 360 degrees of the field of vision. The Applicant will provide resumes of all proposed PSOs and PAM operators (including alternates) to BOEM for review and approval by NMFS at least 45 days prior to the start of survey operations.

It will be the responsibility of the Lead PSO on duty to communicate the presence of marine mammals as well as to communicate and enforce the action(s) that are necessary to ensure mitigation and monitoring requirements are implemented as appropriate. PAM operators will communicate detected vocalizations to the Lead PSO on duty, who will then be responsible for implementing the necessary mitigation procedures. A mitigation and monitoring communications flow diagram has been included as Appendix C.

PSOs will be equipped with binoculars and have the ability to estimate distances to marine mammals located in proximity to the vessel and/or exclusion zone using range finders. Reticulated binoculars will also be available to PSOs for use as appropriate based on conditions and visibility to support the siting and monitoring of marine species. Digital single-lens reflex camera equipment will be used to record sightings and verify species identification. During night operations, PAM, night-vision equipment, and infrared technology will be used. Specifications for the PAM, night-vision, and infrared equipment will be provided to both NOAA and BOEM for review and acceptance prior to the start of surveys. Position data will be recorded using hand-held or vessel global positioning system (GPS) units for each sighting.

Observations will take place from the highest available vantage point on the survey vessel. General 360-degree scanning will occur during the monitoring periods, and target scanning by the PSO will occur when alerted of a marine mammal presence. In addition, PSOs will continue to monitor the zone for 30 minutes after survey equipment is shut-down or survey activity has concluded.

Data on all PAM/PSO observations will be recorded based on standard PSO collection requirements. This will include dates and locations of construction operations; time of observation, location and weather; details of the sightings (e.g., species, age classification [if known], numbers, behavior); and details of any observed "taking" (behavioral disturbances or injury/mortality). The data sheet will be provided to both NMFS and BOEM for

review and approval prior to the start of survey activities. In addition, prior to initiation of survey work, all crew members will undergo environmental training, a component of which will focus on the procedures for sighting and protection of marine mammals and sea turtles. A briefing will also be conducted between the survey supervisors and crews, the PSOs, and the Applicant. The purpose of the briefing will be to establish responsibilities of each party, define the chains of command, discuss communication procedures, provide an overview of monitoring purposes, and review operational procedures.

11.5 Passive Acoustic Monitoring Program

To support 24-hour survey operations, the Applicant will include PAM as part of the project monitoring during the HRG survey during nighttime operations to provide for optimal acquisition of species detections at night. In addition, PAM systems shall be employed during daylight hours as needed to support system calibration and PSO and PAM team coordination, as well as in support of efforts to evaluate the effectiveness of the various mitigation techniques (i.e., visual observations during day and night, compared to the PAM detections/operations).

Given the range of species that could occur in the survey area, the PAM system will consist of an array of hydrophones with both broadband (sampling mid-range frequencies of 2 kHz to 200 kHz) and at least one low-frequency hydrophone (sampling range frequencies of 75 Hz to 30 kHz).

The PAM operator(s) will monitor the hydrophone signals in real time both aurally (using headphones) and visually (via the monitor screen displays). PAM operators will communicate detections to the Lead PSO on duty who will ensure the implementation of the appropriate mitigation measure.

11.6 Pre-Clearance of the Exclusion Zone

For all HRG survey activities, the Applicant will implement a 30-minute clearance period of the exclusion zone prior to the initiation of ramp-up (Section 11.7). During this period the exclusion zones will be monitored by the PSOs, using the appropriate visual technology and/or PAM for a 30-minute period. Ramp-up may not be initiated if any marine mammal is observed within its respective exclusion zone (e.g. 39-m for HF cetaceans). If a marine mammal is observed within an exclusion zone during the pre-clearance period, ramp-up may not begin until the animal(s) has been observed exiting its respective zone or until an additional time period has elapsed with no further sightings (i.e. 15 minutes for delphinoid cetaceans and pinnipeds and 30 minutes for all other species). This condition is a modification to Lease stipulation 4.4.6.4 and thus Statoil is requesting a reduction in the exclusion zone clearance protocol in accordance with the precedent established by NMFS in recent IHAs issued on the Atlantic OCS.

11.7 Ramp-Up Procedures

Where technically feasible, a ramp-up procedure will be used for HRG survey equipment capable of adjusting energy levels at the start or re-start of HRG survey activities. A ramp-up procedure will be used at the beginning of HRG survey activities in order to provide additional protection to marine mammals near the survey area by allowing them to vacate the area prior to the commencement of survey equipment use. The ramp-up procedure will not be initiated during periods of inclement conditions if the exclusion zone cannot be adequately monitored by the PSOs using the appropriate visual technology (e.g., reticulated binoculars, night vision equipment) and/or PAM for a 30-minute period. A ramp-up would begin with the power of the smallest acoustic equipment at its lowest practical power output appropriate for the survey. When technically feasible the power would then be gradually turned up and other acoustic sources added in way such that the source level would increase in steps not exceeding 6 dB per 5-minute period.

Ramp-up activities will be delayed if a marine mammal(s) enters an exclusion zone(s). Ramp-up will continue if the animal has been observed exiting the exclusion zone or until an additional time period has elapsed with no further sighting (i.e. 15 minutes for delphinoid cetaceans and pinnipeds and 30 minutes for all other species).

11.8 Shut-Down and Power-Down Procedures

The vessel operator must comply immediately with any call for shutdown by the Lead PSO. Any disagreement should be discussed only after shutdown. The following outlines the shut-down procedures:

If a non-delphinoid cetacean is sighted at or within the established exclusion zone, an immediate shutdown of the survey equipment is required. Subsequent restart of the electromechanical survey equipment must use the ramp-up procedures described above and may only occur following clearance of the exclusion zone of all non-delphinoid cetaceans for at least 30 minutes, and all delphinoid cetaceans and pinnipeds for at least 15 minutes.

If a delphinoid cetacean or pinniped, such as the Atlantic white-sided dolphin, bottlenose dolphin, Short beaked common dolphin, harbor porpoise, or harbor seal, is sighted at or within the exclusion zone, the HRG survey equipment (including the sub-bottom profiler) must be powered down to the lowest power output that is technically feasible. Subsequent power up of the survey equipment must use the ramp-up procedures described above and may occur after (1) the exclusion zone is clear of a delphinoid cetacean and/or pinniped or (2) a determination by the PSO after a minimum of 10 minutes of observation that the delphinoid cetacean or pinniped is approaching the vessel or towed equipment at a speed and vector that indicates voluntary approach to bow-ride or chase towed equipment.

If the HRG sound source (including the sub-bottom profiler) shuts down for reasons other than encroachment into the exclusion zone by a non-delphinoid cetacean, including but not limited to a mechanical or electronic failure, resulting in in the cessation of sound source for a period greater than 20 minutes, a restart for the HRG survey equipment (including the sub-bottom profiler) is required using the full ramp-up procedures and clearance of the exclusion zone of all cetaceans and pinnipeds for 30 minutes. If the pause is less than less than 20 minutes, the equipment may be restarted as soon as practicable at its operational level as long as visual surveys were continued diligently throughout the silent period and the exclusion zone remained clear of cetaceans and pinnipeds. If the visual surveys were not continued diligently during the pause of 20 minutes or less, a restart for the HRG survey equipment (including the sub-bottom profiler) is required using the full ramp-up procedures and clearance of the exclusion zone for all cetaceans and pinniped for 30 minutes.

12.0 ARCTIC PLAN OF COOPERATION

Potential impacts to species or stocks of marine mammals will be limited to individuals of marine mammal species located in the northeast region of the United States, and will not affect Arctic marine mammals. Given that the Project is not located in Arctic waters, the activities associated with the Applicant's marine characterization surveys will not have an adverse effect on the availability of marine mammals for subsistence uses allowable under the MMPA.

13.0 MONITORING AND REPORTING

13.1 Monitoring

Visual and passive acoustic monitoring protocols are described in Section 11.0.

13.2 Reporting

The Applicant will provide the following reports as necessary during construction activities:

- The Applicant will contact BOEM and NMFS within 24 hours of the commencement of survey activities and again within 24 hours of the completion of the activity;
- Any observed significant behavioral reactions (e.g., animals departing the area) or injury or mortality to any marine mammals must be reported to BOEM and NMFS within 24 hours of observation. Dead or injured protected species (e.g., marine mammals, sea turtles, and sturgeon) are reported to NMFS Northeast Region's Stranding Hotline (800-900-3622) within 24 hours of sighting, regardless of whether the injury is caused by a vessel. In addition, if the injury of death was caused by a collision with a project related vessel, the Applicant must ensure that BOEM and NMFS are notified of the strike within 24 hours. The Applicant must use the form included as Appendix A to Addendum C of the Lease to report the sighting or incident. If The Applicant is responsible or the injury or death, the vessel must assist with any salvage effort as requested by NMFS; and
- Within 90 days after completion of the marine site characterization survey activities, a final technical report will be provided to BOEM, and NMFS that fully documents the methods and monitoring protocols, summarizes the data recorded during monitoring, estimates the number of listed marine mammals and sea turtles that may have been taken during survey activities, and provides an interpretation of the results and effectiveness of all monitoring tasks.

14.0 SUGGESTED MEANS OF COORDINATION RESEARCH

All marine mammal data collected by the Applicant during marine characterization survey activities will be provided to NMFS, BOEM, and other interested government agencies, and be made available upon request to educational institutions and environmental groups. These organizations could use the data collected during this period to study ways to reduce incidental taking and evaluate its effects.

All hydroacoustic data and resulting transmission loss rates collected during field verification of the safety and/or exclusion zone by the Applicant during HRG surveys will be provided to NMFS, BOEM, and other interested government agencies, and be made available upon request to educational institutions and environmental groups. These organizations could use the data collected during this period to study ways to reduce incidental taking from survey activities and evaluate its effects.

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APPENDIX A NATIONAL MARINE FISHERIES SERVICE SCREENING LEVEL METHODOLOGY CALCULATION SPREADSHEETS FOR THE DETERMINATION FOR ONSET OF PERMANENT AND TEMPORARY THRESHOLD SHIFTS (VERSION 1.1 AUGUST 2016)

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F: MOBILE SOURCE: Impulsive, Intermittent (SAFE DISTANCE METHODOLOGY†)

VERSION: 1.1 (Aug-16)

KEY

(green)	Action Proponent Provided Information
(pink)	NMFS Provided Information (Acoustic Guidance)
(blue)	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Statoil Empire Wind Project
PROJECT/SOURCE INFORMATION Please include any assumptions	USBL Positioning System
PROJECT CONTACT	Tetra Tech, Inc.

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value

Weighting Factor Adjustment (kHz)¥	50

¥ Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 62), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

* BROADBAND Sources: Cannot use WFA higher than maximum applicable frequency (See GRAY tab for more information on WFA applicable frequencies)

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: Choose either F1 OR F2 method to calculate isopleths (not required to fill in sage boxes for both)

F1: METHOD USING RMS SPL SOURCE LEVEL

Source Level (RMS SPL)	188
Source Velocity (meters/second)	2.058
Pulse Duration^Δ (seconds)	0.001
1/Repetition rate^ (seconds)	2
Duty Cycle	0.00
Source Factor	3.15479E+15

‡Methodology assumes propagation of 20 log R; Activity duration (time) independent

ΔWindow that makes up 90% of total cumulative energy (5%-95%) based on Madsen 2005

^Time between onset of successive pulses.

Marine Mammal Hearing Group
Low-frequency (LF) cetaceans: baleen whales
Mid-frequency (MF) cetaceans: dolphins, toothed whales, beaked whales, bottlenose whales
High-frequency (HF) cetaceans: true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* & *L. australis*
Phocid pinnipeds (PW): true seals
Otariid pinnipeds (OW): sea lions and fur seals

RESULTANT ISOPLETHS*

* Note: For impulsive sounds, action proponent must also consider isopleths peak sound pressure level (PK) thresholds (dual thresholds).

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	183	185	155	185	203
PTS Isopleth to threshold (meters)	0.0	0.0	1.5	0.0	0.0

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (dB)†	-17.85	-0.64	-0.12	-10.80	-13.34

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

F: MOBILE SOURCE: Impulsive, Intermittent (SAFE DISTANCE METHODOLOGY‡)

VERSION: 1.1 (Aug-16)

KEY	
(green)	Action Proponent Provided Information
(pink)	NMFS Provided Information (Acoustic Guidance)
(blue)	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Statoil Empire Wind Project
PROJECT/SOURCE INFORMATION	Shallow Penetration SBP
Please include any assumptions	
PROJECT CONTACT	Tetra Tech, Inc.

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value

Weighting Factor Adjustment (kHz)¥	10

¥ Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 62), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

* BROADBAND Sources: Cannot use WFA higher than maximum applicable frequency (See GRAY tab for more information on WFA applicable frequencies)

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: Choose either F1 OR F2 method to calculate isopleths (not required to fill in sage boxes for both)

F1: METHOD USING RMS SPL SOURCE LEVEL

Source Level (RMS SPL)	179
Source Velocity (meters/second)	2.058
Pulse Duration^Δ (seconds)	0.0658
1/Repetition rate^ (seconds)	4
Duty Cycle	0.02
Source Factor	1.30667E+16

‡Methodology assumes propagation of 20 log R; Activity duration (time) independent

ΔWindow that makes up 90% of total cumulative energy (5%-95%) based on Madsen 2005

^Time between onset of successive pulses.

Marine Mammal Hearing Group
Low-frequency (LF) cetaceans: baleen whales
Mid-frequency (MF) cetaceans: dolphins, toothed whales, beaked whales, bottlenose whales
High-frequency (HF) cetaceans: true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* & *L. australis*
Phocid pinnipeds (PW):true seals
Otariid pinnipeds (OW):sea lions and fur seals

RESULTANT ISOPLETHS*

* Note: For impulsive sounds, action proponent must also consider isopleths peak sound pressure level (PK) thresholds (dual thresholds).

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	183	185	155	185	203
PTS Isopleth to threshold (meters)	0.0	0.0	1.7	0.0	0.0

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (dB)†	-17.85	-0.64	-0.12	-10.80	-13.34

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

F: MOBILE SOURCE: Impulsive, Intermittent (SAFE DISTANCE METHODOLOGY‡)

VERSION: 1.1 (Aug-16)

KEY	
(green)	Action Proponent Provided Information
(pink)	NMFS Provided Information (Acoustic Guidance)
(blue)	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Statoil Empire Wind Project
PROJECT/SOURCE INFORMATION Please include any assumptions	Medium Penetration SBP
PROJECT CONTACT	Tetra Tech, Inc.

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value

Weighting Factor Adjustment (kHz)¥	1.4

¥ Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 62), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

* BROADBAND Sources: Cannot use WFA higher than maximum applicable frequency (See GRAY tab for more information on WFA applicable frequencies)

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: Choose either F1 OR F2 method to calculate isopleths (not required to fill in sage boxes for both)

F1: METHOD USING RMS SPL SOURCE LEVEL

Source Level (RMS SPL)	206
Source Velocity (meters/second)	2.058
Pulse Duration∆ (seconds)	0.008
1/Repetition rate^ (seconds)	4
Duty Cycle	0.00
Source Factor	7.96214E+17

‡Methodology assumes propagation of 20 log R; Activity duration (time) independent

∆Window that makes up 90% of total cumulative energy (5%-95%) based on Madsen 2005

^Time between onset of successive pulses.

Marine Mammal Hearing Group
Low-frequency (LF) cetaceans: baleen whales
Mid-frequency (MF) cetaceans: dolphins, toothed whales, beaked whales, bottlenose whales
High-frequency (HF) cetaceans: true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* & *L. australis*
Phocid pinnipeds (PW):true seals
Otariid pinnipeds (OW):sea lions and fur seals

RESULTANT ISOPLETHS*

* Note: For impulsive sounds, action proponent must also consider isopleths peak sound pressure level (PK) thresholds (dual thresholds).

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	183	185	155	185	203
PTS Isopleth to threshold (meters)	0.6	0.0	0.2	0.2	0.0

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (dB)†	0.00	-24.52	-32.34	-3.80	-2.62

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

WEIGHTING FACTOR ADJUSTMENTS (WFA) **VERSION: 1.1 (Aug-16)**

Numerical criteria presented in the Technical Guidance consist of both an acoustic threshold and auditory weighting function associated with the SELcum metric. NMFS recognizes that the implementation of marine mammal weighting functions represents a new factor for consideration, which may extend beyond the capabilities of some action proponents. Thus, NMFS has developed simple weighting factor adjustments (WFA) for those who cannot fully apply auditory weighting functions associated with the SELcum metric.

WFAs consider marine mammal auditory weighting functions by focusing on a single frequency. This will typically result in similar, if not identical, predicted exposures for narrowband sounds or higher predicted exposures for broadband sounds, since only one frequency is being considered, compared to exposures associated with the ability to fully incorporate the Technical Guidance's weighting functions.

WFAs have the advantage of allowing everyone to use the same acoustic thresholds and allows for adjustments to be made for each hearing group based on source-specific information.

For Narrowband Sounds: The selection of the appropriate frequency for consideration associated with WFAs is fairly straightforward. WFAs for a narrowband sound would take the weighting function amplitude, for each hearing group, associated with the particular frequency of interest and use it to make an adjustment to better reflect the hearing's group susceptibility to that narrowband sound.

For Broadband Sounds*: The selection of the appropriate frequency for consideration associated with WFAs is more complicated. The selection of WFAs associated with broadband sources is similar to the concept used for to determine the 90% total cumulative energy window (5 to 95%) for consideration of duration associated with the RMS metric and impulsive sounds (Madsen 2005) but considered in the frequency domain, rather than the time domain. This is typically referred to as the 95% frequency contour percentile (Upper frequency below which 95% of total cumulative energy is contained; Charif et al. 2010).

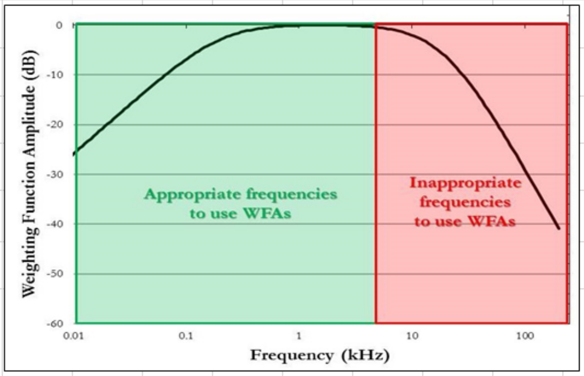
* Special Considerations for Broadband Sounds: Since the intent of WFAs is to broadly account for auditory weighting functions below the 95% frequency contour percentile, it is important that only frequencies on the "left side" of the weighting function be used to make adjustments (i.e., frequencies below those where the weighting function amplitude is zero or below where the function is essentially flat; resulting in every frequency below the WFA always having a more negative amplitude than the chosen WFA) (Figure below). It is inappropriate to use WFAs for frequencies on the "right side" of the weighting function (i.e., frequencies above those where the weighting function amplitude is zero). For a frequency on the "right side" of the weighting function (Table below), any adjustment is inappropriate and WFAs cannot be used (i.e., an action proponent would be advised to not use weighting functions and evaluate its source as essentially unweighted; see "Use" frequencies in Table below, which will result in a weighting function amplitude of 0 dB).

TABLE

Hearing Group	Applicable Frequencies	Non-Applicable Frequencies*
Low-Frequency Cetaceans (LF)	4.8 kHz and lower	Above 4.8 kHz (Use: 1.7 kHz)
Mid-Frequency Cetaceans (MF)	43 kHz and lower	Above 43 kHz (Use: 28 kHz)
High-Frequency Cetaceans (HF)	59 kHz and lower	Above 59 kHz (Use: 42 kHz)
Phocid Pinnipeds (PW)	11 kHz and lower	Above 11 kHz (Use: 6.2 kHz)
Otariid Pinnipeds (OW)	8.5 kHz and lower	Above 8.5 kHz (Use: 4.9 kHz)

* With non-applicable frequencies, user should input the "use" frequency in the User Spreadsheet, which will result in a weighting function amplitude/adjustment of 0 dB (i.e., unweighted). NOTE: "use" frequency is only appropriate for that particular hearing group. Thus, if unweighted isopleths are required for more than one hearing group, users will need to provide multiple spreadsheets supporting isopleths (i.e., separate spreadsheets for each different WFA used).

FIGURE



Example weighting function illustrating where the use of weighting function adjustments are (Green: "left side") and are not (Red: "right side") appropriate for broadband sources.

APPENDIX B SOUND SOURCE VERIFICATION PLAN

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8 ACOUSTIC FIELD VERIFICATION

8.1 ITT Requirements

As per condition 4.4.6.2 of the Lease OCS-A 0512 and the clarification submitted to Statoil, Gardline understand that a field verification test (FVT) must be conducted prior to commencing any HRG acquisition. Due to different equipment being utilized onboard the two proposed vessels it is understood that a FVT will likely need to be conducted on both the Shearwater and Ocean Researcher.

All HRG survey equipment operating below 200kHz will need to be verified prior to data acquisition to confirm the suitability of the 200m exclusion zone. Tables 13 and 14 detail the equipment that will operate below this frequency during each survey. This equipment list will be updated as necessary based on the final specifications provided by the survey contractor and will be provided to BOEM prior to the start of surveys.

8.2 Field Verification Methodology

Static hydrophone arrays will be deployed at two locations within the Lease Area ensuring a backup system. At each mooring location the hydrophones will be deployed at two water depths -- a depth at mid-water and a depth at approximately 1m (3.3 ft.) above the seafloor. The primary hydrophone location will be positioned around 50m from the vessel survey line to ensure sufficient clearance from survey vessel, whilst a second reference location will be offset from the primary mooring by approximately 150 m, and be used as a backup for initial field verification. The hydrophones will be housed in Autonomous Recording Units (ARUs) and attached to a mooring line secured by a bottom anchor, with a high visibility marker buoy on the sea surface. A depiction of the proposed deployment configuration is provided in Figure 2. To ensure the accuracy of the hydrophone measurements, a calibration tone at 250Hz will be recorded for each hydrophone before and after the measurement period using an onboard pistonphone. In addition our ARUs are calibrated yearly using an ISO 17025 standard reference and source hydrophone over the frequency ranges of 1.5kHz to 125kHz.

The precise deployment location for the moorings will be established in advance using known bathymetric, tidal and sediment data. Once in the field, if hazards are identified at the proposed deployment location, the mooring will be deployed at an alternative position. The final deployment position will be recorded and a dhan/pick-up buoy used to mark the location.

Statoil US Wind LLC
New York 2018 Campaign
Alpine Quote Ref: 11915
Gardline Quote Ref. 690Y/17/OPH

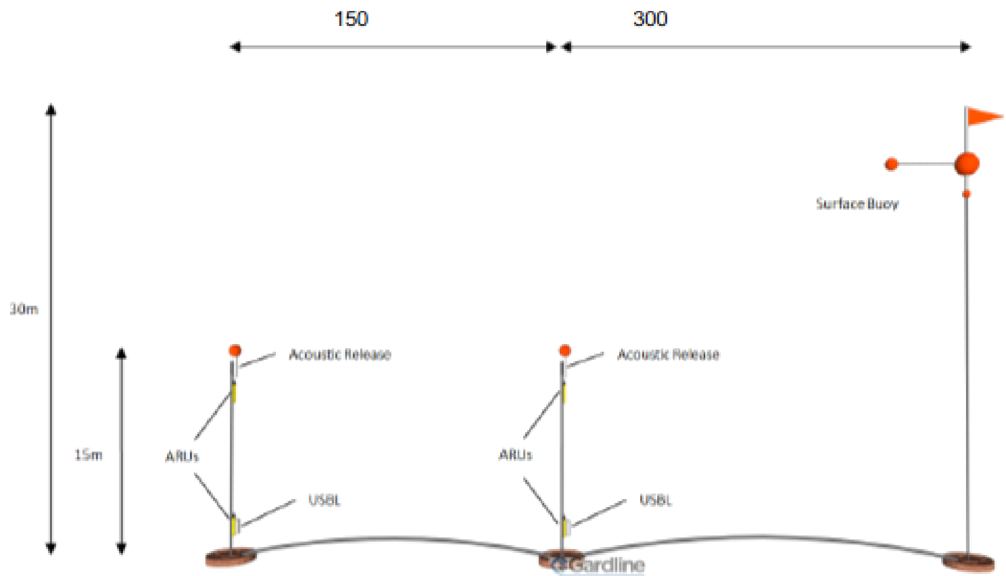

Figure 4. Proposed Sample Mooring Line Deployment with Hydrophone Array

Following the successful deployment of the ARU moorings, the survey vessel will navigate past the ARU mooring at known distances allowing acoustic verification of sound sources to be ascertained and measurements at multiple reference locations to be collected. The following passes will be run along a 2km transect line which spans 1km either side of the ARU moorings:

- Transects (two lines) will be run for the equipment operating below 200kHz independently to enable the apparent peak source levels (at 1 meter) of each piece of equipment to be calculated and determine the distance to the PTS onset of marine mammal, marine turtle, fish and the 166 dB, 160 dB, and 150 dB re 1µPa sound pressure level (SPLrms) isopleths.
- One transect run whilst no equipment is operational to collect data on vessel noise for later assessment should this be required.

During the survey lines "ping/firing intervals" and the ship speed that best correspond with the HRG survey activities will be maintained. Distances and bearings between the vessel and ARU's will be accurately recorded during each pass and sound levels measured at the various ranges for subsequent analysis to confirm the suitability of the exclusion zone for the HRG survey equipment. Similarly, the measured sound levels at the proposed distances will allow for the calculation of the apparent peak source levels (SPLRMS90% and SPLpeak) and distances to the ear injury will be computed for each marine mammal hearing group according BOEM 2016 technical guidance and for marine turtle and fish according to Popper et al 2016. The distance to 160 dB SPLRMS90% re 1µPa marine mammal Level B harassment zone, the behavioural harassment thresholds for sea turtles at 166 dB SPLRMS90% re 1µPa, the 150 dB SPLRMS90% re 1µPa Atlantic Sturgeon behavioural disturbance threshold will also be reported. The proposed survey track is shown below in Figure 3. Data acquisition for the field verification will be conducted in one deployment and every effort will be made that operations are completed within one day (this will be subject to marine mammal shutdowns/power-downs and weather conditions on site). We will attempt to conduct field verification in favourable weather conditions, preventing weather-related artefacts causing interference with the sound propagation monitoring. Deployment and recovery of any in-sea equipment however will be assessed by the

field team, and the working proximity of the survey vessel to the mooring, particularly while operating towed acoustic equipment will be at the discretion of the vessel Master.

In order to reduce inherent risks associated with over-board operations and the close passing of the survey vessel to moored equipment, the field verification and mooring deployment and recovery will occur during the hours of daylight. We anticipate one day will be required for data collection. The vessel will not sail directly above the ARU in order to avoid entanglement. Effort will be made to ensure one of the reference locations is as close as possible to the sound source, whilst avoiding clipping of the data.

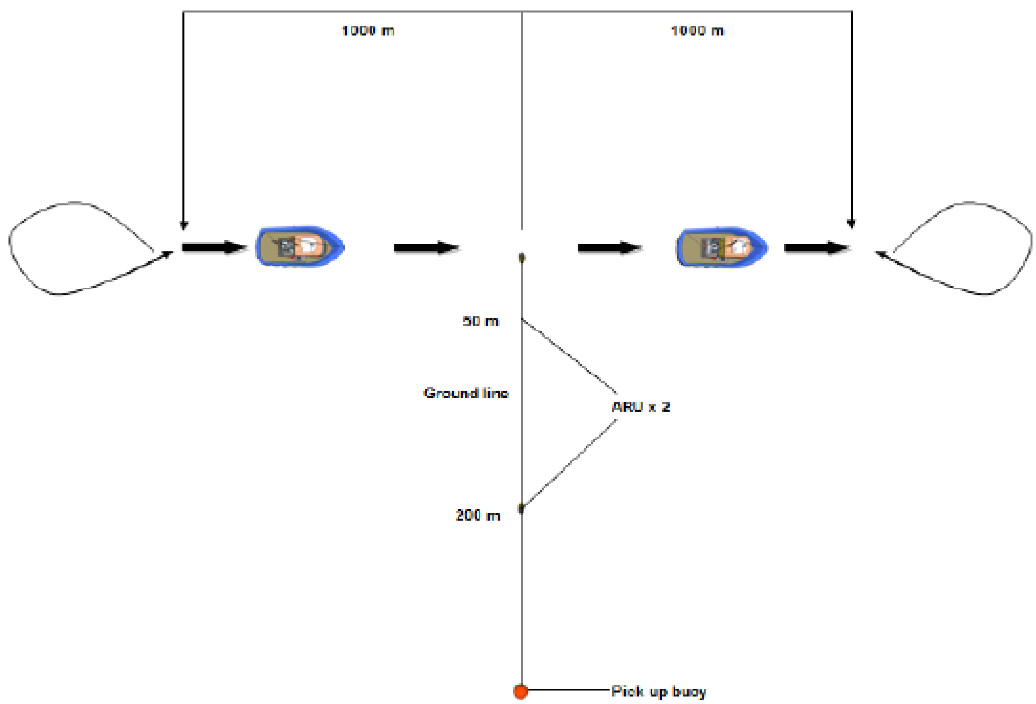

Figure 5. Survey Vessel Track Lines for Field Verification

8.3 Acoustic Verification Equipment

ARUs are stationary and operator independent recording devices, they allow continuous acoustic monitoring within a frequency spectrum and dynamic range regardless of seasonal/weather conditions. Two Wildlife Acoustic Song Meters SM3M with ultrasonic hydrophones (or SM2M as backup units) will be utilized at each mooring location. A spectrum of frequencies will be analyzed in the empirical acoustic data collected during the sound source verification exercise in order to cover vessel noise, biological noise and HRG equipment noise. The ARU hydrophones will record at a sampling rate of 96kHz collecting data between 2Hz to 48kHz. This will enable us to translate the SPL/SEL levels for all the equipment in question firing below 200kHz to carry out the field verification assessment.

SM2M+ Deep Water		SM2M+/SM3M+ Submersible	
Height	148 cm including mounting bracket and hydrophone cage	Height	79.4 cm including eyebolt and hydrophone
Diameter	16.5 cm	Diameter	16.5 cm
Mounting Bracket Slots	3.8 cm high 7.6 cm wide	Eyebolt Anchor	4.3 cm outer diameter 2.5 cm inner diameter 5.1 cm height
Standard Hydrophone	6.4 cm length 1.9 cm diameter	Standard Hydrophone	6.4 cm length 1.9 cm diameter
Weight (air)	24.4 kg with no batteries 32.2 kg fully populated with batteries	Weight (air)	9.5 kg with no batteries 13.5 kg fully populated with batteries
Buoyancy (salt water)	1 kg with no batteries -9.8 kg fully populated with batteries	Buoyancy (salt water)	15.5 kg with no batteries 1.5 kg fully populated with batteries
Rated Depth	800 m	Rated Depth	150 m

Table 16. Specifications of the SM2M+ Deep Water and SM2M+/SM3M+ Submersible ARUs

8.4 Data Processing and Reporting

Data quality is of the upmost importance to ensure the overall accuracy of the monitoring results. Therefore, it is imperative that external factors influencing field measurements should be avoided where possible.

Once acoustic data is retrieved from each ARU unit, initial processing will be conducted on data from the two primary ARUs using Matlab in order to extract the necessary acoustic parameters and information. Signal processing techniques will be used to isolate geophysical equipment acoustic information based on its operating frequency. The underwater noise measurement will be expressed in metrics most commonly used to describe underwater sound including Sound Pressure Level (SPL) and Sound Exposure Level (SEL). SEL containing 90% of central pulse energy will be aggregated over the exposure duration to estimate the cumulative exposure level. Metrics used in the analysis will be clearly stated with reference values to avoid wrong interpretations or comparisons.

Noise analysis includes the use of signal processing to generate a local sound propagation

profile using the measurement within the survey area. This information will be used to inform the propagations of the noise sources expressed in terms of transmission loss (TL), where the rate of attenuation over distance can be determined. This allows the received sound level at any point relative to the ARU position within the survey area to be estimated. In addition, an appropriate spreading model will also be incorporated to estimate the propagation trends of the geophysical equipment as well as to extrapolate for the prediction of the source level. In addition, a detailed spectral analysis will be performed on the field verification data in order to identify the spectral contents of the survey vessel and HRG equipment, specifically at one third octave bands between frequency 20 Hz – 192 kHz, for the assessment of acoustic impact on marine mammal.

Further analysis of the data gathered by the hydrophones deployed 200 m from the survey line will be used for verification purposes or if there are any problems with the data recorded at the close proximity location. Should any discrepancies arise between the data between the two mooring locations these will be reported to BOEM.

Should the Field Verification take place immediately prior to the HRG Survey, data analysis from the primary mooring will be undertaken in the field and the results submitted in a tabulated format (see Appendix B) within 48 hours from data download.

A detailed draft report for the Equipment Field Verification will be submitted to Statoil(the timescales for delivery will be discussed on contract award), which will include:

- A full description of the survey vessel
- Technical description of the equipment being used
- Set-up of the survey equipment
- Thorough description of the methodology for the field verification

The report will detail comprehensive results of the Equipment Field Verification including:

- The apparent peak source levels at 1m for each piece of survey equipment
- Distance to BOEM 2016 PTS onset for 5 marine mammal species group.
- Distance to Popper et al 2016 PTS onset for marine turtle and fish.
- Distance to the 166 dB SPLRMS90% re 1μPa sound pressure level isopleth
- Distance to the 160 dB SPLRMS90% re 1 μPa sound pressure level isopleth
- Distance to the 150 dB SPLRMS90% re 1 μPa sound pressure level isopleth

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APPENDIX C MITIGATION AND MONITORING COMMUNICATIONS FLOW DIAGRAM

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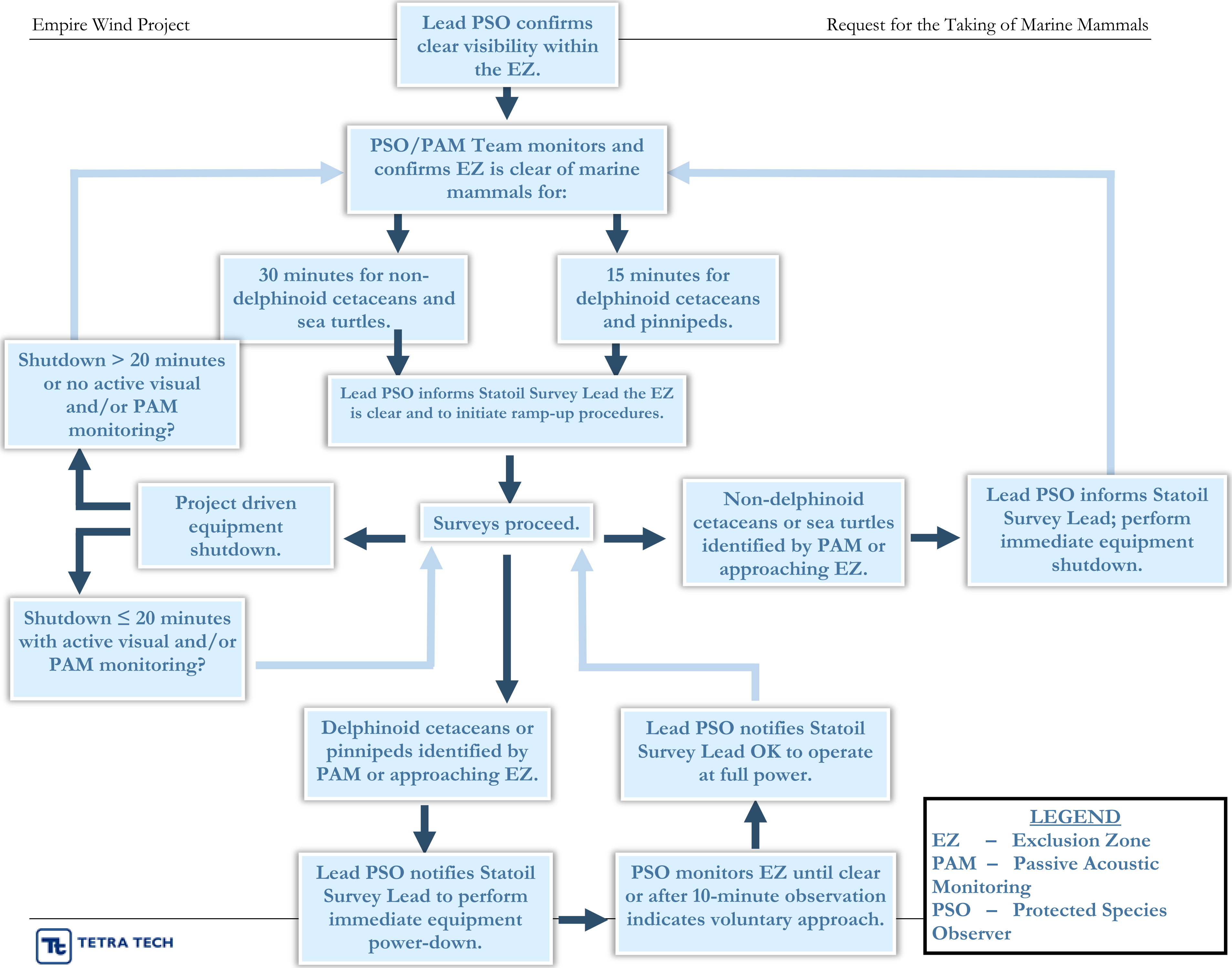
Lead PSO confirms clear visibility within the EZ.
PSO/PAM Team monitors and confirms EZ is clear of marine mammals for:
30 minutes for non-delphinoid cetaceans and sea turtles.
15 minutes for delphinoid cetaceans and pinnipeds.
Lead PSO informs Statoil Survey Lead the EZ is clear and to initiate ramp-up procedures.
Shutdown > 20 minutes or no active visual and/or PAM monitoring?
Project driven equipment shutdown.
Surveys proceed.
Non-delphinoid cetaceans or sea turtles identified by PAM or approaching EZ.
Lead PSO informs Statoil Survey Lead; perform immediate equipment shutdown.
Shutdown ≤ 20 minutes with active visual and/or PAM monitoring?
Delphinoid cetaceans or pinnipeds identified by PAM or approaching EZ.
Lead PSO notifies Statoil Survey Lead OK to operate at full power.
Lead PSO notifies Statoil Survey Lead to perform immediate equipment power-down.
PSO monitors EZ until clear or after 10-minute observation indicates voluntary approach.
LEGEND
EZ – Exclusion Zone
PAM – Passive Acoustic Monitoring
PSO – Protected Species Observer