Request for the Incidental Taking of Marine Mammals from the Use of Geophysical and Geotechnical Equipment During Marine Site Characterization

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μPa	microPascal
ANSI	American National Standards Institute
AMI	Area of Mutual Interest
BOEM	Bureau of Ocean Energy Management
BSEE	Bureau of Safety and Environmental Enforcement
CCB	Cape Cod Bay
CETAP	Cetacean and Turtles Assessment Program
CGFZ	Charlie-Gibbs Fracture Zone
CFR	Code of Federal Regulations
COP	Construction and Operations Plan
cm	centimeter
CPT	cone penetration testing
CRMC	Coastal Resources Management Council
dB	decibel
DMA	Dynamic Management Area
DoN	U.S. Department of the Navy
DWW	Deepwater Wind, LLC
EA	Environmental Assessment
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FLIDAR	floating light and detection ranging buoy
ft.	foot
GB	Georges Bank
GoM	Gulf of Maine
GPS	global positioning system
GSC	Great South Channel
HDD	Horizontal Directional Drill
Hz	hertz
IHA	Incidental Harassment Authorization
ITP	Incidental Take Permit
in	inch
IUCN	International Union for the Conservation of Nature
IWC	International Whaling Commission
km	kilometer
km^2	square kilometer

km/h	kilometer per hour
kHz	kilohertz
LME	Large Marine Ecosystem
LOA	Letter of Authorization
m	meter
MA	Massachusetts
MA WEA	Massachusetts Wind Energy Area
MAB	Mid-Atlantic Bight
MAR	Mid-Atlantic Ridge
mi	mile
MMPA	Marine Mammal Protection Act
MW	megawatt
ms	milliseconds
mtDNA	mitochondrial DNA
µs	microseconds
NEFSC	Northeast Fisheries Science Center
nm	nautical mile
NOAA	National Oceanic and Atmospheric Administration
NMFS	National Marine Fisheries Service
NTL	Notice to Lessees
OCS	Outer Continental Shelf
OMP	Ocean Management Plan
OPAREA	Operations Area
Project	Deepwater Wind wind project within RI-MA WEA
PSO	Protected Species Observer
PTS	permanent threshold shift
RAM	Range-Dependent Acoustic Model
RI Ocean SAMP	Rhode Island Ocean Special Area Management Plan
RMS	root mean square
SAP	Site Assessment Plan
SAR	Stock Assessment Report
SEL	sound exposure level
SMA	Seasonal Management Area
SNE	Southern New England
SPL	sound pressure level
SPUE	sightings per unit effort
sq mi	square mile

TNASS	Trans North Atlantic Sighting Survey
TTS	temporary threshold shift
U.S.	United States of America
USFWS	United States Fish and Wildlife Service
WEA	Wind Energy Area
ZOI	Zone of Influence

1.0 Introduction

Deepwater Wind, LLC (DWW) ("Applicant") is proposing to conduct marine site characterization (geophysical and geotechnical) surveys in the area of the Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (OCS) lease area #OCS-A-0486 ("Lease Area") and along potential submarine cable routes to a landfall location in Easthampton, New York ("Submarine Cable Corridor") (collectively the Lease Area and Submarine Cable Corridor are the 'Project Area'). The Lease Area is approximately 97,498 acres (394 km^2 or 152 sq. mi.) that is within the Rhode Island Massachusetts Wind Energy Area (RI-MA WEA) defined by the Bureau of Ocean Energy Management ("BOEM"). Water depths in the Lease Area range from 31-45 meters and along the Submarine Cable Corridor in Federal Waters range from15-52 meters.

An overview of the Project Area is provided in Figure 1. The RI-MA WEA was defined after a multi-year stakeholder engagement process led by BOEM.

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 in the Project Area during geophysical and geotechnical survey activities. This request is specifically being submitted in keeping with recent guidance from the National Oceanic and Atmospheric Administration–National Marine Fisheries Service (NOAA-NMFS, 2016) that modifies the methods used to calculate the potential take of marine mammals by acoustic harassment from mobile sound sources. For NOAA-NMFS to consider authorizing the taking of small numbers of marine mammals by U.S. citizens 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 this application.

The Applicant proposes to conduct geophysical surveys for up to 168 days between May 15, 2017 and December 31, 2017. The Applicant proposes to conduct geotechnical surveys for up to 75 days between June 15, 2017 and December 31, 2017.

Marine site characterization surveys will include the following:

Geophysical surveys:

- depth sounding (multibeam depth sounder) to determine water depths and general bottom topography;
- shallow penetration sub-bottom profiler (chirp) to map the near surface stratigraphy (top 0-5 meter [m] soils below seabed);
- medium penetration sub-bottom profiler (boomer) to map deeper subsurface stratigraphy as needed;
- medium penetration sub-bottom profiler (sparker) to map deeper subsurface stratigraphy as needed; and
- seafloor imaging (sidescan sonar survey) for seabed sediment classification purposes, and to identify natural (e.g., hard bottom substrate) and man-made acoustic targets (e.g., archaeological or cultural objects) resting on the bottom as well as any anomalous natural seafloor features.

- marine magnetometer for the detection and mapping of all sizes of ferrous objects, including anchors, chains, cables, pipelines, ballast stone and other scattered shipwreck debris, munitions of all sizes (UXO), aircraft, engines and any other object with magnetic expression.

Geotechnical Investigation:

- vibracores will be taken to determine the geological and geotechnical characteristics of the sediments; and
- core penetration testing (CPT) will be performed to determine stratigraphy and in-situ conditions of the sediments.

Table 1 identifies the representative survey equipment and dynamic position ("DP") vessel that is being considered for the survey activities. The make and model of the listed equipment will vary depending on availability and will be finalized as part of the survey preparations and contract negotiations with the survey contractor. The final selection of the survey equipment will be confirmed prior to the start of the survey activities.

Table 1. Summary of representative geophysical and geotechnical survey equipment and DP vessels

Equipment	Operating Frequencies	Source Level	Source Depth	Beam width (degrees)	Pulse Duration
Multibeam Depth Sounding					
Reson SeaBat 7125 Multibeam Echosounder	200 kHz or 400 kHz	220 dB_{RMS}	4m below surface	0.5º beam by 128º coverage	0.03 to 0.3 milliseconds (ms)
Reson Multibeam Echosounder (7125)1	200 kHz or 400 kHz	221 dB_{RMS}	1 meter below surface	128º	30-300 µs
RESON 7000[1]	200 & 400 kHz	162 dB_{RMS}	2-5m below surface	140º	0.33 ms
R2SONIC	200 & 400 kHz	162 dB_{RMS}	1 meter below surface	1º'28	0.11 ms
Shallow Sub-bottom Profiling (chirp)					
Teledyne Benthos Chirp III Sub-bottom Profiler	2-7 kHz	217 dB_{RMS}	4m below surface	45º	0.2 ms
EdgeTech Full-Spectrum (Chirp) Ssub-bottom Profiler Equipped with a SB216 Tow Vehicle	2-16 kHz	140-180 dB (peak SPL, dB re 1µPa)	0.5 - 1 meter distance from transducer	170º	45 to 120 ms
Medium Penetration Sub-bottom Profiling (boomer)					
Applied Acoustics (Fugro provided specs for Fugro boomer)	0.1-10 kHz	175 dB_{RMS}	1-2m below surface	60º	58 ms

Equipment	Operating Frequencies	Source Level	Source Depth	Beam width (degrees)	Pulse Duration
Applied Acoustics high-resolution (S-Boom System) medium penetration sub-bottom profiling system consisting of a CSP-D 2400HV power supply and 3-plate catamaran (600 joules/pulse)	0.250-8 kHz	222dB (re 1μPa at 2 meters)	0.5 meter below surface	25º -35º	300-500 μs
Medium Penetration Sub-bottom Profiling (sparker)					
800 Joule GeoResources Sparker	0.75 - 2.75 kHz	213 dB_{RMS} (186 dB_{SEL} for 1,000 Joul*)	4m below surface	omni directional 360º	0.1 to 0.2 ms
Applied Acoustics 100–1,000 joule Dura-Spark 240 System	0.03 to 1.2 kHz	213 dB_{RMS} 186 dB_{SEL} for 1,000 Joul*	0.5-1m below surface	omni directional 360	0.5-1.5 ms
Side Scan Sonar					
EdgeTech 4200 Dual Frequency Side Scan Sonar System	300 kHz and 900 kHz	215-220 dB	5-10m above seafloor	horizontal 300 kHz: 0.5º; 900kHz:0.2º vertical (50º)l	300 kHz up to 12 ms 900 kHz up to 3 ms
Side Scan Sonar: EdgeTech 4000[2] (spec provided for 4125)	410 kHz	225 dB_{RMS}	5-10m above seafloor	400 kHz: 0.4º	10-20 ms
EdgeTech 4200 Dual Frequency side scan sonar system	300 kHz 600 kHz	215-220 dB	5-10m above seafloor	horizontal 300 kHz: 0.5º, 600 kHz: 0.26º vertical (50º)	300 kHz up to 12 ms 600 kHz up to 5 ms
Magnetometer (No sound is generated)					
G-882 Marine Magnetometer (self-oscillating split-beam nonradioactive cesium vapor)	N/A	N/A	N/A	highest sensitivity at 0.004 nT/ÖHz	N/A
SeaSPY	N/A	N/A	N/A	highest sensitivity at 0.01 nT/ÖHz	N/A
Vibracores					
Alpine Model P pneumatic Vibracore System3	Unknown	Unknown	Seabed to 20ft above seabed	omni directional 360	duration of core
Vibracore Operations: HPC or Rossfelder Corer4	10-20 kHz	185 dB_{RMS}	46 meters	n/a	n/a
CPTs					
Serafloor deployed 200kN CPT Rig	Unknown	Unknown	Seabed	omnidirectional 360	duration of CPT
Seabed CPT	n/a	n/a no effect	On seafloor	n/a	n/a

Equipment	Operating Frequencies	Source Level	Source Depth	Beam width (degrees)	Pulse Duration
DP Thruster System (possible during both geophysical and geotechnical surveys)					
DP Thruster/ Propeller System	0.1 to 10 kHz	150 dB_{RMS}	12 m depth	Unknown	Unknown

*BOEM, 2016, Table 10.

- For the sparker (plus all other acoustic systems), it is planned to be operated 22-24 hours per day. Even if there is maintenance on a separate system, the sparker source firing would be kept. The primary reasons to shut down would be to perform maintenance on the sparker or take SVP velocity profiles. No DP thrusters are needed during the geophysical acquisition.

- Vibracore and CPT operations would utilize DP thrusters for about 60% of the time while holding on position and conducting the CPT or vibracore. Each CPT or vibracore would take about 15 to 30 minutes to conduct. About 10 vibracores per day or 8 CPTs per day is expected, either one or the other (not both). Therefore, for vibracores that would work out to about 10 per day at 0.5 hr per test or total of 5 hours per day. DP thrusters would be operating about 60% of the time or 3hours per day. DP thrusters during a day when in CPT mode would be less or 8 CPTs about 0.5hr = 4hrs; where 4hrs x 0.6 = 2.4hrs/day.

- On average 22 hours per day for acoustic systems and 2.4 to 3 hours per day for DP thrusters.

The deployment of geophysical and geotechnical survey equipment, including the use of sound-producing equipment operating between 7 Hz and 160 kHz, has the potential to cause acoustic harassment to marine species, in particular marine mammals (NOAA-NMFS, 2016). When evaluating the effects of geophysical and geotechnical equipment, DWW compared the operating frequencies of the survey equipment (Table 1) with the hearing ranges of marine mammals potentially transiting the Project Area (Table 2). The following equipment were determined to be potential sources of disturbance to LF, MF, and HF cetaceans and phocid pinnipeds:

- Teledyne Benthos Chirp III Sub-bottom Profiler (2-7 kHz)
- EdgeTech Full-Spectrum (Chirp) Sub-bottom Profiler Equipped with a SB216 Tow Vehicle (2-16 kHz)
- Applied Acoustics Medium Penetration Sub-Bottom Profiling System (boomer) (0.1-10 kHz)
- Applied Acoustics High-Resolution (S-Boom System) Medium Penetration Sub-bottom Profiling System consisting of a CSP-D 2400HV power supply and 3-plate catamaran (0.250-8 kHz)
- 800 Joule GeoResources Sparker (0.75 - 2.75 kHz)/Applied Acoustics 100–1,000 joule Dura-Spark 240 System (0.03 to 1.2 kHz)
- HPC or Rossfelder Corer (10-20 kHz)
- DP Thruster/ Propeller System (0.1 to 10 kHz)

Based on the same comparison, the following equipment was eliminated as a source for disturbance, as the frequencies of the sound sources (e.g., 400 kH) fell far outside of the lower or upper bounds of the hearing range of marine mammals which could occur in the project area as reported by NOAA (Table 2)::

- Reson SeaBat 7125 Multibeam Echosounder (200 kHz or 400 kHz)

- Reson Multibeam Echosounder (7125) (200 kHz or 400 kHz)
- RESON 70001 (200 and 400 kHz)
- R2SONIC (200 and 400 kHz)
- EdgeTech 4200 Dual Frequency Side Scan Sonar System (300 kHz and 900 kHz)
- EdgeTech 4000[2] (410 kHz)
- EdgeTech 4200 Dual Frequency Side Scan Sonar System (300 kHz and 600 kHz)
- G-882 Marine Magnetometer
- SeaSPY Magnetometer
- CPTs

Field studies conducted off the coast of Virginia by Tetra Tech on behalf of Dominion Energy to determine the underwater noise produced by borehole drilling and CPTs (e.g., Serafloor deployed 200kN CPT Rig and Seabed CPT) confirmed that these activities do not result in underwater noise levels that are harassing or harmful to marine mammals (Tetra Tech 2014; DONG 2016). However, underwater noise produced by the thrusters associated with the DP geotechnical vessel (estimated frequency range 0.1 to 10 kHz) that will be used to support the geotechnical activities has the potential to result in Level B harassment (DONG 2016).

The survey activities will be supported by a vessel approximately 100 to 200 feet long which will maintain a speed of between two to five knots while transiting survey lines. Geotechnical surveys are anticipated to be conducted from a 100-ft to 200-ft dynamically positioned (DP) vessel / jack up barge with support of a tug boat. For purposes of this application, use of an approximately 200-ft to 300-ft DP vessel is assumed. All survey activities will be executed in compliance with Lease OCS-A-0486 ("Lease"), 30 CFR Part 585 and the July 2015 *BOEM Guidelines for Providing Geophysical, Geotechnical, and Geohazard Information Pursuant to 30 CFR Part 585.*

Given the size of the Project Area, the Applicant has proposed conducting survey operations 24 hours per day to lessen the duration of survey activities and, therefore, shorten the period of potential impact on marine species.

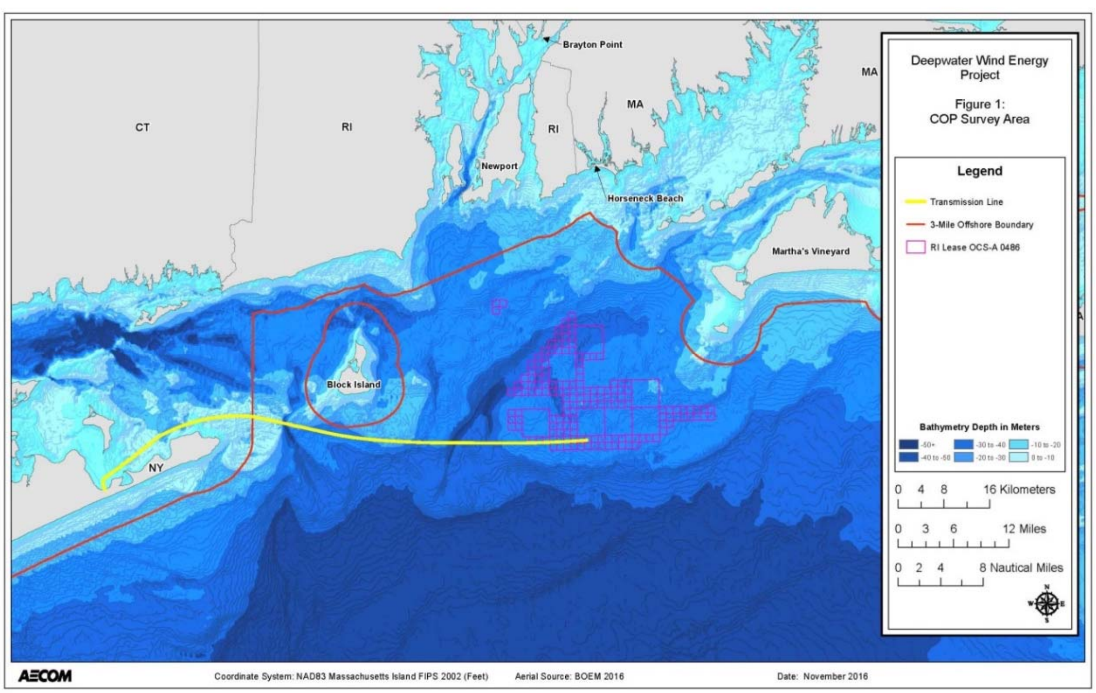

Figure 1. Project Area

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

Marine mammals live in an environment in which vision is not the primary sense because light does not penetrate far beneath the surface of the ocean. As such, marine animals often rely upon sound, instead of sight, as their primary sense for communication and awareness of their environment. Marine mammal communication has a variety of functions such as mother/calf cohesion, group cohesion, individual recognition, and danger avoidance.

1.1.1 United States Regulatory Framework

The potential effects of underwater sound resulting in the 'take' of marine mammals are federally managed by NOAA-NMFS under the MMPA to minimize the potential for both harm and harassment. The term take, as defined in Section 3 (16 U.S. Code [U.S.C.] 1362 of the MMPA, means “to harass, hunt, capture, or kill, or attempt to harass, hunt, capture or kill any marine mammal.” Harassment was further defined in the 1994 amendments to the MMPA, which provided two levels of harassment, Level A (injury) and Level B (disturbance). Level A harassment is statutorily defined as any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild. 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, but does not have the potential to injure a marine mammal or marine mammal stock.

It is likely that any take, as defined above, during the proposed geophysical and geotechnical surveys will occur because of the introduction of sound to the marine environment. NOAA-NMFS will authorize incidental take of marine mammals under the MMPA if the taking of marine mammals is of a small number, will have no more than a "negligible impact" on those marine mammal species or stocks, and will not have an "immitigable adverse impact" on the availability of the species or stock for subsistence uses (50 CFR 216). An application for an Incidental Take Permit (ITP) and issuance of a letter of authorization (LOA) is required if the take of marine mammals is expected to cause harm (i.e., serious injury or mortality to any marine mammal species) or result in harassment (i.e., injury or disturbance) and is planned for multiple years. An IHA is required for activities that result in harassment of marine mammals (i.e., injury or disturbance), such as could be the case for the proposed geophysical and geotechnical surveys, where the taking of marine mammals is expected to result in harassment (Level B take) only and for a short duration (less than one year). For this survey, the maximum time frame is less than one year.

1.1.2 Hearing Sensitivity in Marine Mammals in the Region

Current data (via direct behavioral and electrophysiological measurements) and predictions (based on inner ear morphology, modelling, behavior, vocalizations, or taxonomy) indicate that not all marine mammal species have the same hearing capabilities in terms of absolute hearing sensitivity and the frequency band of hearing (Richardson et al. 1995; Wartzok and Ketten 1999; Southall et al. 2007; Au and Hastings 2008; NOAA-NMFS 2016). In the July 2016, guidance for assessing the effects of anthropogenic sound on marine mammal hearing were assigned to functional hearing groups based on their hearing characteristics by Southall et al. (2007) and NOAA-NMFS (2016) estimates. Table 2 presents the estimated auditory bandwidth for each functional hearing group and examples of species relevant to this assessment (NOAA-NMFS 2016).

Table 2. Summary of the Four Functional Hearing Groups of Marine Mammals Commonly Found Within the Project Area

Functional Hearing Group	Estimated Auditory Bandwidth	Species or Taxonomic Groups (Examples in Project Area*)
Low-frequency (LF) cetaceans	7 Hz to 35 kHz	All baleen whales
Mid-frequency (MF) Cetaceans	150 Hz to 160 kHz	Dolphins, toothed whales and beaked whales
High frequency (HF) cetaceans	275 Hz to 160 kHz	True porpoises
Phocid pinnipeds (underwater)	50 Hz to 86 kHz	True seals

* Represents the generalized hearing range for the entire group as a composite (i.e., all species within the group), where individual species' hearing ranges are typically not as broad. Generalized hearing range chosen based on ~65 dB threshold from normalized composite audiogram, with the exception for lower limits for LF cetaceans (Southall et al. 2007) and PW pinniped (approximation). Source: NOAA-NMFS 2016

Note: Otariid pinnipeds do not occur in the North Atlantic and Project Area and so are not presented in this table or discussed further.

1.1.3 Acoustic Threshold Levels for Marine Mammals in the Region

The NOAA-NMFS criterion for Level A harassment for noise is that which results in a permanent threshold shift (PTS) (i.e., any level above that which is known to cause a temporary threshold shift [TTS]). NOAA-NMFS has compiled, interpreted, and synthesized the best available science, including a recent Navy Technical Report (Finneran, 2015), to produce updated acoustic threshold levels for the permanent threshold shifts (PTS) onset and replace those currently in use by NOAA-NMFS for determining PTS onset thresholds (NOAA-NMFS 2016). Updates include a protocol for estimating PTS onset threshold levels for impulsive sound sources (e.g., airguns, impact pile drivers) and non-impulsive sound sources (e.g., sonar, DP thrusters, vibratory pile drivers). Impulsive sources produce sounds that are typically transient, brief (less than 1 second), broadband, and consist of high peak sound pressure with rapid rise time and rapid decay (ANSI 1986; NIOSH 1998; ANSI 2005). Non-impulsive sources produce sounds that can be broadband, narrowband or tonal, brief or prolonged, continuous or intermittent and typically do not have the high peak sound pressure with rapid rise/decay time that impulsive sounds do (ANSI 1995; NIOSH 1998).

Table 3 provides the underwater acoustic threshold levels for the onset of PTS. Cumulative sound exposure level over a 24 hour period and peak sound pressure level have been recommended as the most appropriate parameters for establishing PTS onset acoustic threshold levels for marine mammals found in the North Atlantic (NOAA-NMFS 2016).

Table 3. Summary of NOAA-NMFS PTS Onset Acoustic Thresholds for Marine Mammals Possibly Transiting the Area

PTS Onset Thresholds* Levels (Received Level)

Hearing Group	Impulsive	Non-impulsive
LF Cetaceans	$L_{pk,flat}$: 219 dB $L_{E,LF,24h}$: 183 dB	$L_{E,LF,24h}$: 199 dB
MF Cetaceans	Lpk,flat: 230 dB $L_{E,MF,24h}$: 185 dB	$L_{E,MF,24h}$: 198 dB
HF Cetaceans	Lpk,flat: 202 dB	$L_{E,HF,24h}$: 173 dB

Hearing Group	Impulsive	Non-impulsive
	$L_{E,HF,24h}$: 155 dB	
Phocid Pinnipeds (Underwater)	Lpk,flat: 218 dB $L_{E,PW,24h}$: 185 dB	$L_{E,PW,24h}$: 201 dB

Notes: > = greater than; dB = decibel; SEL = sound exposure level; SPL = sound pressure level.

* Dual metric acoustic thresholds for impulsive sounds: Use whichever results in the largest isopleth for calculating PTS onset. If a non-impulsive sound has the potential of exceeding the peak sound pressure level thresholds associated with impulsive sounds, these thresholds should also be considered.

Peak sound pressure (Lpk) has a reference value of 1 μPa, and cumulative sound exposure level (LE) has a reference value of 1μPa2s. In this table, thresholds are abbreviated to reflect American National Standards Institute (ANSI) standards (ANSI 2013). However, peak sound pressure is defined by ANSI as incorporating frequency weighting, which is not the intent for this Technical Guidance. Hence, the subscript flat is being included to indicate peak sound pressure should be flat weighted or unweighted within the generalized hearing range. The subscript associated with cumulative sound exposure level thresholds indicates the designated marine mammal auditory weighting function (LF, MF, and HF cetaceans, and PW and OW pinnipeds) and that the recommended accumulation period is 24 hours. The cumulative sound exposure level thresholds could be exceeded in a multitude of ways (i.e., varying exposure levels and durations, duty cycle). When possible, it is valuable for action proponents to indicate the conditions under which these acoustic thresholds will be exceeded.

Source: NOAA-NMFS 2016.

While NOAA-NMFS has published TTS Thresholds as part of their 2016 Guidance document, they are not yet being used to evaluate Level B take for marine mammals. Therefore, NOAA-NMFS has instructed that DWW use the previous guidance regarding Level B harassment, which is reflected in our analysis. The NOAA-NMFS criterion for Level B harassment is the acoustic threshold that causes behavioral disruption. NOAA-NMFS has defined the threshold level for Level B harassment as 120 dB_{RMS} re 1 μPa for non-impulsive sound sources (e.g., sonar, DP thrusters, vibratory pile drivers, and other continuous sounds) and 160 dB_{RMS} re 1 μPa for impulsive sound sources (e.g., airguns, impact pile drivers) (Table 4). At some distance from the sound source (meters) received sound levels could exceed Level B thresholds and Project activities may approach or exceed ambient sound levels (within the zone of influence); however, actual perceptibility of marine mammals to the sound source will depend on the actual hearing thresholds of the species under consideration and the inherent masking effects of ambient sound levels.

Table 4. Level B Harassment Acoustic Thresholds for Marine Mammals Possibly Transiting the Project Area

Criterion	Acoustic threshold (SEL_{cum})
Possible Behavioral Disruption (for impulsive sound pressure level)	160 dB
Possible Behavioral Disruption (for continuous sound pressure level)	120 dB

Source: NOAA-NMFS 2015

1.1.4 Zone of Influence (ZOI)

Geophysical devices operate across wide frequency ranges (Hz or kHz) as well as different source levels (dB) and beam widths depending on survey objectives. In general, the lowest frequency at which the equipment may operate and loudest source level, represents a worst-case scenario. However, most geophysical equipment is highly directional and beamwidth can have a significant impact on sound propagation. Equipment that focuses its energy in vertical direction does not see as

much horizontal propagation. While equipment that transmits its energy over a wider beamwidth, such as a towed sparker, is more likely to see greater horizontal propagation.

To better understand both the level and extent of underwater sound generated by Project activities, equipment was evaluated over the range of expected operating conditions. This hydroacoustic modelling exercise of the representative survey equipment was used to predict the potential acoustic zones of influence (ZOI) associated with the proposed survey equipment. The acoustic modelling took into consideration the following factors: equipment type, operating frequencies, source level, and pulse duration for Level A harassment thresholds. For level B harassment thresholds the source level and the reference distance were used.

In accordance with the BOEM #OCS-A-0486 Lease stipulation 4.3.6.2 of Addendum C, the Applicant will verify in the field distances calculated by the hydroacoustic modeling and within the protected species exclusion zone. To satisfy this requirement, the Applicant will conduct underwater acoustic measurements of noise-producing activities at the start of the geophysical and geotechnical survey programs. Acoustic measurements will be taken at a minimum of two reference locations and at two depths (i.e. midwater, and 1 meter above the seafloor). Field verification of actual sound propagation will enable adjustment of the critical MMPA threshold level distances to fit actual survey conditions, if necessary. See Section 11 for additional details on mitigation, monitoring, and reporting.

2.0 Survey Dates, Duration, and Specific Geographic Region

2.1 Survey Activity Dates and Duration

As stated above, the geophysical survey is expected to take up to 168 days between May 15, 2017 and December 31, 2017. The geotechnical surveys are expected to take up to 75 days between June 15, 2017 and December 31, 2017.

2.2 Specific Geographic Region

The Applicant's survey activities will occur in the approximately 97,498-acre (394 km^2) Lease Area. The Lease Area falls within the RI-MA WEA and along a transmission line route to Long Island as shown in Figure 1. An evaluation of site assessment activities within the RI-MA WEA was fully assessed in the BOEM Environmental Assessment (EA) for site assessment activities on the OCS (BOEM 2014) and associated Finding of No Significant Impact, revised in June 2014.

3.0 Species and Numbers of Marine Mammals

There are 36 species of marine mammals in the Northwest Atlantic Outer Continental Shelf (OCS) region that are protected by the MMPA (Table 5) (BOEM 2014). Thirty-one (31) of these species are cetaceans, including twenty-five (25) which belong to the suborder Odontoceti (toothed whales) and six (6) which belong to the suborder Mysticeti (baleen whales). There are five whale species listed under the Endangered Species Act (ESA) as endangered that could, in theory, transit the Project Area, including the following species that are listed as threatened or endangered: sperm whale (*Physeter macrocephalus*), fin whale (*Balaenoptera physalus*), sei whale (*Balaenoptera borealis*), blue whale (*Balaenoptera musculus*), and North Atlantic right whale (*Eubalaena glacialis*). In addition to these listed species, several dolphin species protected under the MMPA have been sighted near the Project Area.

There are four species of *phocids* (true seals) that could transit the Project Area, all of which are protected under the MMPA, including: harbor seals, gray seals, harp seals, and hooded seals (USFWS 1997). Harbor seals (*Phoca vitulina*) are the most common seals along the U.S. east coast (Waring et al. 2008). Finally, while very rare, one species of *Sirenian*, the West Indian manatee, *Trichechus manatus*, has been sighted in the region.

The status and distribution of the species listed in Table 5 are discussed in more detail in Section 4.0.

Table 5. Marine Mammals Thought to Occur in the Region

Common Name	Scientific Name	Federal ESA/ MMPA Status[1]	Relative Occurrence in the Region[2]	Estimated Minimum Number (Nmin)[3]	Best Estimate[3]
Toothed Whales (*Odontoceti*)					
Sperm whale	*Physeter macrocephalus*	ESA Endangered/ Depleted and Strategic	Common	1,815	2,288
Dwarf sperm whale	*Kogia sima*	Protected	Rare[4]	2,598[5]	3,785[5]
Pygmy sperm whale	*Kogia breviceps*	Protected	Rare[4]	2,598[5]	3,785[5]
Killer Whale	*Orcinus orca*	Protected	Rare	unknown	unknown
Pygmy killer whale	*Feresa attenuata*	Protected	Hypothetical	unknown	unknown
False killer whale	*Pseudorca crassidens*	Strategic	Rare	212	442
Northern bottlenose whale	*Hyperoodon ampullatus*	Protected	Hypothetical	unknown	unknown
Cuvier's beaked whale	*Ziphius cavirostris*	Protected	Rare	5,021	6,532
Mesoplodon beaked whales	*Mesoplodon spp.*	Depleted[6]	Rare	4,632[7]	7,092[7]
Melon-headed whale	*Peponocephala electra*	Protected	Hypothetical	unknown	unknown
Risso's dolphin	*Grampus griseus*	Protected	Common	12,619	18,250
Long-finned pilot whale	*Globicephala melas melas*	Protected	Common	3,464	5,636
Short-finned pilot whale	*Globicephala macrorhynchus*	Protected	Rare	15,913	21,515
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	Protected	Common	30,403	48,819

Common Name	Scientific Name	Federal ESA/ MMPA Status[1]	Relative Occurrence in the Region[2]	Estimated Minimum Number (Nmin)[3]	Best Estimate[3]
White-beaked dolphin	*Lagenorhynchus albirostris*	Protected	Regular	1,023	2,003
Short-beaked common dolphin	*Delphinus delphis delphinis*	Protected	Common	112,531	173,486
Atlantic spotted dolphin	*Stenella frontalis*	Protected	Regular[4]	31,610	44,715
Pantropical spotted dolphin	*Stenella attenuata*	Protected	Rare	1,733	3,333
Striped dolphin	*Stenella coeruleoalba*	Protected	Rare/Regular[8]	42,804	54,807
Fraser's dolphin	*Lagenodelphis hosei*	Protected	Data deficient	unknown	unknown
Rough toothed dolphin	*Steno bredanensis*	Protected	Rare[8]	134	271
Clymene dolphin	*Stenella clymene*	Protected	Hypothetical	unknown	unknown
Spinner dolphin	*Stenella longirostris*	Protected	Hypothetical	unknown	unknown
Common bottlenose dolphin[9]	*Tursiops truncatus truncatus*	Protected	Common	85,945	118,974
Harbor Porpoise	*Phocoena phocoena*	Protected	Common	61,415	79,833
Baleen Whales (*Mysticeti*)					
Fin whale	*Balaenoptera physalus*	ESA Endangered/ Depleted and Strategic	Common	1,234	1,618
Sei whale	*Balaenoptera borealis*	ESA Endangered/ Depleted and Strategic	Regular	236	357
Minke whale	*Balaenoptera acutorostrata acutorostrata*	Protected	Common	16,199	20,741
Blue whale	*Balaenoptera musculus*	ESA Endangered/ Depleted and Strategic	Rare	440	unknown
Humpback whale	*Megaptera novaeangliae*	Strategic[10]	Common	823	823
North Atlantic right whale	*Eubalaena glacialis*	ESA Endangered/ Depleted and Strategic	Common	476	476
True Seals (*Phocidae*)					
Harbor Seal	*Phoca vitulina concolor*	Protected	Common	66,884	75,834
Gray Seal	*Halichoerus grypus*	Protected	Common	unknown	unknown
Harp Seal	*Pagophilus groenlandica*	Protected	Common	unknown	unknown
Hooded Seal	*Cystophora cristata*	Protected	Regular	unknown	unknown

Common Name	Scientific Name	Federal ESA/ MMPA Status[1]	Relative Occurrence in the Region[2]	Estimated Minimum Number (Nmin)[3]	Best Estimate[3]
Sirenians					
West Indian manatee[11]	*Trichechus manatus*	ESA Endangered/ Depleted and Strategic	Rare	unknown	unknown

Notes: Common = greater than 100 records, Regular = 10–100 records, Rare = less than 10 records, Hypothetical = the remote possibility to occur in the region at some time (Kenney and Vigness-Raposa 2010).

1 Denotes ESA listing as either endangered or threatened, or MMPA listing as depleted and/or strategic. All marine mammal stocks are considered protected under the MMPA.

2 BOEM 2014

3 Waring et al 2007, 2010, 2013, 2014, and 2016.

4 Based on Waring et al. 2012 and 2013

5 Estimate includes both the dwarf and pygmy sperm whales.

6 Of the *Mesoplodon* species in the Atlantic, only the Gervais' beaked whale is depleted.

7 This estimate includes all *Mesoplodon* species in the Atlantic (Blainville's, Gervais', Sowerby's, and True's beaked whales)

8 AMAPPS 2011

9 Numerous stocks for this species have been identified; please refer to Table 6

10 NOAA-NMFS 2016a

11 NOAA-NMFS 2016b

4.0 Northwest Atlantic OCS Species Status and Distribution

Of the 36 marine mammal species transiting the Northwest Atlantic OCS region, four marine mammal species are listed under the ESA and are thought to be present, at least seasonally, in the waters of Southern New England: sperm whale, fin whale, sei whale, and North Atlantic right whale. However, these species are highly migratory and do not spend extended periods of time in a localized area. Other species protected under the MMPA that are more common in the Northwest Atlantic OCS, and so could transit the Project Area include the following species: humpback whale, minke whale, Risso's dolphin, long-finned pilot whale, Atlantic white-sided dolphin, White-beaked dolphin, short-beaked common dolphin, Atlantic spotted dolphin, striped dolphin, common bottlenose dolphin, harbor porpoise, harbor seal, gray seal and harp seal.

The following information summarizes data on the status and trends, distribution and habitat preferences, behavior and life history, and auditory capabilities of marine mammals found in the, Northwest Atlantic OCS region as available in published literature and reports, including NOAA-NMFS marine mammal stock assessment reports.

4.1 Regular or Common Odontocetes in the Northeast Atlantic Region

4.1.1 Sperm Whale (*Physeter macrocephalus*)

<u>*Abundance, Density, and Stock Status:*</u> Sperm whales are listed as endangered under the ESA. Data are insufficient to assess population trends, and the current abundance estimate was based on only a fraction of the known stock range (Waring et al. 2007). A Draft Recovery Plan for sperm whales was written and is available for review (NOAA-NMFS 2006c).

Total numbers of sperm whales off the U.S. or Canadian Atlantic coasts are unknown. The best recent abundance estimate for sperm whales is the sum of the estimates from the two 2011 U.S. Atlantic surveys 2,288 (CV=0.28) where the estimate from the northern U.S. Atlantic is 1,593, and from the southern U.S. Atlantic is 695 sperm whales. The minimum population estimate for the western North Atlantic sperm whale is 1,815 (Waring et al. 2014).

Distribution and Habitat: Sperm whales are principally distributed along the continental shelf edge, over the continental slope, and into mid-ocean regions (CETAP 1982; Hamazaki 2002; Waring et al. 2001; Waring et al. 2007). Waring et al. (2007) suggest that this offshore distribution is more commonly associated with the Gulf Stream edge and other features. Off the Northeast U.S. coast there appears to be a distinct seasonal cycle (CETAP 1982; Scott and Sadove 1997). In winter, sperm whales concentrate east and northeast of Cape Hatteras. In spring, distribution shifts northward to east of Delaware and Virginia, and is widespread throughout the central Mid-Atlantic Bight (MAB) and the southern part of Georges Bank (GB). Summer distribution includes the area east and north of GB and into the Northeast Channel region, as well as the continental shelf (inshore of the 100 m (328 ft.) isobath) south of New England (Scott and Sadove 1997). In the fall, sperm whale occurrence on the continental shelf south of New England reaches peak levels, and there remains a continental shelf edge occurrence in the MAB (Waring et al. 2007). Similar inshore (< 200 m) observations have been made on the southwestern and eastern Scotian Shelf, particularly in the region of "the Gully” (Whitehead et al. 1991). Cetacean and Turtle Assessment Program (CETAP) and NOAA-NMFS/Northeast Fisheries Science Center (NEFSC) sightings in shelf-edge and off-shelf waters included many social groups with calves/juveniles (CETAP 1982).

Sperm whales occupied the entire length of the Mid-Atlantic Ridge during a summer 2004 vessel survey from the Reykjanes Ridge to north of the Azores (Waring et al. 2008). Some animals were concentrated north of the Charlie-Gibbs Fracture Zone (CGFZ) and in the southern region. The area at the CGFZ coincided with a frontal region with local maximum surface temperature and salinity gradients. Sperm whales were usually seen at the tops of the seamounts and rises and did not generally occur over the slopes. Sperm whales were recorded over depths varying from 800 m to 3500 m.

Acoustics and Hearing: As summarized in DoN (2008a, and citations therein), sperm whales typically produce short-duration (less than 30 ms), repetitive broadband clicks used for communication and echolocation. These clicks range in frequency from 0.1 to 30 kHz, with dominant frequencies between the 2 to 4 kHz and 10 to 16 kHz ranges. When sperm whales are socializing, they tend to repeat series of group-distinctive clicks (codas), which follow a precise rhythm and may last for hours (Whitehead 2009). Codas are shared between individuals of a social unit and are considered to be primarily for intra-group communication. Neonatal clicks are of low directionality, long duration (2 to 12 ms), low frequency (dominant frequencies around 0.5 kHz) with estimated source levels between 140 and 162 dB re 1 µPa-m rms. Source levels from adult sperm whales' highly directional (possible echolocation), short (100 µs) clicks have been estimated up to 236 dB re 1 µPa-m rms. Creaks (rapid sets of clicks) are heard most frequently when sperm whales are engaged in foraging behavior in the deepest portion of their dives with intervals between clicks and source levels being altered during these behaviors. In summary, sperm whales are in the mid-frequency functional hearing group, with an estimated auditory range of 150 Hz to 160 kHz (Southall et al. 2007). Vocalizations, including echolocation clicks, range from 100 Hz to 30 kHz (DoN 2008a).

4.1.2 Risso's Dolphin (*Grampus griseus*)

Abundance, Density, and Stock Status: Risso's dolphins are not listed as either endangered or threatened under the ESA. The best abundance estimate for Risso's dolphins combines estimates from the two 2011 U.S. Atlantic surveys, 18,250 (CV=0.46). The estimate from the northern U.S. Atlantic is 15,197, and from the southern U.S. Atlantic is 3,053. The minimum population estimate for the western North Atlantic Risso's dolphin is 12,619 (Waring et al. 2014, 2016).

Distribution and Habitat: Risso's dolphins are distributed worldwide in tropical and temperate seas (Jefferson et al. 2008, 2014), and in the Northwest Atlantic occur from Florida to eastern Newfoundland (Leatherwood et al. 1976; Baird and Stacey 1991). Off the Northeastern U.S. coast, Risso's dolphins are distributed along the continental shelf edge from Cape Hatteras northward to Georges Bank during spring, summer, and autumn (CETAP 1982; Payne et al. 1984). In winter, Risso's dolphins range from the mid-Atlantic Bight and extend outward into oceanic waters (Payne et al. 1984). Generally, the population occupies the mid-Atlantic continental shelf edge year round, and is rarely seen in the Gulf of Maine (GoM) (Payne et al. 1984).

Acoustics and Hearing: Risso's dolphins are in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Vocalizations range from 400 Hz to 65 kHz (DoN 2008).

4.1.3 Long-finned Pilot Whale (*Globicephala melas melas*)

Abundance, Density, and Stock Status: The best estimate of abundance for the western North Atlantic long-finned pilot whales is 5,636 animals (CV=0.63). This estimate is from summer 2011 surveys covering waters from central Virginia to the lower Bay of Fundy (Waring et al. 2016). However, the 2011 surveys did not include areas of the Scotian Shelf where the highest densities of pilot whales have been observed and are likely an underestimation. They are not listed as threatened or endangered under the ESA. Because long and short-finned pilot whales are different to distinguish at sea, sightings are reported as *Globicephala* sp.; to arrive at separate abundance estimates, the spatial distribution of the two species was used based on genetic analyses of biopsy samples (Waring et al. 2016, NOAA-NMFS unpublished data).

Distribution and Habitat: Pilot whales (*Globicephala* sp.) occur throughout the NEFSC survey area from Canada to Cape Hatteras. Long-finned pilot whales concentrate along the Northeast U.S. shelf edge between the 100 m (328 ft.) and 1000 m (3,280 ft.) isobaths during mid-winter and early spring (CETAP 1982; Payne and Heinemann 1993; Abend and Smith 1999). In late spring, pilot whales move from the mid-Atlantic region onto GB and the Scotian Shelf, and into the GoM, where they remain through late autumn (Sergeant and Fisher 1957; Mitchell 1975b; CETAP 1982; Payne and Heinemann 1993; Waring et al. 2011). Pilot whales generally occur in areas of high relief or submerged banks and are also associated with the Gulf Stream wall and thermal fronts along the continental shelf edge (Hamazaki 2002). Pilot whales feed primarily on squid (Sergeant 1962; Mercer 1975; Gannon et al. 1997), but also consume fish (Overholtz and Waring 1991).

Acoustics and Hearing: Globicephala spp. are in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Their vocalizations range from 2 to 60 kHz (DoN 2008).

4.1.4 Atlantic White-Sided Dolphin (*Lagenorhynchus acutus*)

Abundance, Density, and Stock Status: Atlantic white-sided dolphins are not listed as threatened or endangered under the ESA. There are insufficient data to determine population trends and the total number of white-sided dolphins along the eastern U.S. and Canadian Atlantic coast is unknown (Waring et al. 2009). The best estimate of abundance for the western North Atlantic stock of white-sided dolphins is 48,819 (CV=0.61) derived from the 2011 summer surveys (Waring et al. 2014, 2016). The minimum population estimate for these white-sided dolphins is 30,403.

Distribution and Habitat: Atlantic white-sided dolphins occur in temperate and sub-polar regions of the North Atlantic, primarily in continental shelf waters to the 100 m depth contour. The species ranges from central West Greenland to North Carolina (about 35˚ N) and perhaps as far east as 43˚ W (Evans 1987). Distribution of sightings, strandings, and incidental takes suggest the possible existence of three stocks: GoM, Gulf of St. Lawrence, and Labrador Sea stocks (Palka et al. 1997). Evidence for a separation between the well-documented unit in the southern GoM and a Gulf of St.

Lawrence population comes from a lack of summer sightings along the Atlantic side of Nova Scotia. This was reported in Gaskin (1992), is evident in Smithsonian stranding records, and was seen during abundance surveys during the summers of 1995 and 1999 that covered waters from Virginia to the entrance of the Gulf of St. Lawrence. White-sided dolphins were seen frequently in the GoM and at the mouth of the Gulf of St. Lawrence, but few were recorded between these two regions. The GoM stock of white-sided dolphins is most common in continental shelf waters from Hudson Canyon (approximately 39˚ N) north through GB, and in the GoM to the lower Bay of Fundy.

Sightings data indicate seasonal shifts in distribution (Northridge et al. 1997). During January to May, low numbers of white-sided dolphins are found from GB to Jeffrey's Ledge (off New Hampshire), and even lower numbers are found south of GB, as documented by a few strandings on beaches of Virginia and North Carolina. From June through September, large numbers of white-sided dolphins are found from GB to the lower Bay of Fundy, including waters of the western GoM and east and southeast of Cape Cod (CETAP 1982; Selzer and Payne 1988; Hamazaki 2002). From October to December, they occur at intermediate densities from southern GB to southern GoM (Payne and Heinemann 1990). Sightings south of GB, particularly around Hudson Canyon, have been made at all times of the year but at low densities. The Virginia and North Carolina observations appear to represent the southern extent of the species range. Prior to the 1970s, white-sided dolphins in U.S. waters were found primarily offshore on the continental slope, while white-beaked dolphins (*L. albirostris*) were found on the continental shelf. During the 1970s, there was an apparent switch in habitat use between these two species. This shift may have been a result of the decrease in herring and increase in sand lance in the continental shelf waters (Katona et al. 1993; Kenney et al. 1996). White-sided dolphins are opportunistic feeders and their diet is based on available prey (Waring et al. 1990; Craddock et al. 2009).

White-sided dolphin habitat preference along the Mid-Atlantic Ridge, based on a summer 2004 vessel survey from the Reykjanes Ridge to north of the Azores, was associated with cold (5-16°C) and less saline (34.6-35.8‰) water masses north of the Charlie-Gibb Fracture Zone (Waring et al. 2008). Water depth ranged between 1200 m and 2400 m.

Acoustics and Hearing: Atlantic white-sided dolphins are in the mid-frequency functional hearing group with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Their vocalizations range from 6 to 15 kHz (DoN 2008).

4.1.5 White-beaked Dolphin (*Lagenorhynchus albirostris*)

Abundance, Density, and Stock Status: White-beaked dolphins are not listed as threatened or endangered under the ESA. Data are insufficient to determine population trends and the total number of white-beaked dolphins in U.S. and Canadian waters is unknown (Waring et al. 2009). The best and only recent abundance estimate for the western North Atlantic white-beaked dolphin is 2003 from 2006. This is presumably negatively biased because the survey only covered part of the species' range. The best estimate is 2,003 (CV=0.94) and the minimum population estimate for these white-beaked dolphins is 1,023 (Waring et al. 2009).

Distribution and Habitat: White-beaked dolphins are the more northerly of the two species of *Lagenorhynchus* in the northwest Atlantic (Leatherwood et al. 1976). They occur in waters from southern New England (SNE) north to western and southern Greenland and Davis Straits (Leatherwood et al. 1976; CETAP 1982), and in the Barents Sea and south to at least Portugal (Reeves et al. 1999). In waters off the northeastern U.S. coast, white-beaked dolphin sightings have been concentrated in the Western GoM and around Cape Cod (CETAP 1982). The limited distribution of this species in U.S. waters has been attributed to opportunistic feeding (CETAP 1982). Prior to the 1970s, white-sided dolphins (*L. acutus*) in U.S. waters were found primarily offshore on the continental slope, while white-beaked dolphins were found on the continental shelf. During the 1970s, there was an apparent switch in habitat use between these two species. This shift may have been a result of the increase in sand lance in the continental shelf waters (Katona et al. 1993;

Kenney et al. 1996). White-beaked dolphins were only observed over the central part of the Reykjanes Ridge, during a summer 2004 vessel survey from the Reykjanes Ridge to north of the Azores (Waring et al. 2008).

Acoustics and Hearing: White-beaked dolphins are in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Their vocalizations range from 6.5 to 15 kHz (DoN 2008).

4.1.6 Short-Beaked Common Dolphin (*Delphinus delphis*)

Abundance, Density, and Stock Status: Although the common dolphin may be one of the most widely distributed cetacean species, total numbers off the U.S. and Canadian Atlantic coasts is unknown, as is stock status within these waters. Data are also insufficient to determine population trends. Common dolphins are not listed as endangered or threatened under the ESA. The best estimate of abundance for common dolphins is 173,486 animals (CV=0.55). The minimum population estimate for the western North Atlantic common dolphin is 112,531.

Distribution and Habitat: Common dolphins are distributed world-wide in temperate, tropical, and subtropical seas. In the North Atlantic, they typically occur over the continental shelf along the 200-2000 m isobaths or over prominent underwater topography from 50º N to 40º N latitude (Evans 1994). The species is less common south of Cape Hatteras, although schools have been reported as far south as eastern Florida (Gaskin 1992). Common dolphins are distributed along the continental shelf -break and slope (100 to 2000 m), and are associated with Gulf Stream features in waters off the northeastern U.S. coast (CETAP 1982; Selzer and Payne 1988; Waring et al. 2007). They are widespread from Cape Hatteras northeast to GB (35˚ to 42˚ N) in outer continental shelf waters from mid-January to May (Hain et al. 1981; CETAP 1982; Payne et al. 1984). Common dolphins move northward onto GB and the Scotian Shelf from mid-summer to autumn. Selzer and Payne (1988) reported very large aggregations (greater than 3000 animals) on GB in autumn. They are occasionally found in the GoM, where temperature and salinity regimes are lower than on the continental slope of the GB/mid-Atlantic region (Selzer and Payne 1988). Migration onto the Scotian Shelf and continental shelf off Newfoundland occurs during summer and autumn when water temperatures exceed 11º C (Sergeant et al. 1970; Gowans and Whitehead 1995). Common dolphins are opportunistic feeders and their diet is based on available prey (Craddock and Polloni 2006; Overholtz and Waring 1991).

Common dolphins associated with warmer (>14°C) and more-saline (34.8-36.7%) waters along the Mid-Atlantic Ridge during a summer 2004 vessel survey from the Reykjanes Ridge to north of the Azores (Waring et al. 2008). During some observations, the animals were associated with striped dolphins and Cory's shearwaters (*Calonectris diomedea*).

Acoustics and Hearing: Common dolphins are in the mid-frequency functional hearing group with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Their vocalizations range widely from 200 Hz to 150 kHz (DoN 2008).

4.1.7 Atlantic Spotted Dolphin (*Stenella frontalis*)

Abundance, Density, and Stock Status: Atlantic spotted dolphins are not listed as threatened or endangered under the ESA. The Atlantic spotted dolphin occurs in two forms which may be distinct sub-species: the large, heavily spotted form which inhabits the continental shelf and is usually found inside or near the 200-m isobath; and the smaller, less spotted island and offshore form which occurs in the Atlantic Ocean but is not known to occur in the Gulf of Mexico. Prior to 1998, species of spotted dolphins were not differentiated during surveys, resulting in insufficient data to determine the population trends. Stock status is also unknown (Waring et al. 2007).

The best estimate of abundance for the western North Atlantic stock of Atlantic spotted dolphins is 44,715 (CV=0.43), derived from the 2011 surveys (Waring et al. 2014). The minimum population estimate for these Atlantic spotted is 31,610.

Distribution and Habitat: Atlantic spotted dolphins are distributed in tropical and warm temperate waters of the western North Atlantic (Leatherwood et al. 1976). They range from SNE, south through the Gulf of Mexico and the Caribbean to Venezuela (Leatherwood et al. 1976; Perrin et al. 1994). They regularly occur in the inshore waters south of Chesapeake Bay and near the continental shelf edge and continental slope waters north of this region (Payne et al. 1984; Mullin and Fulling 2003). Atlantic spotted dolphins north of Cape Hatteras also associate with the north wall of the Gulf Stream and warm-core rings (Waring et al. 1992).

Acoustics and Hearing: Atlantic spotted dolphins are in the mid-frequency functional hearing group with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Vocalizations similarly range from 100 Hz to 130 kHz (DoN 2008).

4.1.8 Striped Dolphin (*Stenella coeruleoalba*)

Abundance, Density, and Stock Status: Little information exists on stock structure of striped dolphins in the western North Atlantic. The species is not listed as either threatened or endangered under the ESA and data are inadequate to determine population trends (Waring et al. 2007). Total numbers of striped dolphins off the U.S. or Canadian Atlantic coast are unknown. The best abundance estimate for striped dolphins is the sum of the estimates from the two 2011 U.S. Atlantic surveys, 54,807 (CV=0.3) (Waring et al. 2014). The minimum population estimate for the western North Atlantic striped dolphin is 42,804.

Distribution and Habitat: Striped dolphins in the western North Atlantic range from Nova Scotia south to, at least, Jamaica, and the Gulf of Mexico (Leatherwood et al. 1976; Perrin et al. 1994). Off the U.S. east coast, they distribute along the continental shelf edge from Cape Hatteras to the southern margin of GB, and also occur offshore over the continental slope and continental rise in the mid-Atlantic region (CETAP 1982; Mullin and Fulling 2003). Continental shelf edge sightings were generally centered along the 1000 m depth contour in all seasons (CETAP 1982). During 1990 and 1991 cetacean habitat-use surveys, striped dolphins were associated with the Gulf Stream north wall and warm-core ring features. Striped dolphins seen in a survey of the New England Sea Mounts were in waters that were between 20° and 27°C and deeper than 900 m. Striped dolphins observed along the Mid-Atlantic Ridge during a summer 2004 vessel survey from the Reykjanes Ridge to north of the Azores were associated with warmer waters (> 18°C) (Waring et al. 2008). During some observations, animals associated with common dolphins and Cory's shearwater (*C. diomedea*).

Acoustics and Hearing: Striped dolphins are in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Their vocalizations range from 6 to > 24 kHz (DoN 2008).

4.1.9 Common Bottlenose Dolphin (*Tursiops truncatus truncatus*)

There are two morphologically and genetically distinct common bottlenose dolphin morphotypes (Duffield et al. 1983; Duffield 1986) described as the coastal and offshore forms. Both inhabit waters in the western North Atlantic Ocean (Hersh and Duffield 1990; Mead and Potter 1995; Curry and Smith 1997) along the U.S. Atlantic coast. The two morphotypes are genetically distinct based upon both mitochondrial and nuclear markers (Hoelzel et al. 1998). Hersh and Duffield (1990) also described morphological differences between offshore morphotype dolphins and dolphins with hematological profiles matching the coastal morphotype which had stranded in the Indian/Banana River in Florida. North of Cape Hatteras, there is separation of the two morphotypes across bathymetry during summer months.

Abundance, Density, and Stock Status:

Coastal Morphotype

The coastal migratory stock was designated as depleted under the MMPA. From 1995 to 2001, NOAA-NMFS recognized only one migratory stock of coastal bottlenose dolphins in the western North Atlantic, with the entire stock listed as depleted.

Stock structure was revised in 2002 to recognize both multiple stocks and seasonal management units and again in 2008 and 2009 to recognize resident estuarine stocks and migratory and resident coastal stocks (Waring et al. 2010, Table 6). The western North Atlantic coastal stock was, subsequently, divided into the Central Florida, Northern Florida, South Carolina-Georgia, and the Southern Migratory and Northern Migratory Coastal stocks (Rosel et al. 2009, Waring et al. 2010). All coastal stocks retain the depleted status (Waring et al. 2010). The resident estuarine stocks within range of the NEFSC research area include: Northern North Carolina Estuarine System (NNCES), Southern North Carolina Estuarine System (SNCES), Northern South Carolina Estuarine System (NSCES), Charleston Estuarine System (CES), Northern Georgia/Southern South Carolina Estuarine System (NGSSCES), Southern Georgia Estuarine System (SGES), Jacksonville Estuarine System (JES), and Indian River Lagoon Estuarine System (IRLES). The Southern Migratory and Northern Migratory Coastal stocks are those most likely to interact with NEFSC fisheries research activities; the estuarine system stocks do not overlap in time or space with most NEFSC-affiliated research activities; only the COASTSPAN and Apex predators surveys occur in areas where these stocks may occur. The species is not listed as threatened or endangered under the ESA (Waring et al. 2009).

The best abundance estimates for the Northern and Southern Migratory Coastal stocks are from summer 2010 and 2011 surveys. The resulting abundance estimate for the Northern Migratory Coastal stock was 11,548 and the Southern Migratory Coastal Stock was 9,173. The respective PBRs are 86 and 63 (Waring et al. 2014). Total U.S. fishery-related mortality and serious injury for these stocks cannot be directly estimated because of spatial overlap of several stocks in North Carolina. Best estimates of annual average mortality and serious injury for 2007-2011 was 3.8-5.8 for the Northern Migratory Coastal stock and 2.6-16.5 for the Southern Migratory Coastal stock. Most are taken in the Mid-Atlantic coastal gillnet fishery (Waring et al. 2014).

The best available abundance estimates for the estuarine system stocks are based on 2006 survey data. Please refer to Table 6 for abundance estimates for the numerous estuarine stocks. Many of these stocks are small or of unknown size so PBR values are small or cannot be determined for lack of a minimum population estimate. These stocks are considered strategic under the MMPA either because estimated human-caused mortality and serious injury exceeds 10 percent of PBR (i.e., NNCES and SNCES) or because relatively few human-caused mortality and serious injuries would likely exceed PBR if it could be calculated (i.e., stocks with unknown PBR).

Offshore Morphotype

The western North Atlantic offshore bottlenose dolphin is not listed as depleted under the MMPA, or as threatened or endangered under the ESA. Stock status within U.S. Atlantic waters is unknown and data are insufficient to determine population trends. The best available estimate for offshore morphotype bottlenose dolphins in the western North Atlantic is 77,532 (CV=0.40). This estimate is from summer 2011 surveys covering waters from central Florida to the lower Bay of Fundy (Waring et al. 2014. Additional abundance estimates were obtained from aerial surveys of the northern portion of the range in August 2002 (southern edge of GB to Maine: 5,100 animals) and in August 2006 (southern edge of GB to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence: 2,989 animals) (Waring et al. 2009). Although the latter estimates encompass only a portion of the range of western North Atlantic bottlenose dolphins, they include most of the area in which NEFSC

conducts surveys. Please refer to Table 6 for abundance estimates for the numerous stocks of offshore bottlenose dolphin.

Distribution and Habitat: The coastal morphotype of bottlenose dolphins is continuously distributed along the Atlantic coast south of Long Island, New York around the Florida peninsula and into the Gulf of Mexico. The offshore form is distributed primarily along the outer continental shelf and continental slope from GB to Cape Hatteras during spring and summer (CETAP 1982; Kenney 1990). North of Cape Hatteras, there is separation of the two morphotypes across bathymetry during summer months. Aerial surveys flown during 1979-1981 indicated a concentration of bottlenose dolphins in waters < 25 m deep corresponded with the coastal morphotype, and an area of high abundance along the shelf break, corresponded with the offshore stock (CETAP 1982; Kenney 1990). Biopsy tissue sampling and genetic analysis demonstrated that bottlenose dolphins concentrated in nearshore waters (< 20 m deep) were of the coastal morphotype, while those in waters > 40 m depth were from the offshore morphotype (Garrison et al. 2003). Torres et al. (2003) found a statistically significant break in the distribution of the morphotypes at 34 km from shore, based upon the genetic analysis of tissue samples collected in nearshore and offshore waters.

The offshore morphotype was found exclusively seaward of 34 km and in waters deeper than 34 m. Within 7.5 km of shore, all animals were of the coastal morphotype. More recently, offshore morphotype animals have been sampled as close as 7.3 km from shore, in water depths of 13 m (Garrison et al. 2003). Systematic biopsy collection surveys were conducted coast-wide during summer and winter 2001-2005 to evaluate the degree of spatial overlap between the two morphotypes. Over the continental shelf south of Cape Hatteras, the two morphotypes overlap spatially, and the probability of a sampled group being from the offshore morphotype increased with increasing depth (Garrison et al. 2003). During winter months, bottlenose dolphins are rarely observed north of the North Carolina-Virginia border, and their northern distribution appears to be limited by water temperatures < 9.5 ºC (Garrison et al. 2003; Kenny 1990).

Acoustics and Hearing: Coastal and offshore stocks of bottlenose dolphins are in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Bottlenose dolphin vocalization frequencies range from 3.4 to 130 kHz (DoN 2008).

Table 6. Stocks of Common Bottlenose Dolphins (*Tursiops truncatus*) in the North Atlantic

Stock	MMPA Status	Min. #	Best Estimate
Western North Atlantic Offshore	Protected	56,053	77,532
Western North Atlantic, northern migratory coastal	Depleted	8,620	11,548
Western North Atlantic, southern migratory coastal	Depleted	6,326	9,173
Coastal, Northern Migratory	Depleted/Strategic	8,620	11,548
Coastal, Southern Migratory	Depleted/Strategic	6,326	9,173

Source: Waring et al. 2016.

4.1.10 Harbor Porpoise (*Phocoena phocoena*)

Abundance, Density, and Stock Status: The stock of harbor porpoise found in U.S. and Canadian Atlantic waters is the GoM/Bay of Fundy stock (Waring et al. 2014). This stock is currently not listed under the ESA. In 1993, however, NOAA-NMFS proposed listing the GoM harbor porpoise as threatened under the ESA (NOAA-NMFS 2001). NOAA-NMFS subsequently made available a review of the biological status of the GoM/Bay of Fundy harbor porpoise population and the determination was made that listing under the ESA was not warranted. The stock was removed from

the ESA candidate species list (NOAA-NMFS 2001). Population trends for this species are unknown. The best, and most recent, population estimate for harbor porpoise in the GoM/Bay of Fundy region is 79,833 (CV=0.32), based on 2011 survey results. The minimum estimated population size is 61,415 (Waring et al. 2011, 2014, 2016).

Distribution and Habitat: The GoM/Bay of Fundy harbor porpoise population primarily occupies cooler (< 17° C) and relatively shallow (< 200 m) coastal waters off the Northeast U.S. and adjacent waters in the Bay of Fundy and southwest Nova Scotia, Canada (Gaskin 1984; Palka et al. 1996; Read 1999). Observed bycatch in the winter Atlantic pelagic drift gillnet fishery off Cape Hatteras (Read et al. 1996) and satellite tracks of a rehabilitated animal (Westgate et al. 1998) indicate that they also use deeper (> 1800 m) waters off the Northeast U.S. Harbor porpoise exhibit strong seasonal distribution patterns off the Northeast U.S. coast. During summer (July to September), they concentrate in the northern GoM and southern Bay of Fundy region, with highest densities in waters between 10° and 15.5° C (Gaskin 1977; Gaskin and Watson 1985; Kraus et al. 1983; Palka 1995a, b; Palka et al. 1996). There are a few sightings in the upper Bay of Fundy and on the northern edge of GB at that time (Palka 2000). During fall (October-December) and spring (April-June), harbor porpoise are widely dispersed from New Jersey to Maine, with lower densities farther north and south. A component of the population occupies shelf waters between Massachusetts and North Carolina during fall (Palka et al. 1996). During winter (January to March), intermediate densities of harbor porpoise can be found in waters off New Jersey to North Carolina, and lower densities are found in waters off New York to New Brunswick, Canada. Habitat use is believed to be associated with prey, particularly Atlantic herring (Recchia and Read 1989; Palka 1995; Gannon et al. 1998).

Acoustics and Hearing: Harbor porpoise are in the high-frequency functional hearing group, whose estimated auditory bandwidth is 200 Hz to 180 kHz (Southall et al. 2007). Their vocalizations range from 110 to 150 kHz (DoN 2008).

4.2 Rare Odontocetes in the Northeast Atlantic Region

4.2.1 Pygmy Sperm Whale (*Kogia breviceps*) and Dwarf Sperm Whale (*Kogia sima*)

Abundance, Density, and Stock Status: Neither of these species of sperm whale is listed as either endangered or threatened under the ESA. Dwarf sperm whales (*K. sima*) and pygmy sperm whales (*K. breviceps*) are difficult to distinguish at sea (Jefferson et al. 1994). Sightings are, therefore, generally listed as *Kogia* spp. and abundance estimates are similarly grouped. Distinct morphological characteristics, as well as data obtained from blood and muscle tissues, enable species determination of stranded animals.

Total numbers of dwarf and pygmy sperm whales off the U.S. Atlantic coast is unknown. The best available abundance estimate for *Kogia* spp. is 3,785 (CV=0.47), derived by combining estimates from two 2011 surveys (Waring et al. 2014). The minimum population estimate for t *Kogia* spp. is 2,598 (Waring et al. 2014).

Data are insufficient to estimate population trends. *Kogia* spp. are not listed as either threatened or endangered.

Distribution and Habitat: Both species occupy temperate to tropical waters (Caldwell and Caldwell 1989; McAlpine 2002). Off the Northeast U.S. they utilize shelf-edge and deeper oceanic regions (Waring et al. 2007).

Acoustics and Hearing: *Kogia* spp. are in the high-frequency functional hearing group, with an estimated auditory bandwidth of 200 Hz to 180 kHz; vocalizations frequencies range from 13 to 200 kHz (Southall et al. 2007). Recordings of clicks emitted by free-ranging *K. sima* (dwarf sperm whales) in the Lesser Antilles were in the lower end of the range (13-30 kHz). Recordings of stranded *K. breviceps* (pygmy sperm whales) were in the 60 to 200 kHz range (DoN 2008).

Pygmy and Dwarf sperm whales are not expected (unlikely) to occur in the Project Area due to their preference for continental shelf edge and slope waters.

4.2.2 Killer Whale (*Orcinus orca*)

Abundance, Density, and Stock Status: Killer whales are not listed as either threatened or endangered under the ESA. As summarized in Waring et al. (2011, and citations therein), killer whales are characterized as uncommon or rare in waters of the U.S. Atlantic EEZ. The 12 killer whale sightings in this region constituted 0.1% of the 11,156 cetacean sightings in the 1978-81 CETAP surveys (CETAP 1982). The same is true for eastern Canadian waters, where the species has been described as relatively uncommon and numerically few (Mitchell and Reeves 1988). Their distribution, however, extends from the Arctic ice-edge to the West Indies. They are normally found in small groups, although 40 animals were reported to have been seen the southern GoM in September 1979, and 29 animals were reported in Massachusetts Bay in August 1986 (Katona et al. 1988). In the U.S. Atlantic EEZ, while their occurrence is unpredictable, they do occur in fishing areas, perhaps coincident with tuna, in warm seasons (Katona et al. 1988). In an extensive analysis of historical whaling records, Reeves and Mitchell (1988) plotted the distribution of killer whales in offshore and mid-ocean areas. Their results suggest that the offshore areas need to be considered in present-day distribution, movements, and stock relationships.

Unlike the killer whales in the Pacific Northwest where three killer whale ecotypes are recognized, stock definition in the western Atlantic is unknown. Results from other areas (e.g., the Pacific Northwest and Norway) suggest that social structure and territoriality may be important.

The total number of killer whales off the eastern U.S. coast is unknown. Present data are insufficient to calculate a minimum population estimate and there are insufficient data to determine population trends for this species.

Distribution and Habitat: Killer whales are found in all oceans and are second only to humans as the most widely spread of all mammals (Ford 2009). They are most commonly found in coastal and temperate waters of high productivity. Killer whales are very social and the basic social unit is based on matrilineal relationship and linked by maternal decent. A typical matrilineal relationship is composed of a female, her sons and daughters, and the offspring of her daughters (Ford 2009). Females may live to 80-90 years so a female's line may contain four generations. The pod is the next level of organization that is a group of related matrilines that shared a common maternal ancestor. The next level of social structure is the clan, followed by a resident society.

Births may occur in any month, but most are in October-March. Females give birth when between 11 and 16 years of age, with a 5 year interval between births. Gestation is 15-18 months, and weaning is about 1-2 years after birth. Males attain sexual maturity at about 15 years of age. Life expectancy for females is about 50 years, with a maximum of 80-90 years; males typically live to about 29 years of age (Ford 2009).

Acoustics and Hearing: Killer whales, like most cetaceans, are highly vocal and use sound for social communication and to find and capture prey. The sounds include a variety of clicks, whistles, and pulsed calls (Ford 2009). As summarized in DoN (2008), the peak to peak source levels of echolocation signals range between 195 and 224 dB re 1 µPa-m. The source level of social vocalizations ranges between 137 to 157 dB re 1 µPa-m. Acoustic studies of resident killer whales in British Columbia have found that there are dialects, in their highly stereotyped, repetitive discrete calls, which are group-specific and shared by all group members (Ford 2009). These dialects likely are used to maintain group identity and cohesion, and may serve as indicators of relatedness that help in the avoidance of inbreeding between closely related whales (Ford 2009). The killer whale has the lowest frequency of maximum sensitivity and one of the lowest high frequency hearing limits known among toothed whales. The upper limit of hearing is 100 kHz for this species.

Killer whales are not expected (highly unlikely) to occur in the Project Area.

4.2.3 Pygmy Killer Whale (*Feresa attenuata*)

Abundance, Density, and Stock Status: Pygmy killer whales are not listed as either endangered or threatened under the ESA. They are assumed to be part of the cetacean fauna of the tropical western North Atlantic. The paucity of sightings is probably due to a naturally low number of groups compared to other cetacean species Waring et al. 2011, and citations therein). Sightings in the more extensively surveyed northern Gulf of Mexico occur in oceanic waters (Mullin et al. 1994; Mullin and Fulling 2004). The western North Atlantic population is provisionally being considered one stock for management purposes.

The numbers of pygmy killer whales off the U.S. or Canadian Atlantic coast are unknown, and seasonal abundance estimates are not available for this stock, since it was rarely seen in any surveys (Waring et al. 2011, and citations therein). A group of 6 pygmy killer whale was sighted during a 1992 vessel survey of the western North Atlantic off of Cape Hatteras, North Carolina, in waters >1,500 m deep, but this species was not sighted during subsequent surveys (ibid). Abundance was not estimated for pygmy killer whales from the 1992 vessel survey because the sighting was not made during line-transect sampling effort; therefore, the population size of pygmy killer whales is unknown. Present data are insufficient to calculate density or a minimum population estimate for this stock and there are insufficient data to determine population trends.

Distribution and Habitat: Pygmy killer whales occur in tropical and subtropical waters worldwide, and are regularly sighted in the Eastern Tropical Pacific (Donahue and Perryman 2009). Sightings are more common in warmer coastal waters than offshore (Wade and Gerrodette 1993). The feeding behavior of pygmy killer whales is not well known. Remains of cephalopods and small fish have been found in stomachs of stranded and incidentally caught individuals. They may be one of the species of small whales that attack and sometimes eat smaller dolphins caught in the tuna purse-seine fishery (Donahue and Perryman 2009).

Pygmy killer whales are generally in small schools of 12-50 animals, although larger schools have been observed. They are known to bow ride. Pygmy killer whale life history is poorly understood.

Acoustics and Hearing: Pygmy killer whales are classified in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz-160 kHz (Southall et al. 2007).

Due to its rarity in the western North Atlantic, this species is not expected (highly unlikely) to occur in the Project Area.

4.2.4 False Killer Whale (*Pseudorca crassidens*)

Abundance, Density, and Stock Status: The western North Atlantic population is being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the northern Gulf of Mexico stock(s). While it may be a unique situation, false killer whales that inhabit U.S. waters around the Hawaiian Islands are made up of two genetically identifiable populations (i.e., near-shore island and pelagic; Chivers et al. 2007) and the near-shore population is a distinct population segment (Oleson et al. 2010). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation in the western North Atlantic. The best available abundance estimate for the western Atlantic false killer whale is 442 (CV= 1.06) and the minimum population estimate is 212 (Waring et al. 2015).

Distribution and Habitat: False killer whales, large members of the dolphin family, prefer deep (>0.5 mi [>1,000 m]), tropical to temperate waters. Along the eastern seaboard of the United States, they are found from the mid-Atlantic southward. They feed on fishes and cephalopods (Waring et al. 2008).

<u>Acoustics and Hearing:</u> False killer whales are part of the mid-frequency hearing group with an estimated auditory bandwidth of 150 Hz to 160 kHz, with their best hearing from approximately 10-120 kHz (Southall et al. 2007, DoN 2008).

Due to their preference for deeper water, this species is not expected (unlikely) to occur in the Project Area.

4.2.5 Northern bottlenose whale (*Hyperoodon ampullatus*)

<u>Abundance, Density, and Stock Status:</u> Northern bottlenose whales are not listed as either endangered or threatened under the ESA. They are characterized as extremely uncommon or rare in waters of the U.S. Atlantic EEZ. The two sightings of three individuals constituted less than 0.1% of the 11,156 cetacean sightings in the 1978-82 CETAP surveys. Both sightings were in the spring, along the 2,000-m isobath (CETAP 1982). In 1993 and 1996, two sightings of single animals, and in 1996, a single sighting of six animals (one juvenile), were made during summer shipboard surveys conducted along the southern edge of Georges Bank.

As summarized by Waring et al. (2011, and citations therein), there are two main centers of bottlenose whale distribution in the western north Atlantic, one in the area called "the Gully" just north of Sable Island, Nova Scotia, and the other in Davis Strait off northern Labrador. Studies at the entrance to the Gully from 1988-1995 identified 237 individuals and estimated the local population size at about 230 animals (95% C.I.). Wimmer and Whitehead (2004) identified individuals moving between several Scotian Shelf canyons more than 100 km from the Gully. Whitehead and Wimmer (2005) estimated a population of 163 animals (95% confidence interval 119-214), with no statistical significant population trend. These individuals are believed to be year-round residents and all age and sex classes are present. Stranding records document northern bottlenose whales in the Bay of Fundy and as far south as Rhode Island and three stranded individuals were documented on Sable Island, Nova Scotia, Canada.

Stock definition is currently unknown for those individuals inhabiting/visiting U.S. waters. The total number of northern bottlenose whales off the eastern U.S. coast is unknown. Present data are insufficient to calculate a minimum population estimate and there are insufficient data to determine the population trends for this species.

<u>Distribution and Habitat:</u> Bottlenose whales are typically found in small groups of 1-4 individuals but groups up to 20 have been observed. Northern bottlenose whales are distributed in the North Atlantic from Nova Scotia to about 70º in the Davis Strait to 77º and from England to the west coast of Spitzbergen. It is largely a deep-water species and is very seldom found in waters less than 2,000 m deep (Mead 1989). There is no information on the life history of northern bottlenose whales. They are believed to be deep divers feeding primarily on squid, with fish and benthic invertebrates infrequently consumed (Gowans 2009). Northern bottlenose whales have been recorded to dive to 1,400 m (ibid).

<u>Acoustics and Hearing:</u> There is no information on acoustics for this species. However, DON (2008b) reviewed the literature on beaked whale acoustics and reported that beaked whales use frequencies of between 300 Hz and 129 kHz for echolocation, and between 2 and 10 kHz, and possibly up to 16 kHz, for social communication. There is no information on the hearing abilities of northern bottlenose whales. They are likely in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Vocalizations ranges are similar at 300 Hz to 135 kHz (DoN 2008).

Due to their preference for deeper water, Northern bottlenose whales are not expected (unlikely) to occur in the Project Area.

4.2.6 Cuvier's Beaked Whale (*Ziphius cavirostris*) and Mesoplodon Beaked Whale Complex (*Mesoplodon* spp.)

Abundance, Density, and Stock Status: None of the beaked whales are listed as either endangered or threatened under the ESA. Cuvier's and *Mesoplodon* spp. beaked whales (including True's beaked whale, *M. mirus*; Gervais' beaked whale, *M. europaeus*; Blainville's beaked whale, *M. densirostris*; and Sowerby's beaked whale, *M. bidens*) are difficult to identify to the species level at sea; therefore, much of the available characterization for beaked whales is to genus level only. Because of this, they are grouped into what is called the undifferentiated complex of beaked whales and treated together for the purposes of stock assessments. Stock structure is unknown. Off the eastern U.S. and Canadian Atlantic coast the best and minimum population estimates for Cuvier's beaked whales are 6,532 (CV=0.32) and 5,021(Waring et al. 2014) The best and minimum abundance estimate for the *Mesoplodon* spp. complex is the sum of the 2011 survey estimates – 7,092 (CV=0.54), and 4,632 (Waring et al. 2014). Neither genus is listed as threatened or endangered under the ESA.

Distribution and Habitat: Beaked whales occur principally along the continental shelf edge and in deeper oceanic waters (CETAP 1982; Waring et al. 2007). Most sightings are in late spring and summer, which corresponds to survey effort. Distribution is otherwise derived from stranding reports (Waring et al. 2009). During spring and summer, Cuvier's and Mesoplodon spp. beaked whales occupy shelf-edge and deeper oceanic waters (CETAP 1982; Hamazaki 2002; Palka 2006). They are associated with warm waters (20.7° to 24.9° C), Gulf Stream features and warm-core rings, and steep bathymetry (Tove 1995; Hamazaki 2002; Waring et al. 2001; Palka 2006). During a 2002 survey south of GB, beaked whales were associated with water 500 m to 2000 m deep. Few beaked whales (Mesoplodon spp.) were sighted along the Mid-Atlantic Ridge during a summer 2004 vessel survey from the Reykjanes Ridge to north of the Azores, which was likely due to sub-optimal survey conditions (Waring et al. 2008).

Acoustics and Hearing: Cuvier's and *Mesoplodon* spp. beaked whales are in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Vocalizations ranges are similar at 300 Hz to 135 kHz (DoN 2008).

Due to their preference for deeper water, Cuvier's beaked whales and species of the genus Mesoplodon are not expected (unlikely) to occur in the Project Area.

4.2.7 Melon-headed Whale (*Peponocephala electra*)

Abundance, Density, and Stock Status: Melon-headed whales are not listed as either endangered or threatened under the ESA. As summarized in Waring et al. (2011, and citations therein), the numbers of melon-headed whales off the U.S. or Canadian Atlantic coast are unknown, and seasonal abundance estimates are not available for this stock, since it was rarely seen in any surveys. A group of melon-headed whales was sighted during both a 1999 (20 whales) and 2002 (80 whales) vessel survey of the western North Atlantic off of Cape Hatteras, North Carolina in waters >2500 m deep. Abundances have not been estimated from the 1999 and 2002 vessel surveys in western North Atlantic because the sighting was not made during line-transect sampling effort; therefore the population size of melon-headed whales is unknown. No melon-headed whales have been observed in any other surveys. The western North Atlantic population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the northern Gulf of Mexico stock(s). Present data are insufficient to calculate a minimum population estimate for this stock and there are insufficient data to determine the population trends. Potential Biological Removal (PBR) for the western North Atlantic stock of melon-headed whales is unknown because the minimum population size is unknown.

Distribution and Habitat: Melon-headed whales are distributed worldwide in tropical and subtropical waters. They generally occur offshore in deep oceanic waters. Nearshore distribution is generally

associated with deep water areas near to the coast (Perryman 2009). Squid appear to be the preferred prey, along with some fish and shrimp (Perryman 2009). They are often in large schools (mean school size is about 200), including in mixed schools with Fraser's dolphins (Perryman 2009, Wade and Gerrodette 1993). They may also form mixed schools with spinner, bottlenose, and rough-toothed dolphins (Perryman 2009). Females reach sexual maturity at approximately 11.5 years of age and males at about 15 years (Perryman 2009).

<u>*Acoustics and Hearing:*</u> Melon-headed whales are classified in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz-160 kHz (Southall et al. 2007).

Due to its rarity in the western North Atlantic and preference for warmer waters, this species is not expected (highly unlikely) to occur in the Project Area.

4.2.8 Short-finned pilot whale (*Globicephala macrorhynchus*)

<u>*Abundance, Density, and Stock Status:*</u> The short-finned pilot whale is not listed as threatened or endangered under the ESA. The short-finned pilot whale is found in tropical to warm-temperate seas. It usually does not range north of 50º N or south of 40º S. Short-finned pilot whales occur worldwide in tropical to warm temperate waters and may seasonally extend into shelf-edge waters north of Cape Hatteras (Leatherwood and Reeves 1983). As summarized in Waring et al. (2013), pilot whale biopsy samples were collected during summer months (June-August) from South Carolina to the southern flank of Georges Bank between 1998 and 2007. These samples were identified to species using genetic analysis of mitochondrial DNA (mtDNA) sequences. A portion of the mtDNA genome was sequenced from each biopsy sample collected in the field, and genetic species identification was performed through phylogenetic reconstruction of the haplotypes. Samples from stranded specimens that were morphologically identified to species were used to assign clades in the phylogeny to species and thereby identify all survey samples. The probability of a sample being from a short-finned (or long-finned) pilot whale was evaluated as a function of sea surface temperature and water depth using logistic regression. This analysis indicated that the probability of a sample coming from a short-finned pilot whale was near 0 at water temperatures <22°C, and near 1 at temperatures >25°C. The probability of a short-finned pilot whale also increased with increasing water depth.

Spatially, during summer months, this regression model predicts that all pilot whales observed in offshore waters near the Gulf Stream are most likely short-finned pilot whales. The area of overlap between the 2 species occurs primarily along the shelf break off the coast of New Jersey between 38°N and 40°N latitude. This model was used to partition the abundance estimates from surveys conducted during the summer of 2011. The sightings from the southeast shipboard survey covering waters from Florida to central Virginia were predicted to consist entirely of short-finned pilot whales. The aerial portion of the northeast surveys covered the GoM and the Bay of Fundy where the model predicted that only long-finned pilot whales would occur, but no pilot whales were observed. The vessel portion of the northeast survey recorded a mix of both species along the shelf break, and the sightings in offshore waters near the Gulf Stream were predicted to consist predominantly of short-finned pilot whales. The best abundance estimate for short-finned pilot whales is thus the sum of the 2004 southeast survey estimate (21,515[CV=0.37]) and the estimated number of short-finned pilot whales from the northeast vessel survey (3,618 [CV=0.50]). The best available abundance estimate is thus 24,674 (CV=0.45) (Waring et al. 2014). The minimum population estimate for short-finned pilot whales is 15,913 (Waring et al. 2014).

<u>*Distribution and Habitat:*</u> Short-finned pilot whales occur worldwide in tropical to warm temperate waters and may seasonally extend into shelf-edge waters north of Cape Hatteras (Leatherwood and Reeves 1983). The NEFSC and Southeast Fisheries Science Center (SEFSC) are using genetic and photo-identification data to better define the northern range of this species and habitat overlap with the long-finned pilot whale off the northeastern U.S.

Acoustics and Hearing: Short-finned pilot whale whistles and clicks have a dominant frequency range of 2 to14 kHz and a source level of 180 dB re 1 µPa-m for whistles (DoN 2008). *Globicephala* spp. are in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007).

Due to their preference for deeper and warmer water, short-finned pilot whales are not expected (unlikely) to occur in the Project Area.

4.2.9 Pantropical spotted dolphin (*Stenella attenuata*)

Abundance, Density, and Stock Status: The pantropical spotted dolphin is distributed worldwide in tropical and some sub-tropical oceans (Perrin 2009b). The Pantropical spotted dolphin is not listed as threatened or endangered under the ESA. There are two species of spotted dolphin in the Atlantic Ocean, the Atlantic spotted dolphin, *Stenella frontalis* (see account above), and the pantropical spotted dolphin, *S. attenuata* (Perrin et al. 1987). Where they co-occur, the offshore form of the Atlantic spotted dolphin and the pantropical spotted dolphin can be difficult to differentiate at sea. The western North Atlantic pantropical spotted dolphin population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the northern Gulf of Mexico stock(s).

As summarized in Waring et al. (2011 and citations therein), total numbers of pantropical spotted dolphins off the U.S. or Canadian Atlantic coast are unknown, although estimates are available from selected regions for select time periods. Sightings have been concentrated in the slope waters north of Cape Hatteras, but in the shelf waters south of Cape Hatteras sightings extend into the deeper slope and offshore waters of the mid-Atlantic. Because *S. frontalis* and *S. attenuata* are difficult to differentiate at sea, the reported abundance estimates, prior to 1998, are for both species of spotted dolphins combined. At their November 1999 meeting, the Atlantic Scientific Review Group (SRG) recommended that without a genetic determination of stock structure, the abundance estimates for the coastal and offshore forms should be combined. There remains debate over how distinguishable both species are at sea, though in the waters south of Cape Hatteras identification to species is made with very high certainty. This does not, however, account for the potential for a mixed species herd, as has been recorded for several dolphin assemblages. Pending further genetic studies for clarification of this problem, a single species abundance estimate will be used as the best estimate of abundance, combining species specific data from the northern as well as southern portions of the species' ranges

The best abundance estimate available for western North Atlantic pantropical spotted dolphins is 3,333 (CV=0.91) and is derived from the 2011 surveys (Waring et al. 2014). The minimum population estimate is 1,733 dolphins. These surveys covered the waters from central Florida to the lower Bay of Fundy. However, no pantropical spotted dolphins were sighted in the northern component (Virginia to Bay of Fundy) of the surveys (Waring et al. 2014). There are insufficient data to determine population trends for this species, because prior to 1998 spotted dolphins were not differentiated during surveys.

Distribution and Habitat: Distribution of spotted dolphins is worldwide in tropical and some sub-tropical waters between 30-40° N latitude to 20-40° S latitude (Perrin 2009b). Offshore spotted dolphin habitat is characterized by well-stratified water, warm (>25° C) surface temperatures, low salinity, and a sharp, but shallow, thermocline at approximately 50 m (Ballance et al. 2006; Perrin 2009b; Reilly et al. 2002). Spotted dolphins primarily eat small epipelagic fish, squid, crustaceans, and flying fish in some areas (Perrin 2009b). Pantropical spotted dolphins often occur in large multi-species schools, particularly with spinner dolphins (Perrin 2009b). School size ranges from a few hundred to several thousand, with mean school size of 120 in the ETP (Perrin 2009b).

Acoustics and Hearing: Spotted dolphins are classified in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz-160 kHz (Southall et al. 2007).

Due to its preference for warmer water, Pantropical spotted dolphins are not expected (unlikely) to occur in the Project Area.

4.2.10 Fraser's dolphin (*Lagenodelphis hosei*)

Abundance, Density, and Stock Status: Fraser's dolphins are distributed worldwide in tropical waters (Dolar 2009) and are assumed to be part of the cetacean fauna of the tropical western North Atlantic. Fraser's dolphin is not listed as threatened or endangered under the ESA. As summarized in Waring et al. (2011 and citations therein), the paucity of sightings is probably due to naturally low abundance compared to other cetacean species. Sightings in the more extensively surveyed northern Gulf of Mexico are uncommon but occur on a regular basis. Fraser's dolphins have been observed in oceanic waters (>200 m) in the northern Gulf of Mexico during all seasons. The western North Atlantic population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the northern Gulf of Mexico stock(s).

The numbers of Fraser's dolphins off the U.S. or Canadian Atlantic coast are unknown, and seasonal abundance estimates are not available for this stock, since it was rarely seen in any surveys. A group of an estimated 250 Fraser's dolphins was sighted in waters 3300 m deep in the western North Atlantic off Cape Hatteras during a 1999 vessel survey. Abundance has not been estimated from the 1999 vessel survey in western North Atlantic because the sighting was not made during line-transect sampling effort; therefore, the population size of Fraser's dolphins is unknown. No Fraser's dolphins have been observed in any other surveys. Therefore present data are insufficient to calculate a minimum population estimate for this stock.

Distribution and Habitat: Fraser's dolphins are a tropical species generally found between 30° N and 30° S (Dolar 2009). They are typically oceanic and commonly occur in water depths of 1500-2500 m. They prey primarily on mesopelagic fish, cephalopods, and crustaceans and, in the ETP, are thought to feed at 250 to 500 m depth (Dolar 2009). Fraser's dolphins often occur in tightly grouped, fast moving schools of 100-1,000 individuals. They commonly occur in large mixed-species schools with melon-headed whales in the Eastern Tropical pacific (Dolar 2009, Wade and Gerrodette 1993). They are deep divers and capable of diving to >600 m (Dolar 2009). Life history data is available for Fraser's dolphins off Japan. The age of sexual maturity appears to be 7-10 years for males and 5-8 years for females (Dolar 2009).

Acoustics and Hearing: Fraser's dolphins are classified in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz-160 kHz (Southall et al. 2007).

Due to its preference for deeper water, Fraser's dolphins are not expected (unlikely) to occur in the Project Area.

4.2.11 Rough toothed dolphin (*Steno bredanensis*)

Abundance, Density, and Stock Status: For management purposes, rough-toothed dolphins observed off the eastern U.S. coast are provisionally considered a separate stock from dolphins recorded in the northern Gulf of Mexico, although there is currently no information to differentiate these stocks. Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

As summarized in Waring et al. (2013, and citations therein), the number of rough-toothed dolphins off the eastern U.S. and Canadian Atlantic coast is unknown, and seasonal abundance estimates are not available for this stock, since it was rarely seen during surveys. With one exception, sightings were exclusively over or seaward of the continental slope north of the Bahamas. Though abundance estimates have been calculated in some cases, given the paucity of sightings as well as limited survey effort in deep, offshore areas, an accurate abundance estimate has not been made, and

therefore the population size of rough-toothed dolphins in the western North Atlantic is presently considered unknown. There have been no sightings of rough-toothed dolphins during shipboard or aerial surveys since 1999, except in the Caribbean, despite survey cruises conducted in areas where previous sightings of this species had been made. Survey effort in deep, offshore areas off the eastern U.S. coast and in the Caribbean, where this species may occur with more frequency, has, however, been limited. Recent surveys suggest a best estimate of 271 rough-toothed dolphins and a minimum estimate of 134 dolphins (Waring et al. 2014).

Distribution and Habitat: This is a tropical to warm temperate species found in oceanic waters worldwide, as well as over continental shelf and coastal waters in some areas, including the ETP (Jefferson 2009a; May-Collado 2005). A summarized in Waring et al. (2011 and citations therein), five rehabilitated and tagged rough-toothed dolphins in the western North Atlantic moved through a large range of water depths averaging greater than 100 m, though each of the five tagged dolphins transited through very shallow waters at some point, with most of the collective movements recorded over a gently sloping sea floor. These five rough-toothed dolphins moved through waters ranging from 17° to 31°C, with temperatures averaging 21° to 30°C. Recorded dives were rarely deeper than 50 m, with the tagged dolphins staying fairly close to the surface. Three rehabilitated rough-toothed dolphins released with tags near Ft. Pierce, Florida in March 2005 were tracked in waters averaging 1,100 m in depth with sea surface temperatures averaging 24°C during the first week of tracking, moving to waters of 19°C. These dolphins are typically seen in small groups of 10-20 animals but larger groups of 50 or more are not uncommon. They feed on a variety of fish and cephalopods but their general ecology is poorly studied. They may stay submerged for up to 15 minutes and are known to dive as deep as 150 m (Jefferson 2009a).

Acoustics and Hearing: As summarized in DoN 2008a, the rough-toothed dolphin produces a variety of sounds, including broadband echolocation clicks and whistles. Echolocation clicks typically have a frequency range of 0.1 to 200 kHz, with a dominant frequency of 25 kHz. Whistles have a wide frequency range of 0.3 to greater than 24 kHz but dominate in the 2 to 14 kHz range. They are in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007).

Due to their preference for deeper waters, this species is not expected (unlikely) to occur in the Project Area.

4.2.12 Clymene dolphin (*Stenella clymene*)

Abundance, Density, and Stock Status: The numbers of Clymene dolphins off the U.S. or Canadian Atlantic coast are unknown, and seasonal abundance estimates are not available for this species since it was rarely seen in any surveys. The best estimate of abundance for the Clymene dolphin was 6,086 (CV=0.93) (Mullin and Fulling 2003) and represents the first and only estimate to date for this species in the U.S. Atlantic EEZ. No Clymene dolphins have been observed in subsequent surveys. No minimum population estimate is available and there are insufficient data to determine population trends for this stock. The species is not listed as threatened or endangered under the ESA.

Distribution and Habitat: Clymene dolphins are found only in the Atlantic Ocean in tropical to warm-temperate waters; the exact range is not well understood (Jefferson 2009b). Most sightings have been in deep, offshore waters, but may be seen near shore when deep water approaches the coast (ibid). It likely feeds on mesopelagic fishes and squid. They are known to associate with spinner dolphins. Schools of this species are often moderately large but most consist of less than a few hundred animals (ibid).

Acoustics and Hearing: There has been little work done on the acoustic behavior of these animals but they appear to be quite vocal with whistles in the frequency range 0f 6-19 kHz (Jefferson 2009b). It is assumed that they are in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007).

Due to their preference for warmer waters, this species is not expected (unlikely) to occur in the Project Area.

4.2.13 Spinner Dolphin (*Stenella longirostris*)

Abundance, Density, and Stock Status: The numbers of spinner dolphins off the U.S. or Canadian Atlantic coast are unknown, and seasonal abundance estimates are not available for this stock since it was rarely seen in any of the surveys. Present data are insufficient to calculate a minimum population estimate and there are insufficient data to determine the population trends for this stock. Spinner dolphins are not listed as threatened or endangered under the ESA.

Distribution and Habitat: Spinner dolphins occur in all tropical and most sub-tropical waters between 30-40° N and 20-40° S latitude, generally in areas with a shallow mixed layer, shallow and steep thermocline, and little variation in surface temperatures (Perrin 2009a). Its distribution in the Atlantic is very poorly known. In the western North Atlantic, these dolphins occur in deep water along most of the U.S. coast south to the West Indies and Venezuela, including the Gulf of Mexico. Spinner dolphin sightings have occurred exclusively in deeper (>2,000 m) oceanic waters (Waring et al. 2011 and citations therein) off the northeast U.S. coast. Stranding records exist from North Carolina, South Carolina, Florida and Puerto Rico in the Atlantic and in Texas and Florida in the Gulf of Mexico. The western North Atlantic population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the northern Gulf of Mexico stock(s). School size varies from a few animals to over a thousand. Mixed schools with other species, particularly pantropical spotted dolphins, are common (Perrin 2009a). Mating appears to be promiscuous. Gestation is about 10 months and breeding is seasonal. Females reach sexual maturity at 4-7 years, and males at 7-10 years. Calving interval is 3 years and calves nurse for 1-2 years (Perrin 2009a).

Acoustics and Hearing: Spinner dolphins produce an array of whistles and burst pulses that vary by activity and geographically (Perrin 2009a). Spinner dolphins are in the mid-frequency functional hearing group of Southall et al. (2007), with an estimated auditory bandwidth of 150 Hz to 160 kHz.

Due to its preference for deeper water, spinner dolphins are not expected (unlikely) to occur in the Project Area.

4.3 Regular or Common *Mysticetes* in the Region

4.3.1 Fin Whale (*Balaenoptera physalus*)

Abundance, Density, and Stock Status: The fin whale is listed as endangered under the ESA, yet the status of the stock off the U.S. Atlantic coast relative to the optimum sustainable population is unknown, and data are inadequate to determine the population trend for fin whales. A Draft Recovery Plan for fin whales is available for review (NOAA-NMFS 2006a). The best abundance estimate for western North Atlantic fin whales is 1,618 (CV=0.33) with a minimum population estimate of 1,234 whales (Waring et al. 2016).

Distribution and Habitat: Fin whales are common in waters off the U.S. east coast, principally from Cape Hatteras northward. Fin whales accounted for 46 percent of the large whales and 24 percent of all cetaceans sighted over the continental shelf during aerial surveys (CETAP 1982) between Cape Hatteras and Nova Scotia during 1978-82. While much remains unknown, the magnitude of the ecological role of the fin whale is impressive. In this region, fin whales are probably the dominant large cetacean species in all seasons, with the largest standing stock, the largest food requirements, and therefore the largest impact on the ecosystem of any cetacean species (Kenney et al. 1997; Hain et al. 1992).

New England waters represent a major feeding area for fin whales (Hain et al. 1992; Kenney et al. 1997), with key feeding grounds in the western GoM, from Stellwagen Bank to Jeffreys Ledge, and the Great South Channel (GSC). These are areas associated with sand lance (Kenney and Winn 1986; Hain et al. 1992). Secondary seasonal areas of importance are off eastern Long Island, along the northern edge of GB and in the northern GoM (CETAP 1982; Waring and Finn 1995). There is evidence of site fidelity by females and possible segregation of sexual maturational or reproductive classes in the feeding area (Agler et al. 1993). Clapham and Seipt (1991) showed maternally directed site fidelity for fin whales in the GoM. Calving, mating, or wintering areas are unknown for most of the population, although Hain et al. (1992) suggested calving takes place during October to January off the U.S. mid-Atlantic region. Fin whales off the U.S. Atlantic coast may migrate into Canadian waters, open-ocean areas, or even subtropical or tropical regions. It is unlikely, however, that fin whales undergo distinct annual migrations (Waring et al. 2011).

Fin whale habitat preference along the Mid-Atlantic Ridge (MAR), based on a summer 2004 vessel survey from the Reykjanes Ridge to north of the Azores, was associated with foraging on krill patches (Waring et al. 2008). This includes areas north of the Charlie-Gibbs Fracture Zone and the southern portion of the MAR. Water depths in these regions varied between 1,760 m to 4,470 m.

Acoustics and Hearing: Fin whales are in the low-frequency functional hearing group, with an estimated auditory range of 7 Hz to 22 kHz (Southall et al. 2007). They also vocalize at low frequencies of 15-30 Hz (DoN 2008).

4.3.2 Sei Whale (*Balaenoptera borealis*)

Abundance, Density, and Stock Status: Sei whales in the NEFSC survey area are part of the Nova Scotia stock, the range of which includes continental shelf waters of the northeastern U.S., and extends northeastward to south of Newfoundland (Waring et al. 2011). Sei whales are listed as endangered under the ESA, but stock status is unknown and data are insufficient for assessing population trends. A Recovery Plan for sei whales was written and is awaiting legal clearance (Waring et al. 2011).

The best population estimate for the Nova Scotia stock of sei whales (357) is the most recent, with a minimum estimate is 236 sei whales. The 2004/2006 estimate should be viewed as very conservative, considering the range of sei whales in the entire western North Atlantic, and uncertainties about population structure and whale movements between surveyed and unsurveyed areas (Waring et al. 2011).

Distribution and Habitat: At least during the feeding season, most of the Nova Scotia sei whale stock appears to concentrate in northerly waters, including the Scotian Shelf (Mitchell and Chapman 1977. The southern portion of the species' range during spring and summer includes the GoM and GB. Abundance in U.S. waters is highest in spring, with sightings concentrated along the eastern margin of GB and into the Northeast Channel area, and along the southwestern edge of GB in the area of Hydrographer Canyon (CETAP 1982). NOAA-NMFS aerial surveys in 1999, 2000 and 2001 found concentrations of sei and right whales along the northern edge of GB in the spring. Sei whales often occur in the deeper waters of the continental shelf edge region (Hain et al. 1985), where NOAA-NMFS aerial surveys found substantial numbers, particularly south of Nantucket, in the spring of 2001. Similarly, Mitchell (1975a) reported that sei whales off Nova Scotia were often distributed closer to the 2000-m depth contour than were fin whales.

This general offshore pattern of sei whale distribution is disrupted during episodic incursions into more shallow and inshore waters. Although known to take piscine (fish) prey, sei whales (like right whales) are largely planktivorous, feeding primarily on euphausiids and copepods. In years of reduced predation on copepods by other predators, and thus greater abundance of this prey source, sei whales are reported in more inshore locations, such as the GSC (in 1987 and 1989) and Stellwagen Bank (in 1986) (Payne et al. 1990). Mitchell (1975) speculated that sei whales migrate

from south of Cape Cod and along the coast of eastern Canada in June and July, and return south again in September and October. This remains unverified (Waring et al. 2011).

Sei whale habitat preference along the MAR, based on a summer 2004 vessel survey from the Reykjanes Ridge to north of the Azores, was near the frontal area just north and southwest of the Charlie-Gibbs Fracture Zone (Waring et al. 2008). This area was a local zone of maximum surface temperature and salinity. In general, sei whales were associated with the slopes of seamounts and rises and were in waters varying from 1,160 m to 4,500 m deep. The whales were often observed feeding and in areas where zooplankton (calanoid copepods) were sampled.

Acoustics and Hearing: Sei whales are in the low-frequency hearing group, along with other baleen whales, with an estimated auditory bandwidth of 7 Hz to 22 kHz (Southall et al. 2007). There are few recordings of sei whale vocalizations in the North Atlantic, where the sweep frequency ranged from 1.5 to 3.5 kHz (DoN 2008). This differed greatly from the low-frequency (average 433±192 Hz) sounds recorded in the Antarctic (McDonald et al. 2005).

4.3.3 Minke Whale (*Balaenoptera acutorostrata*)

Abundance, Density, and Stock Status: Minke whales off the eastern coast of the U.S. are considered to be part of the Canadian East Coast stock, which inhabits the area from the eastern half of the Davis Strait (45º W) to the Gulf of Mexico (Waring et al. 2011). The number of minke whales comprising the Canadian East Coast stock is unknown and data are insufficient to calculate population trends. The best available current abundance estimate for the stock (20,741) was derived from a summer 2007 aerial Trans North Atlantic Sighting Survey (TNASS) (Lawson and Gosselin 2009, Waring et al. 2016). The minimum estimate is 16,199 animals (Waring et al. 2016). Minke whales are not listed as either threatened or endangered under the ESA.

Distribution and Habitat: Minke whales are common and widely distributed off the northeast U.S. coast, particularly in the GoM/GB regions (CETAP 1982; Waring et al. 2011). There appears to be a strong seasonal component to minke whale distribution. They are most abundant, widespread, and common in New England waters in spring and summer (CETAP 1982; Waring et al. 2007). Numbers diminish during fall and, during winter, minke whales are largely absent from the area (Mitchell 1991; Waring et al. 2011). Minke whales generally occupy the continental shelf proper, including bays and estuaries rather than shelf-edge waters (Mitchell and Kozicki 1975; Hamazaki 2002; Waring et al. 2007). Minke whales are largely piscivorous, and consume a variety of forage fishes (e.g., Atlantic herring, mackerel, and sand lance). Their dietary composition on the U.S. OCS was estimated as 95% fish and 5% euphausiids (Kenney et al. 1997).

Acoustics and Hearing: Minke whales are in the low-frequency functional hearing group with an estimated auditory bandwidth of 7 Hz to 22 kHz (Southall et al. 2007). Vocalizations range from 60 Hz to 20 kHz (DoN 2008).

4.3.4 Humpback Whale (*Megaptera novaeangliae*)

Abundance, Density, and Stock Status: Population estimates for this stock are considered too outdated to be usable, but the minimum population is estimated to be 823 animals (Waring et al. 2016). Also, the most recently available data suggests that the GoM humpback whale stock is characterized by a positive trend (Waring et al. 2016). A Recovery Plan was published and is currently in effect (NOAA-NMFS 1991b). On September 8, 2016, NOAA-NMFS published a final decision changing the status of humpback whales under the ESA (81 FR 62259), effective October 11, 2016. Previously, humpback whales were listed under the ESA as an endangered species worldwide. In the 2016 decision, NOAA-NMFS recognized the existence of 14 distinct population segments (DPSs), of which four were listed as endangered, one was listed as threatened, and the remaining nine did not warrant protection under the ESA. The West Indies DPS, whose range includes the NE coast, is not listed as endangered under the ESA.

Distribution and Habitat: As summarized in Waring et al. (2007 and 2009, and citations therein) humpback whales in the western North Atlantic feed during spring, summer, and fall over a range which encompasses the eastern coast of the U.S. (including the GoM), the Gulf of St. Lawrence, Newfoundland/Labrador, and western Greenland. Additional feeding areas are off Iceland and northern Norway. These areas represent six relatively discrete subpopulations. Based on genetic analyses, the GoM feeding stock is treated as a separate management stock (IWC 2002).

Most North Atlantic humpback whales, including the GoM stock, migrate to the West Indies during the winter to mate and calve (Clapham et al. 1993). Not all migrate south, however, as significant numbers occur in mid- and high-latitude regions in winter (Clapham et al. 1993; Swingle et al. 1993). An increased number of sightings of humpback whales in the vicinity of the Chesapeake and Delaware Bays occurred in 1992 (Swingle et al. 1993). Wiley et al. (1995) reported 38 humpback whale strandings during 1985-1992 in the U.S. mid-Atlantic and southeastern states, particularly along the Virginia and North Carolina coasts. Most stranded animals were sexually immature and some may have only recently separated from their mothers. The question of population identity of humpbacks sighted off the coasts of the southeastern and mid-Atlantic States were addressed using fluke photographs of both living and dead whales (Barco et al. 2002). Most of the identified whales were from the GoM, but there were photographic matches to whales from Newfoundland and the Gulf of St. Lawrence. The mid-Atlantic region primarily represents a supplemental winter feeding ground for humpbacks whales (Barco et al. 2002). Wiley et al. (1995) concluded that these areas were becoming increasingly important habitats for juvenile humpback whales and anthropogenic factors may negatively impact whales in this area.

Feeding is the principal activity of humpback whales in New England waters, and their distribution in this region has been largely correlated to prey species and abundance (Payne et al. 1986, 1990). Humpback whale habitat shifts in response to prey availability; but overall, the important foraging habitats are: sandy shoals in the southwestern GoM, offshore waters of Cultivator Shoal, the Northeast Peak of GB, Jeffreys Ledge, and northern GoM (Payne et al. 1986; Paquet et al. 1997). Humpback whales are frequently piscivorous in these waters, feeding on Atlantic herring (*Clupea harengus*), sand lance (*Ammodytes* spp.), and other small fishes. In the northern GoM, euphausiids are also frequently taken (Paquet et al. 1997). Commercial depletion of herring and Atlantic mackerel (*Scomer scombrus*) led to an increase in sand lance in the southwestern GoM in the mid-1970s, with a concurrent decrease in humpback whale abundance in the northern GoM. Humpback whales were densest over the sandy shoals in the southwestern GoM, favored by the sand lance during much of the late 1970s and early 1980s; humpback distribution appeared to have shifted to this area (Payne et al. 1986). An apparent reversal began in the mid-1980s, and herring and mackerel increased as sand lance again decreased (Fogarty et al. 1991). Humpback whale abundance in the northern GoM increased dramatically during 1992-1993, along with a major influx of herring. Humpback whales were few in nearshore Massachusetts waters in the 1992-1993 summer seasons. They were more abundant in the offshore waters of Cultivator Shoal and the Northeast Peak on GB, and on Jeffreys Ledge; these latter areas are more traditional locations of herring occurrence. In 1996 and 1997, sand lance, and therefore humpback whales were once again abundant in the Stellwagen Bank area. However, unlike previous cycles, when an increase in sand lance corresponded to a decrease in herring, herring remained relatively abundant in the northern GoM, and humpbacks correspondingly continued to occupy this portion of the habitat, where they also fed on euphausiids (unpublished data, Provincetown Center for Coastal Studies and College of the Atlantic).

Acoustics and Hearing: Humpback whales are in the low-frequency functional hearing group, with an estimated auditory bandwidth of 7 Hz to 22 kHz (Southall et al. 2007). Their vocal repertoire ranges from 20 Hz to greater than 10 kHz (DoN 2008).

4.3.5 North Atlantic Right Whale (*Eubalaena glacialis*)

Abundance, Density, and Stock Status: The North Atlantic right whale is considered one of the most critically endangered large whales in the world (Clapham et al. 1999; Perry et al. 1999; Kenney

2009). A Recovery Plan, originally published in 1991 and most recently revised in 2005, is currently in effect for this species (NOAA-NMFS 2005). The western population of North Atlantic right whales remains at very low levels, leaving it vulnerable to anthropogenic impacts throughout much of its range (NOAA-NMFS 2006b).

The western North Atlantic minimum stock size is estimated using a census of individual whales identified using photo-identification techniques. A review of the photo-ID recapture database as it existed on 20 October 2014 indicated that 476 individually recognized whales in the catalog were known to be alive during 2011, which represents a minimum population size (Waring et al. 2016).

The population appeared to be showing signs of slow recovery, with an estimated growth rate of 2.5 percent for the period 1986-1992 (Knowlton et al. 1994). Subsequently, additional analyses showed a decline in survival probability in the 1990s (Caswell et al. 1999; Clapham 2002). The decline appeared to be particularly marked in adult females. Recent mortalities also suggest an increased annual mortality rate that could reduce population growth by approximately 10%/year (Kraus et al. 2005).

Distribution and Habitat: The western North Atlantic right whale population ranges from wintering and calving grounds in the coastal waters of the southeastern U.S. to summer feeding and nursery grounds in New England waters and the Canadian Bay of Fundy, Scotian Shelf, and Gulf of St. Lawrence (Cetacean and Turtle Assessment Program [CETAP] 1982; Waring et al. 2011). The six major habitats or congregation areas are: coastal waters of the southeastern U.S.; the GSC; GoM/GB; Cape Cod Bay (CCB) and Massachusetts Bays; the Bay of Fundy; and the Scotian Shelf (Waring et al. 2009). Movements within and between habitats are extensive. Critical habitat for right whales was designated for CCB and GSC.

Right whales have been sighted from the MAB to the GoM during all months of the year (NOAA-NMFS 2005). Peak abundance of right whales in CCB begins in late winter. In early spring (May), abundance shifts to Wilkinson Basin and to the Great South Channel (Kenney et al. 1995). During late June and July, distribution gradually shifts to the northern edge of GB, then, in late summer and fall, the population is centered in waters of the Bay of Fundy and around Roseway Basin (Winn et al. 1986; Kenny et al. 1995; Kenny et al. 2001). Right whales are found in New England waters throughout the winter months, as well as off Florida and Georgia, yet the location of much of the population during winter remains unknown (NOAA-NMFS 2005).

New England waters constitute important feeding habitat for right whales, which feed primarily on zooplankton, specifically copepods of the genera *Calanus* and *Pseudocalanus* in this area. These dense zooplankton patches are likely key attributes of spring, summer, and fall right whale habitats (Kenney et al. 1986, 1995). Feeding has been well documented in the coastal waters off Massachusetts. Right whales have also been observed feeding along the margins of GB, in the GSC, in the GoM, in the Bay of Fundy, and over the Scotian Shelf (Kenney 2001).

In 1994, NOAA-NMFS designated critical habitat areas for the North Atlantic right whale in U.S. waters due to their importance as feeding and nursery areas (59 FR 28805), and in January 2016 they expanded the critical habitat areas (81 FR 4838) (Figure 2). The Project Area falls outside of the critical habitat area and no impacts to critical habitat are anticipated.

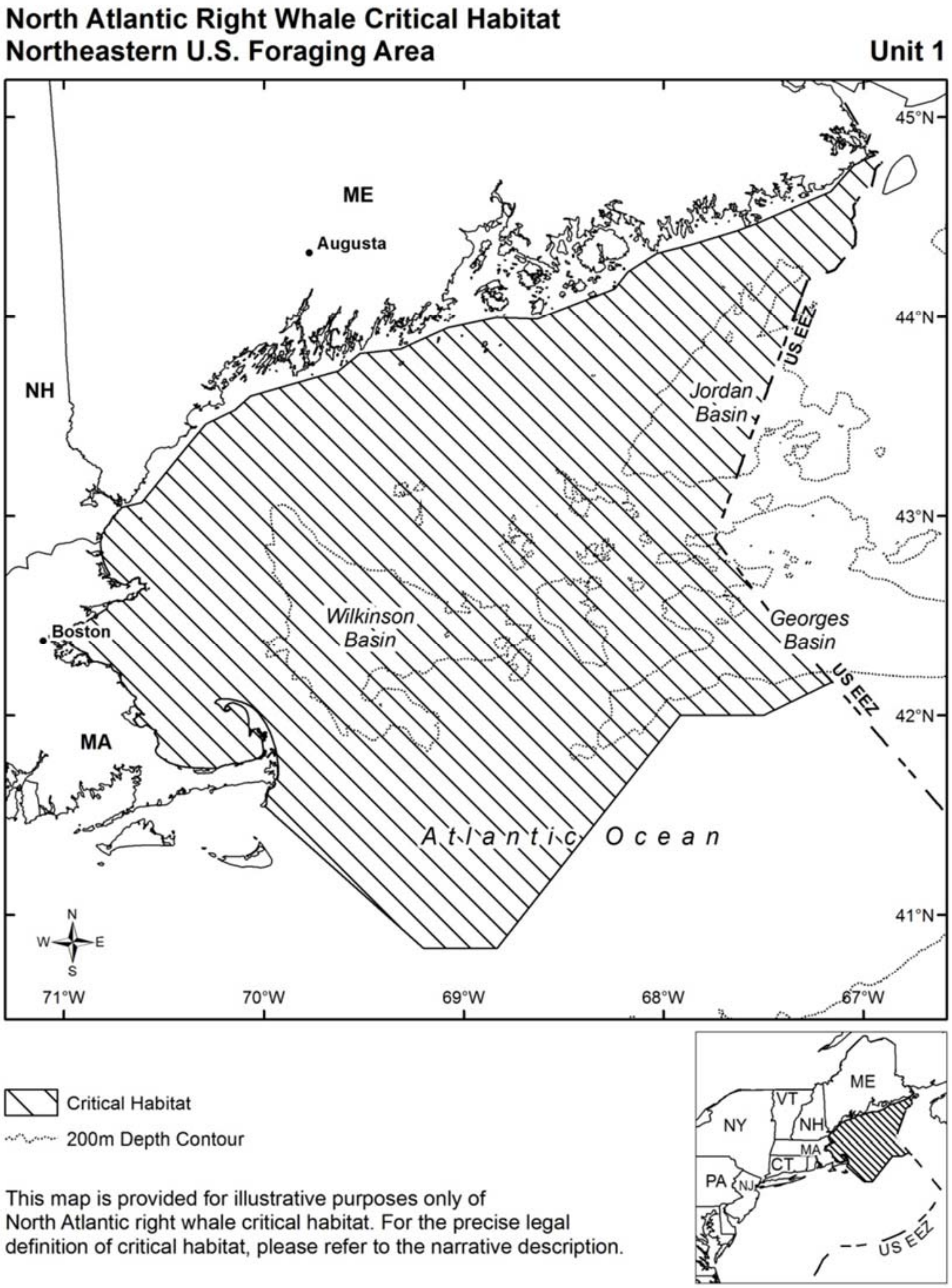

Figure 2. North Atlantic Right Whale Critical Habitat, Northeastern U.S. Foraging Area

Acoustics and Hearing: Parks et al. (2007) recently developed a preliminary model of the frequency range of hearing for North Atlantic right whales using morphometric analyses of inner ears of stranded whales and a previously established model for marine mammal hearing. The predicted total hearing range was 10 Hz to 22 kHz (Parks et al. 2007). North Atlantic right whales are, thus, in the low-frequency functional hearing group of Southall et al. (2007). Their vocalizations range from 20 Hz to 15 kHz (DoN 2008).

As per U.S. federal regulations, vessels greater than or equal to 65 ft (19.8 m) in overall length and subject to the jurisdiction of the United States and all vessels greater than or equal to 65 ft in overall length entering or departing a port or place subject to the jurisdiction of the United States must comply with a mandatory speed restriction of 10 knots or less in Seasonal Management Areas (SMEs) along the U.S. East Coast during times when right whales are likely to be present (*Endangered Fish and Wildlife; Final Rule To Implement Speed Restrictions to Reduce the Threat of Ship Collisions With North Atlantic Right Whales* -50 CFR 224*).* Vessels must steer a course away from any sited North Atlantic right whale at 10 knots (<18.5 km/h) or less until the 500 m minimum separation distance has been established. If a North Atlantic right whale is sited in a vessel's path, or within 100 m 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.

4.4 Rare Mysticetes in the Region

4.4.1 Blue Whale (*Balaenoptera musculus*)

Abundance, Density, and Stock Status: Blue whales are listed as endangered under the ESA, although the status of this stock is unknown and data are insufficient to determine population trends (Waring et al. 2010). A Recovery Plan has been published (Reeves et al. 1998) and is in effect.

Little is known about the population size of blue whales except for in the Gulf of St. Lawrence area. The 440 individually identified blue whales from the Gulf of St. Lawrence catalogued by Sears et al. (1987) are considered a minimum population estimate for the western North Atlantic stock (Waring et al. 2010).

Distribution and Habitat: Blue whale distribution in the western North Atlantic generally extends from the Arctic to at least mid-latitude waters. Most sightings are in the waters off eastern Canada, particularly the Gulf of St. Lawrence (Sears et al. 1987). The current Canadian distribution is, in general, spring, summer, and fall in the Gulf of St. Lawrence, especially along the north shore from the St. Lawrence River estuary to the Strait of Belle Isle and off eastern Nova Scotia. A blue whale photographed by a NOAA-NMFS large whale survey in August 1999 had previously been observed in the Gulf of St. Lawrence in 1985 (R. Sears and P. Clapham, unpublished data cited in Waring et al. 2007). The blue whale is best considered as an occasional visitor in U.S. Atlantic waters, which may represent the current southern limit of its feeding range (CETAP 1982, Wenzel et al. 1988). Four of the 5 sightings described in the aforementioned references were in August; one was in October.

Acoustics and Hearing: Blue whales, along with other mysticetes (baleen whales), are in the low-frequency functional hearing group, with an estimated auditory range of 7 Hz to 22 kHz (Southall et al. 2007). Their vocalizations range from 12 Hz to 400 Hz, with a dominant range of 12-25 Hz (DoN 2008).

Due to its preference for deeper colder water and considered only an occasional visitor in U.S. Atlantic waters blue whales are not expected (unlikely) to occur in the Project Area.

4.5 Regular or Common Phocids in the Region

4.5.1 Harbor Seal (*Phoca vitulina*)

Abundance, Density, and Stock Status: The stock structure of the western North Atlantic population of harbor seals is unknown, although those found along the eastern U.S. and Canadian coasts are thought to represent one population (Temte et al. 1991). Observed counts of harbor seals along the New England coast have been steadily increasing since passage of the MMPA in 1972.The best current abundance estimate is 75,834 (CV=.15) and the minimum population estimate is 66,884 (Waring et al. 2016). Harbor seals are not considered threatened or endangered under the ESA.

Distribution and Habitat: Harbor seals occupy all nearshore waters of the Atlantic Ocean and adjoining seas above about 30º N (Katona et al. 1993). In the western north Atlantic, they are distributed from the eastern Canadian Arctic and Greenland south to SNE and New York, and occasionally to the Carolinas (Mansfield 1967; Boulva and McLaren 1979; Katona et al. 1993; Gilbert and Guldager 1998; Baird 2001). In U.S. waters, breeding and pupping normally occur in waters north of the New Hampshire/Maine border, although breeding occurred as far south as Cape Cod in the early part of the 20th century (Temte et al. 1991; Katona et al. 1993). Harbor seals are year-round inhabitants of the coastal waters of eastern Canada and Maine (Katona et al. 1993), and occur seasonally along the SNE and New York coasts from September through late May (Schneider and Payne 1983). In recent years, their seasonal interval along the SNE to New Jersey coasts has increased (Barlas 1999; Hoover et al. 1999; Slocum et al. 1999; Schroeder 2000; deHart 2002). Scattered sightings and strandings have been recorded as far south as Florida (NOAA-NMFS unpublished data). A general southward movement from the Bay of Fundy to SNE waters occurs in autumn and early winter (Rosenfeld et al. 1988; Whitman and Payne 1990; Barlas 1999; Jacobs and Terhune 2000). A northward movement from SNE to Maine and eastern Canada occurs prior to the pupping season, which takes place from mid-May through June along the Maine coast (Richardson 1976; Wilson 1978; Whitman and Payne 1990; Kenney 1994; deHart 2002). No pupping areas have been identified in SNE (Payne and Schneider 1984; Barlas 1999). More recent information suggests that some pupping is occurring at high-use haul-out sites off Manomet, Massachusetts.

Harbor seals use a variety of terrestrial and aquatic habitats in U.S. waters. Their activities are influenced by regional topography, life history requirements, environmental parameters, anthropogenic activities, prey distribution, and, possibly, inter-specific competition with gray seals (Richardson 1976, Gilbert and Stein 1981, Schneider and Payne 1983, Payne and Selzer 1989, Barlas 1999, Lucas and Stobo 2000, Schroeder 2000, deHart 2002, Bowen et al. 2003, Renner 2005, Robillard et al. 2005). Rocky areas (i.e., small islands, isolated rocks, tidal ledges) are the predominant haul-out substrate in coastal waters from the Maine – Canadian border south to Plymouth, Massachusetts (Richardson 1976, Schneider and Payne 1983, Harris et al. 2003, Gilbert et al. 2005, Renner 2005). Rocky substrates are also used during pupping, breeding and molting seasons when harbor seals are concentrated in Maine coastal waters (Richardson 1976, Katona et al. 1993, Guldager 2001, Gilbert et al. 2005). Between Cape Cod and New Jersey, the coastal geology is more variable, and seals utilize a wider variety of substrates (i.e., tidally exposed sand and gravel bars, sand-peat hummock in tidal marshes, sandy beaches and islands, rock outcroppings and stone jetties) (Schneider and Payne 1983, Payne and Selzer 1989, Barlas 1999, Schroeder 2000, deHart 2002). Seals also haul-out on near-shore ice (Katona et al. 1993), and small groups have been observed on ice floes around Cape Cod in winter when conditions restrict access to traditional (i.e., sandy beach) haul-out sites (John Prescott, pers. comm., Massachusetts Audubon Society, Wellfleet, Massachusetts).

Further, storm events alter the characteristics of or access to sandy haul-out sites, particularly around the outer portion of Cape Cod and eastern Nantucket Sound. Harbor seals readily acclimate to newly formed haul-out sites (i.e., barrier beach breaks, re-emerged sand bars), thus giving the appearance of a sudden influx or population growth of seal populations in Cape Cod waters. The use of non-

coastal waters (i.e. > 25 nm from the coast) has been documented in fishery bycatch data (Waring et al. 2007).

Harbor seals are opportunistic predators and the diet composition exhibits temporal and spatial preferences (Selzer and Payne 1989; Williams 1999; Craddock and Polloni 2006). Harbor seal diet off the Northeast U.S. coast reflects seasonal spatial distributions of prey delineated in NEFSC research trawl surveys (Mountain and Murawski 1992; Garrison 2001). For example, sandlance (*Ammodytes* spp.) are abundant on Stellwagen Bank, which is adjacent to a major harbor seal haul-out location on the outer portion of Cape Cod, and, silver hake (*Merluccius bilinearis*) is widely distributed in the GoM.

Acoustics and Hearing: Harbor seals are assigned to functional hearing groups based on the medium (air or water) through which they are detecting the sounds, for an estimated auditory bandwidth of 75 Hz to 75 kHz (Southall et al. 2007). Vocalizations range from 25 Hz to 4 kHz (DoN 2008).

4.5.2 Gray Seal (*Halichoerus grypus*)

Abundance, Density, and Stock Status: Data are currently insufficient to calculate a best or minimum population estimate for U.S. waters (Waring et al. 2016). However, estimates of portions of the stock are available for select time periods. The Canadian gray seal stock assessment (DFO 2014) reports gray seal pup production in 2014 for the three Canadian herds (Gulf of St. Lawrence, Sable Island, and Nova Scotia) as 93,000 (95%CI=48,000-137,000) animals, and total population levels at 505,000 individuals (95%CI=329,000-682,000). Gray seals are not listed as threatened or endangered under the ESA.

Distribution and Habitat: Gray seals occur on both sides of the North Atlantic, with three major populations in eastern Canada, northwestern Europe and the Baltic Sea (Katona et al. 1993). There are two breeding concentrations in eastern Canada: one at Sable Island, and one on the pack ice in the Gulf of St. Lawrence (Laviguer and Hammill 1993). Tagging studies indicate that there is little intermixing between the two breeding groups (Zwanenberg and Bowen 1990), and for management purposes, they are treated by the Canadian Department of Fisheries and Oceans as separate stocks (Mohn and Bowen 1996).

In U.S. waters, gray seals currently pup at three established colonies: Muskeget Island, Massachusetts, Green Island, Maine, and Seal Island, Maine, as well as, more recently, at Matinicus Rock and Mount Desert Rock in Maine. Gray seals have been observed using the historic pupping site on Muskeget Island in Massachusetts since 1990. Pupping has taken place on Seal and Green Islands in Maine since at least the mid-1990s. Aerial survey data from these sites indicate that pup production is increasing. A minimum of 2,620 pups (Muskeget= 2,095, Green= 59, Seal= 466) were born in the U.S. in 2008 (Wood LaFond 2009).

Gray seals are also observed in New England outside of the pupping season. In April-May 1994 a maximum count of 2,010 was obtained for Muskeget Island and Monomoy combined (Rough 1995). Maine coast-wide surveys conducted during summer revealed 597 and 1,731 gray seals in 1993 and 2001, respectively (Gilbert et al. 2005). In March 1999 a maximum count of 5,611 was obtained in the region south of Maine (between Isles of Shoals, Maine and Woods Hole, Massachusetts) (Barlas 1999). In March 2011 a maximum count of 15,756 was obtained in southeastern Massachusetts coastal waters (Waring et al. 2014).

Gray seals use a variety of terrestrial and aquatic habitats in U.S. waters, and topography, life history requirements, environmental parameters, anthropogenic activities, prey distribution, and, perhaps, competition with harbor seals influence their activities (Lucas and Stobo 2000; Robillard et al. 2005; Murray 2009). They readily acclimate to newly formed haul-out sites, such as barrier beach breaks and re-emerged sand bars, thus giving the appearance of a sudden influx or population growth of

seal populations in Cape Cod waters. Gray seal use of waters > 25 nm from the coast has been documented through fishery bycatch data (Waring et al. 2007). Tagging studies in Atlantic Canada and New England have also documented trans-boundary movements of gray seals (Wood 2009; NOAA-NMFS/NEFSC, unpublished data). Gray seals are opportunistic predators and diet composition reflects temporal and spatial prey preferences (Rough 1995; Craddock and Polloni 2006; Ampela 2009).

Acoustics and Hearing: Gray seals, as with all pinnipeds, are assigned to functional hearing groups based on the medium (air or water) through which they are detecting the sounds, for an estimated auditory bandwidth of 75 Hz to 75 kHz (Southall et al. 2007). Vocalizations range from 100 Hz to 3 kHz (DoN 2008).

4.5.3 Harp Seal (*Pagophilus groenlandica*)

Abundance, Density, and Stock Status: The world's harp seal population is divided into three separate stocks, each identified with a specific breeding site (Bonner 1990; Lavigne and Kovacs 1988). The largest stock is located off eastern Canada and is divided into two breeding herds which breed on the pack ice. The Front herd breeds off the coast of Newfoundland and Labrador, and the Gulf herd breeds near the Magdalen Islands in the middle of the Gulf of St. Lawrence (Sergeant 1965; Lavigne and Kovacs 1988). The second stock breeds on the West Ice off eastern Greenland (Lavigne and Kovacs 1988). The third stock breeds on the ice in the White Sea off the coast of Russia. The Front/Gulf stock is equivalent to western north Atlantic stock. The status of the western north Atlantic harp seal stock in the U.S. Atlantic is unknown, but the stock's abundance appears to have stabilized (McAlpine and Walker 1990). The species is not listed as threatened or endangered under the ESA (Waring et al. 2009).

The population size for western North Atlantic harp seals in 2012 was 7.1 million animals (95% CI 5.9-8.3 million; Hammill et al. 2012), based on a population model that was applied to 1952-2012 population data (Waring et al. 2014). Data are insufficient to calculate the minimum population estimate and density estimates for U.S. waters (Waring et al. 2014). The increased number of stranded harp seals suggests an increasing harp seal population in U.S. waters (Waring et al. 2014).

Distribution and Habitat: Harp seals occur throughout much of the North Atlantic and Arctic Oceans (Ronald and Healey 1981; Lavigne and Kovacs 1988) and are highly migratory (Sergeant 1965; Stenson and Sjare 1997). Breeding occurs at different times for each stock between mid-February and April. Adults then assemble north of their whelping patches to undergo the annual molt. The migration then continues north to Arctic summer feeding grounds. In late September, after a summer of feeding, nearly all adults and some of the immature animals of the western north Atlantic stock migrate southward along the Labrador coast, usually reaching the entrance to the Gulf of St. Lawrence by early winter. There they split into two groups, one moving into the Gulf and the other remaining off the coast of Newfoundland. The southern limit of the harp seal's habitat extends into the U.S. Atlantic waters during winter and spring.

In recent years, numbers of sightings and strandings have been increasing off the east coast of the U.S. from Maine to New Jersey (Katona et al. 1993; Stevick and Fernald 1998; McAlpine 1999a; Lacoste and Stenson 2000). These extralimital appearances usually occur in January-May (Rubinstein 1994; Harris et al. 2002), when the western North Atlantic stock of harp seals is at its most southern point of migration. Concomitantly, a southward shift in winter distribution off Newfoundland was observed during the mid-1990s, which was attributed to abnormal environmental conditions (Lacoste and Stenson 2000). Most of the information on their distribution in Northeast U.S. waters is limited to fishery bycatch and stranding records (Waring et al. 2007). In coastal regions, individual harp seals have been observed on coastal beaches, frozen ponds, up coastal rivers or on ice floes. Overall, little is known regarding the ecology of harp seals in U.S. waters.

Acoustics and Hearing: Harp seals, as with other pinnipeds, are assigned to functional hearing groups based on the medium (air or water) through which they are detecting the sounds, for an estimated auditory bandwidth of 75 Hz to 75 kHz (Southall et al. 2007) (Table 5). The frequencies of underwater vocalizations range from 66 to 120 kHz (DoN 2008).

4.5.4 Hooded Seal (*Cystophora cristata*)

Abundance, Density, and Stock Status: The western North Atlantic stock of hooded seals appears to be increasing in abundance, although stock status in U.S. Atlantic waters is unknown. The best abundance estimate for western North Atlantic hooded seals is 592,100. The minimum population estimate based on the 2005 pup survey is 512,000. Data are not currently adequate to calculate the minimum population estimate or density estimates for U.S. waters. The species is not listed as threatened or endangered under the ESA (Waring et al. 2007).

Distribution and Habitat: The hooded seal occurs throughout much of the North Atlantic and Arctic Oceans (King 1983) preferring deeper water and occurring farther offshore than harp seals (Sergeant 1976; Campbell 1987; Lavigne and Kovacs 1988; Stenson et al. 1996). The western North Atlantic stock of hooded seals whelps off the coast of eastern Canada and is divided into three whelping areas. The Front herd (largest) breeds off the coast of Newfoundland and Labrador, Gulf herd breeds in the Gulf of St. Lawrence, and the third area is in the Davis Strait. Hooded seals are highly migratory and may wander as far south as Puerto Rico (Mignucci-Giannoni and Odell 2001), with increased occurrences from Maine to Florida. These appearances usually occur between January and May in New England waters, and in summer and autumn off the southeast U.S. coast and in the Caribbean (McAlpine et al. 1999b; Harris et al. 2001; Mignucci-Giannoni and Odell 2001). Three of 4 hooded seals stranded, satellite tagged, and released in the U.S. in 2004 migrated to the eastern edge of the Scotian Shelf and 2 of the 4 seals moved to the southeast tip of Greenland (Waring et al. 2009; WHALENET at http://whale.wheelock.edu). Although it is not known which stock these seals come from, it is known that during spring, the northwest Atlantic stock of hooded seals are at their southernmost point of migration in the Gulf of St. Lawrence.

Acoustics and Hearing: Like other pinnipeds, hooded seals are assigned to functional hearing groups based on the medium (air or water) through which they are detecting the sounds, for an estimated auditory bandwidth of 75 Hz to 75 kHz (Southall et al. 2007) (see Table 5). Vocalizations range from <4 to 120 kHz (DoN 2008).

4.6 Rare Sirenians in the Region

4.6.1 West Indian Manatee (*Trichechus manatus*)

Abundance, Density, and Stock Status: The West Indian manatee includes two subspecies: the Antillean manatee (*Trichechus manatus manatus*) and the Florida manatee (*Trichechus manatus latirostris*). The Antillean manatee occurs in eastern Mexico, Central America, northern and eastern South America, and in the Greater Antilles; distribution extends eastward only to Puerto Rico, with occasional sightings in the Lesser Antilles. The Puerto Rico population of the Antillean manatee is considered a separate stock (USFWS 2009a and citations therein). Florida manatees occur throughout the southeastern U.S. (USFWS 2009b). While extremely rare, there are recorded sightings of manatees in the north-eastern U.S., as far north as Point Judith, Rhode Island (SMC 2016).

The West Indian Manatee is listed as endangered under the ESA and falls under the jurisdiction of the U.S. Fish and Wildlife Service (USFWS). In its five-year review, the USFWS suggested that the West Indian manatee no longer meets the definition of an endangered species and should be reclassified as threatened due to continued threats of potential habitat loss and watercraft collisions and concerns regarding adequate regulation of those threats (USFWS 2007). The USFWS, in a 90-day finding on a petition to reclassify the West Indian manatee, determined that the petitioned action

may be warranted, prompting the initiation of a status review of the species and a new five-year review
(79 FR 37706, July 2, 2014). The manatee is considered a strategic stock as defined in Section 12 of the MMPA.

Distribution and Habitat: Florida manatees occur throughout the southeastern U.S., which is at the northern limit of their range (Lefebvre et al. 2001). They occur in freshwater, brackish, and marine environments that typically include coastal tidal rivers and streams, mangrove swamps, salt marshes, freshwater springs, and vegetated bottoms (FWC 2005). Manatees use different habitats at different times of the year. During cold winter temperatures, they concentrate along peninsular Florida and many rely on warm water from natural springs, passive thermal basins, and power plant outfalls (Laist et al. 2013, USFWS 2001). During summer, they expand their range; manatees are occasionally seen as far north as Rhode Island on the Atlantic coast and as far west as Texas on the Gulf of Mexico coast (USFWS 2001).

Acoustics and Hearing: Manatees have an estimated auditory bandwidth of .4 to 46 kHz, with peak frequency sensitivity at 16 to 18 kHz (Gerstein et al. 1999).

5.0 Type of Incidental Taking Requested

The Applicant is requesting authorization under the MMPA (see Section 1) for potential taking of marine mammals to allow for incidental harassment (Level A and Level B take) resulting from the geophysical surveys, and vibracoring and DP thruster use during geotechnical surveys. Specifically, this request is for an IHA to allow for the incidental harassment of very small numbers of marine mammals at Level A take and larger numbers of marine mammals at Level B take resulting from the operation of survey equipment during the geophysical and geotechnical surveys. The request is based upon projected survey activities (as described in Section 1) during the anticipated survey schedule (as described in Section 2.1), and the number of takes requested (see Section 6).

The Level B take (harassment) may be manifested as a temporary threshold shift (TTS) (Southall et al. 2007) in the immediate vicinity of the sound source where the received levels of sound exposure might be high enough to cause a temporary loss of hearing sensitivity, or in the zone of responsiveness where the received level is such that the animal responds by causing behavioral modifications (Holt 2008). No permanent hearing loss or physiological damage (PTS) or injury (Level A harassment); is expected to occur to marine mammals by the acoustic gear or vessel movements during proposed surveys; therefore, no Level A take is being requested as part of this IHA.

6.0 Take Estimates for Marine Mammals

The Applicant seeks authorization for potential taking of small numbers of marine mammals under the jurisdiction of the NOAA-NMFS in the region of the proposed survey activity. Below you will find the basis for estimating take and the Applicant's requested take of marine mammals related to geophysical surveys and DP thrusters used during geotechnical surveys.

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

To estimate the potential number of instances that marine mammals could be exposed to project sound sources, density (animals/km^2) of marine mammals were estimated within the Project Area (calculated based on Roberts et al., 2016) and multiplied by the daily ensonified area (km^2). The number of instances of take within one day was then multiplied by the number of survey days. The product (rounded) is the number of instances of unmitigated take, within one day. The result is an estimate of the potential number of instances that marine mammals could be exposed to geophysical and geotechnical survey related sound above the Level A and Level B harassment threshold over the duration of the planned survey.

Possible Level A exposures were estimated by multiplying the calculated density of each species by the area estimated to be ensonified to PTS onset threshold levels shown in Table 3 (above) based on the hearing category of the species possibly transiting the Project Area. These results were then multiplied by the number of days of survey activity to estimate the total number of exposures that might occur during the geophysical and geotechnical surveys. Level B exposures were estimated by multiplying the calculated density of each species in the Project Area (calculated based on Roberts et al., 2016) by the area estimated to be ensonified (Table 4) to levels exceeding 120 dB re 1 μPa (rms) for continuous sound (i.e. stationary sources such as vibracore and DP thruster), and 160 dB re 1 μPa (rms) for impulsive sound (sources such as sparkers) within an average day of activity. The ensonified area was first doubled as a conservative measure and then multiplied by species density to calculate take.

6.1.1 Marine Mammal Density Calculation

To estimate densities for common cetaceans (odontocetes and mysticetes) that could transit the Project Area, DWW used the annual mean density of marine mammals in the North Lease Area and the cable corridor, calculated from spatial gridded datasets developed by the Marine Geospatial Ecology Laboratory/Duke University from the *Habitat-based cetacean density models for the U.S. Atlantic and Gulf of Mexico* (2015 Version; Roberts et al., 2016). The datasets for each species were downloaded from the Duke University website and were modeled as estimated mean year-round abundance (number of individual animals) per grid cell (100 km by 100 km) for most species. For certain species, the model predicted monthly mean abundance rather than mean year-round abundance, for which the annual mean abundance was calculated using Spatial Analyst tools in ArcGIS (ESRI, 2011). Based on the annual mean abundance datasets, the mean density (animals/km^2) was calculated in ArcGIS by averaging the abundance of animals within the Project Area and dividing by 100 (Table 7) which gives you animals/km^2.

Densities for pinnipeds were taken from the Department of Defense (Navy) 2007 Operating Area Density Estimates (DoN 2007). The DoN's methodology for determining density is described in detail in Sections 2.8.3.1, 2.8.3.2, and 3.2 of their 2007 report. Other IHA applications have used these density measurements, but in response to NOAA-NMFS guidance and the Marine Mammal Commission's review of those applications, no correction factor has been applied to the DoN's density estimates (such as reducing by 20%). Instead, the calculation assumes take on the highest estimated number of animals, resulting in the most conservative take estimates possible (Table 6).

Table 7. Estimated Density (animals/km^2) of Marine Mammals within the Northeast LME

Common Name	Scientific Name	Federal ESA/ MMPA Status	Relative Occurrence in the region	Density (#/km^2)	Data Notes
Sperm whale	*Physeter macrocephalus*	ESA Endangered/ Depleted and Strategic	Common	0.00007657	Annual

Common Name	Scientific Name	Federal ESA/ MMPA Status	Relative Occurrence in the region	Density (#/km²)	Data Notes
Dwarf sperm whale	*Kogia sima*	Protected	Rare	0.0	Annual
Pygmy sperm whale	*Kogia breviceps*	Protected	Rare	0.0	No Data
Killer Whale	*Orcinus orca*	Protected	Rare	0.00000895	Annual
Pygmy killer whale	*Feresa attenuata*	Protected	Hypothetical	0	No data
False killer whale	*Pseudorca crassidens*	Strategic	Rare	0.00007786	Annual
Northern bottlenose whale	*Hyperoodon ampullatus*	Protected	Hypothetical	0.0	Annual
Cuvier's beaked whale	*Ziphius cavirostris*	Protected	Rare	0.000184410	Annual
Mesoplodon beaked whales	*Mesoplodon spp.*	Depleted	Rare		
Melon-headed whale	*Peponocephala electra*	Protected	Hypothetical	0.0	Annual
Risso's dolphin	*Grampus griseus*	Protected	Common	0.00000221	Annual
Long-finned pilot whale	*Globicephala melas melas*	Protected	Common	0.001497470	Annual
Short-finned pilot whale	*Globicephala macrorhynchus*	Protected	Rare		
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	Protected	Common	0.01444053	Annual
White-beaked dolphin	*Lagenorhynchus albirostris*	Protected	Regular	0.00008411	Annual
Short-beaked common dolphin	*Delphinus delphis delphinis*	Protected	Common	0.04027238	Annual
Atlantic spotted dolphin	*Stenella frontalis*	Protected	Regular	0.00006577	Annual
Pantropical spotted dolphin	*Stenella attenuata*	Protected	Rare	0.0	Annual
Striped dolphin	*Stenella coeruleoalba*	Protected	Rare/Regular	0.00003174	Annual
Fraser's dolphin	*Lagenodelphis hosei*	Protected	Data deficient	0.0	Annual
Rough toothed dolphin	*Steno bredanensis*	Protected	Rare	0.0	Annual
Clymene dolphin	*Stenella clymene*	Protected	Hypothetical	0.0	Annual
Spinner dolphin	*Stenella longirostris*	Protected	Hypothetical	0.0	Annual
Common bottlenose dolphin	*Tursiops truncatus truncatus*	Protected	Common	0.0115608	Annual
Harbor Porpoise	*Phocoena phocoena*	Protected	Common	0.03340904	Annual
Fin whale	*Balaenoptera physalus*	ESA Endangered/ Depleted and Strategic	Common	0.00207529	Annual
Sei whale	*Balaenoptera borealis*	ESA Endangered/ Depleted and Strategic	Regular	0.00008766	Annual
Minke whale	*Balaenoptera acutorostrata acutorostrata*	Protected	Common	0.00046292	Annual

Common Name	Scientific Name	Federal ESA/ MMPA Status	Relative Occurrence in the region	Density (#/km^2)	Data Notes
Blue whale	*Balaenoptera musculus*	ESA Endangered/ Depleted and Strategic	Rare	0.00000918	Annual
Humpback whale	*Megaptera novaeangliae*	Strategic	Common	0.0014806	Annual
North Atlantic right whale	*Eubalaena glacialis*	ESA Endangered/ Depleted and Strategic	Common	0.00295075	Annual
Harbor Seal[1]	*Phoca vitulina concolor*	Protected	Common	0.313166136	Annual
Gray Seal[1]	*Halichoerus grypus*	Protected	Common	0.036336364	Annual
Harp Seal	*Pagophilus groenlandica*	Protected	Common	No data	No Data
Hooded Seal	*Cystophora cristata*	Protected	Regular	No data	No Data
West Indian manatee[2]	*Trichechus manatus*	ESA Endangered/ Depleted and Strategic	Rare	No data	No Data

1 DoN 2007

2 Take was not estimated for this extralimital species, which is under USFWS jurisdiction.

3 Source: Roberts, et al. 2016.

Based on NOAA-NMFS's estimates of marine mammal occurrence in the region (Waring et al. 2016) and density estimates in the Project Area calculated from spatial gridded datasets developed by the Marine Geospatial Ecology Laboratory/Duke University the modeled estimates for mean year-round density (animals/km2) was less than 1 (Roberts et al., 2016).

6.1.1.1 Zone of Influence (ZOI) Calculations

The ZOI is the maximum ensonified area around the sound source over a 24-hr period. The ZOI was calculated per the following formulae:

Stationary Source: ZOI = π r2

Mobile Source: ZOI = (Distance/day x 2r)+ πr^2

Where r is the PTS Isopleth to Level A thresholds; and the spreading distance from the sound source for Level B thresholds. A distance of 110 km was assumed for mobile equipment under the proposed project. The PTS Isopleth to Level A thresholds were estimated using NOAA-NMFS Technical Guidance's companion User Spreadsheet (Tabs A and D for stationary and mobile sources as described below) applying the source sound pressure levels of possible concern described in Table 1. The distance to the sound thresholds for Level B harassment was determined by applying the source sound pressure levels described in Table 1 to spreading models to provide ZOI estimates based on the spreading model requested by NOAA-NMFS (NOAA-NMFS 2016).

6.1.1.2 Zone of Influence (ZOI) and Maximum Worst-Case Distance Estimates

As discussed above, the following subset of equipment were used to model the worst-case scenario for acoustic effects: HPC or Rossfelder Corer; DP Thruster; 802 Joule GeoResources Sparker; and Applied Acoustics 100–1,000 joule Dura-Spark 240 System. The estimated duration of the survey activities is approximately 168 days. The estimated duration of the geotechnical work is 75 days.

The isopleths for Level A harassment PTS onset thresholds for stationary sound sources such as vibracore and DP thruster were estimated using Worksheet A (Non-impulsive-Stationary-Continuous), of the NOAA-NMFS Technical Guidance's companion User Spreadsheet. The isopleths for Level A harassment PTS onset thresholds for mobile sound sources such as 800 Joule Geo Resources Sparker and Applied Acoustics 100–1,000 joule Dura-Spark 240 System were estimated using Worksheet F (Impulsive-Mobile-Intermittent), of the NOAA-NMFS Technical Guidance's companion User Spreadsheet. Source sound pressure levels from the worst-case scenario equipment were used as inputs to the models (Table 1). The ensonified area for Level B harassment thresholds (stationary sound sources such as vibracore and DP Thruster) were determined by applying the source sound pressure levels and reference distance described in Table 1 spreading models to provide ZOI estimates based on the spreading model requested by NOAA-NMFS (NOAA-NMFS 2016).

However, these calculations result in an overly conservative ZOI because it assumes that once an area along a survey trackline is ensonified by the sound source, the area will remain ensonified at a level that will result in Level B acoustic take throughout the entire 24 hr period for mobile sources. Because the area is not ensonified for the entire 24 hour period and an individual marine mammal will most likely not stay within that ensonified area, this approach overestimates take. As summarized in Section 1.2, the only time survey activities could result in take by Level B acoustic harassment is if a marine mammal were to enter into the ensonified area associated with the geophysical survey equipment being operated and stay in that area for the entire 24 hour period. For the proposed DWW geophysical and geotechnical survey activities, the maximum worst-case distance to the PTS isopleth (meters) for Level A harassment and the spreading distance from the sound source for Level B thresholds are shown in Table 8.

Table 8. Maximum Worst-Case Distance (m) and Area (km^2) to the Level A and Level B Thresholds

Hearing Group	SELcum Threshold[1] (dB)	Equipment	Vibracore Operations: HPC or Rossfelder Corer			DP Thruster		800 Joule Geo Resources Sparker	Sparker System
		Source PLS	**185 dB RMS**			**150 dB RMS**		**186 dB SEL**	**186 dB SEL,**
Level A									
	Threshold	**Frequency (kHz)**	**1.7**	**6.2**	**20**	**1.7**	**5**	**2.75**	**1.2**
Low-Frequency Cetaceans	199	**PTS Isopleth to threshold (meters)[2]**	11.97 m, 0 km^2			0.06 m, 0 km^2		1.29 m, 0.283 km^2	1.30 m, 0.287 km^2
Mid-Frequency Cetaceans	198				12.96 m, 0.001 km^2		0.03 m, 0 km^2	0.02 m, 0.005 km^2	
High-Frequency Cetaceans	173				207.58 m, 0.135 km^2		2.17 m, 0 km^2	5.12 m, 1.127 km^2	
Phocid Pinnipeds	201			9.51 m, 0 km^2			0.11 m, 0 km^2	0.65 m, 0.144 km^2	
Level B									
All Marine Mammals	**Threshold**	**Source PLS**	**185 dB RMS**			**150 dB RMS**		**213 dB RMS**	**213 dB RMS,**
	120	**Spreading Distance[2]**	3,557 m, 39.74 km^2			499 m, 0.78 km^2			
	160							893 m, 199.0481 km^2	893 m, 199.0481 km^2

[1]Cumulative sound exposure level threshold over a 24 hour period.

[2] The calculations are not based on cumulative noise levels from all equipment, but from each equipment separately. The calculated sound levels and the results are based on NMFS Technical Guidance's companion User Spreadsheet as indicated in the IHA application. Noise levels from different sources can only be combined and then added cumulatively when all equipment not only operate simultaneously but also operate at the same location (e.g. within a few feet from each other).

6.1.2 Take Calculation

Estimates of take were calculated according to the following formula:

$$\text{Estimated Take} = D \times ZOI \times \#\text{ of Days}$$

Where: D = average species density (per km^2); and ZOI = maximum ensonified area to NOAA-NMFS thresholds for noise.

To estimate take, DWW used the estimated density of marine mammals within the Project Area (animals/km^2) and multiplied that number by the daily ensonified area (km^2). That result is then multiplied by the number of survey days to arrive at the estimated take. The product is then rounded. This final number equals the instances of take within one 24 hour period.

The result is an estimate of the maximum potential number of instances that marine mammals could be exposed to sounds above the Level A or Level B harassment thresholds over the duration of each planned survey. DWW has agreed to extensive mitigation measures to reduce any potential Level B harassment and eliminate the possibility of any Level A harassment (though we are not expecting Level A harassment to occur.

6.2 Estimated Numbers of Marine Mammals that Might be Taken by Harassment

6.2.1 Estimated Level A Harassment of Marine Mammals

NOAA-NMFS recently published technical guidance for assessing the effects of underwater anthropogenic sound on the hearing of marine mammal species under the jurisdiction of the NMFS. DWW used this technical guidance to assess the auditory impacts to marine mammals to estimate take as described above in detail in Sections 1.1 and 6.1(NOAA-NMFS, 2016).

Acoustic stimuli generated during the geophysical survey and by the DP thrusters on the drill barge during geotechnical work has the potential to result in behavioral disturbance of some marine mammals which could result in Level B harassment. However, based on the methodology described above and recommended by NOAA-NMFS (2016) for assessing the effects of underwater anthropogenic sound on the hearing of marine mammal species our Level A take estimates are shown in Table 9. DWW's worst-case scenario estimated Level A take for major cetaceans present in the area are as follows: Atlantic white-sided dolphins (0); short-beaked common dolphins (0); and harbor porpoises (6); fin whale (0); minke whale (0); humpback whale (0); and North Atlantic right whale (0). Modeled worst-case Level A take for harbor seals and gray seals is 8 and 1, respectively. Hence, very low Level A harassment is anticipated. This is due to the nature of the survey equipment (primarily non-impulsive and localized ZOI), low marine mammal density, and marine mammal behavior. The take estimates do not take into consideration mitigation measures and therefore are likely to significantly overestimate of the actual potential for take by Level A acoustic harassment..

Table 9. Level A Take Estimates

Equipment	HPC or Rossfelder Corer			DP Thruster		800 Joule Geo Resources Sparker Or Applied Acoustics 100–1,000 joule Dura-Spark 240 System
Sound Source (dB)	**185**			**150**		**186**
Frequency Range (kHz)	**1.7**	**6.2**	**20**	**1.7**	**5**	**2.75**
Number of Activity Days	**75**			**75**		**168**
Species Common Name	**Take Estimate (multiplied by number of days and rounded to a whole number)**					
Odontoceti (Toothed Whales and Dolphins)						
Sperm whale			0		0	0
Dwarf sperm whale			0		0	0
Pygmy sperm whale			0		0	0
Killer Whale			0		0	0
Pygmy killer whale						
False killer whale			0		0	0
Northern bottlenose whale			0		0	0
Cuvier's beaked whale			0		0	0

Mesoplodon beaked whales (True's, Gervais', Blainville's, and Sowerby's beaked whales)			0		0	0
Melon-headed whale			0		0	0
Risso's dolphin			0		0	0
Long-finned pilot whale			0		0	0
Short-finned pilot whale			0		0	0
Atlantic white-sided dolphin -			0		0	0
White-beaked dolphin			0		0	0
Short-beaked common dolphin			0		0	0
Atlantic spotted dolphin			0		0	0
Pantropical spotted dolphin			0		0	0
Striped dolphin			0		0	0
Fraser's dolphin			0		0	0
Rough toothed dolphin			0		0	0
Clymene dolphin			0		0	0
Spinner dolphin			0		0	0
Common bottlenose dolphin9			0		0	0
Harbor Porpoise			0		0	6
Mysticeti (Baleen Whales)						
Fin whale	0			0		0
Sei whale	0			0		0
Minke whale	0			0		0
Blue whale	0			0		0
Humpback whale	0			0		0
North Atlantic right whale	0			0		0
Phocids (Seals)						
Harbor seal		0			0	8
Gray seal		0			0	1

6.2.2 Estimated Level B Harassment of Marine Mammals

Level B exposures were estimated by multiplying the calculated density of each species (see Table 7) in the Project Area (calculated based on Roberts et al., 2016) by the area estimated to be ensonified to levels exceeding 120 dB re 1 μPa (rms) for continuous sound and 160 dB re 1 μPa (rms) for impulsive sound as described above in Sections 1.1 and 6.1 (Southall et al. 2007).

Table 10 summarizes the Level B take estimates for all species having a density estimate in the Project Area (including extremely rare species). As described above, NOAA-NMFS has defined the threshold level for Level B harassment as 120 dB_{RMS} re 1 µPa for continuous sound and 160 dB_{RMS} re 1 µPa for impulsive sound (Table 4). When considering the approach for estimating take, it is important to note that the estimates represent the maximum potential take numbers. However, it is highly unlikely that a cetacean or pinniped would dwell within the small areas encompassing the behavioral threshold zones for the modelled period of 24 hours. In addition, because of the spatial distribution and transient nature of the marine mammal species identified, the relatively short duration of the activities, and the time of year the Applicant proposes to conduct geophysical and geotechnical survey activities, these estimates are an overestimate of Level B take. Lastly, the take estimates do not take into consideration mitigation measures and therefore are likely to significantly overestimate of the actual potential for take by Level B acoustic harassment.

Table 10. Level B Take Estimates

Equipment	**HPC or Rossfelder Corer**	**DP Thruster**	**800 Joule Geo Resources Sparker Or Applied Acoustics 100–1,000 joule Dura-Spark 240 System**
Sound Source (dB)	**185**	**150**	**213**
Number of Activity Days	**75**	**75**	**168**
Threshold	**RMS 120 dB**	**RMS 120 dB**	**RMS 160 dB**
Species Common Name	**Level B Take Estimate (multiplied by number of days)**		
Odontoceti (Toothed Whales and Dolphins)			
Sperm whale	0	0	3
Dwarf sperm whale	0	0	0
Pygmy sperm whale	0	0	0
Killer Whale	0	0	0
Pygmy killer whale	0	0	0
False killer whale	0	0	3
Northern bottlenose whale	0	0	0
Cuvier’s beaked whale	1	0	6
Mesoplodon beaked whales (True's, Gervais', Blainville's, and Sowerby's beaked whales)	0	0	0
Melon-headed whale	0	0	0
Risso’s dolphin	0	0	0
Long-finned pilot whale	4	0	50
Short-finned pilot whale	0	0	0
Atlantic white-sided dolphin	43	1	483
White-beaked dolphin	0	0	3
Short-beaked common dolphin	120	2	1347

Atlantic spotted dolphin	0	0	2
Pantropical spotted dolphin	0	0	0
Striped dolphin	0	0	1
Fraser's dolphin	0	0	0
Rough toothed dolphin	0	0	0
Clymene dolphin	0	0	0
Spinner dolphin	0	0	0
Common bottlenose dolphin	34	1	387
Harbor Porpoise	100	2	1117
Mysticeti (Baleen Whales)			
Fin whale	6	0	69
Sei whale	0	0	3
Minke whale	1	0	15
Blue whale	0	0	0
Humpback whale	4	0	50
North Atlantic right whale	9	0	99
Phocids (Seals)			
Harbor seal	933	18	10472
Gray seal	108	2	1215

7.0 Anticipated Impacts of the Activity

Because of the low marine mammal densities in the Project Area, as well as the low level of predicted takes relative to population size, and because harassment will likely be avoided through the implementation of the proposed mitigation measures (Section 11), DWW believes that its activities:

1) will have a minimal impact on the affected species or stocks of marine mammals (based on the likelihood that the activities will not affect annual rates of recruitment or survival); and

2) will not have an immitigable adverse impact on the availability of the species or stocks.

Despite best efforts to estimate realistic potential marine mammal takes, DWW believes actual takes would be substantially lower than its take estimates, and many of the species for which it estimated take would not be taken. There is substantial inherent uncertainty in estimating numbers and species that could be potentially taken, and the DWW take estimates reflect this uncertainty. Further, as it is highly unlikely that a cetacean or pinniped would dwell within the small areas encompassing the behavioral threshold zones for the modelled period of 24 hours these take estimates likely overestimate the amount of Level B take. The conservative nature of these estimates is designed to acknowledge the possibility that, although the likelihood is low, there could be Level B take associated with the geophysical surveys and DP thrusters used during geotechnical surveys.

7.1 Impact Analysis Framework

The impact level is determined by first selecting the appropriate consequence and likelihood descriptors from the definitions included in Tables 12 and 13.

Consequence levels reflect the impact that exposure to underwater sound from the Project would have on a species. In determining the consequence level, DWW has considered the sources of sound from each Project activity relative to existing noise levels in the environment.

Table 11. Impact Analysis Framework Consequence Descriptors

Consequence Level to Impacted Species				
Negligible	**Minor**	**Moderate**	**Major**	**Extreme**
Minimal impact in a localized area of little or no consequence to the species.	Low impact in a localized or regional area with a functional recovery within one year.	Moderate impact in a localized or regional area with a functional recovery of 1 to 5 years.	High impact in a localized or regional area with a functional recovery within 5 to 10 years.	High impact in a regional area with functional recovery in greater than 10 years, if at all.

Likelihood levels consider how probable it is for members of a functional hearing group or species to be impacted by exposure to noise from an activity associated with the Project. To determine likelihood we considered the following: the temporary and spatially explicit nature of the proposed survey work; the transient and seasonal nature of the species moving through the Project Area, and the ability of animals to move away from potential sound sources.

Table 12. Impact Analysis Framework Likelihood Levels

Likelihood of Harassment to Individual or Species from Sound Source				
Rare	**Unlikely**	**Likely**	**Almost certain**	**Certain**
Highly unlikely to occur but theoretically possible.	May occur within the life of the Project or activity.	Likely to occur during the life of the Project or activity.	Very likely to occur during the life of the Project or activity.	Will occur as a result of the Project or activity.

Risk is then determined by identifying the matching risk row and consequence column of the risk matrix shown below in Table 13, with the risk level given by the matrix cell which the risk row and consequence column intersect.

Table 13. Risk of Impact Assessment Matrix

Likelihood	Consequence				
	Negligible	Minor	Moderate	Major	Extreme
Rare	Low	Low	Low	Medium	High
Unlikely	Low	Low	Medium	Medium	High
Likely	Low	Medium	Medium	High	High
Almost certain	Medium	Medium	High	High	Critical
Certain	Medium	Medium	High	Critical	Critical

All sound sources from the proposed surveys are considered to have a 'negligible' consequence and 'rare' likelihood to species of marine mammals, relative to PTS onset (Level A harassment) because Level A take in the Project Area from the geophysical and geotechnical surveys was -0- for all species. The overall risk of impact to marine mammals for Level A harassment is considered 'low', though the risk is only theoretical because our take estimates are -0- for all species potentially transiting the area.

It is difficult to predict behavioral shifts (Level B harassment) due to anthropogenic sounds because the behavioral response of marine mammals to a perceived marine sound depends on a range of factors, including: (1) the sound pressure level (SPL); (2) frequency, duration, and novelty of the sound; (3) the physical and behavioral state of the animal at the time of perception; and (4) the ambient acoustic features of the environment (Hildebrand 2004). The radiation of sound through marine waters during the survey will generally be within the immediate vicinity of the survey equipment and effects are expected to be temporary. Consequently, Level B harassment for all species are ranked as negligible.

Although species abundance varies by season in the Project Area, the likelihood of Level B harassment from the geophysical and geotechnical surveys to individuals or species due to underwater sound ranges from 'rare' to 'likely' because of the transient and seasonal nature of the species moving through the Project Area and the ability of animals to move away from sound sources. Overall risk from underwater sound for each functional group and species is determined by identifying the matching risk row and consequence column of the risk matrix in Table 13. Risks for each functional hearing group of marine mammals from exposure to sound from the worst-case scenario survey equipment for Level B harassment are summarized in Table 14.

Table 14. Level B Harassment Risk to Marine Mammals

Functional Hearing Group	Activity/Equipment	Consequence	Likelihood	Risk
LF Cetaceans	HPC or Rossfelder Corer	Negligible	Rare	Low
	DP Thruster	Negligible	Rare	Low
	800 Joule GeoResources Sparker	Negligible	Unlikely	Low
	Sparker System	Negligible	Unlikely	Low
MF Cetaceans	HPC or Rossfelder Coret	Negligible	Rare	Low
	DP Thruster	Negligible	Rare	Low
	800 Joule GeoResources Sparker	Negligible	Unlikely	Low
	Sparker System	Negligible	Unlikely	Low
HF cetaceans	HPC or Rossfelder Coret	Negligible	Rare	Low
	DP Thruster	Negligible	Rare	Low
	800 Joule GeoResources Sparker	Negligible	Unlikely	Low
	Sparker System	Negligible	Unlikely	Low
Phocid Pinnipeds	HPC or Rossfelder Coret	Negligible	Rare	Low
	DP Thruster	Negligible	Rare	Low
	800 Joule GeoResources Sparker	Negligible	Unlikely	Low
	Sparker System	Negligible	Unlikely	Low

Note: Risk is not assessed for Level A take, because we do not expect Level A take to occur (see Table 9).

Based on the density estimates for the Project Area there are two whale species listed as endangered under the ESA that could realistically transit the Project Area that are classified as LF cetaceans: fin whales (*Balaenoptera physalus*) and North Atlantic right whales (*Eubalaena glacialis*).

All sound sources from the proposed surveys are considered to have no consequences to LF cetaceans with respect to Level A harassment or harm (PTS onset) as estimated take was -0-. Only 'negligible' consequences to LF cetaceans with respect to Level B Harassment (TTS; behavioral shifts). Because these animals are unlikely to dwell within the small areas encompassing the worst-case distance threshold zones for the modelled period of 24 hours they are ranked as 'rare' or 'unlikely' in terms of likelihood. **For this reason, risk of impacts to LF Cetaceans is considered to be low.**

Similarly, all sound sources from the proposed surveys are considered to have no consequences to MF and HF cetaceans and phocid pinnipeds with respect to Level A harassment or harm (PTS onset) and only negligible consequences to MF and HF cetaceans and phocid pinnipeds. Because the modeled Level B take estimates for vibracores and DP thrusters are so low we consider the likelihood of impacts from this equipment to be rare for these species. The two sparker systems modelled do indicate Level B take, hence we consider the likelihood of impact to be "likely" for MF and HF cetaceans and phocid pinnipeds. However, because these animals are unlikely to dwell within the small areas encompassing the threshold zones for the modelled period of 24 hours we consider the likelihood of impact to be "unlikely". **For this reason, risk of impacts to MF and HF cetaceans and phocid pinnipeds is considered to be low.**

8.0 Anticipated Impacts on Subsistence Uses on Subsistence Uses

The proposed activity in the Project Area will not affect Arctic marine mammals that are harvested for subsistence use. Therefore, there are no relevant subsistence uses of marine mammals implicated by this action as identified in MMPA Section 101(a)(5)(A)(i).

9.0 Anticipated Impacts on Habitat

Bottom disturbance associated with the proposed survey activities may include vibracores, CPTs, and grab sampling to validate the seabed classification obtained from the multibeam echosounder/ sidescan sonar data. Although there could be some small, localized and temporary impacts to benthic habitat and prey during the G&G survey, long term impacts or effects to the survival of listed marine mammal species due to these small and temporary impacts to prey are not thought to occur. There is potential for marine mammal avoidance and or abandoning due to project activities, however population level impacts are not expected. In addition, these potential small and localized impacts to benthic habitat will not cause any significant impacts to principal constituent elements (PCAs) such that the survival of a listed marine mammal or their critical habitat would be impacted.

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. Because marine mammals are traveling such long distances and the impacts to habitat from this G&G study are very localized and short term we do not believe that marine mammal species will be impacted, nor do we believe that this project will cause jeopardy to any listed species.

11.0 Mitigation Measures

The Applicant commits to engaging in ongoing consultations with the NOAA-NMFS. Per the Lease, the Applicant has committed to following a comprehensive set of mitigation measures during marine site characterization surveys. The mitigation procedures outlined in this section are based on protocols and procedures that have been successfully implemented for similar offshore projects and were previously approved by NOAA-NMFS (ESS 2013; Dominion 2013 and 2014; DWBI 2016).

11.1 Vessel Strike Avoidance Procedures

DWW will ensure that vessel operators and crew maintain a vigilant watch for cetaceans and pinnipeds, and slow down or stop 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. During survey operations, vessel strike avoidance measures will include 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 will comply with 10 knot (<18.5 km per hour [km/h]) speed restrictions in any Dynamic Management Area (DMA).
- All survey vessels will maintain a separation distance of 500 m 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/h) or less until the 500 m minimum separation distance has been established. If a North Atlantic right whale is sited in a vessel's path, or within 100 m 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 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 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 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 will maintain a separation distance of 50 m (164 ft) or greater from any sighted pinniped.

There will be a Project Specific DWW Protected Species Observer (PSO) training program initiated 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 the NMFS North Atlantic right whale reporting systems for the presence of North Atlantic right whales throughout survey operations. The proposed survey activities will, however, occur outside of the seasonal management area (SMA) located off the coast of Massachusetts and Rhode Island.

Throughout all survey operations, DWW will monitor the NMFS North Atlantic right whale reporting systems for the establishment of a DMA. If NMFS should establish a DMA in the area where survey is planned, DWW will work with NMFS within 24 hours to alter the survey plans to avoid the DMA.

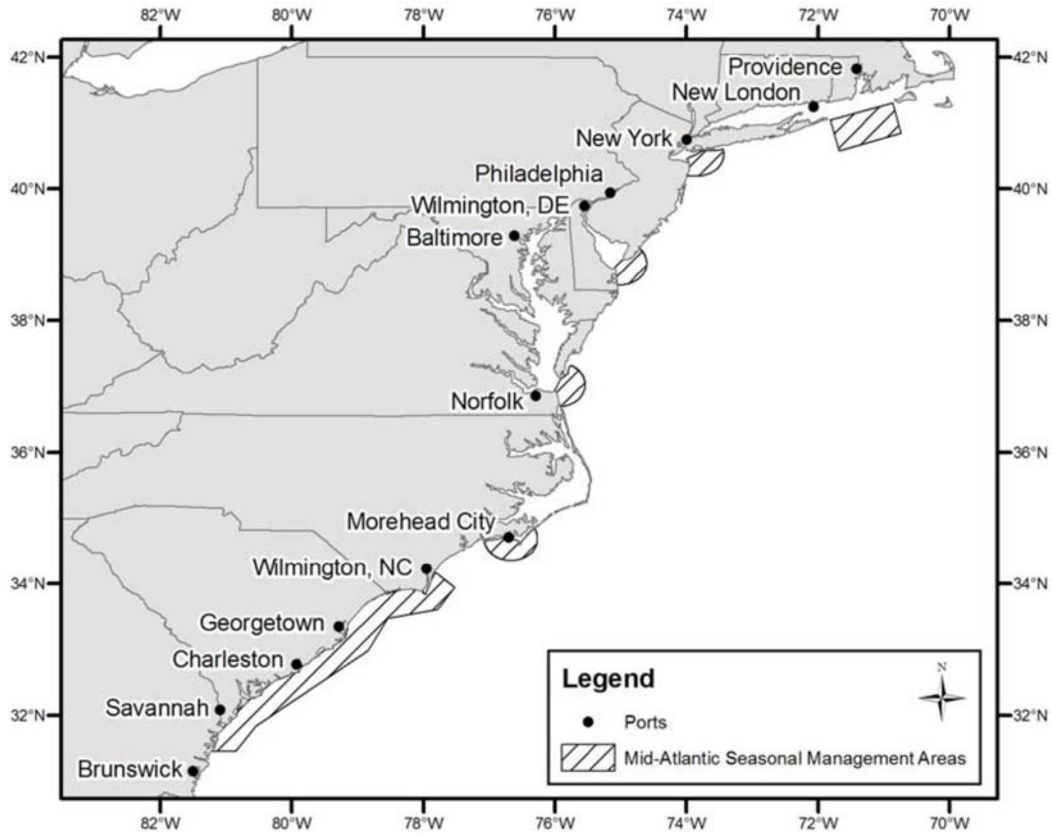

Figure 3. Seasonal Management Area, Mid-Atlantic U.S. (Mandatory Speed Restriction November 1 through April 30)

Source: http://www.fisheries.noaa.gov/pr/pdfs/shipstrike/map_sma.pdf

11.3 Visual Monitoring Program

Based on a recent hydroacoustic modeling assessment for an almost identical project in the same area (Tetra Tech 2016), DWW proposes to employ the following conservative exclusion zones during survey activities:

- A 400-m exclusion zone during geophysical surveys when the sub-bottom profiler (sparker) is in operation
- A 200-m exclusion zone during geophysical surveys when all other equipment is in operation
- A 200-m exclusion zone when the DP drill barge is operating

An exclusion zone is an area established for the PSOs to monitor for the presence of marine mammals. Its radial distance from the sound source (geophysical survey equipment) is derived from the hydroacoustic modeling. While these exclusion zones (200-m and 400-m) were suggested in the modeling assessment conducted by Tetra Tech (2016), these exclusion zones are also in compliance with BOEM Lease #OCS-A-0486 stipulations 4.3.6.1 and 4.3.6.1.1. If an exclusion zone does not encompass the 180 dB Level A Harassment radius calculated for the acoustic source having the highest source level (i.e. sparker), an expanded exclusion zone (>200-m) may be required by the Lessor. DWW has adopted this 400-m exclusion zone for the sparker as a conservative measure.

Visual monitoring of the established exclusion zone(s) will be performed by qualified and NMFS-approved 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 the survey 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. Each PSO will monitor 360 degrees of the field of vision. Per the Lease requirements, the DWW 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.

PSOs will be responsible for visually monitoring and identifying marine mammals approaching the established exclusion zone(s) during survey activities. 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.

PSOs will be equipped with binoculars and can 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. During night operations, PAM, night-vision equipment with infrared light-emitting diodes spotlights, and infrared video monitoring will be used. 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 PSOs will occur when alerted of a marine mammal presence.

The PSOs will begin observation of the exclusion zone(s) at least 60 minutes prior to ramp-up of geophysical survey equipment. Use of noise-producing equipment will not begin until the exclusion zone is clear of all marine mammals for at least 60 minutes.

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; latitude and longitude; weather information; details of the sightings (e.g., species, age classification [if known], numbers, behavior); and details of any observed take (behavioral disturbances, injury or mortality) of marine mammals. The data sheet templates will be provided to 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. A briefing will also be conducted between the survey supervisors and crews, the PSOs, and DWW. 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.

11.4 Passive Acoustic Monitoring Program

To support 24-hour survey operations, the Applicant will include PAM as part of the project monitoring during the geophysical and geotechnical survey programs during night time operations to provide for optimal acquisition of species detections at night. Given the range of species that could occur in the Lease 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.

11.5 Exclusion Zone Implementation

An exclusion zone out to the 160 dB_{RMS} re 1 μPa isopleth for noise has been established to minimize impacts to marine mammals during geophysical and geotechnical survey activities. DWW will establish a 200-m default exclusion zone for all geophysical and geotechnical survey operations. However, per the results of the acoustic analysis, a larger 400-m exclusion zone will be established during the operation of the sparker. These monitoring zones represent the maximum area of coverage. At all times, the vessel operator will maintain a separation distance of 500 m from any sighted North Atlantic right whale as stipulated in the vessel strike avoidance procedures (Section 11.1). These stated requirements will be included in the site-specific training to be provided to the survey team. These exclusion zones will be field verified (see Section 13.0), adjusted as necessary, and monitored for individual take during survey activities as described in Section 1.2.

11.6 Ramp-Up Procedures

Where technically feasible, a ramp-up procedure will be used for geophysical survey equipment capable of adjusting energy levels at the start or re-start of survey activities. A ramp-up procedure will be used at the beginning of geophysical survey activities in order to provide additional protection to marine mammals by allowing them to vacate the area prior to the commencement of survey equipment use. The ramp-up procedure will not be initiated during daytime, night time, or periods of inclement weather if the exclusion zone cannot be adequately monitored by the PSOs using the appropriate visual technology and/or PAM for a 60-minute period. A ramp-up would begin with the power of the smallest acoustic geophysical 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. If marine mammals are sighted within the survey exclusion zone prior to or during the ramp-up, activities will be delayed until the animal(s) has moved outside the monitoring zone and no marine mammals are sighted for a period of 60 minutes.

The DP vessel thrusters will be engaged from the time the vessel leaves the dock. Therefore, there is no opportunity to engage in a ramp up procedure.

11.7 Shut-Down and Power-Down Procedures

The exclusion or shut-down zone(s) around the geophysical and geotechnical survey equipment will be monitored, as previously described, by PSOs and at night by PAM operators for the presence of marine mammals before, during, and after any noise-producing activity. The vessel operator must comply immediately with any call for shutdown by the Lead PSO. Any disagreement should be discussed only after shutdown.

Geophysical Survey Equipment:

If a non-delphinoid cetacean is sighted at or within the established exclusion zone (200-m default during geophysical survey equipment use; 400-m exclusion zone during the operation of the sparker), an immediate shutdown of the survey equipment is required. Subsequent restart of the survey equipment must use the ramp-up procedures described above and may only occur following clearance of the exclusion zone of all cetaceans and pinnipeds for 60 minutes.

If a delphinoid cetacean or pinniped is sighted at or within the exclusion zone, the geophysical survey equipment 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. An incursion into the exclusion zone by a non-delphinoid cetacean during power down requires implementation of the shut-down procedures as described above.

If the geophysical sound source 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 survey equipment is required using the full ramp-up procedures and clearance of the exclusion zone of all cetaceans, pinnipeds for 60 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 the geophysical survey equipment is required using the full ramp-up procedures and clearance of the exclusion zone for all cetaceans and pinnipeds for 60 minutes.

DP Vessel for Geotechnical Survey:

During the geotechnical survey DP thrusters will be engaged at all times. During DP vessel operations if marine mammals enter or approach the established exclusion zone, DWW proposes to reduce DP thruster to the maximum extent possible, except under circumstances when ceasing DP thruster use would compromise safety (both human health and environmental) and/or the integrity of the Project. Reducing thruster energy will effectively reduce the potential for exposure of marine mammals to sound energy. Normal use may resume when PSOs report that the monitoring zone has remained clear of marine mammals for a minimum of 60 minutes since last the sighting.

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

Field verification of the exclusion zones will be conducted to determine whether the proposed zones are adequate to minimize impacts to marine mammals. DWW will submit a plan for verifying the sound source levels of any electromechanical survey equipment operating at frequencies below 200 kHz to BOEM no later than 45 days prior to the commencement of the field verification activities.

13.2 Reporting

DWW will ensure compliance with the following reporting requirements for site characterization activities performed in support of the COP submittal:

- DWW will contact BOEM and NOAA-NMFS within 24 hours of the commencement of survey activities and again within 24 hours of the completion of the activities.
- DWW will ensure that sightings of any injured or dead marine mammals are reported to the NOAA-NMFS Northeast Region's Stranding Hotline (800-900-3622 or current) within 24 hours of sighting, regardless of whether the injury or death is caused by a Project vessel. The notification of any strike will include the date and location (latitude/longitude) of the strike, the name of the vessel involved, and the species identification or a description of the animal, if possible. If the Project activity is responsible for the injury or death, DWW will ensure that the vessel assist in any salvage effort as requested by NOAA-NMFS.
- DWW will provide the BOEM and NOAA-NMFS with a report within 90 calendar days following the completion of the geophysical and geotechnical sampling activities that includes a summary of the survey activities and an estimate of the number of listed marine mammals observed or taken during these survey activities.
- Data on all protected-species observations will be recorded based on standard marine mammal observer collection data by PSOs. This information will include: dates, times, and locations of survey operations; time of observation, location and weather; details of marine mammal sightings (e.g., species, numbers, behavior); and details of any observed taking (e.g., behavioral disturbances or injury/mortality).
- In addition to DWW's reporting requirements outlined above, DWW will provide an assessment report of the effectiveness of the various mitigation techniques, i.e., visual observations during day and night, compared to the PAM detections/operations. This will be submitted to BOEM and NOAA-NMFS 30 days after the completion of geophysical survey.

14.0 Suggested Means of Coordinated Research

All marine mammal data collected by DWW during marine characterization survey activities will be provided to NOAA-NMFS, BOEM, and other interested government agencies, and be made available upon request to educational institutions and environmental groups.

Any hydroacoustic data and resulting transmission loss rates collected during field verification of the safety and/or exclusion zone by DWW during geophysical surveys will be provided to NOAA-NMFS, BOEM and other interested government agencies, and be made available upon request to educational institutions and environmental groups.

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