DEEPWATERWIND

April 18, 2018

Ms. Jolie Harrison, Division Chief
Permits and Conservation Division
Office of Protected Resources
National Marine Fisheries Service
1315 East-West Highway
Silver Spring, MD 20910

RE: Request for the Taking of Marine Mammals Incidental to Marine Site Characterization Surveys

Dear Ms. Harrison:

Deepwater Wind New England, LLC (Lessee), the holder of the Outer Continental Shelf Lease #OCS-A 0486 in the Rhode Island Massachusetts Wind Energy Area (RI MA WEA), respectfully submits the enclosed revised application to the National Oceanic and Atmospheric Administration, National Marine Fisheries Service requesting the issuance of an Incidental Harassment Authorization. This application is submitted pursuant to Section 101(a)(5) of the Marine Mammal Protection Act and 50 Code of Federal Regulations § 216 Subpart I to allow for the incidental harassment of small numbers of marine mammals resulting from the execution of marine site characterization surveys.

The Lessee intends to conduct marine site characterization surveys in the area of Lease #OCS-A 0486 and along potential submarine cable routes to landfall location options in Massachusetts, Rhode Island, and Long Island, New York. Site characterization activities, consisting of geophysical and geotechnical surveys, are proposed to be conducted between May 15, 2018 and December 31, 2018.

If you have any questions regarding the enclosed application, please do not hesitate to contact me at 401-648-2644 or swilson@dwwind.com.

Sincerely,

Stephanie Wilson
Director of Permitting and Environmental Affairs

cc: Jordan Carduner – NMFS OPR, *via email*
Julie Crocker – NOAA Fisheries, *via email*
Jessica Stromberg – BOEM, *via email*

Application for Incidental Harassment Authorization for the Non-Lethal Taking of Marine Mammals:

Site Characterization Surveys
Rhode Island-Massachusetts Wind Energy Area

Prepared by:

CSA Ocean Sciences

Prepared for:

Deepwater Wind New England, LLC

16 April 2018

Application for Incidental Harassment Authorization for the Non-Lethal Taking of Marine Mammals: Site Characterization Surveys

DOCUMENT NO.CSA-DEEPWATERWIND-FL-18-80520-3182-02-REP-01-FIN-REV01

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01	11/22/17	Initial draft for review	M.J. Barkaszi J. Martin	B. Douglas	M.J. Barkaszi
02	01/3/18	Revised draft	M.J. Barkaszi J. Martin	M. Cahill	M.J. Barkaszi
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List of Acronyms

μPa	microPascal
ANSI	American National Standards Institute
BOEM	Bureau of Ocean Energy Management
BSEE	Bureau of Safety and Environmental Enforcement
CETAP	Cetacean and Turtles Assessment Program
CetMap	Cetacean Density and Distribution Mapping Working Group
CFR	Code of Federal Regulations
COP	Construction and Operations Plan
cm	centimeter
CPT	cone penetration testing
dB	decibel
DMA	Dynamic Management Area
DoN	U.S. Department of the Navy
DP	dynamically positioned
DWW	Deepwater Wind, LLC
EA	Environmental Assessment
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ft.	foot
GPS	global positioning system
Hz	hertz
IHA	Incidental Harassment Authorization
in	inch
IUCN	International Union for the Conservation of Nature
IWC	International Whaling Commission
ISO	International Organization for Standardization
km	kilometer
km^2	square kilometer
kph	kilometer per hour
kn	knots
kHz	kilohertz
Lease Area	Outer Continental Shelf (OCS) Lease Area #OCS-A 0486
m	meter
MABS	Mid-Atlantic Baseline Studies / Maryland Baseline Studies
mi	mile
MMPA	Marine Mammal Protection Act
msec	millisecond
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
OPAREA	Operations Area
OPR	Office of Protected Resources
PBR	Potential Biological Removal
PK	peak sound pressure level

List of Acronyms (Continued)

Project Area	RI-MA lease area and associated cable corridors
PSO	Protected Species Observer
PTS	permanent threshold shift
RAM	Range-Dependent Acoustic Model
RI-MA WEA	Rhode Island-Massachusetts Wind Energy Area
RL	received level
RMS	root mean square
rpm	rotations per minute
SAP	Site Assessment Plan
SAR	Stock Assessment Report
ScOT	Screen Out Team
SEL	sound exposure level
SL	source level
SMA	Seasonal Management Area
SOC	Standard Operating Conditions
SPL	sound pressure level
sq mi	square mile
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 Description of Proposed Activities

The Applicant submits this request for Incidental Harassment Authorization (IHA) pursuant to Section 101(a)(5) of the Marine Mammal Protection Act (MMPA) for incidental take of small numbers of marine mammals by Level B harassment during high-resolution geophysical (HRG) and geotechnical surveys conducted as part of site characterization activities. The information provided in this document is submitted in response to the requirements of 50CFR § 216.104 to allow for the incidental harassment of small numbers of marine mammals resulting from the execution of marine site characterization surveys.

1.1 PROJECT DESCRIPTION

Deepwater Wind New England, LLC (DWW) (Applicant) on its behalf and on behalf of any successors in interest or assignee, submits this application to the National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS) requesting the issuance of an IHA to allow for the incidental harassment of small numbers of marine mammals resulting from the execution of marine site characterization (geophysical and geotechnical) surveys. DWW is proposing to conduct marine site characterization surveys (geophysical and geotechnical) within federal waters located in the area of 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 landfall location options in New York, Rhode Island, and Massachusetts. **Figure 1** shows the Rhode Island-Massachusetts Wind Energy Area (RI-MA WEA) and project boundaries for the site characterization surveys, including potential cable routes.

The Applicant proposes to conduct site characterization surveys of the Project Area using active acoustic sources and geotechnical sampling equipment. The site characterization surveys will include up to 200 days of geophysical surveys and up to 100 days of geotechnical surveys between June 15, 2018 and December 31, 2018.

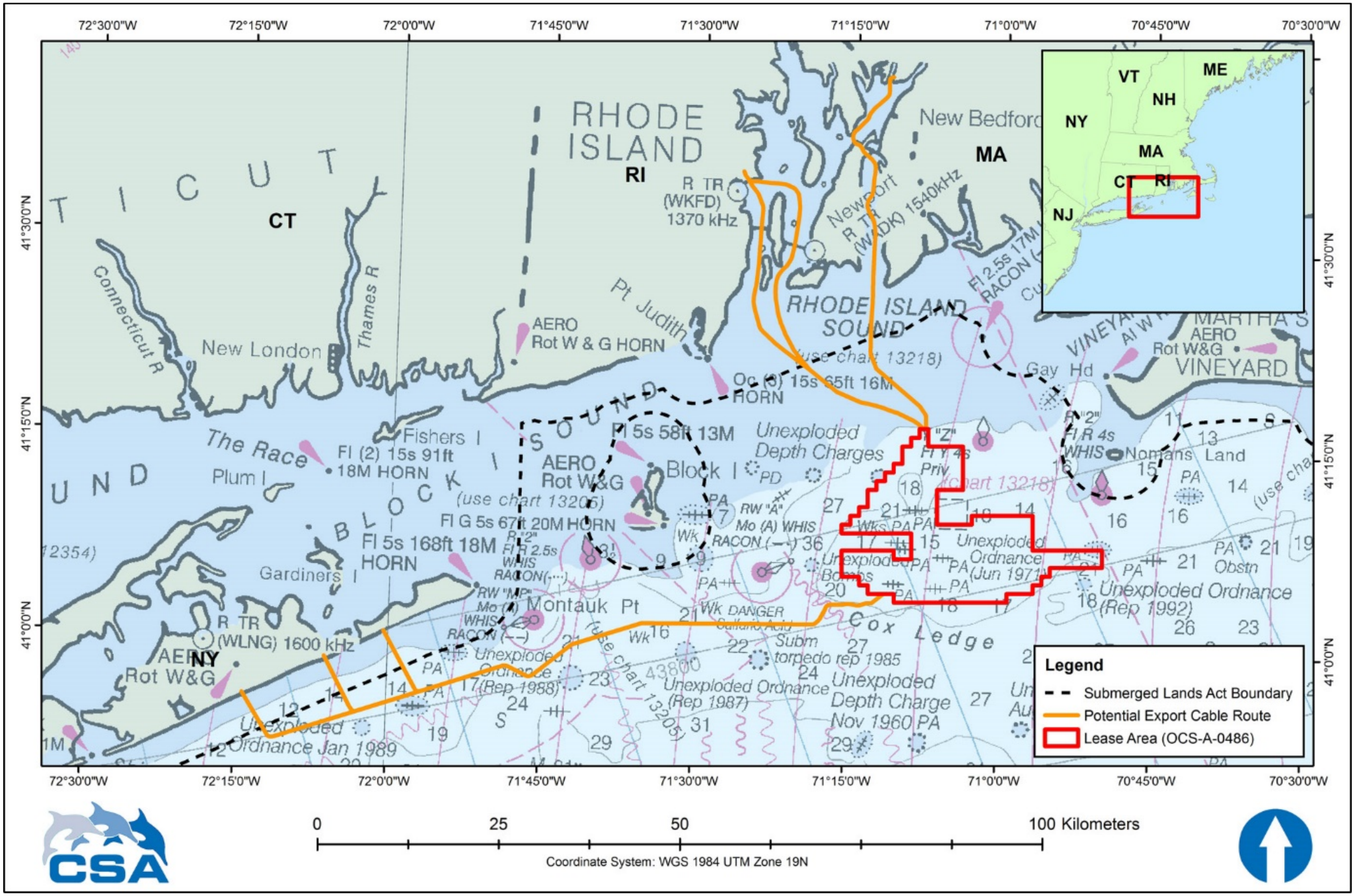

Figure 1. Location of the Rhode Island-Massachusetts Wind Energy Area and project boundaries for the site characterization surveys.

1.2 ACTIVITIES CONSIDERED IN APPLICATION

Site characterization surveys will include HRG surveys and geotechnical investigations, utilizing the survey methods and acoustic sources identified below. Survey activities will be executed in compliance with the July 2015 Bureau of Ocean Energy Management (BOEM) *Guidelines for Providing Geophysical, Geotechnical, and Geohazard Information Pursuant to 30 CFR Part 585*.

1.2.1 Geophysical Surveys

Geophysical surveys propose to use the equipment described below.

- **Multibeam Depth Sounder** to determine water depths and general bottom topography. The multibeam echosounder sonar systems project sonar pulses in several angled beams from a transducer mounted to a ship's hull. The beams radiate out from the transducer in a fan-shaped pattern orthogonally to the ship's direction.

- **Shallow Penetration Sub-Bottom Profiler (Chirp)** to map the near-surface stratigraphy (top 0 to 5 m of sediment below seabed). A Chirp system emits sonar pulses that increase in frequency (3.5 to 200 kHz) over time. The pulse length frequency range can be adjusted to meet project variables.

- **Medium Penetration Sub-Bottom Profiler (Boomer)** to map deeper subsurface stratigraphy as needed. A boomer is a broad-band sound source operating in the 3.5 Hz to 10 kHz frequency range. This system is commonly mounted on a sled and towed behind a boat.

- **Medium Penetration Sub-Bottom Profiler (Sparker and/or bubble gun)** to map deeper subsurface stratigraphy as needed. Sparkers create acoustic pulses from 50 Hz to 4 kHz omni directionally from the source that can penetrate several hundred meters into the seafloor. Hydrophone arrays towed nearby receive the return signals.

- **Seafloor Imaging (Sidescan Sonar Survey)** for seabed sediment classification purposes and to identify natural and man-made acoustic targets on the seafloor. The sonar device emits conical or fan-shaped pulses down toward the seafloor in multiple beams at a wide angle, perpendicular to the path of the sensor through the water. The acoustic return of the pulses is recorded in a series of cross-track slices, which can be joined to form an image of the sea bottom within the swath of the beam.

- **Marine Gradiometer** to detect ferrous metal objects on and below the seafloor which may cause a hazard including anchors, chains, cables, pipelines, ballast stones and other scattered shipwreck debris, munitions of all sizes, unexploded ordinances, aircraft, engines and any other object with magnetic expression.

- **Acoustic Cores** to provide multi-aspect acoustic intensity imaging to delineate sub-seabed stratigraphy and buried geohazards.

1.2.2 Geotechnical Investigation

Geotechnical surveys propose to use the equipment described below.

- **Vibracores** to characterize the geological and geotechnical characteristics of the seabed, up to approximately 5 meters (m) (16.4 feet [ft]) deep. A hydraulic or electric-driven pulsating head is used to drive a hollow tube into the seafloor and recover a stratified representation of the sediment.

- **Cone Penetration Testing (CPT)** to determine stratigraphy and *in-situ* conditions of the sediments. Target penetration is 60- to 75-m. While CPT is proposed as part of the geotechnical investigation, the equipment used to conduct CPT activities does not produce sound levels that could harass marine mammals.

- **Deep Boring Cores** to determine the vertical and lateral variation in seabed conditions and provide geotechnical data to depths at least 10 m deeper than design penetration of the proposed foundations. Target penetration is 60- to 75-m.

1.2.3 Vessel Activity

The proposed site characterization surveys will be conducted utilizing multiple vessels due to water depth limitations. The survey in deep water will be conducted using an approximately 45- to 60-m (150- to 200-ft) vessel, while smaller vessels, proposed for surveying in shallower nearshore areas, will range from 7 to 22 m (24 to 74 ft). Deep geotechnical survey activities may be conducted from an 80- to 100-m (250- to 300-ft) lift vessel or dynamically positioned (DP) vessel with support of a tug boat. The final vessel choices will vary depending on the final survey design, vessel availability, and survey contractor selection.

1.2.4 Acoustic Analysis of Proposed Activities

Acoustic Terminology

Acoustic source levels, exposure levels, and associated measurements are expressed in decibels (dB). The dB is a logarithmic unit that must be referenced to the measurement properties. In the case of underwater acoustics, the dB is used as a unit of sound pressure level (SPL) referenced to 1 µPa. In turn, SPL units can be expressed in several ways depending on the measurement properties (**Table 1**). Expression of acoustic measurement units throughout this document use the glossary terms in the 2016 National Marine Fisheries Service (NMFS) *Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts*. The unit standard used in this document may be different from other reference documents, including Southall et al. (2007) and ISO (2017); however, for consistency purposes with the NMFS document, the terminology listed in **Table 1** is used for all referenced units.

Table 1. Sound pressure level (SPL) definitions and units of measurement used in this document.

Metric	Definition (NMFS, 2016)	Units	Expression
0 to Peak SPL	Maximum absolute value of the amplitude of a pressure time series without weighting.	dB re 1 µPa	PK
Root-mean-square SPL	The square root of the average of the square of the pressure of the sound signal over a given duration (usually 1 second).	dB re 1 µPa	RMS SPL
Source Level	The acoustic pressure at a specified distance, usually 1 m. If measurement is anything other than 1 m, specify distance.	dB re 1 µPa @ 1 m	SL
Received Level	The SPL measured at the receiver, can be expressed in peak or rms.	dB re 1 µPa	$RL_{pk\ (or)\ rms}$
Cumulative Sound Exposure Level	A measure of sound level that takes into account the duration of the signal. Ten times the logarithm to the base 10 of the ratio of a given time integral of squared instantaneous frequency-weighted sound pressure.	dB re 1µPa^2 s	SEL_{cum}

SPL = sound pressure level

Regulatory Criteria

The included analysis applies the most recent noise exposure criteria utilized by NMFS, Office of Protected Resources (OPR) to estimate harassment (NMFS, 2016). The MMPA defines two levels of harassment. Level A harassment is statutorily defined as any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild. The MMPA defines Level B harassment 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. The NMFS acoustic criteria were purposely developed to be protective of all marine mammal species from exposure to high SPL, primarily to address the regulatory requirements of the MMPA. In 2016, NMFS published acoustic guidance thresholds for marine mammals for use in impact assessment.

Hearing Groups

Recognizing that marine mammal species do not have equal hearing capabilities, marine mammals are separated into hearing groups (NMFS, 2016). There are three hearing groups of the marine mammals potentially occurring in the Project Area:

- Low-frequency (LF) cetaceans – Mysticetes with a collective generalized hearing range of approximately 7 Hz to 35 kHz;
- Mid-frequency (MF) cetaceans – Most dolphins, all toothed whales except for *Kogia* spp., and all beaked and bottlenose whales with a generalized hearing range of approximately 150 Hz to 160 kHz; and
- High-frequency (HF) cetaceans – All true porpoises, river dolphins, *Kogia* spp., *Cephalorhynchid* spp. (genus in the dolphin family, Delphinidae), and two species of *Lagenorhynchus* (Peale’s and hourglass dolphins) with a generalized hearing range of approximately 275 Hz to 160 kHz.

The 2016 guidance also defines otariid and phocid pinniped underwater hearing groups. In addition, NMFS recognizes two main types of sound sources: impulsive and non-impulsive. These are further broken down into operational categories such as intermittent and moving or stationary sources. The sound sources of potential concern during site characterization surveys include stationary non-impulsive sources and moving impulsive sources. The acoustic thresholds are used to establish the ensonified area of received SPL or cumulative SPL (SEL_{cum}), depending on the source type and marine mammal hearing group.

Impact Levels

Level A auditory impacts under the MMPA include permanent threshold shift (PTS), which is a condition that occurs when sound intensity is very high and/or of such long duration that the result is a permanent loss of hearing sensitivity which is an irreversible auditory tissue injury (Southall et al., 2007). Level A thresholds are defined as sound exposures that potentially illicit the onset of a PTS in marine mammal hearing

Level B harassment impacts include temporary threshold shift(s) (TTS) and behavioral responses. Compared to PTS, TTS is a lesser impact to hearing. TTS results when sounds of sufficient loudness cause a transient condition in which an animal's hearing sensitivity over the frequency band of exposure is impaired for a period of time (minutes to days). A TTS does not cause permanent damage and is not considered a tissue injury (Richardson et al., 1995; Southall et al., 2007). Similarly, underwater sound may illicit a behavioral response from marine mammals, that may or may not be biologically significant. In principle, behavioral thresholds are lower than TTS thresholds. TTS

thresholds are defined in the 2016 criteria; however, TTS thresholds and behavioral response thresholds have not yet been separated within a regulatory framework and are all considered Level B harassment. NMFS currently uses a step function at an unweighted RMS SPL to assess Level B behavioral impacts (NMFS 2005, 2016).

Because TTS and behavioral thresholds have not been separated within the regulatory criteria (i.e., both TTS and behavioral disturbance constitute Level B take) and because pure behavioral disturbance thresholds have not yet been defined, the regulatory framework uses interim guidance to define Level B thresholds (NMFS, 2005). The corresponding Level A and Level B acoustic threshold criteria are summarized in **Table 2**.

Table 2. Summary of interim (2005) and existing (2016) National Marine Fisheries Service (NMFS) regulatory levels for Level A and Level B acoustic exposure from impulsive and non-impulsive sources.

Marine Species Acoustic Threshold Levels For Impulsive and Non-Impulsive Sources					
Source Type	Non-Impulsive		Impulsive - Peak		Impulsive - Cumulative Exposure
Functional Group	Level B[1]	Level A[2]	Level B[1]	Level A[3]	Level A[2]
Low Frequency Cetacean	120‡	199†	160‡	219†	183†
Mid Frequency Cetacean		198†		230†	185†
High Frequency Cetacean		173†		202†	155†
Phocid Seals (in water)		201†		218†	185†

† National Marine Fisheries Service. 2016. Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing: Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Dept. of Commerce NOAA. NOAA Technical Memorandum NMFS-OPR-55, 178 pp.
‡ National Marine Fisheries Service. 2005. Endangered Fish and Wildlife; Notice of Intent to Prepare an Environmental Impact Statement 70 Fed. Reg. 1871. pp 1871-1875. Available online at http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/threshold_guidance.html.
[1] Units expressed as RMS SPL dB re 1 µPa.
[2] Units expressed as SELcum dB re 1µPa2 s (Weighted).
[3] Units expressed as Lpk,flat dB re 1 µPa.

Equipment and Vessel Assessment

A summary of the proposed geophysical equipment is provided in **Table 3**; a summary of geotechnical equipment along with representative DP vessels are provided in **Table 4**. Source information was retrieved from equipment specifications within the application to 82 FR 22250 (*Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to Site Characterization Surveys off the Coast of New York*) when field, published, or manufacturer information was not available. The final equipment choices will vary depending on the final survey design, vessel availability, and survey contractor selection.

Table 3. Summary of representative project source levels (SL) and operating parameters for geophysical survey equipment.

Manufacturer	Equipment	Operating Frequencies (kHz)	95% frequency (kHz) contour	Source Level (SL_{rms} dB re 1 µPA @ 1 m)	Source Operational Depth (meters below surface)	Beam width (degrees)	Pulse Duration (milliseconds)	1/Repetition rate
Multibeam Depth Sounding								
Reson†	SeaBat 7125[1]	200 and 400	-	220	4	128	0.03 to 0.3	-
Reson†	SeaBat 7101[2]	100	-	162	2 to 5	140	0.8 to 3.04	-
R2SONIC†	Sonic 2020[1]	170 to 450	-	162	2 to 5	160	0.11	-
Shallow Sub-bottom Profiling:								
Teledyne Benthos	Chirp III[3]	2 to 7	3.5	197	4	45	0.2[6]	0.5[6]
EdgeTech	SB 3200 XS SB216[4a]	2 to 16	9	176	2 to 5	170	3.4	0.5[6]
Medium Penetration Sub-bottom Profiling								
Applied Acoustics Engineering	Fugro boomer[1]	0.1 to 10	Information or suitable proxy not available[7]	175	1 to 2	60	58	2.48[1]
Applied Acoustics Engineering	S-Boom System - CSP-D 2400HV power supply and 3-plate catamaran (600 joules/ pulse)[4]	0.250 to 8	6.3	203	2	25 to 35	0.6	2.48[1]
Geo-Resources (S) PTE LTD	800 Joule Sparker[4b]	0.75 to 2.75	1.9	203	4	360	0.1 to 0.2	2.48[1]
PanGeo Subsea	Acoustic Corer	1.5-115[‡]	6	177.5[‡]	seabed	-	481.5	16.6
Falmouth Scientific, Inc.	HMS 620 Bubble Gun[4c]	.02 to 1.7	1.6	196	1.5	360	1.6	2.48[1]
Applied Acoustics Engineering	Dura-Spark 240[4]	0.03 to 5	3.2	213	1 to 2	170	2.1	2.48[1]
Sidescan Sonar								
Klein Marine Systems, Inc.†	Model 3900	445 and 900	-	242	20	40	0.025	-
EdgeTech†	Model 4125	105 and 410	-	225	10	158	10 to 20	-
EdgeTech†	Model 4200	300 and 600	-	215 to 220	1	0.5 and 0.26	5 to 12	-

Table 3. (Continued).

[1] Source information retrieved from equipment specifications provided in the application submitted for 82 FR 22250 (*Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to Site Characterization Surveys Off the Coast of New York*).
[2] Source level based on published manufacturer specifications and/or systems manual.
[3] Due to lack of specifics provided, assumed configured as TTV-171 with AT-471 transducer per System Manual
[4] Crocker and Fratantonio, 2016.

a. Assume to be 3200 XS with SB216. Used as proxy: 3200 XS with SB424 in 4-24 kHz mode Since the 3200 XS system manual lists same power output between SB216 and SB 424.
b. Used ELC820 as proxy.
c. Used single plate 1 due to discrepancies noted in Crocker and Fratantonio (2016) regarding plate 2.

[5] Source level reported for 1,000 j operating level which is the expected maximum.
[6] Data from CSA Ocean Sciences HRG field survey (unpublished).
[7] User spreadsheet not carried through in analysis because operating frequencies were not available for the source or suitable proxy.
[†] Source levels not applicable based on ScOT report (BOEM, 2017). For these sources, the user spreadsheet entries are not provided as they were not carried forward in analysis.
‡ Equipment contains three separate sources; data represents the two low frequency sources combined.

Table 4. Summary of representative project source levels (SL) and operating parameters for geotechnical survey equipment.

Manufacturer	Equipment	Operating Frequencies (kHz)	95% frequency (kHz) contour	Source Level (SL_{rms} dB re 1 µPa @ 1 m)	Source Operational Depth (meters below surface)
Deep Bore Coring					
Fugro	Seafloor Drill	0.2 to 20	20[4]	145[1]	Seafloor
Fugro	Piggyback Drill	0.2 to 20	20[4]	145[1]	Seafloor
Fugro	C25 Marine Drill	0.2 to 20	20[4]	145[1]	Surface
Fugro	SeaDevil	0.2 to 20	20[4]	145[1]	Seafloor
Vibracores					
Alpine Ocean Seismic Survey, Inc.	Model P	Unknown	20[4]	Unknown[2]	20
Rossfelder Corporation	Model P3	10 to 20	20[4]	185[2]	20
DP Thrusters					
80 to 100 m geotechnical vessel	Thruster	0.1 to 10	10[4]	150[3]	5

[1] Erbe and McPherson, 2017.
[2] Source information retrieved from equipment specifications within 82 FR 22250 (*Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to Site Characterization Surveys Off the Coast of New York*).
[3] Based on predicted source levels produced by R/V Fugro Explorer DP thrusters operating at 50% power.
[4] The upper limit of the range was used for the User Spreadsheet to provide a conservative estimate of the impact isopleths because the upper frequencies will produce larger isopleths for high-frequency species with minimal effect on low- and mid-frequency isopleths.

There is limited measured source level information for geotechnical operations. The source information for the deep bore coring used proxy equipment specifications described in Erbe and McPherson (2017). The core drill described in Erbe and McPherson (2017) was mounted on a medium sized jack-up barge that was raised above the sea surface and wave height and used an 83-mm drill bit rotating at 1,500 to 1,600 revolutions per minutes (rpm). Cores were drilled to a maximum depth of 20 m. The *in-situ* measurements were collected within close proximity (10 to 50 m) to the drill string.

In comparison, the proposed drilling equipment is a mix of seafloor and vessel-based rigs that accommodate up to a 73-mm bit spinning at 200 to 660 rpm. The planned target core depth is 60- to 75-m. Both types of drill rigs (seafloor- and surface-driven) produce similar sound levels while collecting core samples. The slightly smaller bit size combined with the slower revolution should produce lower sound levels than those described for the proxy. To maintain the conservative approach of this document, the published SL for the proxy was used for calculations (**Table 4**).

HRG Sources

Operation of certain geophysical equipment has the potential to cause acoustic harassment to marine species, in particular marine mammals (NMFS, 2016). Operating mode, frequency, and beam direction all affect sound propagation. HRG survey impacts, therefore, will be largely driven by the specification of individual HRG sources. HRG sources were addressed extensively in the Environmental Assessment (EA) prepared by BOEM for site assessment activities on the Atlantic OCS offshore New Jersey, Delaware, Maryland, and Virginia (Mid-Atlantic EA) (BOEM, 2012) as well as an EA prepared by BOEM for wind leases on the Atlantic OCS off Rhode Island and Massachusetts (RI-MA EA) (BOEM, 2013).

The Mid-Atlantic EA (BOEM, 2012) refers to an acoustic evaluation conducted by Cape Wind Associates for its project on Horseshoe Shoal offshore Massachusetts to estimate the distances to the 180 and 160 dB re 1 µPa RMS SPL isopleths produced by HRG surveys. No references are supplied for this acoustic evaluation; however, it is assumed to be the sound source verification study conducted by Jasco Applied Sciences within Nantucket Sound between 6 and 7 July 2012 (Martin et al., 2012).

The RI-MA EA (BOEM, 2013) used modeled sound information from the then-draft *Atlantic OCS Proposed Geological and Geophysical Activities, Mid-Atlantic and South Atlantic Planning Areas: Programmatic Environmental Impact Statement*, which was finalized in 2014 (BOEM, 2014), and represents more applicable acoustic analysis for the mid-Atlantic region.

Modeled HRG sources are expected to have broadband SLs ranging from 210 to 229 dB re 1 μPa^2m^2 (Atlantic G&G FPEIS [BOEM, 2014]; RI-MA EA [BOEM, 2013]). The modeled area of ensonification for some HRG survey equipment showed potential Level B thresholds at distances beyond what BOEM considered could be effectively visually monitored for the presence of marine mammals. However, NMFS determined that with the Standard Operating Conditions (SOCs) and the Reasonable and Prudent Measures (RPMs)—as defined in the Biological Opinions dated April 10, 2013 for Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf in Massachusetts, Rhode Island, New York and New Jersey Wind Energy Areas, and the July 19, 2013 Biological Opinion for Programmatic Geological and Geophysical Activities in the Mid and South Atlantic Planning Areas from 2013 to 2020 resulting from BOEM Endangered Species Act (ESA) consultation—the proposed HRG surveys may adversely affect but are not likely to jeopardize the continued existence of threatened or endangered species. Furthermore, the behavioral responses from HRG and geotechnical activities are expected to be temporary and would not affect the reproduction, survival, or recovery of threatened or endangered species.

Additionally, some frequencies may not be within the hearing sensitives of the marine mammals likely to occur in the Project Area. Therefore, proposed geophysical and geotechnical equipment was reviewed along with the Screening Out Team (ScOT) assessment conducted by BOEM for geotechnical and geophysical surveys in the Gulf of Mexico (BOEM, 2017). In this review, sources with operating frequencies above 180 kHz were strongly recommended to be screened out because they are designed to operate at frequencies above marine mammal hearing thresholds and only a small portion of the signal energy could be within marine mammal hearing ranges. Other sources that were strong candidates for being screened out were those that operate within marine mammal frequency bands but have low sound source levels (a single pulse at less than 200 dB re 1 µPa @ 1 m) (BOEM, 2017).

Based on the modeling report (Zeddies et al., 2015) completed for BOEM to address acoustic propagation of geological and geophysical sources; the operating frequencies of the survey equipment (**Table 3**), and the hearing ranges of marine mammals potentially transiting the Project Area, the following equipment was determined to be potential sources of disturbance to LF, MF, and HF cetaceans and phocid pinnipeds:

- Teledyne Benthos Chirp III Sub-bottom Profiler (2 to 7 kHz);
- EdgeTech Full-Spectrum (Chirp) Sub-bottom Profiler Equipped with a SB216 Tow Vehicle (2 to 16 kHz);
- Applied Acoustics Medium Penetration Sub-Bottom Profiling System (Boomer) (0.1 to 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 to 8 kHz);
- 800 Joule GeoResources Sparker (0.75 to 2.75 kHz)/Applied Acoustics 100 to 1,000 joule;

- Falmouth Scientific Bubble Gun (0.02 to 1.7 kHz);
- Dura-Spark 240 System (0.03 to 1.2 kHz);
- Falmouth Scientific Bubble Gun (1.6 to 1.7 Hz);
- PanGeo Subsea Acoustic Corer (1.5 -115kHz);
- HPC or Rossfelder Corer (10 to 20 kHz);
- DP Thruster/ Propeller System (0.1 to 10 kHz)); and
- Deep bore coring equipment.

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 kHz) fell far outside of the lower or upper bounds of the hearing range of marine mammals potentially transiting the Project Area:

- Reson SeaBat 7125 Multibeam Echosounder (200 or 400 kHz);
- Reson 7101 (200 and 400 kHz);
- R2SONIC Sonic 2020 (170 and 450 kHz);
- EdgeTech 4200 Dual Frequency Sidescan Sonar System (300 and 900 kHz);
- EdgeTech 4125 (105 and 410 kHz);
- Klein 3900 (445 and 900 kHz);
- G-882 Marine Magnetometer;
- SeaSPY Magnetometer; and
- CPT (no specific manufacturer).

Geotechnical Surveys

Noise from borehole drilling is not expected to have SLs that reach 120 dB re 1 µPa @ 1 m and noise produced during geotechnical sampling was expected to attenuate to below an RMS SPL of 120 dB re 1 µPa before the 150-m isopleth. (BOEM, 2013). 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., Seafloor 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 (Dominion Resources Inc., 2013, 2014; 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).

Geotechnical and Geophysical Source Operation Considerations

Source levels for the vessel and all geotechnical and geophysical equipment planned for use were collected from existing field data, 82 FR 22250, updated manufacturer specification sheets, or published in-water measurements (Crocker and Fratantonio, 2016). The source parameters were entered in the NMFS Technical Guidance's User Spreadsheet (NMFS, 2016) to estimate the range to prescribed thresholds. Summarizing the source characteristics within the NMFS User Spreadsheet, however, does not account for some *in situ* operational settings that will affect propagation of sound levels. Published operating frequencies are typically given as a range. In order to calculate the threshold isopleths within the User Spreadsheet, the upper frequency containing 95% of the acoustic energy is used rather than the range of frequencies (NMFS, 2016). These frequencies were collected from Crocker and Frantatonio (2016), unpublished field survey data, previous IHA data, and manufacturer documentation (**Table 3**). Additionally, the operational depth and directionality of some sources should be considered when estimating propagation isopleths. Surface-towed omni-directional (e.g., sparkers, boomers) or wide-beam width equipment produce larger ensonified fields. However,

the Teledyne Benthos Chirp III and the EdgeTech Full Spectrum Chirp are towed at deeper depths and project a narrow beam directed at the seabed. As a result, the majority of sound from these sources is absorbed in the seabed while only a small portion is reflected back into open water. The characteristic directionality of the projected beam of all the sources greatly reduces the possibility of direct path exposure to receivers from sounds emitted from these sources. Narrow beam widths allow geophysical equipment to be highly directional, focusing its energy in vertical direction and minimizing horizontal propagation. Other equipment is towed close to the seafloor or operates on the seabed, which also minimizes propagation distances.

Unlike the other HRG sources which are mobile source, acoustic corers are stationary and made up of three distinct sound sources comprised of high frequency parametric sonar, a high frequency chirp sonar, and a low frequency chirp sonar; with each source having its own transducer. Generally the acoustic transducers are operated at a nominal height of 3.5m or less above the seafloor when acquiring data and are directed downward towards the seafloor such that energy is channeled into the seabed rather than released into the water column. Computer modeling was used to predict the propagation of sound generated by the two lower frequency sources operating independently.

Sources may also be operated at varied power levels throughout a survey in order to maximize the desired output data and compensate for environmental conditions and interactions with other equipment. Therefore, while full or near-full power operations of the equipment is assumed, the actual operational level, and subsequently the SL, could vary throughout the survey. Referenced operational power levels are footnoted in applicable tables within this Application.

2.0 Survey Dates, Duration, and Specific Geographic Region

2.1 SURVEY ACTIVITY DATES AND DURATION

The site characterization surveys will occur between June15, 2018 and December 31, 2018. During this time period, geophysical surveys will be conducted for up to 200 days and geotechnical surveys will be conducted for up to 100 days. Survey operations are proposed to be conducted 24 hours per day to minimize the overall duration of survey activities and the associated period of potential impact on marine species.

2.2 SPECIFIC GEOGRAPHIC REGION

The Applicant's survey activities will occur within federal waters in the Lease Area #OCS-A 0486 (Lease Area) and along potential submarine cable routes to landfall locations in Massachusetts, Rhode Island, and Long Island, New York (**Figure 1**). The Lease Area is approximately 394 square kilometers [km^2]) (97,498 acres) and is within the RI-MA WEA of the BOEM North Atlantic planning area. Water depths in the Lease Area range from 26 to 48 m (85 to 157 ft).

Reasonably foreseeable activities within the RI-MA and impact-producing factors associated with the Project Area were fully assessed in the BOEM EA for Commercial Wind Lease Issuance and Site Assessment Activities on the OCS Offshore of Rhode Island and Massachusetts (BOEM, 2013) and associated Finding of No Significant Impact, revised June 2014.

2.3 SURVEY ACTIVITIES

2.3.1 Geophysical Activity

The HRG survey will be conducted within the Lease Area and along export cable routes (**Figure 1**). HRG survey activities will include multi-beam depth sounding, seafloor imaging, shallow and medium penetration sub-bottom profiling, and acoustic cores using combinations of the equipment listed in **Table 3** to meet BOEM requirements as set out in the 2015 Guidelines for Providing Geophysical, Geotechnical, and Geohazard Information Pursuant to 30 CFR Part 585.

HRG surveys are expected to use several equipment types concurrently in order to collect multiple aspects of geophysical data along one transect. Selection of equipment combinations is based on specific survey objectives. Field operation modes of each source are based on survey parameters and ongoing modification due to field conditions and data quality constraints.

2.3.2 Geotechnical Activity

Shallow geotechnical surveys, consisting of CPTs and vibracores, are planned for within the Lease Area and approximately every 1-2 kilometers along the export cable routes. Foundation-depth geotechnical borings are also planned at each proposed foundation location within the Lease Area. While the quantity and locations of wind turbine generators (WTGs) to be installed, as well as cable route, have yet to be determined, an estimate of 153 vibracores, 20 CPTs, and 16 deep borings are planned within the Lease Area and along the export cable routes. The geotechnical sampling will be conducted from a lift vessel and/or DP vessel.

3.0 Species and Numbers of Marine Mammals

3.1 PROTECTED POPULATIONS

All marine mammal species are protected under the MMPA. Some marine mammal stocks (defined as a group of nonspecific individuals that are managed separately) (Hayes et al., 2016) may be designated as strategic under the MMPA, which requires the jurisdictional agency (NMFS or U.S. Fish and Wildlife Service [USFWS]) to impose additional protection measures.

A stock is considered strategic if:

- Direct human-caused mortality exceeds its Potential Biological Removal (PBR) level (defined as the maximum number of animals, not including natural mortality, that can be removed from the stock while allowing the stock to reach or maintain its optimum sustainable population level);
- It is listed under the ESA;
- It is declining and likely to be listed under the ESA; or
- It is designated as depleted under the MMPA.

A depleted species or population stock is defined by the MMPA as any case in which:

- The Secretary, after consultation with the Marine Mammal Commission and the Committee of Scientific Advisors on Marine Mammals established under MMPA Title II, determines that a species or population stock is below its optimum sustainable population;
- A State, to which authority for the conservation and management of a species or population stock is transferred under Section 109 of the MMPA, determines that such species or stock is below its optimum sustainable population; or
- A species or population stock is listed as an endangered species or a threatened species under the ESA.

Some species are further protected under the ESA. Under the ESA, a species is considered endangered if it is "in danger of extinction throughout all or a significant portion of its range." A species is considered threatened if it "is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range."

3.2 MARINE MAMMAL SPECIES

There are 36 species (comprising 37 stocks) of marine mammals in the Northwest Atlantic OCS Region that are protected by the MMPA (**Table 5**) (BOEM, 2014). The marine mammal assemblage comprises 31 cetaceans, including 25 members of the suborder Odontoceti (toothed whales, dolphins, and porpoises) and 6 of the suborder Mysticeti (baleen whales). There are five whale species listed as endangered under the ESA with ranges that include the Project Area:

- Sperm whale (*Physeter macrocephalus*);
- Fin whale (*Balaenoptera physalus*);
- Sei whale (*Balaenoptera borealis*);
- Blue whale (*Balaenoptera musculus*); and,
- North Atlantic right whale (*Eubalaena glacialis*).

Along with cetaceans, seals are also protected under the MMPA. There are four species of phocids (true seals) with ranges that include the Project Area, including harbor seals, gray seals, harp seals,

and hooded seals (Waring et al., 2008). Finally, one species of sirenian, the Florida manatee, *Trichechus manatus*, is an occasional visitor to the region during summer months (USFWS, 2017). The manatee is listed as threatened under the ESA and is protected under the MMPA along with the other marine mammals.

The expected occurrence of each species is based on information provided in the BOEM RI-MA EA (BOEM, 2013), the IHA issued to Deepwater Wind, LLC for marine site characterization surveys off the coast of New York (82 FR 32330), and the Northeast Large Pelagic Survey (NLPS) (Kraus et al., 2016), and/or species habitat models (Best et al., 2012, and Roberts et al., 2016) available for the Project Area:

- Common – Occurring consistently in moderate to large numbers;
- Regular – Occurring in low to moderate numbers on a regular basis or seasonally;
- Uncommon – Occurring in low numbers or on an irregular basis;
- Rare – Records for some years but limited; and
- Not expected – Range includes the Project Area but due to habitat preferences and distribution information species are not expected to occur in the Project Area although records may exist for adjacent waters.

The protection status, stock identification, occurrence, and abundance estimates of the species listed in **Table 5** are discussed in more detail in **Section 4.0**.

Table 5. Marine mammals with geographic ranges that include the Project Area (Hayes et al., 2016; Waring et al., 2015).

Common Name	Scientific Name	Stock	Federal ESA/ MMPA Status[2]	Relative Occurrence in the Region	Best Estimate[3]
Fin whale	*Balaenoptera physalus*	Western North Atlantic	ESA Endangered/ Depleted and Strategic	Common	1,618
Sei whale	*Balaenoptera borealis*	Nova Scotia	ESA Endangered/ Depleted and Strategic	Regular	357
Minke whale	*Balaenoptera acutorostrata*	Canadian East Coast	Protected	Common	2,591
Blue whale	*Balaenoptera musculus*	Western North Atlantic	ESA Endangered/ Depleted and Strategic	Rare	unknown
Humpback whale	*Megaptera novaeangliae*	Gulf of Maine	Protected	Common	823
North Atlantic right whale	*Eubalaena glacialis*	Western North Atlantic	ESA Endangered/ Depleted and Strategic	Common	440
Sperm whale	*Physeter macrocephalus*	North Atlantic	ESA Endangered/ Depleted and Strategic	Common	440
Dwarf sperm whale	*Kogia sima*	Western North Atlantic	Protected	Rare	3,785

Table 5. (Continued).

Common Name	Scientific Name	Stock	Federal ESA/ MMPA Status[2]	Relative Occurrence in the Region	Best Estimate[3]
Pygmy sperm whale	*Kogia breviceps*	Western North Atlantic	Protected	Rare	3,785
Killer Whale	*Orcinus orca*	Western North Atlantic	Protected	Rare	unknown
Pygmy killer whale	*Feresa attenuata*	Western North Atlantic	Protected	Not Expected	unknown
False killer whale	*Pseudorca crassidens*	Western North Atlantic	Strategic	Rare	442
Northern bottlenose whale	*Hyperoodon ampullatus*	Western North Atlantic	Protected	Not Expected	unknown
Cuvier's beaked whale	*Ziphius cavirostris*	Western North Atlantic	Protected	Rare	6,532
Mesoplodon beaked whales	*Mesoplodon spp.*	Western North Atlantic	Depleted[6]	Rare	7,092
Melon-headed whale	*Peponocephala electra*	Western North Atlantic	Protected	Not Expected	unknown
Risso's dolphin	*Grampus griseus*	Western North Atlantic	Protected	Common	18,250
Long-finned pilot whale	*Globicephala melas*	Western North Atlantic	Strategic	Common	5,636
Short-finned pilot whale	*Globicephala macrorhynchus*	Western North Atlantic	Strategic	Rare	21,515
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	Western North Atlantic	Protected	Common	48,819
White-beaked dolphin	*Lagenorhynchus albirostris*	Western North Atlantic	Protected	Rare	2,003
Common dolphin	*Delphinus delphis*	Western North Atlantic	Protected	Common	70,184
Atlantic spotted dolphin	*Stenella frontalis*	Western North Atlantic	Protected	Uncommon	44,715
Pantropical spotted dolphin	*Stenella attenuata*	Western North Atlantic	Protected	Rare	3,333
Striped dolphin	*Stenella coeruleoalba*	Western North Atlantic	Protected	Rare	54,807
Fraser's dolphin	*Lagenodelphis hosei*	Western North Atlantic	Protected	Rare	unknown
Rough toothed dolphin	*Steno bredanensis*	Western North Atlantic	Protected	Rare	271
Clymene dolphin	*Stenella clymene*	Western North Atlantic	Protected	Not Expected	unknown
Spinner dolphin	*Stenella longirostris*	Western North Atlantic	Protected	Rare	unknown
Bottlenose dolphin	*Tursiops truncatus*	Western North Atlantic, Offshore	Protected	Common	77,532
Harbor Porpoise	*Phocoena phocoena*	Gulf of Maine/Bay of Fundy	Protected	Common	79,833
Harbor Seal	*Phoca vitulina*	Western North Atlantic	Protected	Regular	75,834
Gray Seal	*Halichoerus grypus*	Western North Atlantic	Protected	Regular	unknown

Table 5. (Continued).

Common Name	Scientific Name	Stock	Federal ESA/ MMPA Status[2]	Relative Occurrence in the Region	Best Estimate[3]
Harp Seal	*Pagophilus groenlandica*	Western North Atlantic	Protected	Rare	unknown
Hooded Seal	*Cystophora cristata*	Western North Atlantic	Protected	Rare	unknown
Florida manatee[1]	*Trichechus manatus*		ESA Threatened/ Depleted and Strategic	Rare	unknown

[1] Under management jurisdiction of United States Fish and Wildlife Service (USFWS) rather than National Marine Fisheries Service (NMFS).
[2] ESA = Endangered Species Act; MMPA = Marine Mammal Protection Act.
[3] Best estimate from the most recently updated NOAA Stock Assessment Reports (Waring et al., 2007; Waring et al., 2014; Waring et al., 2015; Hayes et al., 2017).

4.0 Affected Species Status and Distribution

Of the 36 marine mammal species with geographic ranges that include the Project Area (**Table 5**), 17 can be reasonably expected to reside, traverse, or occasionally visit the Project Area and may be considered affected species. This information is based on NMFS stock assessment reports (SARs) (Hayes et al., 2017, Waring et al., 2015), and regional survey records (Cetacean and Turtle Assessment Program [CETAP] 1982; Atlantic Marine Assessment Program for Protected Species [AMAPPS], 2010 to 2014; North Atlantic Right Whale Sighting Survey [NARWSS], 2003 to 2013; BOEM RI-MA EA [BOEM, 2013]); 82 FR 32330 [Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to Site Characterization Surveys off the Coast of New York]; and preliminary results (unpublished) of mitigation surveys conducted under 82 FR 32330 during 2017 and 2018.

Affected species are those that have a common, uncommon, or regular relative occurrence in Project Area (**Table 5**); or have a very wide distribution with limited distribution or abundance details. Species not expected or rare are not carried forward in this application. Therefore, the Applicant requests an IHA for Level B disturbance for the 17 species listed below and described in the following sections.

- North Atlantic right whale (*Eubalaena glacialis*)
- Fin whale (*Balaenoptera physalus*)
- Humpback whale (*Megaptera novaeangliae*)
- Sei whale (*Balaenoptera borealis*)
- Minke whale (*Balaenoptera acutorostrata*)
- Blue whale (*Balaenoptera musculus*)
- Sperm Whale (*Physeter microcephalus*)
- Harbor porpoise (*Phocoena phocoena*)
- Bottlenose dolphin (*Tursiops truncatus*)
- Killer whale (*Orcinus orca)*
- Risso's dolphin (*Grampus griseus*)
- Long-finned pilot whale (*Globicephala melas*)
- Atlantic white-sided dolphin (*Lagenorhynchus acutus*)
- Common dolphin (*Delphinus delphis*)
- Atlantic spotted dolphin (*Stenella frontalis*)
- Harbor seal (*Phoca vitulina*)
- Grey seal (*Halichoerus grypus*)

Species will not be equally affected by the proposed activities due to individual exposure patterns, the context in which noise is received, and, most prominently, individual hearing sensitivities. To account for this sensitivity, marine mammal species are categorized into functional hearing groups that are designated to better predict and quantify impacts of noise (Southall et al., 2007). These functional hearing groups are described below with associated reference frequencies. While all these species likely hear beyond these bounds, primary sensitivities and fall within the listed frequencies (**Section 1.2.4**).

- LF cetaceans: 7 Hz and 25 kHz;
- MF cetaceans: 150 Hz and 160 kHz;
- HF cetaceans: 200 Hz and 180 kHz; and,
- Phocid pinnipeds (true seals): 75 Hz to 100 kHz.

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 NMFS marine mammal stock assessment reports (Waring et al., 2007, 2008, 2010, 2013, 2014, 2015, 2016; Hayes et al., 2017)

4.1 MYSTICETES

4.1.1 North Atlantic Right Whale (*Eubalaena glacialis*)

The North Atlantic right whale is the only member of the mysticete family Balaenidae found in North Atlantic waters. It is medium in size when compared to other mysticete species, with adult sizes ranging from 14 to 17 m (Waring et al., 2015). They are skim feeders relying primarily on zooplankton, including copepods, euphausiids, and cyprids. The North Atlantic right whale is listed as endangered and is considered one of the most endangered large whale species in the world. (Jefferson et al., 2011). The most recent SAR estimates a population size of only 440 individuals (Hayes et al., 2017) which has recovered only slightly from the estimated 100 individuals in the 1930s just prior to the species being afforded protection (Reeves, 2001). 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 from 2015 indicated that 440 individually recognized whales were known to be alive in 2012, which represents the minimum population size estimate (Hayes et al., 2017).

Right whales have been sighted in the mid-Atlantic Bight during all months of the year but show peak abundances to the north in Cape Cod Bay during late winter and Georges Basin in late summer. (Winn et al., 1986; Kenney et al., 1995; Kenney et al., 2001). The NMFS SAR (Hayes et al., 2017) identified seven areas where western North Atlantic right whales aggregate seasonally: the coastal waters of the southeastern United States; the Great South Channel; Jordan Basin; Georges Basin along the northeastern edge of Georges Bank; Cape Cod and Massachusetts Bays; the Bay of Fundy; and the Roseway Basin on the Scotian Shelf (Brown et al., 2001; Cole et al., 2013). Several of these congregation areas correlate with seasonal copepod concentrations (Pendleton et al., 2009). New England waters are a primary feeding habitat for the North Atlantic right whale during late winter through spring with feeding moving into deeper and more northerly waters during summer and fall. Less is known regarding winter distributions; however, it is understood that calving takes place during this time in coastal waters of the southeastern United States.

Passive acoustic studies of North Atlantic right whales have demonstrated their year-round presence in the Gulf of Maine (Morano et al., 2012; Bort et al., 2015), New Jersey (Whitt et al., 2013), and Virginia (Salisbury et al., 2016). Additionally, right whales were acoustically detected off Georgia and North Carolina in 7 of 11 months monitored (Hodge et al., 2015). All of this work further demonstrates the highly mobile nature of right whales. Movements are extensive between and within the southern and northern critical habitats. Critical habitat for the North Atlantic Right Whale falls just to the north of the Project Area boundaries.

The major threat to the North Atlantic right whale stock is human-caused mortality (for the years 2010-2014) through incidental fishery entanglement that averaged 4.56 incidents per year and ship strikes that averaged 0.9 incident records per year based on data from 2008 through 2012 (Hayes et al., 2017). The SAR for North Atlantic right whales sets the Potential Biological Removal (PBR) level at 1; therefore, any mortality or serious injury for this stock can be considered significant. The Western North Atlantic stock is considered strategic by NMFS because the average annual

human-related mortality and serious injury exceeds PBR, and because the North Atlantic right whale is an endangered species.

Seasonal Management Areas (SMAs) for reducing ship strikes of the North Atlantic right whale have also been designated in the U.S. and Canada. All vessels greater than 19.8 m in overall length must operate at speeds of 10 kn (18.52 kmph) or less within these areas during specified time periods. The Project Area is located within the Block Island Sound SMA which is in effect, seasonally, from November 1st to April 30th (**Figure 2**).

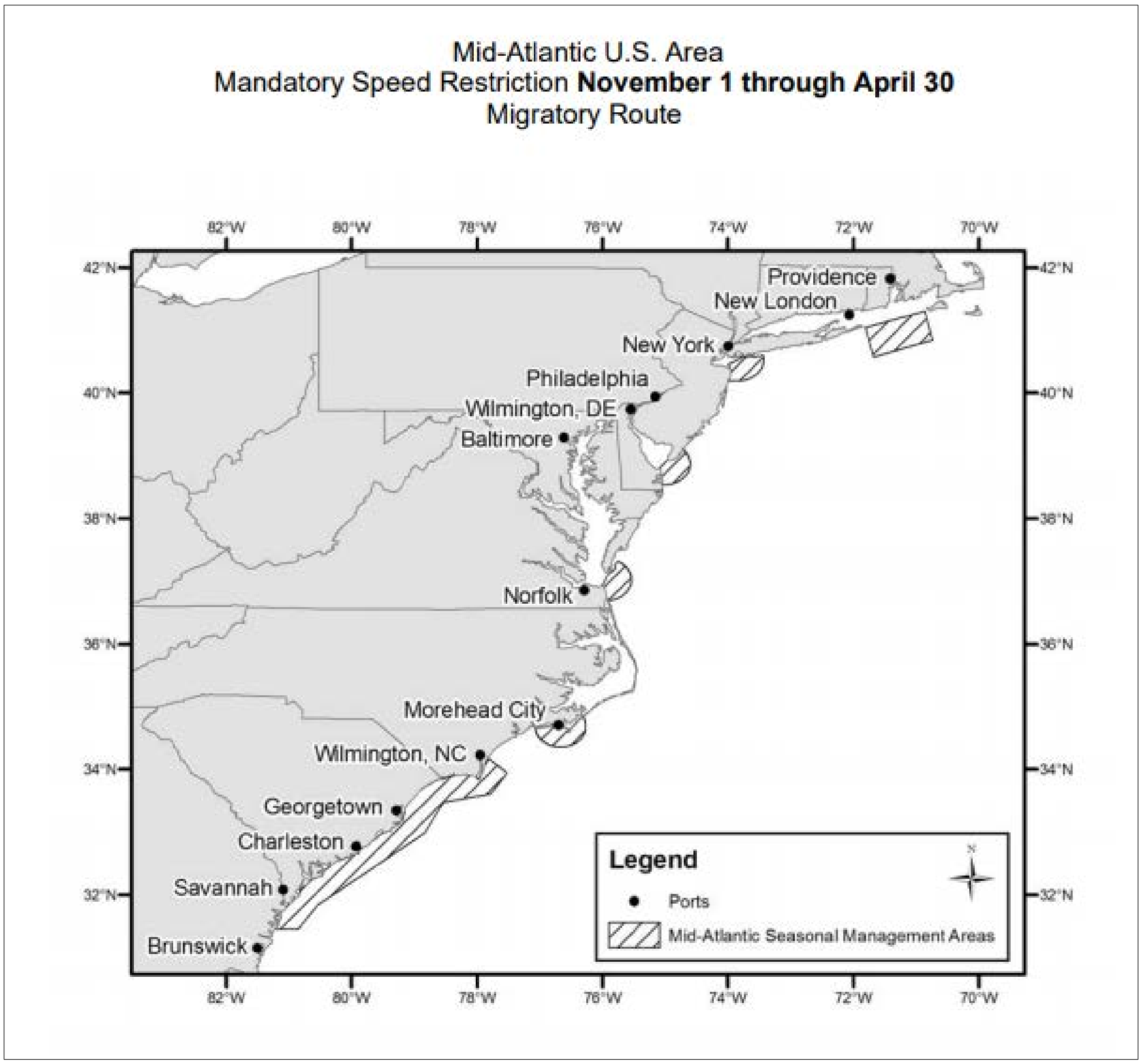

Figure 2. Mid-Atlantic Seasonal Management Areas for North Atlantic Right Whales (source: http://www.nmfs.noaa.gov/pr/shipstrike/).

The North Atlantic right whale underwent a NMFS 5-year review in 2012, which resulted in no change to its listing status. In 2009, NMFS received a petition to expand the critical habitat, and the agency is continuing its ongoing rulemaking process. In January 2016, two additional units comprising 29,763 nmi^2 of marine habitat were designated as critical habitat to encompass the

northeast feeding area in the Gulf of Maine/Georges Bank and the southeast calving grounds from North Carolina to Florida.

The following final rules notices are associated with the North Atlantic right whale:

- Critical Habitat Designation: 59 FR 28805, June 3, 1994.
- Atlantic Large Whale Take Reduction Plan: 62 FR 39157, July 22, 1997.
- Federal Regulations Governing the Approach to North Atlantic Right Whales: 69 FR 69536, November 30, 2004.
- Final Rule to Implement Speed Restrictions to Reduce the Threat of Ship Collisions with North Atlantic Right Whales: 73 FR 60173, October 10, 2008.
- Findings on Petition to Revise Critical Habitat: 75 FR 61690, October 6, 2010.
- Final Rule to Remove the Sunset Provision of the Final Rule Implementing Vessel Speed Restrictions to Reduce the Threat of Ship Collisions with North Atlantic Right Whales 78 FR 73726 December 9, 2013.
- Final Rule for North Atlantic Right Whale (*Eubalaena glacialis*) Critical Habitat 81 FR 4838, January 27, 2016.

Vessel noise resulting from the proposed activity has the potential to disturb North Atlantic right whales. North Atlantic right whales are low frequency cetaceans that vocalize using a number of distinctive call types, most of which have peak acoustic energy below 500 Hz. Most vocalizations do not go above 4 kHz (Matthews et al., 2014). One typical right whale vocalization is the "up call"; a short sweep that rises from roughly 50 Hz to 440 Hz over a period of 2 seconds. These up calls are characteristic of right whales and are used by research and monitoring programs for species presence. A characteristic "gunshot" call is believed to be produced by male right whales. These pulses can have SLs of 174 to 192 dB re 1 µPa @ 1 m with frequency range from 50 to 2,000 Hz (Parks et al., 2005; Parks and Tyack, 2005). Other tonal calls range from 20 to 1,000 Hz and have SLs between 137 and 162 dB re 1 µPa @ 1 m. These low-frequency signals can be masked by human activities including vessel noise. Studies have shown that right whales increase their call amplitude with a rise in background noise, indicating that right whales may attempt to modify their vocalizations to compensate for increased noise within their acoustic environment (Parks et al., 2011). Rolland et al. (2012) correlated noise pollution to an increase in stress-related fecal hormone metabolites in North Atlantic right whales, suggesting that noise pollution may affect the recovery of the species.

4.1.2 Humpback Whale (*Megaptera novaeangliae*)

The humpback whale is a robust and medium-sized mysticete, and adults range from 15 to 18 m in length. Humpback whales are distinguished from all other cetaceans by their long flippers, which are approximately one-third the length of the body (Jefferson et al., 2008). One species of the humpback whale is currently recognized (Committee on Taxonomy, 2017). Humpback whales are largely piscivorous, feeding primarily on herring, sand lance, and other small fishes as well as Euphausids in the Gulf of Maine (Hayes et al., 2017). Humpbacks show fidelity to feeding sites; however, local distribution is driven by prey availability and bathymetry resulting in the whales transiting widely throughout their feeding habitat between spring and fall in search of prey.

Sightings of humpback whales in the mid-Atlantic are common (Barco et al., 2002) as are strandings (Wiley et al., 1995). Barco et al. (2002) suggested that the mid-Atlantic region primarily represents a supplemental winter feeding ground used by humpbacks. In 2016 a high number of humpback mortalities prompted NMFS to declare an Unusual Mortality Event (UME) from January 2016 through August 2017 for Atlantic coast humpbacks (NMFS, 2017). During that time period, a total of 50 humpback whales were found dead between Maine and North Carolina. Of the 20 carcasses that

have been examined, 10 have shown evidence of pre-mortem vessel strikes. This level of vessel strike occurrence is over six times the 16-year average for this region (NMFS, 2017).

The humpbacks occurring within the Project Area are believed to be mainly part of the Gulf of Maine stock (Hayes et al., 2017). Humpback whales have a worldwide distribution and follow a migratory pattern of feeding in the high latitudes during summers and spending winters in the lower latitudes for calving and mating. The Gulf of Maine stock follows this pattern with winters spent in the Caribbean and West Indies; although acoustic recordings show a small number of males persisting in Stellwagen Bank throughout the year (Vu et al., 2012). The overall Atlantic population (including the Gulf of Maine stock) is estimated to be between 10,400 and 11,570 depending on the calculation methodology, with the Gulf of Maine stock estimated at 832 individuals (Hayes et al., 2017).

On September 8, 2016, NMFS published a final decision changing the status of humpback whales under the ESA (81 FR 62259), effective as of October 11, 2016. Previously, humpback whales were listed under the ESA as an endangered species worldwide. In the 2016 decision, 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. A status review of the humpback whale was undertaken by NMFS in 2015 (Bettridge et al., 2015) to identify taxonomic units such as DPSs and assess the extinction risk of these units. To be considered a DPS, a population, or group of populations, must be “discrete” from the remainder of the taxon to which it belongs; and “significant” to the taxon to which it belongs. Information on distribution, ecological situation, genetics, and other factors is used to evaluate a population’s discreteness and significance. This review process resulting in the identification of a “West Indies” DPS which includes the Gulf of Maine stock. The West Indies DPS was considered not to be at risk of extinction. Subsequently, the Gulf of Maine stock is not a strategic stock and no critical habitat has been designated for the humpback whale (Hayes et al., 2017).

Primary threats to humpback whales are fishing gear entanglements and ship strikes. Mortality and serious injury records for large whales in the Northwest Atlantic over a 40-year period (1970 to 2009) were reviewed for assessing the magnitude of human related mortalities (Van der Hoop et al., 2013). Results showed that roughly 27% of mortalities and serious injuries were humpback whale records. Of the humpback records where cause could be determined (203 records), 57% mortalities were caused by entanglements in fishing gear and 15% were attributable to vessel strikes. Glass et al. (2009) reported that between 2002 and 2006, humpback whales belonging to the Gulf of Maine stock were involved in 77 confirmed fishing gear entanglements and 9 confirmed ship strikes. Records assessed between 2008 and 2012 resulted in a minimum annual rate of human-caused mortality and serious injury to the Gulf of Maine stock of 10.3 animals per year (Waring et al., 2015). This value includes incidental fishery interactions and vessel strikes. (Henry et al., 2014; Cole and Henry, 2015).

Like other large whales, increases in noise levels may affect this species’ ability to transmit and access acoustic cues in the environment. For example, Clark et al. (2009) predicted an 8% reduction in communication space due to shipping for singing humpback whales in the northeast. Humpbacks are low frequency species but have one of the most varied vocal repertoires of the baleen whales. Male humpbacks will arrange vocalizations into a complex, repetitive sequence to produce a characteristic “song”. Songs are variable but typically occupy frequency bands between 300 and 3,000 Hz and last upwards of 10 minutes. Songs are predominately produced while on breeding grounds; however, they have been recorded on feeding grounds throughout the year (Clark and Clapham, 2004; Vu et al., 2012). Typical feeding calls are centered at 500 Hz with some other calls and songs reaching 20 kHz. Common humpback calls also contain series of grunts between 25 and 1,900 Hz as well as strong, low-frequency pulses (with SLs up to 176 dB re 1 μPa @ 1 m) between 25 and 90 Hz (Clark and Clapham, 2004; Vu et al., 2012).

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, Payne and Heinemann, 1990).

4.1.3 Fin Whale (*Balaenoptera physalus*)

Fin whales are a widely distributed species found in all oceans of the world. The fin whale is listed as endangered under the ESA and a Draft Recovery Plan for fin whales is available for review (NMFS, 2006). Fin whales transit between summer feeding grounds in the high latitudes and the wintering, calving, or mating habitats in low latitudes or offshore. However, acoustic records indicate that fin whale populations may be less migratory than other mysticetes whose populations make distinct annual migrations (Watkins et al., 2000). Fin whales typically feed in New England waters on sea lance, capelin, krill, herring, copepods, and squid in deeper waters near the edge of the continental shelf (90 to 180 m [295 to 591 ft]), but will migrate towards coastal areas following prey distribution. Seasonal areas of importance for fin whale feeding near the Project Area are off eastern Long Island and along the northern edge of Georges Bank (CETAP, 1982; Waring and Finn, 1995).

Along the Atlantic seaboard they are mainly found from Cape Hatteras northward with distribution in both shelf and deep water habitats (Hayes et al., 2017). The northern fin whale subspecies is found within the Project Area. Fin whales accounted for 46% of the large whales sighted during aerial surveys along the continental shelf (CETAP, 1982) between Cape Hatteras and Nova Scotia from 1978 to 1982. In the MABS surveys (Williams et al., 2015a,b) reported two fin whales during winter and two during spring. The fin whales that occur with the Project Area are part of the Western North Atlantic stock of fin whales. This is considered a strategic stock because fin whales are listed as endangered throughout their range. In 2011, NMFS undertook a 5-year status review of the fin whale and determined that there should be no change in its listing status.

There is no designated critical habitat for the fin whale (Waring et al., 2015). The best population abundance estimate is 1,618 (minimum population estimate for this stock is 1,234) individuals (Hayes et al., 2017).

Threats to fin whales are entanglements in fishing gear and ship strikes. For the time period between 2008 through 2012, the minimum annual rate of human-caused mortality and serious injury to fin whales was 3.35 per year. This value includes 1.55 fishery interaction records per year and 1.8 vessel strike records per year (Cole and Henry, 2015).

Fin whales produce short duration, down sweep calls between 15 and 30 Hz, typically termed “20-Hz pulses” as well as tonal calls up to 150 Hz. The SL of the fin whale vocalizations can reach 186 dB re 1 µPa @ 1 m, making it one of the most powerful biological sounds in the ocean (Charif et al., 2002).

4.1.4 Sei Whale (*Balaenoptera borealis*)

Sei whales are a widespread species throughout the world’s temperate, subpolar, subtropical, and tropical oceans. The sei whale is the third largest cetacean (following the blue and fin whales), with adult length ranging from 16 to 20 m (Waring et al., 2015). It is very similar in appearance to fin and Bryde’s whales. Two subspecies of sei whales are currently recognized (Committee on Taxonomy, 2017). The northern sei whale (*B. b. borealis*) is known to occur within the Project Area. The sei whales occurring in the Project Area are part of the Nova Scotia stock (formerly the Western North Atlantic stock). Sei whales are most common in deeper waters along the continental shelf edge (Hayes et al., 2017) but will forage occasionally in shallower, inshore waters. There is no designated critical habitat for this species.

Sei whales are most abundant in Northeastern US waters during spring, with sightings concentrated along the eastern and southwestern margins of Georges Bank in the area of Hydrographer Canyon (CETAP, 1982). Less is known about the sei whale in the mid-Atlantic region. Only one sei whale was reported during the MABS surveys, and this sighting occurred during the winter survey (Williams et al., 2015a,b). The sei whale feeds primarily on euphausiids and copepods, but will also prey upon fish, and local abundance is largely driven by prey availability. The occurrence and abundance of sei whales on feeding grounds may shift dramatically from one year to the next.

The best estimate of abundance for the Nova Scotia stock is 357 (coefficient of variation [CV]= 0.52); however, this estimate is considered low and limited given the known range of the sei whale (Waring et al., 2015). From 2010 through 2014, the minimum rate of confirmed human-caused serious injury and mortality to the Nova Scotia stock was 0.8 per year, which was attributed only to vessel collisions, unlike the 2008 to 2012 records which were split equally with 0.4 per year due to fisheries interactions and 0.4 per year due to vessel strikes (Hayes et al., 2017). The Nova Scotia stock is strategic because the species is listed as endangered under the ESA and the average human-related mortality and serious injury exceeds the PBR.

There are limited confirmed sei whale vocalizations; however, studies indicate that this species produces several, mainly low-frequency (<1,000 Hz) vocalizations. Several calls attributed to sei whales include pulse trains up to 3 kHz, broadband “growl” and “whoosh” sounds between 100 and 600 Hz, tonal calls and upsweeps between 200 and 600 Hz, and down sweeps between 34 and 100 Hz (Baumgartner et al., 2008; Rankin and Barlow, 2007; McDonald et al., 2005).

4.1.5 Minke Whale (*Balaenoptera acutorostrata*)

The minke whale is a small mysticete that is divided into two species: the common minke whale and the Antarctic minke whale. The common minke whale is further divided into three subspecies (Committee on Taxonomy, 2017). The subspecies *B. a. acutorostrata* occurs throughout the North Atlantic. Adult common minke whales reach a length of 8.8 m (Jefferson et al., 2008, Waring et al., 2015). Generally, minke whales occupy warmer waters during winter and travel north to colder regions in summer, with some animals migrating as far as the ice edge. Little is known about their specific movements through the mid-Atlantic region; however, acoustic detections show that minke whales migrate south in mid-October to early November, and return from wintering grounds starting in March through early April (Risch et al., 2014) . Northward migration appears to track the warmer waters of the Gulf Stream along the continental shelf, while southward migration is made farther offshore (Risch et al., 2014). The MABS surveys reported six minke whales between 2012 and 2104; one during spring surveys, 2 during fall surveys, and 3 during winter surveys.

The minke whales that occur within the Project Area are part of the Canadian East Coast stock, which is one of four stocks in the North Atlantic. This stock is not considered strategic under the MMPA because minke whales are not listed as threatened or endangered. The best population estimate for the Canadian East Coast stock is 2,591 (CV=0.81) whales (Hayes et al., 2017). Minkes are frequently observed in coastal or shelf waters, along with humpback and fin whales, owing to their piscivorous feeding habitats where prey includes sand lance and herring

Like other baleen whales, threats to minke whales include ship strikes and fisheries interactions. However, unlike the larger whales, minkes are more susceptible to bycatch threats from bottom trawls, lobster trap/pot, gillnet and purse seine fisheries. During the period from 2010 to 2014, the average annual minimum detected human-caused mortality, and serious injury was 8.25 minke whales per year. This number was composed of 0.2 whales per year from US fisheries bycatch, 6.45 whales per year from U.S. and Canadian entanglement data, and 1.6 per year from ship strikes (Hayes et al.,

2017). Vessel strikes have been documented from New York, North Carolina, New Jersey, and Virginia (Hayes et al., 2017). Additionally, minke whales continue to be hunted as part of an ongoing whaling industry in the northeastern North Atlantic, the North Pacific, and Antarctic (Reeves et al., 2012).

Minke whale recordings have resulted in some of the most variable and unique vocalizations of any marine mammals. Common calls for minke whales found in the North Atlantic include repetitive, low frequency (100 to 500 Hz) pulse trains that may consist of either grunt-like pulses or thump-like pulses. The thumps are very short duration (50 to 70 msec) with peak energy between 100 and 200 Hz. The grunts are slightly longer in duration (165 to 320 msec) with most energy between 80 and 140 Hz. In addition, minke whales will repeat a 6 to 14 minute pattern of 40 to 60 second pulse trains over several hours (Risch et al., 2013). Minke whales produce a unique sound called the “boing” which consists of a short pulse at 1.3 kHz followed by an undulating tonal call around 1.4 kHz. This call was widely recorded but unidentified for many years and had scientists widely speculating as to its source (Rankin and Barlow, 2005). The call frequency of minke whales suggest a hearing sensitivity higher than that of other baleen whales.

4.1.6 Blue Whale (*Balaenoptera musculus*)

The blue whale is the largest cetacean, although its size range overlaps with that of fin and sei whales. The species is currently divided into five subspecies (Committee on Taxonomy, 2017). The northern hemisphere subspecies (*B. m. musculus*) is known to occur within the Project Area. Most adults of this subspecies are 23 to 27 m in length (Jefferson et al., 2011, Waring et al., 2015).

The blue whale is listed as an endangered species, species-wide and range-wide. Blue whales in the North Atlantic were exploited heavily up through the 1920s at which time catch rates began to decrease. A full assessment of present status has not been carried out; although available evidence suggests that they are increasing in numbers at least in the area of the central North Atlantic (Waring et al., 2010). They remain rare; however, in the northeastern Atlantic they were once common. At present, there are an estimated 1,000 individuals off Iceland and several hundred in the Gulf of St Lawrence (http://iwc.int/status). There were no blue whales reported during any of the MABS surveys. 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).

There are insufficient data to determine the status of the Western North Atlantic stock and population within the U.S. A minimum abundance estimate of 440 is provided in Waring et al., 2015. This stock is listed under the MMPA as strategic and depleted, because the species is listed as endangered under the ESA (Waring et al., 2010). There is no designated critical habitat for this species within the Project Area. Blue whales are included in this discussion and considered to be a potentially affected species due to their range and uncertainty in data regarding movements; however, there remains a very low probability of occurrence in the Project Area. The blue whale is considered by NMFS as an occasional visitor in U.S. Atlantic exclusive economic zone (EEZ) waters, which may represent the current southern limit of its feeding range (Waring et al., 2010). In the western North Atlantic Ocean, the blue whale’s range extends from the Arctic to Cape Cod, Massachusetts, although it is frequently sighted off eastern Canada (e.g., Newfoundland) (Waring et al., 2015). Using U.S. Navy asset hydrophone arrays, Clark and Gagnon (2002) identified blue whales as far south as Bermuda (but rarely farther south). In general, the blue whale’s range and seasonal distribution is governed by the availability of prey (Waring et al., 2015).

Blue whales produce some of the most powerful biological sounds in the ocean and at very low frequencies, often below the threshold of human hearing. Typical vocalizations include long pulses,

buzzes, and rasps typically in the 15 to 40 Hz range (Richardson et al., 1995), often below the threshold of human hearing. Blue whale calls exhibit some geographic variations in separate populations (Stafford et al., 2001); although they are generally the same, there are distinct geographic variations that might help scientists distinguish separate populations.

4.2 ODONTOCETES

4.2.1 Sperm Whale (*Physeter macrocephalus*)

Sperm whales are listed as endangered under the ESA and are considered a strategic stock by NMFS (Waring et al., 2015). 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). 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) with a minimum population estimate of 1,815 (Waring et al., 2015).

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 and the southern part of Georges Bank. 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 Mid-Atlantic Bight (Waring et al., 2015). No sperm whales were recorded during the MABS surveys. CETAP and 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 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 to 3,500 m. Although the likelihood of occurrence within the Project Area remains very low, the sperm whale was included in the affected species because of its high seasonal densities east of the Project Area.

Sperm whales are in the mid-frequency hearing group, with an estimated auditory range of 150 Hz to 160 kHz (Southall et al., 2007). Sperm whales produce short-duration 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 (DoN, 2008). Echolocation clicks from adult sperm whales are highly directional clicks and have a SL estimated at up to 236 dB re 1 μPa @ 1 m.

4.2.2 Beaked whales (*Mesoplodon spp*.) and Cuvier's Beaked Whale (*Ziphius cavirostris*)

Beaked whales (Cuvier's beaked whale, *Z. cavirostris;* 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 and characterization is typically done to genus level; therefore, beaked whales are grouped into an undifferentiated complex for stock assessments Sightings of Cuvier's have occurred principally along the continental shelf edge in the Mid-Atlantic region off the northeast U.S. coast, and most sightings were in late spring or summer.

The current abundance estimate for this stock is 6,532 animals with PBR at 50 (Waring et al., 2016). The main threat to this species is interactions with fisheries and stranding associated with Naval activities (Waring et al., 2014).

Beaked whales occur primarily along the continental shelf edge and in deep slope habitats (CETAP, 1982; Waring et al., 2007). Beaked whales feed mainly on squid in deep water. While all beaked whales are considered rare for the project area, the minimal available information on year-round distribution and the fact that multiple species are contained within the beaked whale complex, beaked

whales are being considered in this application as a potentially affected group. Beaked whales are considered MF cetaceans although their vocalizations, consisting of echolocation clicks, are higher frequency than most other odontocetes. Clicks have a bandwidth of 300 Hz to 135 kHz (DoN, 2008).

4.2.3 Killer Whale (*Orcinus orca*)

The killer whale is the largest member of the dolphin family (6.7 to 9.1 m) and is the most widely distributed cetacean species (Waring et al., 2015). Killer whales are most abundant in colder waters and mildly temperate waters. They occur in both offshore and coastal habitats following selected food sources and are characterized as uncommon or rare in waters of the U.S. Atlantic EEZ (Waring et al., 2015). Sightings within the Project Area would be considered very rare. Killer whales that might visit or transit the Project Area are part of the Western North Atlantic stock. Within the North Atlantic, its range extends from the Arctic ice-edge to the West Indies. While their occurrence is unpredictable throughout the U.S. Atlantic EEZ, they do occur in fishing areas, perhaps coincident with tuna, in warm seasons (Katona et al., 1993; Waring et al., 2015). The stock is not listed as threatened or endangered and is not considered strategic under the MMPA. There are not sufficient data available for a population abundance estimate for this stock.

Although fisheries interactions are a potential threat to killer whales, there were no observed mortalities or serious injuries in U.S. fisheries between 2008 and 2012. Adult killer whales are not highly susceptible to vessel strikes, although there is one record reported for British Columbia, Canada, in the Large Whale Ship Strike Database. (Jensen and Silber, 2003).

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. There remains a very low likelihood of occurrence for killer whales within the Project Area. However, due to their wide-ranging habits and a uniform habitat density presence within the entire US Atlantic coast, they were included as potentially affected species.

Killer whales are highly vocal and use a variety of sound for social communication and to find and capture prey. The sounds include a variety of clicks, whistles, and pulsed calls (Ford, 2009). The SLs of echolocation clicks typically range from 195 to 224 dB re 1 µPa @ 1 m (DoN, 2008). The SLs of social vocalizations ranges between 137 to 157 dB re 1 µPa@ 1 m (DoN, 2008).

4.2.4 Risso's Dolphin (*Grampus griseus*)

Risso's dolphins are large dolphins with characteristic blunt head and light coloration, often with extensive scarring. Adults reach body lengths of over 3.8 m (Jefferson et al., 2008, Waring et al., 2015).

The status of the Western North Atlantic stock of the Risso's dolphin in the U.S. Atlantic EEZ is not well documented. An abundance estimate of 18,250 Risso's dolphins was generated from a shipboard and aerial survey conducted between central Florida to the lower Bay of Fundy during June August 2011 (Palka, 2012). Risso's dolphins are not listed as threatened or endangered under the ESA and the Western North Atlantic stock is not considered strategic under the MMPA.

Risso's dolphins are widely distributed in tropical and temperate seas. In the Northwest Atlantic they occur from Florida to eastern Newfoundland (Leatherwood et al., 1976; Baird and Stacey, 1991). Risso's dolphins occur along the continental shelf edge from Cape Hatteras to Georges Bank during spring, summer, and autumn. In winter, they occur in oceanic (slope) waters within the Mid-Atlantic

Bight (Waring et al., 2014). The majority of sightings during the 2011 surveys occurred along the continental shelf break with generally lower sighting rates over the continental slope (Palka, 2012).

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).

4.2.5 Long-Finned Pilot Whale (*Globicephala melas melas*)

Pilot whales attain a body length of 7.2 m (short-finned pilot whale) and 6.7 m (long-finned pilot whale) (Jefferson et al., 2011, Waring et al., 2015). There are two species of pilot whale in the Western North Atlantic, long-finned (*G. melas*) and short-finned (*G. macrorhynchus*). The species overlap, are difficult to tell apart, and parameters that define their distributions are not well differentiated. However, it is generally accepted that pilot whale sightings above approximately 42° N are most likely long-finned pilot whales (Waring et al., 2015). Additionally, in the northern extent of the ranges, long-finned pilot whales occupy inshore areas, whereas short-finned pilot whales remain in offshore habitats. Therefore, the pilot whales that occur within the Project Area are most likely long-finned pilot whales that are part of the Western North Atlantic stock. Pilot whales are not listed as threatened or endangered, and the Western North Atlantic stock is not considered strategic under the MMPA. The best population estimate for the Western North Atlantic stock of long-finned pilot whales is 5,636 individuals (Waring et al., 2015).

Long-finned pilot whales occur over the continental slope in high densities during winter and spring then move inshore and into shelf waters during summer and autumn following prey populations of squid and mackerel (Reeves et al., 2012). They will also readily feed on other fish, cephalopods, and crustaceans. Pilot whales are common in central and northern Georges Bank, Great South Channel, Stellwagen Bank, and Gulf of Maine during the summer and early fall (May and October) (DOC, 2010). Long-finned pilot whales concentrate along the Northeast U.S. shelf edge between the 100 m and 1,000 m isobaths during mid-winter and early spring (CETAP, 1982). In late spring, pilot whales move from the mid-Atlantic region onto Georges Bank and the Scotian Shelf, and into the GoM, where they remain through late autumn (CETAP, 1982). 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 are highly social and vocal and are typically observed in groups of 10 to 20 Pilot whales are highly social and vocal and are typically observed in groups of 10 to 20 surface-active individuals.

A source of mortality and injury to long-finned pilot whales is through bycatch during gillnet fishing, pelagic trawling, longline fishing, and purse seine fishing. For the period between 2008 and 2012, the observed average fishery-related mortality or serious injury was 35 long-finned pilot whales per year. The highest observed bycatch rate for all pilot whales occurred in the pelagic longline fishery with peak bycatch occurring during September and October along the mid-Atlantic coast. Based on biopsy data; however, the majority, if not all, of the bycatch whales were short-finned. Other fisheries mortalities (bottom trawls, mid- water trawls, gillnet) are more frequently observed north of 40°N; therefore, these fisheries likely have a higher proportional impact on long-finned pilot whales.

Pilot whales also demonstrate a propensity to mass strand; however, the role that human activities play in these strandings is not known. From 2008 to 2012, 37 long-finned and seven undetermined pilot whales stranded between Maine and Florida. Bioaccumulated toxins are also a potential source of human-caused source of mortality in pilot whales. Polychlorinated biphenyls (PCBs) and chlorinated pesticides (DDT, DDE, dieldrin, etc.) have been found in pilot whale blubber (Muir et al., 1988; Weisbrod et al., 2000); and bioaccumulation levels of these toxins were more similar in whales

from the same stranding group than from animals within the same sex or age category (Weisbrod et al., 2000).

Pilot whales are acoustic mid-frequency specialists with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al., 2007). Pilot whales echolocate and produce tonal calls. The primary tonal calls of the long-finned pilot whale range from 1 to 8 kHz with a mean duration of about 1 second. The calls can be varied with seven categories identified (level, falling, rising, up-down, down-up, waver, and multi-hump) and are likely associated with specific social activities (Vester et al., 2014).

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

The Atlantic white-sided (AWS) dolphin is robust and attains a body length of approximately 2.8 m (Jefferson et al., 2008, Waring et al., 2015). It is characterized with a strongly “keeled” tail stock and distinctive color pattern. The AWS dolphin occurs primarily along the 100-m depth contour within temperate and subpolar waters of the North Atlantic. Seasonally, the AWS dolphin occupies northern, inshore waters during summer and southern, offshore waters in the winter. The AWS dolphins that potentially occur in the Project Area are all part of the Western North Atlantic stock. The Western North Atlantic stock inhabits waters from central West Greenland to North Carolina (about 35°N) (Waring et al., 2015). There is some evidence supporting the division of the Western Atlantic population into three separate stocks; however, this has not been established. The estimated average annual human-related mortality does not exceed the PBR for this stock and the AWS dolphin is not listed as threatened or endangered; therefore, the stock is not considered strategic under the MMPA. The best abundance estimate for the Western North Atlantic AWS dolphin stock is 48,819.

Mortality to AWS dolphins resulting from fisheries interactions averaged 116 dolphins per year between 2008 and 2012. This number was comprised of recorded mortality or serious injury from gillnets (35 per year), bottom trawls (77 per year), and mid-water trawls (3.8 per year).

AWS dolphins feed on a variety of fish such as herring, hake, smelt, capelin, and cod as well as squid and shrimp. Like many dolphins, this species is highly gregarious and will often travel in groups of 100 or more and are highly vocal when in these aggregations. Breeding takes place between May and August with most calves born in June and July. Recordings from Pacific white sided dolphins show that this Lagenorhynchus species produce echolocation clicks were centered at 115 kHz and up to 15 whistle types between 7 and 16 kHz (Rasmussen and Miller, 2002).

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., 2007; Craddock et al., 2009).

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).

4.2.7 Common Dolphin (*Delphinus delphis*)

The common dolphin may be one of the most widely distributed species of cetaceans, as it is found worldwide in temperate, tropical, and subtropical seas (Waring et al., 2015). Two species were

previously recognized: the long beaked common dolphin (*Delphinus capensis*) and the short-beaked common dolphin; however, Cunha et al., (2015) summarized the relevant data and analyses, along with additional molecular data and analysis, and recommended that *Delphinus capensis* not be further used. This taxonomic convention is used by the Society or Marine Mammalogy. The best population estimate for this stock is 70,184 (CV=0.28). The species is not listed as threatened or endangered under the ESA, and the stock is not classified as a strategic or depleted stock.

Common dolphins are distributed in waters off the eastern U.S. coast from Cape Hatteras northeast to Georges Bank (35° to 42° N) during mid-January to May and move as far north as the Scotian Shelf from mid-summer to autumn (CETAP, 1982; Hayes et al., 2017; Hamazaki, 2002; Selzer and Payne, 1988). Primarily occurring at the shelf and shelf break along the Gulf Stream, however, common dolphins are known to occur in many water depths including coastal waters.

Common dolphins aggregate in large schools numbering in the hundreds, although the typical group size is 30 or fewer (Reeves et al., 2012). The common dolphin feeds on small schooling fish and squid; as such, common dolphins are subject to bycatch in gillnets, pelagic trawls, and longline fisheries. During 2008 to 2012, an estimated average of 298 common dolphins were taken each year in fisheries activities.

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).

4.2.8 Atlantic Spotted Dolphin (*Stenella frontalis*)

Atlantic spotted dolphins are widely distributed in tropical and warm temperate waters of the western North Atlantic (Leatherwood et al., 1976). They range from southern New England, 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., 2007). Four sighting of Atlantic spotted dolphins were recorded between 2012 and 2014 during the summer MABS surveys.

Atlantic spotted dolphins are not listed as threatened or endangered under the ESA. Atlantic, 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. Abundance estimates by month and region showed a best estimate of 3,578 (CV=0.48) for June through August 2004, between Maryland and the Bay of Fundy; and 47,400 (CV=0.45) for the same time period between Florida and Maryland (Waring et al., 2014).

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 typically range from 100 Hz to 130 kHz (DoN, 2008).

4.2.9 Bottlenose Dolphin (*Tursiops truncatus*)

Adult bottlenose dolphins range in length from 1.8 to 3.8 m. Within the western North Atlantic, including the Project Area, there are two distinct bottlenose dolphin forms, or morphotypes: coastal and offshore. The two forms are genetically and morphologically distinct, though regionally variable (Jefferson et al., 2008; Waring et al., 2015). Both inhabit waters in the western North Atlantic Ocean (Hersh and Duffield, 1989; Mead and Potter, 1995; Curry and Smith, 1997) along the U.S. Atlantic coast. The bottlenose dolphin is not listed as threatened or endangered under the ESA.

Analysis of stranding data, satellite tagging and genetic studies resulted in the western North Atlantic stock being divided into five geographic stocks: the Central Florida, Northern Florida, South Carolina-Georgia, Southern Migratory Coastal, and Northern Migratory Coastal stocks (Rosel et al., 2009; Waring et al., 2010). All coastal stocks are listed as depleted (Waring et al., 2010). The northern migratory stock range is listed as upper New Jersey to lower Maryland, therefore occurrence within the Project Area would be considered rare.

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 abundance estimate for offshore morphotype bottlenose dolphins in the western North Atlantic is 77,532 (CV=0.40) (Hayes et al., 2017).

The offshore stock is distributed primarily along the OCS and continental slope, from Georges Bank to Cape Hatteras during spring and summer (CETAP, 1982). North of Cape Hatteras, there is separation of the two morphotypes across bathymetric contours during summer months. Aerial surveys flown from 1979 through 1981 indicated a concentration of bottlenose dolphins in waters < 25 m (82 ft) deep corresponded with the coastal morphotype, and an area of high abundance along the shelf break, corresponded with the offshore stock (Hayes et al., 2016). Torres et al. (2003) found a statistically significant break in the distribution of the morphotypes at 34 km from shore. 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°C (Garrison et al., 2002).

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).

4.2.10 Harbor Porpoise (*Phocoena phocoena*)

The harbor porpoise is the only porpoise species found in the Atlantic. It is a small, stocky cetacean with a blunt, short-beaked head. There are four subspecies, with *P. phocoena* residing in the North Atlantic (Committee on Taxonomy, 2017). This subspecies reaches a body length of 1.9 m (6.2 ft) (Jefferson et al., 2011). They commonly occur throughout Massachusetts Bay from September through April. During fall and spring, harbor porpoises are widely distributed along the east coast from New Jersey to Maine. During summer, the porpoises are concentrated in the Northern Gulf of Maine and Southern Bay of Fundy in water depths less than 150 m (492 ft). In winter, densities increase in waters off New Jersey to North Carolina and decrease in the waters from New York to New Brunswick, however, specific migratory timing or routes are not apparent.

The harbor porpoises that occur in the Project Area comprise the Gulf of Maine/Bay of Fundy stock. This stock is not considered strategic under the MMPA because they are not listed as threatened or

endangered and the annual human-related mortality rates do not exceed the PBR. In 2001, NMFS conducted a status review for the stock, mainly due to the level of bycatch in fisheries (66 FR 53195). The determination from the review was that listing the harbor porpoise under the ESA was not warranted and the species was removed from the candidate list. The best abundance estimate of harbor porpoises for the Gulf of Maine/Bay of Fundy stock is 79,883.

Harbor porpoise feed on small schooling fish such as mackerel, herring, and cod, as well as worms, squid, and sand eels. Their foraging habits and habitats, make this species particularly susceptible to mortality in bottom-set gill nets (Waring et al., 2015). The average estimated human-caused mortality or serious injury for this stock is 437 harbor porpoises per year, derived from both U.S. and Canadian fisheries observer records. In 2010, a final rule was published for the existing Harbor Porpoise Take Reduction Plan in the Federal Register (75 FR 7383; 75 FR 12698) to address closure areas and timing based on bycatch rates.

Population trends for this species are unknown. The best, and most recent, abundance estimate for harbor porpoise in the Gulf of Maine / Bay of Fundy stock is 79,833 (CV=0.32). Harbor porpoise are the only potentially affected species in the Project Area within the high-frequency hearing group.

The harbor porpoise is a high-frequency specialist using ultrasonic echolocation clicks to navigate and hunt prey. The click frequency is between 110 and 150 kHz, which is consistent with harbor porpoise hearing sensitivity centered between 100 and 120 kHz (Thompson et al., 2013). Click trains can have very short inter-click intervals when close to a prey item which results in a “feeding buzz” due to the rapid succession of individual clicks.

4.3 PHOCIDS

4.3.1 Harbor Seal (*Phoca vitulina*)

The harbor seal is found in all nearshore waters of the Atlantic Ocean and adjoining seas north of 30°N (Waring et al., 2015). In the western North Atlantic, they are distributed from eastern Canada to southern New England and New York, and occasionally to the Carolinas (Payne and Selzer, 1989). Harbor seals are the most abundant seals in the eastern United States. Harbor seals occur seasonally along the Southern New England and New York coasts from September through late May (Schneider and Payne, 1983) with their seasonal interval along the Southern New England to New Jersey coasts increasing (Barlas, 1999; deHart, 2002). No pupping areas have been identified in Southern New England (Barlas, 1999).

Harbor seals are not listed as threatened or endangered. The harbor seals within the Project Area are part of the single Western North Atlantic stock which is not considered strategic under the MMPA. The best population estimate of harbor seals for this stock is 75,834.

Harbor seals will exploit a variety of available food sources and will feed both in shallow coastal habitats and offshore (Waring et al., 2015). Typical prey items include squid and small schooling fish (i.e., herring, alewife, flounder, redfish, cod, yellowtail flounder, sand eel, hake) and spend up to 85% of the day diving, presumably foraging.

Fisheries interactions are common, and harbor seals are legally killed in Canada, Norway, and the United Kingdom to protect fish farms or local fisheries (Reeves et al., 2013). They are also susceptible to bycatch in gillnets, trawls, and purse seines. For the period from 2010 to 2014, the average human-caused mortality and serious injury to harbor seals was 389 per year, of which 377 (96.6%) occurred in fisheries interactions

Male harbor seals produce underwater vocalizations during mating season to attract females and defend territories (Sabinsky et al., 2012). These calls are comprised of “growls” or “roars” with peak energy at 1.2 kHz (Sabinsky et al., 2012). Captive studies have shown that harbor seals have good (>50%) sound detection thresholds between 0.1 and 80 kHz, with primary sound detection between 0.5 and 40 kHz (Kastelein et al., 2009).

4.3.2 Gray Seal (*Halichoerus grypus*)

The gray seal ranges from Canada to New York; however, there are stranding records as far south as Cape Hatteras, North Carolina (Gilbert et al., 2005). Gray seals within the Project Area are part of the Western North Atlantic stock. They are not listed as threatened or endangered and the stock is not considered strategic under the MMPA. A U.S. population estimate for this species is not available. However, the Canadian gray seal population was estimated to be 505,000. (Waring et al., 2015).

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 will aggregate in large numbers to breed, molt, and rest. Gray seals will exploit a variety of available food sources and will feed both in shallow coastal habitats and offshore (Waring et al., 2015). Typical prey items include cephalopods, sessile, and small schooling fish (i.e., herring, alewife, flounder, redfish, cod, yellowtail flounder, sand eel, hake), and crustaceans. Gray seals will go on extensive dives to depths to 475 m to capture food (Waring et al., 2015). Gray seals are susceptible to bycatch and fisheries interactions and, like the harbor seal, are legally killed in some countries to protect fisheries resources. The gray seal is also taken commercially outside the U.S. In the U.S., the average estimated human-caused mortality and serious injury of gray seals between 2010 and 2014 was 4,937 seals per year (Hayes et al., 2016).

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).

5.0 Type of Incidental Take Requested

The Applicant requests an IHA pursuant to Section 101 (a)(5)(D) of the MMPA for incidental take of small numbers of marine mammals by Level B harassment during geophysical surveys conducted as part of site characterizations activities within the Project Area. Proposed activities, as outlined in **Section 1.0**, have the potential to impact marine mammals within the Project Area from sounds generated by the vessel and survey equipment.

NMFS has recently indicated that sound produced during geotechnical survey activities, including use of DP thrusters, is unlikely to result in harassment of marine mammals in the Project Area (NMFS personal communication, 2017, 2018). The vessels proposed for use during the survey produce noise that are similar to that produced by vessel traffic and operations within the region and thus it does not anticipate the need for an MMPA IHA for the use of DP thrusters. The geotechnical survey equipment would be working concurrently with DP thrusters at all times with a predictable operational scenario of DP positioning on station, activation of equipment, completion of sampling, and release of DP station keeping. It is expected that although survey operations will occur on a 24-hr basis, individual sampling would only take place in roughly 3-hr increments. Sound propagation calculations were completed for the geotechnical sources and resulted in relatively small Level A isopleths. Potential isopleth ranges produced by geotechnical sources are provided in **Section 6.0**; however, take calculations for geotechnical surveys are not carried through or requested in this Application because it is not expected that any marine mammal will be exposed to SPLs of strength and duration necessary to constitute a take during geotechnical surveys.

For impulsive sources, the maximum range to a Level A threshold is 11.2 m (36.7 ft) for HF cetaceans, while the ranges to Level A thresholds for other hearing group (MF, LF, PI) extend less than 6 m (19.6 ft) from the source. Although Level A (injury) takes were calculated, Level A take is not anticipated during HRG surveys. The calculations for Level A (and Level B) assumed that all HRG surveys over the entire 200-day period used the source and operations that produced the largest acoustic isopleths. This assumption is conservative and provides a cautious approach to predicting active survey operations and their potential impact on marine mammal species. Additionally, the largest Level A isopleths for LF and MF cetaceans are produced by the SEL_{cum} calculations which require a duration (usually 24 hours) of exposure for Level A to be realized. The small isopleths produced do not provide opportunity, due to animal and vessel movement, for exposure durations that would constitute take. For HF and PI species, Level A takes are not expected due to the small distance to the Level A L_{pk} thresholds and implementation of mitigation measures, as described in **Section 11.0**. The HRG sources are typically towed less than 50 m (164 ft) behind the vessel, therefore animals entering these impact ranges would be navigating close to and/or within the vessel and tow equipment configuration, which is also not common, and is easily mitigated.

The Level B take 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 (Holt, 2008). No permanent hearing loss or physiological damage (such as PTS) or injury is expected to occur to marine mammals by the survey equipment or vessels during proposed surveys.

Level B take may also be manifested in behavioral reactions such as avoidance and temporary displacement for some individuals or groups of marine mammals near the proposed activities. It is expected that the severity of behavioral effects will vary with the duration of operations, the behavior of the animal at the time of reception of the stimulus, and the distance and received level of the sound. Potential impacts will be mitigated through a visual monitoring program and vessel activity management program, both of which are fully described in **Section 11.0**.

6.0 Take Estimates for Marine Mammals

The Applicant is seeking authorization for potential "taking" of small numbers of marine mammals under the jurisdiction of NMFS in the proposed region of activity, as described in **Section 2.0**. The 17 species potentially taken are described in **Section 4.0**. Each species has a geographic distribution that encompasses the Project Area and has at least a minimal potential to occur.

Authorization for Level B harassment is sought for the following 17 species:

- North Atlantic right whale (*Eubalaena glacialis*);
- Humpback whale (*Megaptera novaeangliae*);
- Fin whale (*Balaenoptera physalus*);
- Sei whale (*Balaenoptera borealis*);
- Minke whale (*Balaenoptera acutorostrata*);
- Blue whale (*Balaenoptera musculus*);
- Sperm whale (*Physeter microcephalus*);
- Killer whale (*Orcinus orca*);
- Risso's dolphin (*Grampus griseus*);
- Long-finned pilot whale (*Globicephala melas*);
- Atlantic white-sided dolphin (*Lagenorhynchus acutus*);
- Atlantic spotted dolphin (*Stenella frontalis*);
- Common dolphin (*Delphinus delphis*);
- Bottlenose dolphin (*Tursiops truncatus*);
- Harbor porpoise (*Phocoena phocoena*);
- Harbor seal (*Phoca vitulina*); and
- Grey seal (*Halichoerus grypus*).

The only anticipated impacts to marine mammals are associated with noise and are limited to the use of HRG survey equipment. The potential activities are not expected to take more than a small number of marine mammals or have more than a negligible effect on their populations based on their seasonal density and distribution and their known reactions to exposure to such underwater sound sources. The source activity is described in **Section 1.2**.

6.1 BASIS FOR ESTIMATING NUMBERS OF MARINE MAMMALS THAT MIGHT BE TAKEN BY HARASSMENT

Estimating exposures of marine mammal species assumes that exposure of an animal to a specified noise level within a region of ensonification will result in a take of that animal. The ensonified area is calculated based on the source level and operational mode of the equipment (**Sections 6.1.1** and **6.1.2**). Potential Level B take exposures are estimated within the area ensonified to an RL_{rms} exceeding 120 dB re 1 µPa for continuous sound (e.g. vibracore and DP thruster) and 160 dB re 1 µPa for impulsive sound (sources such as sparkers) within an average day of activity. The potential number of exposed animals is estimated from the densities (animals km^{-2}) of that species expected within the Project Area during the season of the activity as described in **Section 6.1.2**. These densities are then multiplied by the number of days that the source is operating. These calculations result in unmitigated take estimates for each affected species over the entire operational period.

6.1.1 Zone of Influence (ZOI) Calculations

The zone of influence (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 × 2r) + πr^2

Where r is the distance from the source to the isopleth for Level B and Level A L_{pk} thresholds using the spherical transmission loss (*TL*) equation:

$$TL = 20\log_{10} r$$

Isopleth radii for the vibracore and Pan Geo acoustic corer were determined using *dBSea* acoustic modeling software (Marshall Day Acoustics). The modeled scenario used hydro- and geo-acoustic parameters within the Project Area with the source located 3 m above the seafloor, thus representing more realistic operational conditions for these source types.

The modeling scenario took into consideration range variables including bathymetry, sound velocity profile, and seafloor composition. The sources were defined using sound level, spectral content, depth, and directionality. The source sound transmission solution was calculated using 100 radial slices about the source. Each slice contained 100 evaluation range points. The sound field was calculated using a rectilinear grid consisting of 800 points on the X and Y axis and 30 points on the Z (depth) axis. The step size between each point on the X and Y axis was 20 m. The step size between points on the Z axis was dependent on the depth at each point.

For all remaining impulsive sources the NMFS Level A dual criteria SEL_{cum} and L_{pk} (NMFS, 2016) were considered. For the SEL_{cum} criteria, the NMFS Technical Guidance's User Spreadsheet (NOAA, 2016b) was used to calculate the propagation distance to each marine mammal functional hearing group's threshold level. The most conservative (largest) distance between the SEL_{cum} and L_{pk} was used to calculate the ZOI. Dual criteria are not used in Level B take calculations. The range to the Level B thresholds was determined by applying spherical transmission loss calculations to the source RMS SPL described in **Table 1**, and those distances were used to calculate the Level B ZOI. ZOIs were calculated for each source using the maximum potential daily active survey distance of 110 km. The ZOIs for each source are provided in **Table 6**.

The Level A and Level B isopleths were calculated to comprehensively assess the potential impacts of the predicted maximum practicable source operations as required for this Application. However, as described in **Section 5.0**, Level A takes are not expected.

The range to the isopleth for Level A thresholds was estimated using NMFS User Spreadsheet (Tab F for mobile impulsive sources). Weighting factor adjustments (WFA) were determined by examining the frequency range and spectral density for each source and comparing it to the Applicable Frequencies Table located in the WFA tab of the NMFS User Spreadsheet. If the determined frequency was lower than the applicable frequency for all hearing groups, it was entered as the WFA. When the frequency of a source exceeded the applicable frequency for a certain hearing group, an additional worksheet was created that applied the "use" frequency of the exceeded hearing group.

The calculations are not based on cumulative noise levels from multiple sources operating simultaneously, but from each source 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).

Table 6. Maximum distance and Zone of Influence (ZOI) areas encompassing Level A and Level B thresholds for each sound source.†

Source	Distance to Level A Threshold (meters [m])				Level A ZOI (square kilometers [km^2])				Distance to Level B (m)	Level B ZOI (km^2)
Hearing Group[a]	LF	MF	HF	PI	LF	MF	HF	PI	All	All
Continuous Sources										
Deep bore core	0.21	0.22	3.6	0.16	0	0	0	0	17.8	0
Vibracore	14.5	17.4	237.5	12.6	0	0	0.18	0	1778	9.9
DP Thruster	0.37	0.3	3.84	0.28	0	0	0	0	31.6	0
Impulsive Sources										
TB Chirp	0.27	0	1.02	0	0.27	0	1.02	0	70.8	15.59
EdgeTech Chirp	0	0	4.64	0	0	0	0	0	6.3	1.39
AA Boomer	0.01	0	0.59	0	0	0	0.13	0	5.6	1.24
AA S-Boom	0.04	0	3.41	0.02	0.01	0	0.75	0.01	141.3	31.14
Bubble Gun	0	0	1.17	0	0	0	0.26	0	63.1	13.89
800J Spark	0.21	0	5.41	0.08	0.05	0	1.19	0.02	141.3	31.14
PG Acoustic Corer	4.54	1.65	31.27	3.6	0	0	0	0	7.5	0
AA Dura-Spark	1.58	0.04	11.22	1.78	0.35	0.01	2.47	0.39	446.7	98.9

†The Level A and Level B isopleths were calculated to comprehensively assess the potential impacts of the predicted maximum practicable source operations as required for this Application. However, as described in **Section 5.0**, Level A takes are not expected.

[a] As defined in NMFS (2016): LF= Low Frequency; MF = Mid Frequency; HF = High Frequency; PI = Pinnipeds in water.
AA = Applied Acoustics; DP = dynamically positioned; TB Teledyne Benthos.; PG = PanGeo.

6.1.2 Marine Mammal Density Calculation

The density calculation methodology applied to take estimates for this application is derived from the model results produced by Roberts et al. (2016) for the East Coast region. These files are available as raster files from the website http://cetsound.noaa.gov/cda.

In order to determine cetacean densities for take estimates, the density coverages that included the ZOI for the Project Area were selected for months June through December. The mean density for each species per month was an average of 13 raster cells that were inside or adjacent to the Project Area (**Table 7**). Estimates provided by the models are based on a grid cell size of 100 km^2; therefore, model grid cell values were divided by 100 to determine animals km^{-2}. Gray seal and harbor seal densities are not provided in the Roberts et al. (2016) models. Seal densities were derived from the Strategic Environmental Research and Development Program (SERDP) using the Navy OPAREA Density Estimate (NODE) model for the Northeast OPAREAS (DoN, 2007a,b).

Table 7. Estimated Density (animals km^{-2}) of affected marine mammals within the Rhode Island-Massachusetts Wind Energy Area (RI-MA WEA) based on seasonal habitat density models (Roberts et al., 2017).

Common Name	Scientific Name	Stock	Relative Occurrence in the Region	Average Density (#/km^2)
Sperm whale	*Physeter macrocephalus*	North Atlantic	Common	0.0000665
Killer Whale	*Orcinus orca*	Western North Atlantic	Rare	0.0000090
Risso's dolphin	*Grampus griseus*	Western North Atlantic	Common	0.0000040
Long-finned pilot whale	*Globicephala melas*	Western North Atlantic	Common	0.0015364
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	Western North Atlantic	Common	0.0180360
Common dolphin	*Delphinus delphis*	Western North Atlantic	Common	0.0459986
Atlantic spotted dolphin	*Stenella frontalis*	Western North Atlantic	Uncommon	0.0000886
Bottlenose dolphin	*Tursiops truncatus*	Western North Atlantic, Offshore	Common	0.0160936
Harbor Porpoise	*Phocoena phocoena*	Gulf of Maine/Bay of Fundy	Common	0.0225781
Fin whale	*Balaenoptera physalus*	Western North Atlantic	Common	0.0021353
Sei whale	*Balaenoptera borealis*	Nova Scotia	Regular	0.0000500
Minke whale	*Balaenoptera acutorostrata*	Canadian East Coast	Common	0.0004745
Blue whale	*Balaenoptera musculus*	Western North Atlantic	Rare	0.0000098
Humpback whale	*Megaptera novaeangliae*	Gulf of Maine	Common	0.0014439
North Atlantic right whale	*Eubalaena glacialis*	Western North Atlantic	Common	0.0001706
Harbor Seal[1]	*Phoca vitulina*	Western North Atlantic	Regular	0.0649533
Gray Seal[1]	*Halichoerus grypus*	Western North Atlantic	Regular	0.0941067

[1] Seal densities derived from Strategic Environmental Research and Development Program (SERDP)/Navy Oparea Density Estimates (NODE) for the Atlantic model (DoN, 2007a,b).

6.1.3 Take Calculation

Based on the densities in **Table 7**, the estimated number of marine mammal takes per survey type was determined. Calculations were based on towed HRG surveys operating for 200 days.

Estimates of take are calculated according to the following formula:

Estimated Take = D × ZOI × # of Days

Where: D = average species density (per km^2); and ZOI = maximum ensonified area that equates to the NMFS thresholds for noise impact criteria.

To estimate take, DWW used the 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 (rounded to the nearest whole number) to arrive at the estimated take. This final number equals the instances of take for the entire operational period. The result is an estimate of the maximum potential number of instances that marine mammals could be exposed to sounds above the Level B harassment thresholds over the duration of survey activities. DWW has agreed to extensive mitigation measures to reduce any potential Level B harassment and eliminate the possibility of any Level A harassment.

6.2 ESTIMATED NUMBERS OF MARINE MAMMALS THAT MIGHT BE TAKEN BY HARASSMENT

The Applicant is requesting approval for the incidental harassment takes of marine mammals associated with geophysical surveys. Take estimates were projected based on marine mammal presence, calculated density estimates, and activity-specific noise source propagation characteristics.

6.2.1 Estimated Level A Harassment of Marine Mammals

Level A exposures are not expected to occur for any of the hearing groups during operation of geophysical impulsive sources. Linear Level A threshold distances (either SEL_{cum} or L_{pk}) are less than 250 m (820.1 ft) for geotechnical sources and 26 m (85.3 ft) for HRG sources. Mitigation measures, as described in **Section 11.0**, will be employed such that Level A exposures are improbable. Maximum potential Level A take calculations, without mitigation applied, are provided in **Table 8**.

Table 8. Maximum potential Level A take exposures, without mitigation applied, for marine mammal species †

Source	TB Chirp	Edgetech Chirp	AA Boomer	AA S-Boom	Bubble Gun	800J Spark	Acoustic Corer	AA Dura-Spark	% Pop.
LF Cetaceans									
Fin whale	0	0	0	0	0	0	0	0	0
Sei whale	0	0	0	0	0	0	0	0	0
Minke whale	0	0	0	0	0	0	0	0	0
Blue whale	0	0	0	0	0	0	0	0	0
Humpback whale	0	0	0	0	0	0	0	0	0
North Atlantic right whale	0	0	0	0	0	0	0	0	0

Table 8. (Continued).

Source	TB Chirp	Edgetech Chirp	AA Boomer	AA S-Boom	Bubble Gun	800J Spark	Acoustic Corer	AA Dura-Spark	% Pop.
MF Cetaceans									
Sperm Whale	0	0	0	0	0	0	0	0	0
Atlantic white sided dolphin	0	0	0	0	0	0	0	0	0
Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0
Bottlenose dolphin	0	0	0	0	0	0	0	0	0
Killer whale	0	0	0	0	0	0	0	0	0
Long-finned pilot whale	0	0	0	0	0	0	0	0	0
Rissos dolphin	0	0	0	0	0	0	0	0	0
Common dolphin	0	0	0	0	0	0	0	0	0
HF Cetaceans									
Harbor porpoise	**5**	0	**1**	**3**	**1**	**4**	**0**	**11**	0.016
Pinnipeds									
Gray seal	0	0	0	0	0	0	0	**7**	0.001
Harbor seal	0	0	0	0	0	0	0	**5**	0.007

†Bold numbers denote takes that are not expected to occur and are not requested in the Application due to the geometry of the survey and the very small range to impact isopleth.
Population percentages were derived from the highest potential take numbers.
AA = Applied Acoustics; DP = dynamically positioned; TB Teledyne Benthos.

6.2.2 Estimated Level B Harassment of Marine Mammals

Level B exposures were estimated by multiplying the calculated density of each species (**Table 7**) (Roberts et al., 2016) by the ZOI area that was estimated to be ensonified to an RL_{rms} exceeding 160 dB re 1 µPa.

Table 9 summarizes the Level B take estimates for all species having a density estimate in the Project Area that was considered common, uncommon, or regular. Additionally, the killer whale and blue whale, considered rare in the region, were included due to their unpredictable and wide-ranging behavior. As described above, NMFS has defined the RL_{rms} thresholds for impulsive and non-impulsive sound sources. A marine mammal exposed to the thresholds results in a Level B take regardless of the exposure duration (unlike Level A takes where the SEL_{cum} includes an exposure duration). It is assumed that an animal will only be taken once over a 24-hr period; however, an activity may result in multiple takes of the same animal over a period of time. Therefore, both the number of takes and the affected population percentages represent the maximum potential take numbers. In actuality, a limited number of marine mammals may realize behavioral modification. The numbers of individuals in the take estimates range from 1 to 1,861 (**Table 9**). While mitigation will be effective to eliminate Level A takes, the distances represented for Level B ZOIs produced by some sources are large enough whereby mitigation will not be able to effectively eliminate the potential for Level B take.

Table 9. Summary of maximum potential Level B takes, without mitigation applied, for marine mammal species.

Source	TB Chirp	EdgeTech Chirp	AA Boomer	AA S-Boom	Bubble Gun	800J Spark	Acoustic Corer	AA Dura-Spark
Distance to Level B Threshold (m)	70.8	6.3	5.6	141.3	63.1	141.3	7.5	446.7
Level B ZOI (km^2)	15.6	1.4	1.2	31.1	13.9	31.1	0	98.9
Species	Estimated takes (using each source for 100% of the surveys)							
Sperm Whale	0	0	0	0	0	0	0	1
Atlantic White-sided Dolphin	56	5	4	112	50	112	0	357
Atlantic Spotted Dolphin	0	0	0	1	0	1	0	2
Bottlenose Dolphin	50	5	4	100	45	100	0	318
Killer Whale	0	0	0	0	0	0	0	0
Long-finned Pilot Whale	5	0	0	10	4	10	0	30
Risso's Dolphin	0	0	0	0	0	0	0	0
Common Dolphin	143	13	11	286	128	286	0	910
Fin Whale	7	1	1	13	6	13	0	42
Sei Whale	0	0	0	0	0	0	0	1
Minke Whale	1	0	0	3	1	3	0	9
Blue Whale	0	0	0	0	0	0	0	0
Humpback Whale	5	0	0	9	4	9	0	29
North Atlantic Right Whale	1	0	0	1	0	1	0	3
Harbor Porpoise	79	7	6	158	70	158	0	501
Gray Seal	293	26	23	586	261	586	0	1861
Harbor Seal	203	18	16	405	180	405	0	1285

AA = Applied Acoustics; TB Teledyne Benthos.

It is necessary for the Applicant to forecast survey parameters at the time of the IHA application. Because specific equipment and survey needs are not yet fully defined the maximum take estimates were used for the HRG source that produced the largest threshold isopleths in order to estimate the take request numbers. These estimates provide conservative (worst-case) estimates of the potential Level B exposures to any of the species stocks expected to occur within the Project Area.

Table 10 summarizes the take requests for an HRG survey using a Dura-Spark sub-bottom profiler for 200 days with operations occurring 24 hr per day. The 1,000 J operating energy for the Dura-Spark was selected to use as the "worst-case" scenario because although the Dura-Spark can be operated with higher energy (1,250 J), the manufacturer-recommended operating maximum is 1,000 J. Given the fact that we are assigning 100% of the geophysical surveys to the Dura-Spark, the worst-case is still adequately represented by the 1,000 J operation over 200 survey days.

Table 10. Requested Level B takes of marine mammals based on scenario of 200 days Dura-Spark utilization for high-resolution geophysical surveys.

Species/Stock	Density (#/km^2)	Level B Takes HRG Surveys (AA Dura-Spark x 200 days of operation)	% Population or Stock
North Atlantic Right Whale	0.0001706	3	0.68
Humpback Whale	0.0014439	29	3.52
Fin Whale	0.0021353	42	2.59
Sei Whale	0.0000500	1	0.28
Minke Whale	0.0004745	9	0.35
Sperm Whale†	0.0000665	3	0.13
Long-finned Pilot Whale	0.0015364	30	0.53
Atlantic White-sided Dolphin	0.0180360	357	0.73
Common Dolphin	0.0459986	910	1.29
Atlantic Spotted Dolphin	0.0000886	2	<0.01
Bottlenose Dolphin	0.0160936	318	0.41
Harbor Porpoise	0.0253125	501	0.63
Harbor Seal	0.0649533	1285	1.69
Gray Seal	0.0941067	1861	0.37

† Only 1 sperm whale take was calculated; however, based on observer reports from previous surveys, the applicant anticipates that there is a greater potential for sperm whale occurrence and therefore requests 3 takes.

7.0 Effects on Marine Mammal Species or Stocks

Marine mammals exposed to natural or man-made sound may experience non-auditory and auditory impacts, which range in severity (Southall et al., 2007; NMFS, 2016). The potential exists for marine mammals to be exposed to underwater sound associated with survey activities. These impacts are likely to affect individual species and have only negligible effects on the marine mammal stocks and, therefore, will not adversely affect the population of any species.

7.1 NEGLIGIBLE IMPACTS

Under the requirements of 50 CFR § 216.104, NMFS has defined negligible impact as an impact that is not reasonably expected to adversely affect a species or stock through effects on annual rates of recruitment or survival. The small numbers requirement is not based on take estimates alone; rather, for NMFS to make a negligible impact determination, small numbers must denote that the portion of a marine mammal species or stock in the take estimates will have a negligible impact on that species or stock.

As discussed in **Sections 9.0** and **10.0**, physical auditory effects, vessel strikes, permanent or temporary threshold shifts, and long-term impacts to habitat or prey species are not expected to occur. Temporary masking may occur in localized areas for short periods of time when an animal is in proximity to the survey; however, due to movement of the sources that produce the largest zones of influence, masking effects are expected to be negligible and not contribute significantly to other noise sources operating in the region. The reasonably expected impacts from the proposed activities are based on noise exposure thresholds that can potentially elicit a behavioral response and are categorized as Level B takes under the MMPA.

Individual species take-level exposures for geophysical surveys ranged 1 to 1,861 for potential Level B exposures (**Table 9**). The Level B takes represented less than 5% of any stock. The estimated takes—and more importantly the percentage of impacted stock— are acknowledged here to be highly conservative estimates due to the assumption of the single highest source level being used for the entire survey period and the additional considerations detailed below.

7.2 MITIGATION

Mitigation and aversion are not considered in the take estimates. Although the proposed mitigation (**Section 11.0**) is implemented to eliminate the potential for Level A takes, it will also serve to reduce the exposure of animals to source levels that could constitute Level B takes. In the BOEM (2013) EA, the modeled area of ensonification for some HRG survey equipment showed potential Level B thresholds at distances beyond what BOEM considered could be effectively visually monitored for the presence of marine mammals. However, NMFS determined that with the Standard Operating Conditions (SOCs) and the Reasonable and Prudent Measures (RPMs), the proposed HRG surveys may adversely affect but are not likely to jeopardize the continued existence of North Atlantic right, humpback, fin, sei, or sperm whales. This suggests that HRG operations would not jeopardize the sustainability of other cetaceans, particularly other LF and MF species that occupy the same acoustic habitat. Theoretically, an animal entering the Level A exclusion zone has already received a Level B exposure; however, for many of the sources the proposed 200-m (656-ft) exclusion zone will eliminate Level B exposures, thus reducing the actual number of Level B takes.

7.3 MULTIPLE EXPOSURES

The estimated exposures to most species stocks are believed to be a significant over-estimate of the actual proportion of the stock potentially affected by the survey activities. As described in **Section 6.6.2**, the metric (RL_{rms}) used to established Level B isopleths does not consider L_{pk} or a duration (SEL_{cum}) in its calculations. The metric assumes that an animal will only be taken once over a 24-hr period; however, an activity may result in multiple takes of the same animal over a period of time. It is only the multiplication of the same animals being exposed over 200 days (as is the case of the Dura-spark scenario) that numbers become inflated. Animals in an area of exposure may move location depending on their acoustic sensitivity, life stage, and acclimation (Wood et al., 2012) and may or may not demonstrate behavioral responses. Therefore, while the number of takes and the affected population percentages represent the maximum potential take numbers, in actuality a limited number of marine mammals may realize behavioral modification.

7.4 SUMMARY

The primary potential impact on marine mammals from exposure to survey-related underwater sound is behavioral responses, which do not necessarily constitute significant changes in biologically important behaviors. The National Research Council (NRC) (2005) noted that an action or activity becomes biologically significant to an individual animal when it affects the ability of the animal to grow, survive, and reproduce, wherein an impact on individuals can lead to population-level consequences and affect the viability of the species. Due to the variability in species reaction to sound sources, short time period of the survey operations, and use of mitigation measures, any behavioral reactions are expected to be minor and have negligible effects on individuals. It is expected that behavioral reactions will mainly comprise a temporary shift in spatial use. No long-term or population effects are expected from the behavioral reactions to the proposed surveys.

8.0 Minimization of Adverse Effects to Subsistence Uses

This section addresses NFMS' requirement to identify methods to minimize adverse effects of the proposed activity on subsistence uses.

There are no traditional subsistence hunting areas in the vicinity of the proposed Project Area, and there are no activities related to the proposed surveys that may affect the availability of a species or stock of marine mammals for subsistence uses. Consequently, there are no available methods to minimize potentially adverse effects to subsistence uses.

9.0 Anticipated Impacts on Habitat

This section addresses NFMS' requirement to characterize the short- and long-term impacts of the proposed activity on marine mammals associated with the predicted loss or modification of habitat and to address available methods and likelihood of restoration of lost or modified habitat. The site characterization surveys will include geophysical surveys for up to 200 days between June 15, 2018 and December 31, 2018 and geotechnical surveys will be conducted for up to 100 days. Therefore, long-term impacts are not expected. Predicted impacts to marine mammal habitat have been summarized in the following sections.

9.1 SHORT-TERM IMPACTS

The proposed activity has the potential to affect marine mammal habitat primarily through short-term impacts from increases in ambient noise levels from vessel activities.

A variety of impact producing factors—noise, discharges, physical presence, lights, and turbidity—with the potential to temporarily affect marine mammal prey availability may be expected as a result of proposed activities. The cetaceans within the Project Area feed on various pelagic and benthic fish species, cephalopods, and crustaceans. Elevated noise levels may cause some prey species to leave the immediate area of operations, temporarily disrupting feeding behavior. Displaced individuals are expected to return shortly after work is completed. Sediment disturbance is expected during geotechnical sampling and coring within the immediate area (<1 m diameter) around the core, drill, or grab sampler. This disturbance and associated water turbidity is expected to be short-term and temporary with minimal effects of marine mammal habitat or prey items.

Reduction of prey availability might indirectly affect marine mammals by altering prey abundance, behavior, and distribution. Rising sound levels could affect fish populations (McCauley et al., 2003; Popper and Hastings, 2009; Slabbekoorn et al., 2010). Marine fish are typically sensitive to the 100 to 500 Hz range, which is below most HRG sources. However, several studies have demonstrated that seismic airguns and impulsive survey source might affect the behavior of at least some species of fish. For example, field studies by Engås et al. (1996) and Whitlock and Schluter (2009) showed that the catch rate of haddock (*Melanogrammus aeglefinus*) and Atlantic cod (*Gadus morhua*) significantly declined over the 5 days following seismic airgun operation, after which the catch rate returned to normal. Other studies found only minor responses by fish to noise created during or following seismic surveys, such as a small decline in lesser sand eel (*Ammodytes marinus*) abundance that quickly returned to pre-seismic levels (Hassel et al., 2004) or no permanent changes in the behavior of marine reef fishes (Wardle et al., 2001). However, both Hassel et al. (2004) and Wardle et al. (2001) noted that when fish saw the airgun firing they performed a startle response and sometimes fled. Squid (*Sepioteuthis australis*) are an extremely important food chain component for many higher order marine predators, including sperm whales. McCauley et al. (2000) recorded caged squid responding to airgun signals. Given the generally low SPLs produced by HRG sources in comparison to sources such as airguns, no short-term impacts to potential prey items (fishes, cephalopods, crustaceans) are expected from the proposed survey activities.

Discharges will be localized near their source and are not expected to adversely affect fish or squid. While the physical presence of vessels, and deployed equipment may produce avoidance behavior, night lighting may serve to attract fishes and squid. Neither physical presence nor night lighting are expected to adversely affect prey species.

9.2 LONG-TERM IMPACTS

Due to the short duration of the potential activities and the minimal acoustic disturbance expected, no long-term impacts associated with loss or modification habitat and its effect on marine mammals are predicted.

10.0 Anticipated Effects of Habitat Impacts on Marine Mammals

This section addresses the NFMS requirement to characterize the short- and long-term impacts of the proposed activity on predicted habitat loss or modification. Loss or modification of marine mammal habitat could arise from alteration of benthic habitat, degradation of water quality, or effects of noise. These impacts could be short- or long-term in nature. However, no significant short- or long-term impacts on marine mammals or their habitat are expected. The predicted impacts to marine mammal habitat have been summarized in **Sections 10.1** and **10.2**.

10.1 SHORT-TERM IMPACTS

Marine mammals use sound to navigate, communicate, find open water, avoid predators, and find food. Acoustic acuity within the habitat must be available for species to conduct these ecological processes. If noise levels within critical frequency bands preclude animals from accessing the acoustic properties of that habitat, then availability and quality of that habitat has been diminished. The sounds that marine mammals hear and generate will vary in terms of dominant frequency, bandwidth, energy, temporal pattern, and directionality. The same variables in ambient noise will, therefore, determine a marine mammal's acoustic resource availability. In the case of marine mammals, anthropogenic noise can be viewed as a form of habitat fragmentation resulting in a loss of acoustic space that could otherwise be occupied by vocalizations or other acoustic cues (Rice et al., 2014). Primary acoustic habitat for a species will be focused within the vocal ranges for that species; therefore, habitat impact assessment should be conducted within those vocal ranges. The functional extent of the ensonified space around specific vessel operations will require an understanding of the distribution of SPLs by their spectral probability density and knowledge of received exposure levels with coordinated species densities. Therefore, marine mammals may experience some short-term loss of acoustic habitat, but the nature and duration of this loss is not expected to represent a significant loss of habitat.

Due to the small footprint of any sediment disturbance caused by geotechnical activities combined with the temporary nature of the activities and likely availability of similar benthic habitat around the sampling location, it is expected that vibracores, deep core bores, and cone penetration testing would have negligible benthic effects that could impact marine mammals.

10.2 LONG-TERM IMPACTS

Due to the short duration of the potential activities and the minimal acoustic disturbance expected, no long-term impacts associated with loss or modification habitat and its effect on marine mammals are predicted.

11.0 Mitigation Measures

This section addresses NMFS' IHA requirement to assess the availability and feasibility (economic and technological), methods, and manner of conducting such activity or means of effecting the least practicable impact upon effected species or stock, their habitat, and their availability for subsistence uses, paying particular attention to rookeries, mating grounds, and areas of similar significance.

DWW has demonstrated a strong commitment to minimizing impacts to marine mammal species through a comprehensive and progressive mitigation and monitoring program. The marine mammal mitigation program will provide the framework for mitigation and monitoring during all proposed activities. The Applicant commits to engaging in ongoing consultations with the NMFS and has committed to following a comprehensive set of mitigation measures during marine site characterization surveys. These measures include the following components:

- Establishment of exclusion zones;
- Visual and acoustic monitoring;
- Area clearance;
- Operational shutdowns, power downs and delays;
- Ramp up procedures; and
- Vessel strike avoidance procedures.

The mitigation protocols have been designed to provide protection to marine mammals, both individual species as well as species stocks, by minimizing exposure to potentially disruptive noise levels during site characterization activities. The mitigation measures will further reduce any potential ship strikes to large whales in the area.

Project-specific training will be conducted for all vessel crew prior to the start of the site characterization survey activities. 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 activities.

11.1 ESTABLISHMENT OF EXCLUSION ZONES

An exclusion zone is an area established for the NMFS-approved Protected Species Observers (PSOs) to monitor for the presence of marine mammals during activities that have the potential to cause acoustic harassment. The exclusion zones are proposed based on BOEM Lease OCS-A 0486 stipulations and Mandatory Project Design Criteria in the 2013 BOEM EA.

For geophysical survey activities with sound sources operating at frequencies below 200 kHz, a 200-m (656-ft) radius exclusion zone will be monitored for all marine mammals. A voluntary 500-m exclusion zone will be established for the North Atlantic Right Whale. These zones are anticipated to fully encompass the Level A harassment radius for all marine mammal species; and Level B harassment radius for the North Atlantic Right Whale, and is in accordance with Lease stipulation 4.3.6.1.

11.2 VISUAL AND ACOUSTIC MONITORING

Visual and acoustic monitoring of the exclusion zone will be conducted by a team of PSOs and Passive Acoustic Monitoring (PAM) operators. PAM operators will be used to support monitoring

during nighttime survey activities and when visibility is limited. An observer team comprising a minimum of four NMFS-approved PSOs and two trained PAM operators, operating in shifts, will be stationed aboard either the survey vessel or a dedicated PSO-vessel. PSOs and PAM operators will work in shifts such that no one person will work more than 4 consecutive hours without a 2-hr break or longer than 12 hr during any 24-hr period. PSOs will be considered qualified if they have completed a PSO training course and have documented experience conducting similar surveys.

Visual Monitoring

Visual monitoring of the established exclusion zone(s) will be performed by qualified and NMFS-approved PSOs. Per Lease requirements, resumes of all proposed PSOs will be provided to BOEM at least 45 days prior to the scheduled start of the surveys. 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.

PSOs will be equipped with binoculars and will 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. 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.

During nighttime operations, PSOs will use night-vision equipment with infrared light-emitting diodes spotlights and/or infrared video monitoring to monitor the exclusion zone.

Passive Acoustic Monitoring

PAM will be used, when feasible, to support monitoring during nighttime operations and when visibility is limited. The PAM system will consist of an array of hydrophones with both broadband (sampling mid-range frequencies of 2 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 acoustic signals in real-time both aurally (using headphones) and visually (via sound analysis software). PAM operators will communicate nighttime detections to the lead PSO on duty who will ensure the implementation of the appropriate mitigation measure.

11.3 AREA CLEARANCE

At the start of each survey, the PSO or PAM operators will clear the exclusion zone for 30 minutes before initiation of ramp-up procedures (See **Section 11.4**). Ramp-up may not be initiated if any marine mammal is observed within the exclusion zone. If a marine mammal is observed within the exclusion zone during the pre-clearance period, ramp-up may not begin until the animal(s) has been observed exiting its respective zone or until an additional time period has elapsed with no further sightings (i.e., 15 minutes for delphinoid cetaceans and pinnipeds and 30 minutes for all other cetaceans).

11.4 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 to allow marine mammals potentially in the survey area to detect the presence of the noise-producing equipment and to depart the area before full power surveying begins. Ramp-up of the survey equipment will not begin until the exclusion zone has been cleared by the PSOs (and PAM operators when applicable), as described above. Systems will be initiated at their lowest power output and will be incrementally increased to full power.

If any marine mammals are detected within the exclusion zone prior to or during the ramp-up, activities will be delayed until the animal has been observed exiting the exclusion zone or until an additional time period has elapsed with no further sighting (i.e., 15 minutes for delphinoid cetaceans and pinnipeds and 30 minutes for all other species)..

11.5 OPERATIONAL SHUTDOWNS AND DELAYS

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

If a delphinoid cetacean or pinniped is sighted at or within the exclusion zone, the HRG 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 for 15 minutes or (2) a determination by the PSO after a minimum of 10 minutes of observation that the delphinoid cetacean or pinniped is approaching the vessel or towed equipment at a speed and vector that indicates voluntary approach to bow-ride or chase towed equipment.

If the HRG sound source (including the sub-bottom profiler) shuts down for reasons other than encroachment into the exclusion zone, including but not limited to a mechanical or electronic failure, for a period greater than 20 minutes, a restart for the HRG survey equipment is required using the ramp-up procedures described above and clearance of the exclusion zone of all marine mammals for 30 minutes. If shut down occurs for less than 20 minutes, the equipment may be restarted as soon as practicable at its operational level as long as visual surveys were continuously maintained and the exclusion zone remained clear of marine mammal. If the visual surveys were not continued during the pause of 20 minutes or less, a restart for the HRG survey equipment is required using the full ramp-up procedures and clearance of the exclusion zone for all cetaceans and pinniped for 30 minutes

11.6 VESSEL STRIKE AVOIDANCE PROCEDURES

DWW will ensure that vessel operators and crew maintain a vigilant watch for marine mammals, and slow down or stop their vessels to minimize the potential for a vessel strike. Survey vessel crew members responsible for navigation duties will receive site-specific training on marine mammal sighting/reporting and vessel strike avoidance measures. The vessel procedures outlined below will be implemented during survey operations, except when complying with these requirements would put the safety of the vessel or crew at risk.

- All vessel crew members will undergo project-specific marine mammal and compliance training.

- All vessel operators will comply with <10 kn (<18.5 km/h) speed restrictions in any Seasonal Management Area (SMA) or Dynamic Management Area (DMAs) (See **Section 4.1.1** and **Figure 2**). In addition, all vessels operating from November 1 through April 30 will operate at speeds of 10 knots or less (Lease stipulation 4.1.1.2).
- Between November 1 and April 30, vessel operators will monitor NMFS North Atlantic Right Whale reporting systems (e.g., the Early Warning System, Sighting Advisory System, and Mandatory Ship Reporting System) for the presence of North Atlantic right whales during HRG survey operations within or adjacent to these SMAs (Lease stipulation 4.3.6.2).
- All project vessels will attempt to maintain a separation distance of least 500 m (1,640 ft) from any North Atlantic right whale, at least 100 m (328 ft) away from all other whales, and at least 50 m (164 ft) away from dolphins and pinnipeds (Lease stipulations 4.1.1.3.1, 4.1.1.4.1, and 4.1.1.5.1.). Separation distances will be established in the following ways, given that safety of operations can be maintained:
    - If underway, vessels must steer a course away from any sited North Atlantic right whale at 10 kn (<18.5 km/h) or less until the 500-m (1,640-ft) minimum separation distance has been established. If a North Atlantic right whale is sited in a vessel's path or within 100 m (328 ft) of an underway vessel, the underway vessel will 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 (328 ft). If stationary, the vessel will not engage engines until the North Atlantic right whale has moved beyond 100 m (328 ft).
    - Any vessel underway will remain parallel to a sighted delphinoid cetacean's course whenever possible and avoid excessive speed or abrupt changes in direction.
    - Any vessel underway will reduce speed to 10 kn (18.5 km/h) or less when pods (including mother/calf pairs) or large assemblages of delphinoid cetaceans are observed. Vessels will adjust course and speed until the delphinoid cetaceans have moved beyond 50 m (164 ft) and/or the abeam of the underway vessel.

12.0 Arctic Plan of Cooperation

This requirement is applicable only for activities that occur in Alaskan waters north of 60° N latitude. The proposed survey activities will not take place within the designated region and, therefore, will not have an adverse effect on the availability of marine mammals for subsistence uses. As such, there is no need to address such a plan.

13.0 Monitoring and Reporting

As required in Lease OCS-A 0486, DWW will comply with the marine mammal reporting requirements for site characterization activities detailed below.

Reporting Injured or Dead Species. DWW will ensure that sightings of any injured or dead marine mammals are reported to the Greater Atlantic (Northeast) Region Marine Mammal and Sea Turtle Stranding & Entanglement Hotline (866-755-NOAA [6622]) within 24 hr of a sighting, regardless of whether the injury or death is caused by a vessel. In addition, if the injury or death was caused by a collision with a project-related vessel, the DWW will ensure that BOEM is notified of the strike within 24 hr. The notification of such 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 supply a vessel to assist in any salvage effort as requested by NMFS.

Reporting Observed Impacts to Species. The observers will report any observations concerning impacts on marine mammals to BOEM and NMFS within 48 hr. Any observed takes of listed marine mammals resulting in injury or mortality must be reported within 24 hr to BOEM and NMFS.

Report of Activities and Observations. DWW will provide BOEM and NMFS with a report within 90 calendar days following the commencement of survey activities, including a summary of the survey activities and an estimate of the number of marine mammals taken during these survey activities.

Report Information. Data on all marine mammal observations will be recorded and based on standards of marine mammal observer collection data by the 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).

14.0 Suggested Means of Coordinated Research

This section addresses the IHA requirement to suggest means of learning of, encouraging, and coordinating research opportunities, plans, and activities related to reducing incidental take and evaluating its effects.

While no direct research on marine mammals or marine mammal stocks is expected from the project, there is the opportunity for the proposed activity to contribute greatly to the noise characterization in the region and to specific sound source measurements.

Data acquired during the Visual Monitoring Program may provide valuable information to direct or refine future research on marine mammal species present in the area. Sightings data (e.g., date and time, weather conditions, species identification, approximate sighting distance, direction and heading in relation to sound sources, and behavioral observations) may be useful in designing the location and scope of future marine mammal survey and monitoring programs.

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

15.0 List of Preparers

CSA Ocean Sciences Inc.

- Mary Jo Barkaszi, Marine Mammal Programs Manager
- Kim Olsen, Permitting Business Line Manager
- Melanie Cahill, Project Scientist
- Jeffrey Martin, Project Scientist

Deepwater Wind

- Stephanie Wilson, Manager of Permitting & Environmental Affairs
- Aileen Kenney, Vice President of Permitting & Environmental Affairs

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