Request for an Incidental Harassment Authorization Regarding Pile-Driving Activity Associated with Construction of a Meteorological Data Collection Facility for the Bluewater Wind Delaware Offshore Wind Park

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ACRONYMS AND ABBREVIATIONS

BA	Biological Assessment
Caltrans	California Department of Transportation
CTD	Conductivity, Temperature, Depth
COWRIE	Collaborative Offshore Wind Research into the Environment
dB	Decibel
dBL	decibel linear
DNREC	Delaware Department of Natural Resources and Environmental Control
DOI	U.S. Department of the Interior
E	blow energy
EA	Environmental Assessment
EPA	U.S. Environmental Protection Agency
Gulf	Gulf of Mexico
GPS	global positioning system
Hz	Hertz
ICES	International Council for the Exploration of the Seas
IHA	Incidental Harassment Authorization
KJ	kilojoule
LOC	Letter of Concurrence
MDCF	Meteorological Data Collection Facility
MMO	Marine Mammal Observer
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
Navy	U.S. Department of the Navy
OCS	Outer Continental Shelf
OPAREA	Operation Area
OPD	Official Protraction Diagram
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	National Marine Fisheries Service
rms	root mean square
VHF	Very High Frequency
WTG	wind turbine generator
ZOI	zone of influence
μPA	micro-Pascal
VACAPES	Virginia Capes

1.0 INTRODUCTION

Bluewater Wind LLC, through its entity Bluewater Wind Delaware LLC ("Bluewater Wind" or "Bluewater"), will be conducting pile driving to install the foundation structure for its proposed meteorological data collection facility (MDCF), or met tower, located in the Outer Continental Shelf (OCS) Official Protraction Diagram (OPD) lease block Salisbury, NJ 18-05 Lease Block 6325. The Minerals Management Service (MMS) of the U.S. Department of the Interior (DOI) and Bluewater Wind executed a lease in November 2009 for the construction and operation of this MDCF.

Pile driving will be required to install the foundation structure for the MDCF. In order for the pile-driving activities to commence, the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NOAA Fisheries) must review the activity relative to the Marine Mammal Protection Act (MMPA). This document provides the information required in a request for a marine mammal Incidental Harassment Authorization (IHA) by responding to the 14 questions listed in the MMPA IHA regulations.

2.0 DESCRIPTION OF THE ACTIVITY

In accordance with MMS lease guidelines, Bluewater Wind is required to conduct meteorological evaluations of the project area to determine the feasibility of a commercial-scale offshore wind energy project at the proposed project site. Bluewater will collect and analyze at least one full year of meteorological data inclusive of wind speed and direction at multiple heights, information on other seasonal meteorological conditions (e.g., turbulence, temperature, pressure, and atmospheric stability), the marine environment (e.g., ocean currents, tides, and waves), and avian and bat activity (e.g., activity within the potential rotor swept area, flight altitude).

To build the MDCF, Bluewater Wind must conduct pile-driving activities to construct the foundation to support the proposed structure. Bluewater Wind will deploy a deck cargo barge that will be used to transport the MDCF foundation materials and equipment to the project site. In addition, installation of the fixed MDCF will also include the use of crew boats, tugs, and barge support vessels. No aircraft will be used during the MDCF installation.

2.1 Regulatory Criteria

Under the MMPA, Level A harassment is statutorily defined as any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild. NOAA Fisheries defines the zone of injury as the range of received levels from 180 linear decibels (dBL) referenced to 1 microPascal (μPa) root mean square (RMS) (180 dBL re 1 μPa), for mysticetes and odontocetes, and 190 dBL re 1μPa for and pinnipeds. This threshold considers instantaneous sound pressure levels at a given receiver location. NOAA Fisheries 180 dBL re 1 μPa guidelines are designed to protect all marine species from high sound pressure levels at any discrete frequency across the entire frequency spectrum. It is a very conservative criterion as it does not consider species-specific hearing capabilities.

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. NOAA Fisheries defines the threshold level for Level B harassment at 160 dBL re 1μPa for impulsive sound, averaged over the duration of the signal.

2.2 Hydroacoustic Modeling - Derivation of Pile Driving Source Terms

The calculation of the expected received sound levels of impact piling during the construction of the Bluewater Delaware MDCF were completed following an extensive literature review of documents, technical reports and peer-reviewed research papers. Documents referred to include the California Department of Transportation (Caltrans) *Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish* and the Blackwell paper *Underwater Measurements of Pile Driving Sounds during the Port MacKenzie Dock Modifications*, among several others. However, these documents and presented measurement data were principally set in river estuaries and protected bays, or consisted of near-field measurement data, which serve as useful data but principally limited to the study of fish mortality. More relevant data were obtained in a review of recent European and U.S. research and technical documents on offshore wind energy and MDCF construction, which then served as the basis of the acoustic source data in the estimation of received sound levels during impact pile driving at the Delaware MDCF site.

Bluewater is proposing to use a single 3-meter monopole foundation. To drive this monopole foundation, Bluewater will use an IHC-S 900 Hydraulic Impact Hammer (or equal) with a maximum rated impact force of 900 kilojoules (KJ). Noise emissions are proportional to blow energy, which is the energy delivered by a pile driver impact, determined by the weight of the falling mass and height of the fall. To be conservative, the Project has assumed the full impact force of 900 KJ may be required during MDCF construction. Research has shown that that the noise level increases by 13 $\log_{10}(E_2/E_1)$ if the blow energy is increased from E_1 to E_2[1]. In this case, as with the equation below, E_1 is the impact hammer force for the original measurement and E_2 is the estimate hammer force of 900 KJ[2].

Table 2-1 presents underwater sound measurement data collected in the acoustic far field for impact pile driving with similar pile diameter, water column depths, seafloor characteristics, and impact forces, in the context of an offshore oceanic environment. It is assumed that far-field conditions apply at all measurement distances. These data were normalized for Bluewater Delaware MDCF site-specific conditions and impact hammer forces, an approach which is expected to result in a far more accurate estimation of the expected underwater sound pressure levels compared with simply analyzing similar pile-driving activities. The normalization methodology is described in the following equation:

$$L_{normalized} = L_{measured} + 10\log_{10}\left(\frac{25}{H_1}\right) + 15\log_{10}\left(\frac{R_1}{500}\right) + 13\log_{10}\left(\frac{E_2}{E_1}\right)$$

Where: L = sound pressure level

H_1 = depth at which the original pile driving action was made

R_1 = distance at which the original measurement was taken

E_1 = impact hammer force for the original measurement

E_2 = estimated hammer force of 900 KJ

[1] Schultz-von Glahn, M., Betke, K., Nehls, G. (2006): Underwater noise reduction of pile driving for offshore wind turbines – Evaluation of several techniques under offshore conditions. UFOPLAN Ref. No. 205 53 113, final report. The Federal Environment Agency (Umweltbundesamt), Berlin.

[2] Stephen P. Robinson, Paul A. Lepper, and Justin Ablitt, "The measurement of the underwater radiated noise from marine piling including characterisation of a "soft start" period", 10.1109/OCEANSE.2007.4302326 17 September 2007.

Table 2-1 shows three different sound metrics, which were normalized to a distance of 500 meters (see last three columns). These sound levels metrics were reported in terms of the measured peak sound level, the measured sound exposure level (SEL) and the 90% root mean square sound level ($RMS_{90\%}$). These sound descriptors are presented because pile driving sound is characterized as impulsive, which has somewhat unique features in comparison to other sounds. Impulsive sounds can have moderate average, but very high instantaneous pressure peaks, which might be harmful to the auditory system. The measured peak sound level represents these high instantaneous pressure peaks. The SEL is the level of a sound averaged with a stated 1 second duration and the same sound energy as occurring at the instantaneous peak. The SEL may be more appropriate for assessing masking effects at larger distances from the source. The measured SELs range from 173 to 178 dBL. Recent studies of underwater sound generated during impact pile driving have also employed a RMS sound pressure "averaged over the duration of the pulse". A typical pile driving impulse lasts approximately 125 milliseconds with principal energy contained within the first 30 to 40 milliseconds. An integration period (T90) of the RMS signal inclusive of 90 percent of the sound energy has been calculated to result in a net 9 dBL increase relative to the reported sound exposure level (SEL) values shown in Table 2-1, with a 3 dB increase of each halving of the 1-second signal duration. This semi-empirical relationship between SEL and $RMS_{90\%}$ is expected to hold for relatively short ranges; however, at increasing ranges from the source, distortion of the pulse duration will occur, especially in shallow water environments similar to the Bluewater Delaware MDCF Project area.

Although data from the referenced studies in Table 2-1 are too far away from their sources to provide reliable near-field estimates (i.e., sound levels in immediate proximity of the pile itself), for comparative purposes, apparent source levels were estimated for a 900 KJ impact force using the semi-empirical step function model of Marsh and Schulkin (Schulkin and Mercer 1985). Back-calculating source levels from measurements made in the acoustic far-field is subject to a very high level of uncertainty. Therefore, apparent source levels, which are referenced to 1 meter in Table 2-1, are intended for comparative purposes and as rough estimates only.

Table 2-1 Summary of representative underwater peak, SEL, and RMS90% normalized to the Bluewater Delaware MDCF site conditions and pile-driver impact force.

Measurement Site	Pile Diameter	Measured Depth	Measured Distance	Impact Energy	Apparent Source Level	Measured SPLs			Peak Level re 1 μPa Normalized to 500 m	SEL re 1 μPa^{2}s Normalized to 500 m	$RMS_{90\%}$ re 1 μPa Normalized to 500 m
		H_1	R_1	E_1	$RMS_{90\%}$	Peak	SEL	$RMS_{90\%}$	Maximum	Maximum	Maximum
	m	m	m	KJ	re 1 μPa @ 1m	re 1 mPa	re 1 mPa^{2}s	re 1 mPa	900 KJ	900 KJ	900 KJ
Alpha Ventus, 2008[3]	2.7	28.0	1100	250	244	197	167	176	207	177	186
Utgrunden, 2000[4]	3.0	10.0	720	250	245	n/a	166	175	n/a	177	186
SKY 2000, Germany, 2002[5]	3.0	21.0	260	200	240	196	170	179	199	173	182
FINO 2, Germany, 2006[6]	3.3	24.0	530	300	242	190	170	179	195	175	184
Amrumbank West, Germany, 2005[6]	3.5	23.0	850	550	246	196	174	183	200	178	187

Measurement Data References:

[3] Betke, K., Matuschek, M. (2008): Unterwassergeräusche beim Bau und beim Betrieb des Offshore-Windparks "alpha ventus" – Untersuchungen gemäß StUk3. Presented at the kickoff meeting of the "StUK plus" research projects, 17 November 2008. Published on Web page of the German Maritime and Hydrographic Agency BSH http://www.bsh.de/de/

[4] McKenzie Maxon, C. (2000): Offshore Wind-Turbine Construction. Offshore Pile-Driving Underwater and Above-water Noise Measurements and Analysis. Ødegaard & Danneskiold-Samsøe A/S Rådgivende Ingeniører, Report no. 00.877

[5] CRI/DEWI/ITAP (2004): Standardverfahren zur Ermittlung und Bewertung der Belastung der Meeresumwelt durch die Schallimmission von Offshore-Windenergieanlagen. Project 0327528A final report. The German Federal Environment Ministry

[6] Betke, K., Schultz-von Glahn M. & Matuschek, R. (2004): Underwater noise emissions from offshore wind turbines. In: Proceedings of the joint congress CFA/DAGA'04, 591-592, Strasbourg

2.3 Hydroacoustic Modeling – Transmission Loss Calculations and Results

The accuracy of underwater noise modeling results is largely dependent on the referenced sound source data and the accuracy of the intrinsically dynamic data inputs used to describe the medium between the path and receiver including sea surface conditions, water column, and sea bottom. The exact information required can never be obtained for all possible modeling situations, particularly for long-range acoustic modeling of temporally varying sound level sources where uncertainties in model inputs increase at greater propagation distances from the source to receiver. In these instances, the reliance on a simplistic geometric spreading model such as the power law may be inappropriate for calculation of long range sound propagation in the shallow water channel, without further scientific evidence for a given site.

Transmission loss (TL) calculations were completed using frequency dependent acoustic algorithms based on the semi-empirical step model of Marsh and Schulkin. Representative frequency spectrum shapes from similar impact pile driving activities were correlated to the broadband normalized data. Marsh and Schulkin completed over 100,000 TL measurements in a wide variety of offshore shallow water locations and used these measurement results to empirically derive three fundamental equations dependent in part on the linear distance from source to receiver and depth of water column. These equations describe the expected transitions from spherical spreading near the source and modified and cylindrical spreading at greater distances and account for the effects of near field acoustic anomalies, and shallow water attenuation. The probable error of transmission loss computed by these equations is 3-4 dB up to distances of 2.5 kilometers for a given seastate and bottom condition as compared to reported observations. Long range propagation rates at distances in excess of approximately 2.5 kilometers were also estimated from measurement data collected during construction of an offshore wind park[7].

The first Marsh and Schulkin equation used for noise modeling covers TL for short ranges near the source, where sound energy spreads outward unimpeded by interactions at the sea surface or sea floor until the entire channel depth is ensonified. The following equation is used when r, the horizontal separation distance between sound source and receiver in kiloyards, is up to 1 times H, which for the purposes of this analysis was conservatively defined as the average water depth of the acoustic study area:

$$TL = 20\log r + \alpha r + 60 - k_L$$

Where:
- r = horizontal separation distance between sound source and received (kiloyards)
- H = average water depth of the acoustic study area
- α = shallow water absorption coefficient (dB/kiloyard)
- k_L = near-field anomaly

The intermediate (or transition zone) is defined where $H \le r \le 8H$ where modified cylindrical spreading occurs accompanied by mode stripping effects[8]. The transmission loss equation representing this intermediate range is given as follows:

$$TL = 15\log r + \alpha r + \alpha_T\left[\left(\frac{r}{H}\right) - 1\right] + 5\log H + 60 - k_L$$

Where: α_T = shallow water attenuation coefficient

[7] De Jong CAF, Ainslie MA (2008):"Underwater radiated noise due to the piling for the Q7 Offshore Windpark" ASA-EAA joint conference Acoustics '08, Paris

[8] Richardson, W.J. et al. 1995. *Marine Mammals and Noise*. Academic Press, San Diego, California.

Long range TL occurs where r > 8H. Due to the boundaries of the sea surface and sea floor, sound energy is not able to propagate uniformly in all directions from a source indefinitely; therefore, long range TL is represented as cylindrical spreading, limited by the channel boundaries. Cylindrical spreading propagation is applied using the equation given below:

$$TL = 10\log r + \alpha r + \alpha_T\left[\left(\frac{r}{H}\right) - 1\right] + 10\log H + 60 - k_L$$

The near-field anomaly (k_L) and shallow water attenuation coefficient (α_T) are functions of frequency, sea state, and bottom composition[9]. The (k_L) anomaly term is related to the reverberant sound field developed near the source by surface and bottom reflected sound energy resulting in an apparent increase in source levels. The shallow water attenuation coefficient (α_T) is an empirically determined factor related to sound scattering and other losses at water column boundaries.

For an impulsive sound source such as impact pile driving, an additional type of spreading will occur over time as the pulse propagates through the water. At increasing distances from the pile-driving source, the pulse signal time duration will increase in addition to the loss of signal amplitude due to geometric spreading and contain complex multi-path arrivals due to surface and bottom reflections, as well as the direct path signal, which will effect the duration over which the $RMS_{90\%}$ is calculated. The effect of 'time stretching' has been conservatively ignored in the calculation of received sound levels which implies that a certain level of additional conservatism has been added in determining the distances to threshold values.

In summary, the hydroacoustic analysis for received sound levels was based on the similar pile driving activities and resultant far field received underwater sound levels listed in Table 2-1. Using the source data and proven transmission loss calculation methodologies, the distances to the 190, 180, and 160 dBL isopleths have been calculated and are presented in Table 2-2. These distances were then used to calculate take, as described in Sections 6 and 7. Based upon the results of the analysis, the data shows that using the 3-meter pile and worst-case impact hammer force, pile-driving sound corresponding to the 160 dB isopleths may extend out to distances in excess of 7,000 meters.

Table 2-2 Critical distance (meters) to the NOAA Fisheries impact thresholds for the Delaware MDCF site (dB RMS90% re 1 uPa).

Isopleth (dB)		Maximum 900 KJ
190	MMPA Level A Harassment for Pinnipeds	330
180	MMPA Level A Harassment for Mysticetes and Odontocetes	760
160	MMPA Level B Harassment for All Mammals	7230

[9] Etter, P. 2003. *Underwater Acoustic Modeling and Simulation: Principles, Techniques and Applications*, Taylor & Francis Group, New York, New York.

3.0 DATES, DURATION AND LOCATION OF PILE-DRIVING ACTIVITES

Bluewater Wind anticipates conducting pile-driving operations in the month of September 2010. Pile driving will occur at 38º41.235’ N latitude and 74º46.104’ W longitude within the OCS OPD Salisbury, NJ 18-05 Lease Block 6325. The construction radius (total work area needed during construction operations centered on the MDCF construction site) for MDCF construction is approximately 450 meters. This location is exclusively within federal waters beyond Delaware’s territorial 3-mile limit approximately 16.5 miles offshore. Bluewater has taken great care to site the location to avoid to the extent practicable existing known structures, facilities, areas of environmental or cultural significance, and areas of active use (e.g., commercial and recreational fishing, shipping). Bluewater has evaluated the most practical method for installing of the MDCF monopile foundation while minimize the potential of acoustic harassment of marine mammals. The proposed monopile will be installed as a single segment. The installation methodology selected was based on concerns that ceasing pile-driving to weld additional monopile sections could risk increasing surface friction, resulting in less than full pile penetration. Bluewater’s offshore engineering and construction contractor, Fluor, who has been responsible for the installation of similar offshore foundation installations in Europe, indicates that installation of the monopile will require 8 and 12 hours to mobilize and demobilize the pile driving vessel on site with active pile driving occurring during only a continuous period of approximately 3 to 8 hours of the total installation time. Unless already commenced during daylight hours, no pile driving would occur at night. See time-of-day restrictions in Section 14.0.

The water depth in the area of the proposed location is approximately 21 meters. Sediments in the region of the project area are typical of the majority of sediments found in the Mid-Atlantic to Northern continental shelf and characterized by terrigenous quartz sand. This sand typically has an irregular grain size distribution with varying amounts of gravel, silt, and clay (MMS, 2007). Sub-bottom profiling conducted by Bluewater in 2009 shows the benthic subsurface stratigraphy is composed of unconsolidated sediments to a depth of 75 meters. No bedrock was encountered in these surveys. Linear sand ridges (sand shoals) are also a common geomorphologic feature of the continental shelf offshore of Delaware and New Jersey. Other geomorphic features in this area include rocky reefs and outcrops of glauconitic marl, both of which are far less common than the linear sand ridges.

Figure 1. Bluewater Wind Delaware MDCF Platform Profile and Elevations

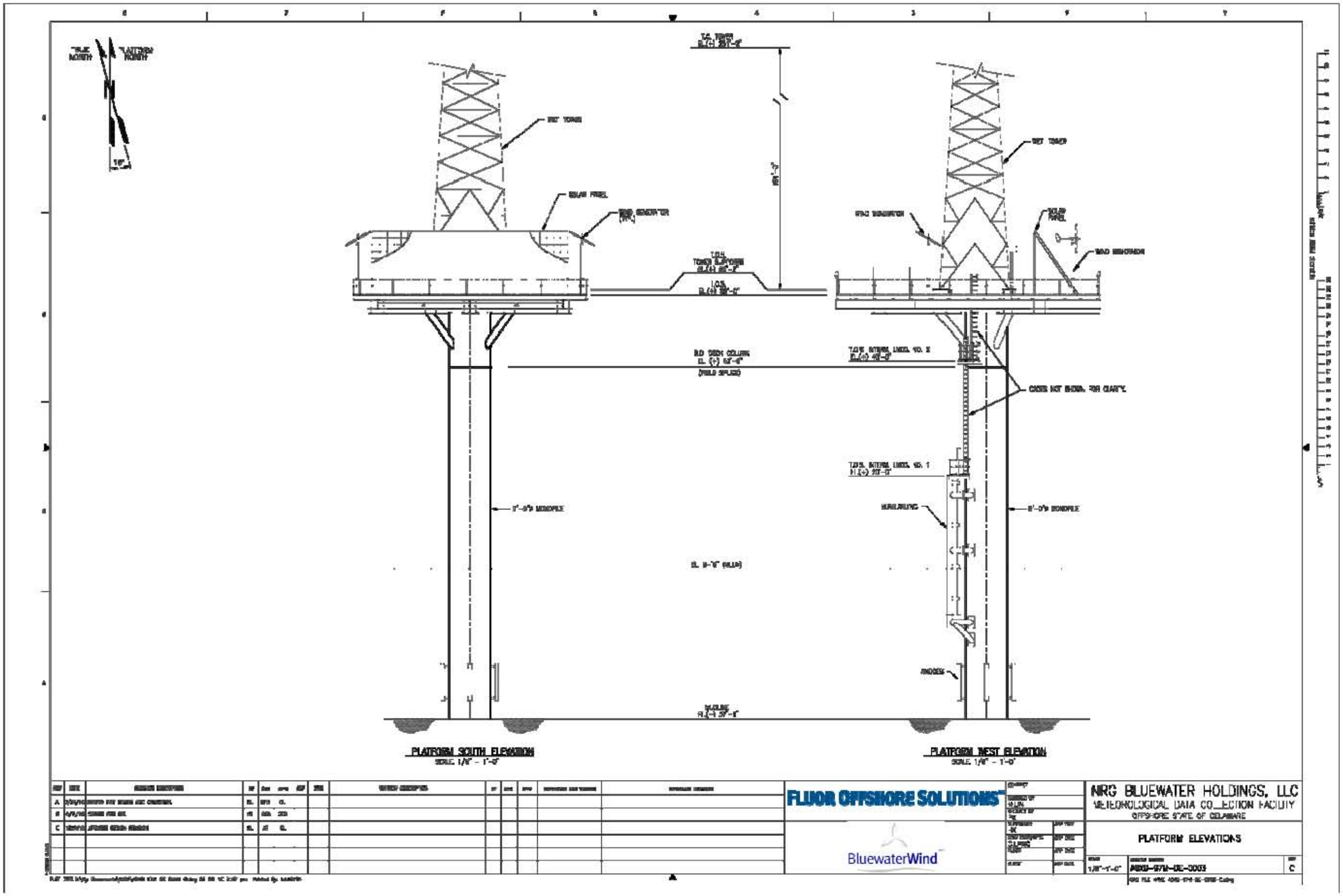
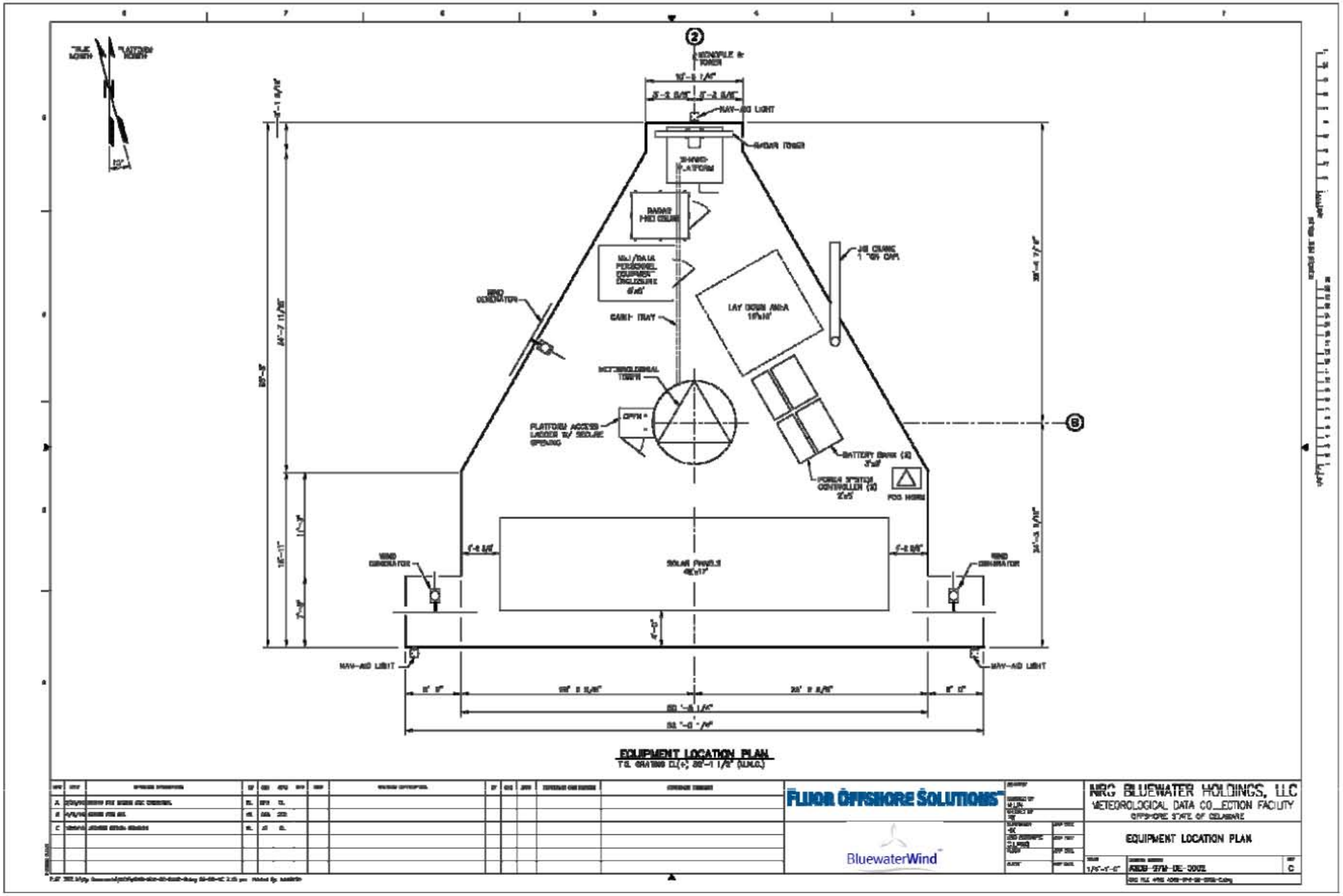


Figure 2. Bluewater Wind Delaware MDCF Platform Equipment Configuration



4.0 MARINE MAMMAL SPECIES AND NUMBERS

Several species of marine mammals are known to traverse or occasionally inhabit the waters within the area of project construction activities, including some species listed as threatened or endangered. As shown in Table 4-1, 39 marine mammals including 33 cetaceans, five pinnipeds, and one sirenian species have confirmed occurrences within the marine waters off the coast of Delaware.

Table 4-1 Marine Mammal Occurrence in Coastal and Offshore Delaware

Species	Status	Northwest Atlantic Estimated Population
Order Cetacea		
Suborder Mysticeti (baleen whales)		
North Atlantic right whale (*Eubalaena glacialis)*	Endangered	306
Humpback whale (*Megaptera novaeangliae)*	Endangered	902
Minke whale (*Balaenoptera acutorostrata)*	*N/A*	2,998
Sei whale (*Balaenoptera borealis)*	Endangered	unknown
Fin whale (*Balaenoptera physalus)*	Endangered	2,269
Blue whale (*Balaenoptera musculus)*	Endangered	unknown
Suborder Odontoceti (toothed whales)		
Sperm whale (*Physeter macrocephalus*)	Endangered	4,804
Pygmy sperm whale (*Kogia breviceps*)	*strategic stock a/*	395 b/
Dwarf sperm whale (*Kogia sima*)	*N/A*	395 b/
Cuvier's beaked whale (*Ziphius cavirostris*)	*strategic stock*	3,513 c/
True's beaked whale (*Mesoplodon mirus*)	*strategic stock*	3,513 c/
Gervais' beaked whale (*Mesoplodon europaeus*)	*strategic stock*	3,513 c/
Sowerby's beaked whale (*Mesoplodon bidens*)	*strategic stock*	3,513 c/
Blainville's beaked whale (*Mesoplodon densirostris*)	*strategic stock*	3,513 c/
Rough-toothed dolphin (*Steno bredanensis*)	*N/A*	*N/A*
Bottlenose dolphin (*Tursiops truncatus*)	*Coastal stock is strategic*	Coastal stock unknown; Oceanic stock: 54,739
Pantropical spotted dolphin (*Stenella attenuata*)	*N/A*	4,439
Atlantic spotted dolphin (*Stenella frontalis*)	*N/A*	50,978
Spinner dolphin (*Stenella longirostris*)	*N/A*	unknown
Clymene dolphin (*Stenella clymene*)	*N/A*	unknown
Striped dolphin (*Stenella coeruleoalba*)	*N/A*	94,462
Common dolphin (*Delphinus delphis*)	*N/A*	120,743
White-beaked dolphin (*Lagenorhychus albirostris*)	*N/A*	2,003
Atlantic white-sided dolphin (*Lagenorhynchus acutus*)	*N/A*	51,640
Risso's dolphin (*Grampus griseus*)	*N/A*	20,479
Melon-headed whale (*Peponocephala electra*)	*N/A*	unknown
Pygmy killer whale (*Feresa attenuate*)	*N/A*	unknown
False killer whale (*Pseudorca crassidens*)	*N/A*	unknown
Killer whale (*Orcinus orca*)	*N/A*	unknown
Long-finned pilot whale (*Globicephala melas*)	*N/A*	31,139 d/
Short-finned pilot whale (*Globicephala macrorhynchus*)	*N/A*	31,139 d/
Beluga whale (*Delphinapterus leucas*)	*N/A*	*N/A*
Harbor porpoise (*Phocoena phocoena*)	*N/A*	89,700
Order Carnivora		
Suborder Pinnipedia (seals, sea lions, walruses)		
Harbor seal (*Phoca vitulina)*	*N/A*	99,340

Species	Status	Northwest Atlantic Estimated Population
Gray seal *(Halichoerus grypus)*	*N/A*	unknown
Hooded seal *(Cystophora cristata)*	*N/A*	unknown
Harp seal *(Pagophilus groenlandicus)*	*N/A*	unknown
Ringed seal (*Pusa hispida)*	*N/A*	*N/A*
Order Sirenia		
West Indian manatee (*Trichechus manatus)*	*Endangered*	1.822

a/ A strategic stock is defined as any marine mammal stock: 1) for which the level of direct human-caused mortality exceeds the potential biological removal level; 2) which is declining and likely to be listed as threatened under the ESA; or 3) which is listed as threatened or endangered under the ESA or as depleted under the Marine Mammal Protection Act (MMPA) (http://www.ncseonline. org/nle/crsreports/biodiversity/biodv-11.cfm).

b/ This estimate may include both the dwarf and pygmy sperm whales.

c/ This estimate includes Cuvier's beaked whales and undifferentiated *Mesoplodon* spp. beaked whales.

d/ This estimate may include both long-finned and short-finned pilot whales.

Source: Waring et al. 2006

Of these species, the MMS has recognized, in the issuance of the project lease (MMS 2009), seven as endangered, including the North Atlantic right whale, humpback whale, sei whale, fin whale, blue whale, sperm whale, and West Indian manatee; five as non-listed species including the common dolphin, the harbor porpoise, harbor seal, hooded seal, harp seal; and one as a strategic stock species, the bottlenose dolphin, that could potentially occur in proposed project area where the MDCF will be constructed (MMS 2008). However, not all seals (e.g., hooded and harp seals) potentially occur in Delaware waters during the fall month (September) in which the pile-driving would occur.

5.0 AFFECTED SPECIES STATUS AND DISTRIBUTION

As described in Section 4.0, of the 39 marine mammals species potentially inhabiting Delaware marine waters, MMS has identified seven listed five non-listed, and one strategic stock for cetaceans, pinnipeds, and sirenian species that are know to occur or potentially occur in the project area. Original consultation with NOAA Fisheries under Section 7 of the Endangered Species Act of 1973 (ESA) concluded that activities in the project area, including pile driving, would be insignificant or discountable and not likely to adversely affect ***any*** listed species known to occur in the project area (MMS 2009; NOAA 2008). However, recalculation of resulting noise pressure levels utilizing recent pile-driving activities for similar projects in Europe (see Section 2) indicates that distances to NOAA Fisheries harassment thresholds are greater than originally anticipated. Bluewater is currently working with NOAA Fisheries to determine if impacts to ESA species continue to be insignificant or discountable within the project area based on species density data, the relatively short duration of pile-driving activities, and the use of monitoring and mitigation measures listed in Section 14.

In general, Risso's dolphin, striped dolphin, white-beaked dolphin, long- and short-fin pilot whales, *Kogia* spp, sperm whales, beluga whale, gray seal, hooded seal, harp seal, and ringed seal range outside the project area, usually in more pelagic or northern waters. The blue whale, sei whale, beaked whales, and spinner dolphin are also more pelagic species and generally range outside the project area. Additionally, the melon-headed whale, Clymene dolphin, and West Indian manatee are species more commonly associated with southern tropical and sub-tropical waters ranging outside the project area. The remaining marine mammal species-harbor seal, harbor porpoise, Atlantic white-sided dolphin, common dolphin, bottlenose dolphin, killer whales, minke whale, North Atlantic right whale, humpback whale, and fin whale-have the potential to occur within or traverse the project area. However, with the exception of the harbor seal, bottlenose dolphin, and harbor porpoise, these species are predominantly found in northern feeding grounds and are likely to be transient in the coastal and offshore waters of Delaware during annual migration periods. A general summary of each of the marine mammals identified as potentially occurring in the project area is provided in the following sections.

5.1 Baleen Whales (Mysticeti)

North Atlantic right whale (*Eubalaena glacialis*) – Endangered

The North Atlantic right whale is a baleen whale and one of the most endangered large whale species in the world. The North Atlantic right whale has seen little to no recovery since it was listed as a protected species. This differs from the stock found in the Southern Hemisphere, which has increased at a rate of 7 to 8 percent (Knowlton and Kraus 2001).

North Atlantic right whales are highly endangered with population size estimated to be 299 individuals in 1998 (Waring et al. 2006; Kraus et al. 2001). This differs from pre-exploitation numbers, which are thought to be around 1,000 individuals. When protection of right whales began in the 1930s, it is believed that the North Atlantic right whale population was roughly 100 individuals (Waring et al. 2006). These whales are sighted regularly every year in the New York Bight, typically in the months of March through June as the animals move through the region on their migration route north. Some move along the coast in nearshore waters past Cape Hatteras and Long Island toward the Great South Channel off Cape Cod Massachusetts. Others seem to migrate northward in offshore waters (CETAP 1982). Occasionally several have been observed feeding in association with large blooms of calanoid copepods (Mayo and Marx 1990). Based on Okeanos Foundation data, the New York Bight waters function mainly as a migration pathway, with sightings of cow/calf pairs and solitary individuals occasionally feeding (USFWS 1997).

There are six major habitats or congregation areas for western North Atlantic right whales: coastal waters of the southeastern United States, Great South Channel, Georges Bank/Gulf of Maine, Cape Cod and Massachusetts Bays, Bay of Fundy, and the Scotian Shelf (Waring et al. 2006). New England waters are a primary feeding habitat for the North Atlantic right whale. North Atlantic right whales inhabit the waters off New England throughout the year, but their presence is highest in the Massachusetts Bay area during the winter/spring months.

The primary prey for North Atlantic right whales are zooplankton (i.e., copepods) (Kelly 1995). Right whales are considered grazers as they swim slowly with their mouths open. They are the slowest swimming whales and can only reach speeds up to 10 miles (16 kilometers) per hour. They can dive at least 1,000 feet (300 meters) and stay submerged for typically 10 to 15 minutes, feeding on their prey below the surface (ACSonline 2004).

Most ship strikes are fatal to the North Atlantic right whales (Jensen and Silber 2004). Right whales have difficulty maneuvering around boats. North Atlantic right whales spend most of their time at the surface, feeding, resting, mating, and nursing, increasing their vulnerability to collisions. Mariners should assume that North Atlantic right whales will not move out of their way nor will they be easy to detect from the bow of a ship for they are dark in color and maintain a low profile while swimming (WWF 2005).

New York Bight and Mid-Atlantic waters function mainly as a migration pathway for this species (USFWS 1997). Therefore, individuals potentially in the area would be transient. Considering the short duration of Bluewater Delaware pile-driving activities, interactions with right whales are not anticipated in the project area. Recent surveys in the Southeast Study Area (Delaware through Florida), inclusive of the Virginia Capes (VACAPES) Operating Area (OPAREA), which includes waters off Delaware through North Carolina, by the Department of the Navy (DoN or Navy) yielded no sightings of North

Atlantic right whales in the vicinity of the project area (DoN 2007a and b). During geophysical surveys of the project area in October, 2009, no marine mammals were sighted (Geo-Marine 2009).

Humpback whale (*Megaptera novaeangliae*) – Endangered

Humpback whales were commercially exploited by whalers throughout their whole range until they were protected in the North Atlantic in 1955 by the International Whaling Commission (IWC) ban. Before whaling activities, it was thought that the abundance of whales in the North Atlantic stock was in excess of 15,000 (Nowak 2002). Today, less than 10 percent of the initial population exists (NOAA Fisheries 1991b). According to the species stock assessment report, the population estimate for the Gulf of Maine stock of humpback whales is 902 individuals (Waring et al. 2004).

The humpback whale is found in all of the world's oceans and it follows a normal migration route of feeding in the temperate and polar waters in the summer and mating and calving in tropical waters during the winter. Humpback whales inhabit waters mainly over the continental shelves; they stay along the edges and around some of the oceanic islands (NOAA Fisheries 1991b; NOAA 1993). There are 13 separate stocks of humpback whales worldwide (NOAA Fisheries 1991b). Through genetic analysis of the whales inhabiting the Gulf of Maine, it was determined that the Gulf has its own feeding stock. Photographic studies suggest that the population composition of the mid-Atlantic is apparently dominated by Gulf of Maine whales; however, lack of recent photographic effort in Newfoundland makes it likely that the observed individuals under-represent the true presence of Canadian whales in the region (Waring et al. 2006).

Humpback whales are thought to feed mainly while migrating and in summer feeding areas; little feeding is known to occur in their wintering grounds. Humpbacks feed over the continental shelf in the North Atlantic between New Jersey and Greenland, consuming roughly 95 percent small schooling fish and 5 percent zooplankton, and they will migrate throughout their summer habitat to locate prey (Kenney and Winn 1986). They swim below the thermocline to pursue their prey, so even though the surface temperatures might be warm, they are frequently swimming in cold water (NOAA Fisheries 1991b).

The biggest threats to humpback whales are gear entanglements and ship strikes. Between the years of 1997 to 2001 approximately three humpback whales were killed each year by anthropogenic factors such as ship strikes and fishery-related. During one study of humpback whale carcasses, anthropogenic factors either contributed to or caused the death of 60 percent of the stranded whales (Wiley et al. 1995 as reported in Waring et al. 2004). Another study found that humpbacks are also subject to bioaccumulation of toxins (Taruski et al. 1975 as reported in NOAA Fisheries 1991b). Increase in ambient noise levels has also had an impact on their utilization of habitats; humpback whales have demonstrated a short-term avoidance of areas with increased whale-watching activity (Corkeron 1995). The species is listed as Endangered due to the depletion of its population from whaling (NOAA Fisheries 1991b). A recovery plan has been written and is currently in effect (NOAA Fisheries 1991b).

Although the humpback whale is found in all of the world's oceans, it follows a normal migration route of feeding in the temperate and polar waters in the summer and mating and calving in tropical waters during the winter. Additionally humpback whales inhabit waters mainly over the continental shelves (NOAA Fisheries 1991b; NOAA 1993). Additionally, migratory pathways likely follow direct, deep, offshore waters (Waring et al. 2009). Therefore, individuals potentially in the area would most likely be transient. Considering the short duration of Bluewater Delaware pile-driving activities, interactions with humpback whales are not anticipated in the project area. Recent surveys in the Southeast Study Area (Delaware through Florida), inclusive of the VACAPES OPAREA, which includes waters off Delaware through North Carolina, by the Navy yielded no sightings of humpback whales in the vicinity of the project area

(DoN 2007a and b). During geophysical surveys of the project area in October 2009, no marine mammals were sighted (Geo-Marine 2009).

Fin whale (*Balaenoptera physalus*) – Endangered
The fin whale is found in all oceans of the world. Fin whales spend the winter in subtropical or offshore waters mating and calving and migrate into cooler temperate to polar waters for feeding during the spring, summer, and fall (Reeves et al. 1998). There has been some controversy regarding the number of fin whale stocks along the eastern coast of the United States. The IWC recognizes one western North Atlantic stock, consisting of whales, which inhabit the waters off New England, north to Nova Scotia, and the southeastern coast of Newfoundland (Donovan 1991 as reported in Waring et al. 2006); however, Breiwick (1993 as reported in Reeves et al. 1998) identified two stocks, one that remains off of Nova Scotia and New England and another that remains in Newfoundland waters. Fin whales are the most common large baleen whale species in the Gulf of Maine/Massachusetts Bay area. They have the largest standing stock and largest food requirements, thus having the largest impact on the ecosystem of any cetacean species (Hain et al. 1992 as reported in Waring et al. 2006).

The waters off New England are an important feeding ground for the fin whale. They generally stay in deeper waters near the edge of the continental shelf (300 to 600 feet; 90 to 180 meters), but will migrate towards coastal areas if prey is available (NOAA 1993). They are known to herd prey such as sea lance, capelin, krill, herring, copepods, and squid for easier consumption (NOAA 1993; EPA 1993). According to the species stock assessment report, the population estimate for the western North Atlantic stock of fin whales is 2,814 (Waring et al. 2006). Off the eastern United States, they are generally found along the 100-meter (330-foot) isobaths, but will follow prey abundance and inhabit shallower water (Reeves et al. 1998).

Spatial patterns of habitat utilization by fin whales are very similar to those of humpback whales. Calving takes place during October to January in latitudes of the U.S. mid-Atlantic region; however, it is unknown where calving, mating, and wintering occurs for most of the population. Results from the Navy's SOSUS program (Clark 1995) indicate a substantial deep-ocean distribution of fin whales. It is likely that fin whales occurring in the U. S. Atlantic EEZ undergo migrations into Canadian waters, open-ocean areas, and perhaps even subtropical or tropical regions.

The biggest threats to fin whales are entanglements in gillnets and ship strikes. During 1997 to 2004, a total of nine fin whales of the western North Atlantic stock were killed by ship strikes and six whales were injured/killed from entanglement in fishing gear (Waring et al. 2004; Waring et al. 2006). Increase in ambient noise has also affected fin whales, for whales in the Mediterranean have demonstrated at least two different avoidance strategies after being disturbed by tracking vessels (Jahoda et al. 2003). Fin whales are the most observed cetacean species during whale-watching activities in the northeastern United States. The species is listed as Endangered due to the depletion of its population from whaling (Reeves et al. 1998). A recovery plan has been written and is awaiting legal clearance (Waring et al. 2006).

Although the fin whale is found in all of the world’s oceans, it spends the winter in subtropical or offshore waters mating and calving and migrates into cooler temperate to polar waters for feeding during the spring, summer, and fall (Reeves et al. 1998). Therefore, individuals potentially in the area would most likely be transient. Considering the short duration of Bluewater Delaware pile-driving survey activities, interactions with fin whales are not anticipated in the project area. Recent surveys in the Southeast Study Area (Delaware through Florida), inclusive of the VACAPES OPAREA, which includes waters off Delaware through North Carolina, by the Navy indicate higher abundance of fin whales in deep, continental slope waters east of Virginia, but few, if any, in the vicinity of the project area (DoN

2007a and b). During geophysical surveys of the project area in October 2009, no marine mammals were sighted (Geo-Marine 2009).

Blue whale (*Balaenoptera musculus*) – Endangered

The blue whale is the largest of the baleen whales, as well as the largest mammal in the world. Blue whales are distributed throughout all the oceans of the world. The distribution of the blue whale in the western North Atlantic generally extends from the Arctic to at least mid-latitudes. They are primarily pelagic but are often found along continental shelf breaks during feeding (Yochem and Leatherwood 1985 in DoN 2007; Sigurjonsson 1995). Traditionally, it was assumed that distribution and movement patterns consisted of seasonal migrations between higher latitudes for foraging and lower latitudes for mating and calving (Mackintosh 1965; Lockyer 1984). No specific breeding areas are known for this species, but calving typically occurs in the winter (Yochem and Leatherwood 1985 in DoN 2007). They are typically found singly or in groups of two or three individuals (Yochem and Leatherwood,1985 in DoN 2007). They are considered as an occasional visitor in waters of the U.S. Atlantic EEZ, which may also be the southern limit of their feeding range (Waring, Quintal, and Fairfield 2002). Blue whales migrate to tropical to temperate waters during winter in order to mate and calve. They feed primarily on krill during summer throughout their distribution range—in polar, temperate, and tropical waters (ACS 2007).

The swimming and diving behavior of blue whales has been relatively well characterized. Dive depths average 460 feet (140 meters). Blue whales typically make 5 to 20 shallow dives at 12 to 20-second intervals followed by a deep dive of 3 to 30 minutes (Yochem and Leatherwood 1985; Croll et al. 1999). The dive depth of foraging blue whales averages 222 feet (67.6 meters) (Croll et al. 2001b).

The global population estimate is about 11,200-13,000 individuals (Maser et al. 1981; U.S. Department of Commerce 1983). The most recent regional stock assessments estimate approximately 300 animals in the western North Atlantic (Waring et al., 2002). According to the Stock Assessment Report (Waring et al., 2002), the blue whale is only considered to be an occasional visitor in U.S. Atlantic Exclusive Economic Zone (EEZ) waters, which may represent the current southern limit of its feeding range (CETAP 1982; Wenzel et al. 1988). The blue whale is currently listed as endangered under the ESA, depleted under the MMPA, protected under Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and classified as endangered by the International Union for the Conservation of Nature and Natural Resources (IUCN). Critical habitat has not been designated for the species.

Blue whales are primarily pelagic and are often found along continental shelf breaks during feeding (Yochem and Leatherwood 1985 in DoN 2007b; Sigurjonsson 1995). Interactions with blue whales are not anticipated in the project area due to the relatively shallow ocean environment. During geophysical surveys of the project area in October 2009, no marine mammals were sighted (Geo-Marine 2009).

Sei whale (*Balaenoptera borealis*) – Endangered

Sei whales are found in all world oceans and adjoining seas, except polar and tropical regions. Like most baleen whales, they usually feed in sub-polar waters in summer and migrate to subtropical waters during winter to mate and calve (Hebridean 2007). They are generally found in the deeper waters characteristic of the continental shelf edge region (Waring et al. 1998). In the western North Atlantic, during the summer and spring feeding season, a major portion of the population is centered in northerly waters, perhaps on the Scotian Shelf; the southern portion of their range includes the northern portions of the U.S. Atlantic EEZ (Waring et al. 1998).

Sei whales feed on plankton, small fish, and squid. In the North Atlantic, sei whales are located off Nova Scotia and Labrador during the summer and as far south as Florida during the winter (Leatherwood and Reeves 1983). Aerial surveys conducted by NOAA Fisheries found concentrations of sei whales along the northern edge of Georges Bank in the spring. They are often found in deeper waters characteristic of the continental shelf edge region (Waring et al. 2005).

The status of the North Atlantic population is estimated at near 10,000 in the central and northeastern Atlantic Ocean (Horwood 2002). The sei whale is currently endangered under the ESA, depleted under the MMPA, protected under CITES, and classified as endangered by the IUCN. They have been federally listed as endangered since 1970, but no critical habitat has been designated for them.

Although the sei whale is found in all of the world's oceans, except polar and tropical regions, this species spends the winter in subtropical waters mating and calving and migrates into cooler sub-polar waters for feeding during the spring, summer, and fall (Hebridean 2007). Therefore, individuals potentially in the area would most likely be transient. Considering the short duration of Bluewater Delaware pile-driving activities, interactions with sei whales are not anticipated in the project area. During geophysical surveys of the project area in October 2009, no marine mammals were sighted (Geo-Marine 2009).

Minke whale (*Balaenoptera acutorostrata*) – Non-Strategic

Minke whales are the smallest and are among the most widely distributed of all the baleen whales. They occur in the North Atlantic and North Pacific, from tropical to polar waters. Currently, scientists recognize two subspecies of the so-called "common" minke whale: the North Atlantic minke and the North Pacific minke. Generally, they inhabit warmer waters during winter and travel north to colder regions in summer, with some animals migrating as far as the ice edge. They are frequently observed in coastal or shelf waters. Minke whales off the eastern coast of the United States are considered to be part of the Canadian East Coast stock. According to the species stock report, the population estimate for the Canadian east coast stock of minke whales is 2,998 individuals (Waring et al. 2006).

As is typical of the baleen whales, minke whales are usually seen either alone or in small groups, although large aggregations sometimes occur in feeding areas (Reeves et al. 2002). Minke populations are often segregated by sex, age, or reproductive condition. Known for the curiosity, minkes often approach boats. They feed on schooling fish (i.e., herring, sand eel, capelin, cod, pollock, and mackerel), invertebrates (squid and copepods), and euphausiids. Minke whales basically feed below the surface of the water, and calves are usually not seen in adult feeding areas.

Minke whales are affected by ship strikes and bycatch from gillnet and purse seine fisheries. The United States total annual estimated average human-caused mortality was 2.8 minke whales per year during 2000 to 2004 (Waring et al. 2006). In addition, hunting for Minke whales continues today, by Norway in the northeastern North Atlantic and by Japan in the North Pacific and Antarctic (Reeves et al. 2002). International trade in the species is currently banned. Average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NOAA Fisheries considers this species as "non-strategic" (Waring et al. 2006).

Although Minke whales are among the most widely distributed of all the baleen whales, generally, they inhabit warmer waters during winter and travel north to colder regions in summer, with some animals migrating as far as the ice edge. Considering the short duration of Bluewater Delaware pile-driving activities, interactions with minke whales are not anticipated in the project area. During geophysical surveys of the project area in October 2009, no marine mammals were sighted (Geo-Marine 2009).

5.2 Toothed Whales (Odontonceti)

Sperm whale (*Physeter macrocephalus*) – Endangered

Sperm whales are primarily found in deeper ocean waters and distributed in polar, temperate and tropical zones of the world (Reeves and Whitehead 1997) and have the largest range of all cetaceans except killer whales (Rice 1989). The migration patterns of sperm whales are not well-studied, but they are often seen along the continental shelf (Wursig, et al. 2000). Along the eastern coast of the U.S., sperm whales are found in regions of pronounced horizontal temperature gradients, along the edges of the Gulf Stream and warm-core rings (Waring et al. 1993; Jaquet et al. 1996; Griffin 1999 in DoN 2007a).

During winter in the western North Atlantic, sperm whales are concentrated east and northeast of Cape Hatteras. In spring, the center of distribution shifts northward to east of Delaware and Virginia, and is widespread throughout the central portion of the mid-Atlantic and the southern portion of Georges Bank. In summer, the distribution is similar to spring but also includes the areas east and north of Georges Bank and into the Northeast Channel region, as well as the continental shelf south of New England. In fall, sperm whale occurrences south of New England increase on the continental shelf; however, some remain on the continental shelf edge in the mid-Atlantic.

Sperm whales primarily feed on large squid, but also include demersal and mesopelagic fish in their diet, although, their feeding habits are region-specific (e.g., Iceland) (Reeves and Whitehead 1997; Whitehead 2002). They spend most of their time in waters with depths of 1,968 feet (600 meters) or more. It is considered uncommon to see them in waters less than 984 feet (300 meters) deep. Sperm whales may be the longest and deepest diving mammals, having been recorded diving for over 2 hours to depths of 3,000 m (9,842 ft) (Clarke 1976; Watkins et al. 1985). Foraging dives typically last about 30 to 40 minutes and descend to depths from 984 to 4,085 feet (300 to 1,245 meters) (Papastavrou et al. 1989; Wahlberg 2002).

The sperm whale is currently endangered under the ESA, depleted under the MMPA, classified by IUCN as vulnerable, and classified as protected under CITES. They have been federally listed as endangered since 1970. No critical habitat has been designated for the sperm whale. Although this species is widely distributed, it is considered uncommon to see them in waters less than 984 feet (300 meters) deep.

Interactions with sperm whales are not expected in the project area. Recent surveys in the Southeast Study Area (Delaware through Florida), inclusive of the VACAPES OPAREA, which includes waters off Delaware through North Carolina, by the Navy indicate higher abundance of sperm whales in deep, continental slope waters east of Virginia, but few, if any, in the vicinity of the project area (DoN 2007a and b). During geophysical surveys of the project area in October 2009, no marine mammals were sighted (Geo-Marine 2009).

***Kogia* spp. (*Kogia breviceps; Kogia simus*) – Strategic**

Kogia spp (pygmy and dwarf sperm whales; *Kogia breviceps* and *K. simus*, respectively) are primarily found in deeper ocean waters and distributed in tropical, sub-tropical and temperate zones of the world Waring et al. 2006, Caldwell and Caldwell 1989). Pygmy sperm whales and dwarf sperm whales are similar in size and shape making them difficult to differentiate (Waring et al. 2006, Caldwell and Caldwell 1989). Thus, sightings for both species are typically categorized as *Kogia* spp. Currently, no information on stock differentiation exists for the Atlantic population. The NOAA Marine Mammal Stock Assessment (2007) estimated the abundance for *Kogia* spp to range from 115 to 695 for the Western North Atlantic stock.

Both species are most common along the waters of the continental shelf edge and slope. Pygmy sperm whales are typically categorized as more seaward along the shelf edge while dwarf sperm whales are considered more coastal relative to the shelf edge.

According to the NOAA Marine Mammal Stock Assessment (2007), the status of the pygmy and dwarf sperm whale in the Western U.S. Atlantic EEZ is unknown and *Kogia* spp are not listed as endangered or threatened under the ESA.

Because sightings are rare and these species are associated with deep ocean waters, interactions with *Kogia* spp are not expected in the project area. During geophysical surveys of the project area in October, 2009, no marine mammals were sighted (Geo-Marine 2009).

Killer whale (*Orcinus orca*) – Non-Strategic

The black-and-white killer whale is the largest member of the dolphin family, roughly 22 to 30 feet (6.7 to 9.1 meters) long and nearly 9,000 pounds (4,080 kilograms). This species is found in all of the world's oceans with highest densities in the high latitudes (Wilson and Ruff 1999). Killer whales do not maintain a regular migration route because they generally migrate towards viable food sources, which are likely to be schools of bluefin tuna. Killer whale presence in the waters off the east coast of the United States is considered uncommon or rare (Katona et al. 1988; Waring et al. 2006). When encountered, they are seen in the southwestern Gulf of Maine from mid-July to September. Killer whales have been found to overwinter in the Gulf of Maine and were seen on Jeffreys Ledge between the Isles of Shoals and Stellwagen Bank (NOAA 1993). They feed on a variety of fish, including tuna, herring, and mackerel, and have also been known to attack seals, seabirds, and other cetaceans such as large baleen and sperm whales (NOAA 1993; Blaylock et al. 1995). According to the species stock report, the population estimate for the western North Atlantic stock of killer whales is unknown (Baylock et al. 1995).

The killer whale is not endangered, although whaling or live-capture operations have depleted some regional populations. They are threatened by pollution, heavy ship traffic, and possibly reduced prey abundance. There have been no observed mortalities or serious injuries by NOAA Fisheries Sea Samplers in the pelagic drift gillnet, pelagic longline, pelagic pair trawl, New England multispecies sink gillnet, mid-Atlantic coastal sink gillnet, or the North Atlantic bottom trawl fisheries (Blaylock et al. 1995). Recent evidence has also indicated that they are subject to biomagnification of toxic substances (ACSonline 2004). Average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NOAA Fisheries considers this species as "non-strategic" (Blaylock et al. 1995).

Although this species is one of the most widely distributed small cetacean species in the world, they are considered uncommon or rare along the U.S. East Coast (Katona et al. 1988; Waring et al. 2006). Additionally, there is insufficient data to estimate abundance of the killer whale off the U.S. East Coast (DoN 2007a and b). Interactions with killer whales are not expected in the project area. During geophysical surveys of the project area in October 2009, no marine mammals were sighted (Geo-Marine 2009).

Long-finned pilot whale (*Globicephala melas*) – Strategic

The long-finned pilot whale is more generally found along the edge of the continental shelf (a depth of 330 to 3,300 feet [100 to 1,000 meters]), choosing areas of high relief or submerged banks in cold or temperate shoreline waters. This species is split between two subspecies: the Northern and Southern subspecies. The Southern subspecies is circumpolar with northern limits of Brazil and South Africa. The Northern subspecies, which could be encountered in the project area, ranges from North Carolina to Greenland (Reeves et al. 2002; Wilson and Ruff 1999). In the western North Atlantic, long-finned pilot whales are pelagic, occurring in especially high densities in winter and spring over the continental slope, then moving inshore and onto the shelf in summer and autumn following squid and mackerel populations (Reeves et al. 2002). They frequently travel into the central and northern Georges Bank, Great South Channel, and Gulf of Maine areas during the summer and early fall (May and October) (NOAA 1993). According to the species stock report, the population estimate from Maryland to the Bay of Fundy for long-finned pilot whale is 15,728 individuals (Waring et al. 2007).

They feed preferentially on squid but will eat fish (e.g., herring) and invertebrates (e.g., octopus, cuttlefish) if squid are not available. They also ingest shrimp (particularly younger whales) and various other fish species occasionally. These whales probably take most of their prey at depths of 600 to 1,650 feet (200 to 500 meters), although they can forage deeper if necessary (Reeves et al. 2002). As a very social species, long-finned pilot whales travel in pods of roughly 20 individuals while following prey. These small pods are thought to be formed around adult females and their offspring. Behaviors of long-finned pilot whales range from quiet rafting or milling on the surface, to purposeful diving, to bouts of playfulness.

The long-finned pilot whales are subject to bycatch during gillnet fishing, pelagic trawling, longline fishing, and purse seine fishing. Approximately 215 pilot whales were killed or seriously injured each year by human activities during 1997 to 2001. Strandings involving hundreds of individuals are not unusual and demonstrate that these large schools have a high degree of social cohesion (Reeves et al. 2002). The species is rated as strategic by NOAA Fisheries because the 1997 to 2001 estimated average annual fishery-related mortality exceeds the potential biological removal (Waring et al. 2007). Recent surveys in the Southeast Study Area (Delaware through Florida), inclusive of the VACAPES OPAREA, which includes waters off Delaware through North Carolina, by the Navy indicate higher abundance of pilot whales in deep, continental slope waters throughout the Mid-Atlantic region, with highest abundance found in oceanic waters east of North Carolina, but few, if any, in the vicinity of the project area (DoN 2007a and b). During geophysical surveys of the project area in October 2009, no marine mammals were sighted (Geo-Marine 2009).

Beaked whales (*Mesoplodon* spp) and Cuvier's Beaked Whale (*Ziphius cavirostris*)– Strategic

There are four species of beaked whales (*Mesoplodon* spp) in the Northwestern Atlantic. These are True's beaked whale (*Mesoplodon mirus*), Gervais' beaked whale (*Mesoplodon europaeus*), Sowerby's beaked whale (*Mesoplodon bidens*), and Blainville's beaked whale (*Mesoplodon densirostris*). At sea, these species are difficult to differentiate between and are collectively referred to as *Mesoplodon* spp (Waring et al. 2009). These species are generally associated with the shelf edge, canyons, other pronounced seafloor features, and areas of ocean current convergence. True's, Gervais' and Blanville's beaked whales are widely distributed throughout temperate waters (Waring et al. 2009). Sowerby's beaked whales have been reported from New England waters north to the ice pack, but there has been a report of a single stranding off the Florida west coast (Mead 1989).

Cuvier's beaked whale, (*Ziphius cavirostris*), like the *Mesoplodon* spp is associated with oceanic environments along the continental shelf edge and slope. This species ranges mainly along the Mid-Atlantic region but ranges throughout the temperate and sub-tropical waters from Florida through Nova Scotia (Waring et al. 2009).

Total population sizes for all of these species are unknown. However, surveys have estimated population size for each of these species to be approximately 3,513 individuals from Florida to the Bay of Fundy (Waring et al. 2009). Fishery interactions tend to be low, however mortality from pelagic longline has been reported for each of these species (Waring et al. 2009).

Although each of these species are widely distributed, the preference of all of these species for oceanic waters along the continental shelf edge makes interactions with beaked whales unlikely in the project area. Recent surveys in the Southeast Study Area (Delaware through Florida), inclusive of the VACAPES OPAREA, which includes waters off Delaware through North Carolina, by the Navy indicate higher abundance of beaked whales in deep, continental slope waters throughout the Mid-Atlantic region, but few, if any, in the vicinity of the project area (DoN 2007a and b). During geophysical surveys of the project area in October 2009, no marine mammals were sighted (Geo-Marine 2009).

Atlantic white-sided dolphin (*Lagenorhynchus acutus*) – Non-Strategic
The Atlantic white-sided dolphin is typically found at a depth of 330 feet (100 meters) in the cool temperate and subpolar waters of the North Atlantic, generally along the continental shelf between the Gulf Stream and the Labrador current to as far south as North Carolina (Bulloch 1993; Reeves et al. 2002).

NOAA Fisheries recognizes three stocks of the Atlantic white-sided dolphin in the western North Atlantic: a Gulf of Maine stock, a Gulf of St. Lawrence stock, and a Labrador Sea stock (Waring et al. 2006). The Gulf of Maine stock occupies regions of both the Gulf of Maine (usually in the southwestern portion) and Georges Bank throughout the entire year. Atlantic white-sided dolphins found in the New York Bight are considered part of the Gulf of Maine stock. However, sightings south of Georges Bank, in the vicinity of Hudson Canyon, have occurred year-round but at low densities (Waring et al. 2006). This species is highly social and is commonly seen feeding with fin whales. They feed on a variety of fish such as herring, hake, smelt, capelin, and cod, as well as squid (NOAA 1993). Estimates of population size, which was arrived from summing the results of two separate aerial surveys, indicate that the population of the Gulf of Maine stock is approximately 51,640 individuals (Waring et al. 2006). Population estimates in U.S. shelf waters suggest around 30,000 individuals. An additional 12,000 animals have been estimated to summer in the Gulf of St. Lawrence (Reeves et al. 2002).

The biggest human-induced threat to the Atlantic white-sided dolphin is bycatch, because they are occasionally caught in fishing gillnets and trawling equipment. An average annual estimate of 24 dolphins each year were killed by human activities during 2000 to 2004 (Waring et al. 2006). Average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NOAA Fisheries considers this species as “non-strategic” (Waring et al. 2006).

Although this species is widely distributed, sightings in the vicinity of Hudson Canyon and points south have occurred at low densities (Waring et al. 2006). Additionally, there is insufficient data to estimate abundance of the Atlantic white-sided dolphin off the U.S. East Coast (DoN 2007a and b). Interactions with Atlantic white-sided dolphin are not expected in the project area. During geophysical surveys of the project area in October 2009, no marine mammals were sighted (Geo-Marine 2009).

Bottlenose dolphin (*Tursiops truncatus*) – Strategic
The bottlenose dolphin is a light- to slate-gray dolphin, roughly 8 to 12 feet (2.4 to 3.7 meters) long with a short, stubby beak. Because this species occupies a wide variety of habitats, it is regarded as possibly the most adaptable cetacean (Reeves et al. 2002). It occurs in oceans and peripheral seas at both tropical and temperate latitudes. In North America, bottlenose dolphins are found in surface waters with temperatures ranging from 10 to 32°C (50 to 90°F).

There are two distinct bottlenose dolphin populations: shallow water and deepwater population. The shallow water, coastal population resides along the inner continental shelf and around islands and is believed to consist of a complex mosaic of stocks (NOAA Fisheries 2001; McLellan et al. 2003). These animals often move into or reside in bays, estuaries, and the lower reaches of rivers (Reeves et al. 2002). The deepwater population is the only one found in the northern latitudes of the North Atlantic, typically in Gulf Stream waters. This deepwater population extends along the entire continental shelf-break from Georges Bank to Cape Hatteras during the spring and summer months, and has been observed in the Gulf of Maine during the late summer and fall. NOAA Fisheries species stock assessment report estimates the population of western North Atlantic offshore bottlenose dolphin stock at 29,774 individuals (Waring et al. 2004). Seven management units within the range of the coastal western North Atlantic bottlenose dolphin (Atlantic coast south of Long Island through the Gulf of Mexico (Gulf)) have been defined.

Stocks within the Northern Migratory Management Unit (from New Jersey through Virginia) have been estimated to be approximately 17,466 individuals (Waring et al. 2006).

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

The biggest threat to the population is bycatch because they are frequently caught in fishing gear, gillnets, purse seines, and shrimp trawls (Waring et al. 2006). They have also been adversely impacted by pollution, habitat alteration, boat collisions, human disturbance, and are subject to bioaccumulation of toxins. Scientists have found a strong correlation between dolphins with elevated levels of PCBs and illness, indicating certain pollutants may weaken their immune system (ACSonline 2004). Average annual fishery-related mortality and serious injury exceeds the potential biological removal for this species in the North Carolina Winter Mixed stocks; therefore, NOAA Fisheries considers this species as “strategic” but not listed as threatened or endangered under the ESA. The management units are “strategic” stocks due to the depleted listing under the MMPA (Waring et al. 2006).

Although this species is widely distributed and known to occur off the coast of Delaware, the limited location and duration of the pile-driving activities as well as the transient nature of this species makes interactions with the bottlenose dolphin unlikely. Furthermore, individuals in the construction area would likely leave and subsequently avoid the immediate vicinity of the pile-driving activities Recent surveys in the Southeast Study Area (Delaware through Florida), inclusive of the VACAPES OPAREA, which includes waters off Delaware through North Carolina, by the Navy indicate higher abundance of bottlenose dolphins in deep, continental slope waters east of North Carolina and Florida but few, if any, in the vicinity of the project area (DON 2007a; DON 2007b). During geophysical surveys of the project area in October, 2009, no marine mammals were sighted (Geo-Marine 2009).

Common dolphin (*Delphinus delphis*) – Non-Strategic

Common dolphins can be found either along the 200- to 2,000-meter (650- to 6,500-foot) isobaths over the continental shelf and in pelagic waters of the Atlantic and Pacific Oceans. They are present in the western Atlantic from Newfoundland to Florida. The short-beaked common dolphin is especially common along shelf edges and in areas with sharp bottom relief such as seamounts and escarpments (Reeves et al. 2002). They show a strong affinity for areas with warm, saline surface waters. Off the coast of the eastern United States, they are particularly abundant in continental slope waters from Georges Bank southward to about 35° north (Reeves et al. 2002) and usually inhabit tropical and warm-temperate waters (Waring et al. 2006). According to the species stock report, the population estimate for the western North Atlantic common dolphin is 30,768 individuals (Waring et al. 2006).

These dolphins typically gather in schools of hundreds of thousands, although the schools generally consist of smaller groups of 30 or fewer. They are eager bow riders and are active at the surface (Reeves et al. 2002). The common dolphin feeds on small schooling fish and squid. They have been known to feed on fish escaping from fishermen’s nets or fish that are discarded from boats (NOAA 1993).

The common dolphin is also subject to bycatch. It has been caught in gillnets, pelagic trawls, and during longline fishery activities. From 2003 to 2007, 160 dolphins were killed by these fishing activities (Waring et al. 2009). The current status of this stock is listed as unknown; however, NOAA Fisheries considers this species as “non-strategic” (Waring et al. 2009).

Although this species is widely distributed, they are more commonly encountered in deeper waters along the continental shelf and are typically more pelagic. Because of the limited location and duration of the pile-driving activities as well as the transient nature of this species, interactions with the common dolphin unlikely. Furthermore, individuals in the construction area would likely leave and subsequently avoid the immediate vicinity of the pile-driving activities. Recent surveys in the Southeast Study Area (Delaware through Florida), inclusive of the VACAPES OPAREA, which includes waters off Delaware through North Carolina, by the Navy indicate higher abundance of common dolphin in deep, continental slope waters throughout the Mid-Atlantic region, but few, if any, in the vicinity of the project area (DON 2007a; DON 2007b). During geophysical surveys of the project area in October, 2009, no marine mammals were sighted (Geo-Marine 2009).

Risso's dolphin (*Grampus griseus*) – Non-Strategic

Risso's dolphin (*Grampus griseus*) are typically an offshore dolphin whose inshore appearance is uncommon (Reeves et al. 2002). Risso's dolphin prefers temperate to tropical waters along the continental shelf edge and can range from Cape Hatteras to Georges Bank from sprint through fall, throughout the Mid-Atlantic Bight out to oceanic waters during winter (Payne et al. 1984). Risso's dolphins are usually seen in groups of 12 to 40 individuals. Loose aggregations of 100 to 200, or even several thousand, are seen occasionally (Reeves et al. 2002).

Risso's dolphin has been subject to bycatch. It has been caught in gillnets and pelagic longline fishery activities. During 2003 to 2007, 26 dolphins total were killed by these fishing activities (Waring et al. 2009). The current status of this stock is listed as unknown; however, NOAA Fisheries considers this species as "non-strategic" (Waring et al. 2009).

Although this species is widely distributed, the preference of this species for oceanic waters along the continental shelf edge makes interactions with Risso's dolphin unlikely in the project area. Recent surveys in the Southeast Study Area (Delaware through Florida), inclusive of the VACAPES OPAREA, which includes waters off Delaware through North Carolina, by the Navy indicate higher abundance of Risso's dolphin in deep, continental slope waters throughout the Mid-Atlantic region, but few, if any, in the vicinity of the project area (DoN 2007a and b). During geophysical surveys of the project area in October, 2009, no marine mammals were sighted (Geo-Marine 2009).

Spotted dolphin (*Stenella attenuata/frontalis*) – Non-Strategic

There are two species of spotted dolphin in the Atlantic Ocean, the Atlantic spotted dolphin (*Stenella frontalis*), and the pantropical spotted dolphin (*S. attenuata*) (Perrin 1987). Where they co-occur, the two species can be difficult to differentiate (Waring et al 2006). Atlantic spotted dolphin prefers tropical to warm temperate waters along the continental shelf 10 to 200 meters (33 to 650 feet) deep to slope waters greater than 500 meters (1640 feet) deep. Their diet consists of a wide variety of fish and squid, as well as benthic invertebrates (Herzing 1997).

No fishing-related mortality of a spotted dolphin has been reported during 1998 through 2003 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004). The estimated abundance of Atlantic spotted dolphins, pooled from 1998 through 2001 continental shelf surveys, has been reported at 30,772 individuals. Average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NOAA Fisheries considers this species as "non-strategic" (Waring et al. 2006).

Although this species is widely distributed, the preference of this species for tropical and warm temperate waters makes interactions with spotted dolphin unlikely in the project area. Recent surveys in the Southeast Study Area (Delaware through Florida), inclusive of the VACAPES OPAREA, which includes waters off Delaware through North Carolina, by the Navy indicate higher abundance of spotted dolphin in deep, continental slope waters east of North Carolina, but few, if any, in the vicinity of the project area (DoN 2007a and b). During geophysical surveys of the project area in October, 2009, no marine mammals were sighted (Geo-Marine 2009).

Harbor porpoise (*Phocoena phocoena*) – Non-Strategic
The harbor porpoise inhabits shallow, coastal waters, often found in bays, estuaries, and harbors. In the western Atlantic, they are found from Cape Hatteras north to Greenland. They are found off the coast of Delaware during fall, winter and spring. They concentrate in southwestern Gulf of Maine, Great South Channel, Jeffreys Ledge, and coastal Maine during the mid-spring months. After April, they migrate north towards the Gulf of Maine and Bay of Fundy. They generally eat small schooling fish such as mackerel, herring, and cod, as well as worms, squid, and sand eel (ACSonline 2004; NOAA 1993). According to the species stock report, the population estimate for the Gulf of Maine/Bay of Fundy harbor porpoise is 89,700 individuals (Waring et al. 2006).

The most common threat to the harbor porpoise is from incidental mortality from fishing activities, especially from bottom-set gillnets. It has been demonstrated that the porpoise echolocation system is capable of detecting net fibers, but they must not have the “system activated” or else they fail to recognize the nets (Reeves et al. 2002). Roughly 365 harbor porpoises are killed by human-related activities each year. In 1999, a Take Reduction Plan to reduce harbor porpoise bycatch in U.S. Atlantic gillnets was implemented. The plan that pertains to the Gulf of Maine focuses on sink gillnets and other gillnets that can catch groundfish in New England waters. The ruling implements time and area closures, some of which are complete closures, as well as requiring pingers on multispecies gillnets. In 2001, the harbor porpoise was removed from the candidate species list for the ESA; a review of the biological status of the stock indicated that a classification of “Threatened” was not warranted (Waring et al. 2004). The species was recently downgraded in 2002 from a NOAA Fisheries rating of “strategic” to “non-strategic” because its current average annual fishery-related mortality and serious injury does not exceed its potential biological removal (Waring et al. 2006).

Although this species is widely distributed and known to occur off the coast of Delaware, the limited location and duration of the pile-driving activities as well as the transient nature of this species makes interactions with the harbor porpoise unlikely. Furthermore, individuals in the survey area would likely leave and subsequently avoid the immediate vicinity of the pile-driving activities. Additionally, there is insufficient data to estimate abundance of the Atlantic white-sided dolphin off the U.S. East Coast in the Southeast region (DoN 2007a and b). During geophysical surveys of the project area in October 2009, no marine mammals were sighted (Geo-Marine 2009).

5.3 Earless Seals (Phocidae)

Harbor seal (*Phoca vitulina*) – Non-Strategic
Harbor seals are the most abundant seals in eastern United States waters and are commonly found in all nearshore waters of the Atlantic Ocean and adjoining seas above northern Florida; however, their “normal” southern range is probably only to the waters off the coast of New Jersey. In the western North Atlantic, they inhabit the waters from the eastern Canadian Arctic and Greenland, south to southern New England and New York, and occasionally as far south as South Carolina. Some seals spend all year in eastern Canada and Maine, while others migrate to southern New England in late September and stay until late May. According to the species stock report, the population estimate for the western North Atlantic stock of harbor seals is 99,340 (Marine Mammal Center 2002; NOAA 1993; Waring et al. 2006).

Harbor seals forage in a variety of marine habitats, including deep fjords, coastal lagoons and estuaries, and high-energy, rocky coastal areas. They may also forage at the mouths of freshwater rivers and streams, occasionally traveling several hundred miles upstream (Reeves et al. 2002). They haul out on sandy and pebble beaches, intertidal rocks and ledges, and sandbars, and occasionally on ice floes in bays near calving glaciers.

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

Harbor seals are opportunistic feeders feeding on squid and small schooling fish (i.e., herring, alewife, flounder, redfish, cod, yellowtail flounder, sand eel, and hake). They spend about 85 percent of the day diving, and much of the diving is presumed to be active foraging in the water column or on the seabed. They dive to depths of about 30 to 500 feet (10 to 150 meters), depending on location.

Historically, these seals have been hunted for several hundred to several thousand years. Harbor seals are still killed legally in Canada, Norway, and the United Kingdom to protect fish farms or local fisheries (Reeves et al. 2002). According to the stock assessment reports, an estimated 4 seals are taken in gillnets each year in the Mid-Atlantic region from 2000 to 2004 (Waring et al. 2006). Average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NOAA Fisheries considers this species as “non-strategic” (Waring et al. 2006).

Although this species is widely distributed and known to occur off the coast of Delaware, the limited location and duration of the pile-driving activities as well as the transient nature of this species makes interactions with the harbor seal unlikely. Furthermore, individuals in the construction area would likely leave and subsequently avoid the immediate vicinity of the pile-driving activities. During geophysical surveys of the project area in October 2009, no marine mammals were sighted (Geo-Marine 2009).

Harp seal (*Pagophilus groenlandicus*) – Non-Strategic

Harp seals are typically found in the pack ice of the North Atlantic and Arctic Ocean, ranging mainly from Newfoundland to northern Russia. This species is highly migratory, traveling from northern whelping sites to waters off eastern Canada and northeastern U.S. Sightings have increased in recent years within waters ranging from Maine to New Jersey (Katona et al. 1993; Stevick and Fernald 1998; McAlpine 1999; Lacoste and Stenson 2000). Such infrequent sightings of harp seals at their most southern point of migration usually occur in January-May (Harris et al. 2002). According to the species stock report, the population estimate for the harp seal is 5.9 million individuals (Waring et al. 2006). During breeding in February and March, and when molting in late spring, harp seals aggregate in large numbers of up to several thousand seals on the pack ice. During extensive seasonal migrations, large groups may feed and travel together.

Historically, these seals have been hunted for several hundred to several thousand years. Other human-caused mortalities include boat strikes, fishing gear interactions, power plant entrainment, oil spills, harassment, and shooting. Additionally, loss of sea ice is a potential threat to their habitat.

Approximately 406,600 harp seals were killed from 2000 to 2004 (Waring et al. 2006). Currently, the population is stable and average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NOAA Fisheries considers this species as “non-strategic” (Waring et al. 2006).

Although this species is widely distributed, they are more commonly encountered in deeper northern, Arctic waters and are typically more pelagic. Finally, they are not expected to occur at all in the project area during the fall month (September) in which the pile-driving activity is proposed to occur. Thus, no interactions with harp seals is expected. During geophysical surveys of the project area in October 2009, no marine mammals were sighted (Geo-Marine 2009).

Hooded seal (*Cystophora cristata*) – Non-Strategic

The hooded seal is distributed throughout much of the North Atlantic and Arctic Oceans preferring deeper, offshore waters (Sergeant 1976; Campbell 1987; Lavigne and Kovacs 1988; Stenson et al. 1996). ICES has divided this species into three separate stocks, each identified with a specific breeding area (Lavigne and Kovacs 1988; Stenson et al. 1996). These stocks are Northwest Atlantic, Greenland Sea ("West Ice"), and White Sea ("East Ice"). The Western North Atlantic stock whelps off the coast of eastern Canada.

Hooded seals are highly migratory, ranging as far south as Puerto Rico (Mignucci-Giannoni and Odell 2001) usually between January and May in New England waters, and off the southeast U.S. coast and in the Caribbean in summer and autumn (McAlpine et al. 1999; Harris et al. 2001; Mignucci-Giannoni and Odell 2001). During winter and spring, hooded seals remain on the Newfoundland continental shelf (Stenson et al. 1996). According to the species stock report, the population estimate for the hooded seal is currently 592,100 individuals (Waring et al. 2006).

Historically, these seals were heavily hunted along with harp seals, mainly by Norway, the Soviet Union, Canada, and Greenland. Human-caused mortalities of hooded seals have declined dramatically since the implementation of protective measures in the 1980s. Other human-caused mortalities include boat strikes and fishing gear interactions

Approximately 4,818 harp seals were killed by human activity from 2000 to 2004 (Waring et al. 2006). Currently, the population appears to be increasing and average annual fishery-related mortality and serious injury does not exceed the potential biological removal for this species; therefore, NOAA Fisheries considers this species as "non-strategic" (Waring et al. 2006).

This species is most commonly encountered in deeper and northern Arctic waters and is typically more pelagic. Finally they are not expected to occur at all in the project area during the fall month (September) in which the pile-driving activity is proposed to occur. Thus, no interaction with hooded seals is expected. During geophysical surveys of the project area in October 2009, no marine mammals were sighted (Geo-Marine 2009).

6.0 INCIDENTAL TAKE DETERMINATION

The MMS Environmental Assessment (EA) conducted for the Issuance of Leases for Wind Resource Data Collection on the Outer Continental Shell Offshore Delaware and New Jersey (2009) and associated Biological Assessment (BA) (2008) concluded that noise generated from pile-driving activities would result in minimal to negligible behavioral harassment and would not result in injury, death, or population level effects to marine mammals. MMS specifically concluded that because of the limited location and duration of pile-driving activities it is expected that few individuals would be present within the project area and that marine mammals would likely leave the immediate vicinity of pile driving. Furthermore, the implementation of mitigation and monitoring measures would minimize or eliminate the potential harmful effects on marine mammals (MMS 2009). Furthermore, NOAA Fisheries (2009) in its response to the MMS request for consultation pursuant to the ESA dated May 14, 2009, has determined that, provided a safety exclusion zone (or safety radius) of 1,000 meters monitored by marine mammal observers in conjunction with start-up and shut-down procedures based on species presence and movement, no listed whales or sea turtles will be exposed to any noise greater than 160 dB. Thus, listed species are not likely to be exposed to levels of construction related noise that will result in injury or disturbance and any acoustic effects of the proposed action will be insignificant and discountable.

To confirm these findings and further evaluate the potential for harassment and take of non-ESA listed species, Bluewater conducted an additional evaluation of noise levels for Delaware MDCF pile-driving activities using more detailed site-specific information in conjunction with noise level data derived from measurements taken at similar recent pile-driving operations (see Section 2.0). Take analyses were then conducted using the proposed 3-meter diameter pile. Based upon an updated sound analysis, results estimate that sounds greater than 160 dB would extend out from driving the 3-meter diameter piles to 7,230 meters. This distance equates to a ZOI, or area ensonified by greater than 160 dB, of 164.1 square kilometers. Table 2-2 shows calculated distances in meters to each isopleth. Take estimates were calculated to assess the potential effects on those marine mammals identified by the MMS (MMS 2008) as potentially occurring in the project area. Estimates were calculated by multiplying published density estimates for each species by the ZOI (164.1 square kilometers) minus the area to be monitored (the 1 kilometer Safety Zone of 3.14 square kilometers; see below), or 161 square kilometers. A maximum take estimate, which is double the estimated take for each species, was used as a conservative approach. The estimated number of takes is presented in Table 6-1.

Given the low abundance of animals during the construction time period and only an 3- to 8-hour actual pile-driving duration, it would appear that this project would result in minimal take of animals, especially if done in conjunction with an observer program with shut-down and start-up procedures, as detailed in Sections 12.0 and 14.0. As such, to ensure no injury occurs to marine mammals, Bluewater proposes to utilize a 1,000-meter (1-kilometer) Safety Zone, which encompasses the estimated 180 dBL isopleth at 760 meters for the 3-meter diameter pile. A 1,000-meter Safety Zone is a conservative estimate using worst-case estimates. All sound producing activity will cease (utilizing the shut-down and start-up procedures identified in Sections 12.0 and 14.0) if marine mammals or sea turtles are observed approaching the 1,000-meter Safety Zone. This conservative approach would prevent injurious noise exposure to marine mammals from pile-driving activities.

Using fall marine mammal density estimates from the Navy (2007a and b) and an unmonitored 160 dB ZOI of 161 square kilometers, none of the endangered whales are estimated to occur in average or maximum numbers greater 1.0. Only dolphins and harbor seals might occur in numbers of any consequence.

Table 6-1 Marine mammal density and estimated Level B harassment take Numbers during fall.

Species	Density Fall (No./100 km²)	Average[a] Take Estimate Fall (No.)	Maximum[b] Take Estimate Fall (No.)	Requested Take Authorization[c] (No.)
North Atlantic Right Whale	0.034	0.05	0.11	0
Humpback Whale	0.041	0.07	0.13	0
Fin Whale	0.022	0.04	0.07	0
Sei Whale	0.013	0.02	0.04	0
Sperm Whale	0.259	0.42	0.83	0
Minke Whale	0.113	0.18	0.36	0
Kogia spp.	0.044	0.07	0.14	0
Beaked Whale	0.057	0.09	0.18	0
Bottlenose Dolphin	3.696	5.95	11.90	15
Spotted Dolphin	8.730	14.06	28.11	35
Common Dolphins	5.275	8.49	16.99	20
Atlantic White-sided Dolphin	0.410	0.66	1.32	15
Risso's Dolphin	3.288	5.29	10.59	15
Pilot Whales	1.696	2.73	5.46	10
Harbor Porpoise	3.200	5.15	10.30	15
Harbor Seal[d]	9.743	15.69	31.37	35

[a]Density values from DoN (2007a and b)
[b]Maximum Take Estimate is 2x the Average Take Estimate.
[c]The Requested Take Authorization takes into account both the species' Maximum Take Estimate and average group size, and assumes a fall construction period only.
[d]Because the SAR-based density estimate for harbor seals is recognized as a gross overestimate, data from Barlas (1999) was used to estimate this density.

7.0 NUMBERS OF MARINE MAMMALS THAT MIGHT BE TAKEN

As described in Section 6.0, incidental take analysis has been based on the 3-meter diameter pile. Based upon an updated sound analysis, results estimate that sounds greater than 160 dB would extend out from driving the 3-meter diameter piles to greater than 7,000 meters. Table 2-2 shows calculated distances in meters to each isopleth. Take estimates were calculated to assess the potential effects on those marine mammals identified by the MMS (MMS 2008) as potentially occurring in the project area. A maximum take estimate, which is 2 times the estimated take for Level B harassment for each species (see Table 6-1), was used as a conservative approach. Using this approach (maximum estimate, 3-meter diameter pile), the estimated number of takes is still relatively low. Only the dolphins have higher harassment take estimates, with bottlenose dolphin being the highest at about 28. No take is estimated or requested for any ESA-listed species. The low abundance estimates and time of year for construction make any interactions with these species unlikely.

The species described in Section 5.0 include those species that that have the highest likelihood of occurring, at least occasionally, in the general pile driving area. However, due to the spatial distribution and transient nature of marine mammal species identified; the short duration of the activities and the time of year Bluewater proposes to conduct pile-driving activities; and the implementation of the mitigation measures as described in Sections 12.0 and 14.0, pile-driving activities are not likely result in serious injury or death. As a result, Bluewater requests authorization of take by incidental harassment, for those species representative take estimates listed in Table 6-1.

8.0 EFFECTS TO MARINE MAMMAL SPECIES OR STOCKS

Bluewater concludes that exposure to marine mammal species and stocks due to pile-driving activities will have no adverse effect on marine mammals and would not affect the overall annual recruitment or survival for the following reasons:

- potential acoustic exposures from Bluewater Delaware pile-driving activities are within the non-injurious behavioral effects zone (Level B harassment) (see Section 2.0);
- pile-driving activities are of short duration (approximately 8 to 16 hours total with 3 to 8 hours of actual pile driving) and limited in area (approximately 450-meter construction radius); and,
- the protective measures as described in Sections 12.0 and 14.0 will effectively minimize the potential for Level A interactions with and exposure to marine mammals.

This conclusion is further supported by the finding of the MMS EA and associated BA conducted for the *Issuance of Leases for Wind Resource Data Collection on the Outer Continental Shell Offshore Delaware and New Jersey* that determined impacts to marine mammals resulting from pile-driving activities would be short-term and consist of minimal to negligible behavioral harassment effects (MMS 2008 and 2009). MMS further notes that marine mammals are mobile and are expected to quickly leave an area when pile driving is initiated. In addition, MMS acknowledges that while pile driving may disturb more than one individual, short-term construction activities are not expected to result in population-level effects and individuals would likely return to normal behavioral patterns after pile driving has ceased or after the animal has left the construction area (MMS 2008 and 2009).

9.0 MINIMIZATION OF ADVERSE EFFECTS TO SUBSISTENCE USES

There are no traditional subsistence hunting areas in the Bluewater Delaware construction area.

10.0 EFFECTS TO MARINE MAMMALS FROM LOSS OR MODIFICATION OF HABITAT AND THE LIKELIHOOD OF RESTORATION

The footprint of the foundation legs and scour protection (if used) is approximately 0.06 acre (30-foot radius around the monopole foundation) at the MDCF site. Consultation with NOAA Fisheries under Section 7 of the ESA concluded that all effects of the proposed project will be insignificant or discountable (MMS 2008; NOAA 2008). Additionally, under the terms of the MMS lease, within a period of one year after cancellation, expiration, relinquishment, or other termination of the lease, the lessee shall remove all devices, works, and structures from the leased area and restore the leased area to its original condition before issuance of the lease (MMS 2008).

Given the relatively small footprint of the Bluewater Delaware MDCF, and the low abundance of marine mammals in the construction area (see Table 6-1), and the required restoration of the leased area to its original condition, it is reasonable to conclude that effects to marine mammals from loss or modification of habitat will be insignificant or discountable.

11.0 THE EFFECTS OF HABITAT LOSS OR MODIFICATION ON MARINE MAMMALS

As stated in Section 10.0, given the relatively small footprint of the Bluewater Delaware MDCF, and the low abundance of marine mammals in the construction area (see Table 6-1), and the restoration of the leased area to its original condition, it is reasonable to conclude that effects to marine mammals from loss or modification of habitat will be insignificant or discountable.

12.0 MEANS OF EFFECTING THE LEAST PRACTICABLE IMPACT UPON AFFECTED SPECIES OR STOCKS, THEIR HABITAT AND THEIR AVAILABILITY FOR SUBSISTENCE USES

As stated in Section 10.0, given the relatively small footprint of the Bluewater Delaware MDCF, and the low abundance of marine mammals in the construction area (see Table 6-1), and the restoration of the leased area to its original condition, it is reasonable to conclude that effects to marine mammals from loss or modification of habitat will be insignificant or discountable.

Bluewater Delaware has committed to a comprehensive set of mitigation measures during pile driving. These measures include:

- Safety exclusion zone implementation;
- Field verification of safety zone;
- Visual monitoring program;
- Shut-down procedures;
- Ramp-up procedures; and
- Time-of-Day restrictions.

Section 14.0 provides more detailed information about the mitigation, monitoring and reporting procedures that are an integral part of the planned activities.

13.0 THE EFFECTS OF PILE-DRIVING ACTIVITIES OFF THE COAST OF DELAWARE ON SPECIES OR STOCK OF MARINE MAMMALS AVAILABLE FOR ARCTIC SUBSISTENCE USES

Potential impacts to species or stocks of marine mammals will be limited to individuals located in the Northeast Region of the United States and will not include Arctic marine mammals. Given that the Bluewater Wind Delaware Offshore Wind Park is not located in Arctic waters, the activities associated with the Bluewater Wind Delaware Offshore Wind Park will not have an adverse affect on the availability of marine mammals for subsistence uses allowable under the MMPA.

14.0 MONITORING AND REPORTING

14.1 Mitigation and Monitoring Procedures

The mitigation and monitoring procedures outlined in the following section are based on protocols identified in the MMS BA (2008), NOAA ESA Section 7 consultation (NOAA 2009), and Exhibit B of the MMS Lease (MMS 2009). The following subsections provide more detailed information about the mitigation measures that are an integral part of the planned activities.

All construction equipment will comply as much as possible with applicable equipment noise standards of the U.S. Environmental Protection Agency (EPA), and all construction equipment, even if modified from the original, will have noise control devices no less effective than those provided on the original equipment.

Safety Exclusion Zone

A preliminary 1,000-meter (approximately 0.54-nautical mile) radius safety exclusion for marine mammals will be established around the pile driving site in order to reduce the potential for serious injury or mortality of these species (i.e., Level A take). The rationale for this conservative safety zone is provided in Section 6.0; the 1,000-meter conservative safety zone for the 3-meter diameter pile encompasses the 180 dB isopleth at 760 meters for the Delaware MDCF, as well as the 180 dB isopleth at 1,000 meters for the New Jersey MDCF, as was calculated from available sound data from similar pile-driving projects.

Field Verification of Safety Zone

Field verification of the exclusion zone will be conducted during pile driving of the first three pile strikes. The results of the measurements from the first three pile strikes will be used to determine whether the proposed 1,000-meter conservative safety exclusion zone is adequate to prevent Level A take of marine mammals. If the field measurements determine that the actual ZOI (area ensonified by sounds exceeding 180 dB) extends beyond the proposed 1,000-meter safety exclusion zone, a new safety exclusion zone, encompassing the actual ZOI, will be established. Otherwise, the 1,000-meter safety exclusion zone will remain in place during the remaining construction. A detailed description of field verification protocols is included in Attachment 1.

In addition to field verification of the safety exclusion zone, Bluewater will be conducting acoustic monitoring in coordination with MMS during the 3 to 8 hours of actual pile driving. The purpose of this combined acoustic monitoring plan is two-fold: first to provide real-time acoustic data to MMOs for the direct purpose of protecting marine mammals from acoustic harassment; and second to collect both near and far-field baseline sound attenuation data from pile driving activities on the outer continental shelf OCS for which relatively little data currently exists. Collection of such baseline acoustic data is critical to both Bluewater and the MMS for better understanding actual sound propagation from construction activities in the deep waters of the OCS and the actual potential affects of future MDCF construction and wind turbine foundation installation activities might have on marine biological species.

Marine Mammal Observers

Visual monitoring of the exclusion zone will be conducted during driving of all piles. Monitoring of the zones will be conducted by at least one qualified NOAA Fisheries approved marine mammal observer (MMO) onboard the pile-driving vessel. Additionally, at least one other dedicated MMO will be stationed onboard the vessel conducting underwater noise field verification surveys. When not conducting actual noise data collection to measure sound pressure levels out to the 160 dB isopleth (see Attachment 1), this vessel will continually patrol the area to monitor for marine mammals. The MMO stationed on this survey vessel will monitor for marine mammals entering the Level B harassment zone within the area defined by the 160 dB isopleth. Observer qualifications will include direct field experience on a marine mammal/sea turtle observation vessel and/or aerial surveys in the Atlantic Ocean/Gulf of Mexico. All MMOs will be approved in advance by NOAA Fisheries after a review of their qualifications.

MMOs will begin monitoring at least 30 minutes prior to soft start of the pile driving. Pile driving will not begin until the zone is clear of all marine mammals for at least 30 minutes. Monitoring will continue through the pile-driving period and end approximately 30 minutes after pile driving is completed.

Each MMO will scan the area surrounding the pile-driving and survey vessels for visual signs of non-vocalizing whales that may enter the construction area. Observations will take place from the highest available vantage point on the associated tug (estimated to be over 20 or more feet above the waterline). General 360° scanning will occur during the monitoring periods, and target scanning by the MMO will occur when alerted of a marine mammal or sea turtle presence.

Observers, using binoculars, will estimate distances to marine mammals either visually, using laser range finders, or by using reticled binoculars during daylight hours. Although unlikely, if pile-driving activities extend into night hours, FLIR Systems, INC, thermal imaging devices will be used. If higher vantage points (>25 feet) are available, distances can be measured using inclinometers. Position data will be recorded using hand-held or vessel global positioning system (GPS) units for each sighting, vessel position change, and any environmental change.

Data on all observations will be recorded based on standard MMO collection requirements. This will include: dates and locations of construction operations; time of observation, location and weather; details of marine mammal sightings (e.g., species, age classification (if known), numbers, behavior); and details of any observed taking (behavioral disturbances or injury/mortality). Any observations concerning impacts on listed marine mammals will be transmitted to NOAA Fisheries and MMS within 24 hours.

Shut-down Procedures

The exclusion zone around the pile-driving activity will be monitored for the presence of marine mammals before, during and after any pile-driving activity. The exclusion zone will be monitored for 30 minutes prior to the soft-start of pile driving. If the safety radius is obscured by fog or poor lighting conditions, pile driving will not be initiated until the entire safety radius is visible for the 30 minute period. If marine mammals are observed within the zone during the 30 minute period and before the soft-start begins, pile driving of the segment will be delayed until they move out of the area and until at least an additional 30 minutes have passed without a marine mammal sighting. Monitoring of the zone will continue for 30 minutes following completion of the pile-driving activity.

If marine mammals approach or enter the exclusion zone after pile driving of a segment has begun, pile driving will cease until the marine mammal leaves the exclusion zone. Observers will monitor and record marine mammal numbers and behavior. Pile driving will not resume until at least 30 minutes have passed without a marine mammal sighting within the exclusion zone. If pile driving of a segment ceases for 30 minutes or more and a marine mammal is sighted within the designated zone prior to commencement of pile driving, the observer(s) must notify the Resident Engineer (or other authorized individual) that an additional 30-minute visual observation period will be completed, as described above, before resuming pile-driving activities.

In addition, pile driving will not be started during night hours or when the safety radius can not be adequately monitored (i.e., obscured by fog, inclement weather, poor lighting conditions). In accordance with the MMS BA (2008) NOAA ESA Section 7 consultation (NOAA 2009), if a soft start has been initiated before dark or the onset of inclement weather, the pile driving of that segment may continue through these periods under the continued monitoring of the area by the MMOs.

Ramp-up Procedures

A ramp-up or soft-start will be used at the beginning of each pile segment in order to provide additional protection to marine mammals near the project area by allowing them to vacate the area prior to the commencement of pile-driving activities. The soft-start requires an initial set of three strikes from the impact hammer at 40 percent energy with a one minute waiting period between subsequent three-strike sets. The procedure will be repeated two additional times. If marine mammals are sighted within the exclusion zone prior to pile-driving, or during the soft start, the Resident Engineer (or other authorized individual) will delay pile driving until the animal has moved outside the exclusion zone and no marine mammals are sighted for a period of 30 minutes. Additionally, if during ramp-up procedures sufficient driving force to drive pile segments is achieved at less than full power, pile-driving will continue at the reduced force subject to safety concerns and construction requirements.

Time-of-Day Restrictions

Pile-driving activities will be limited to day light hours between one-half hour after sunrise and one-half hour prior to sunset. However, in accordance with the MMS BA (2008) NOAA ESA Section 7 consultation (NOAA 2009), if a soft-start has been initiated before dark or prior to the onset of inclement weather (e.g., fog, severe rain events), the pile driving of that segment may be completed. However, no new pile-driving activities can be initiated until 30 minutes after dawn or after the inclement weather has passed per the above requirements.

Other Potential Mitigation Measures

At the request of NOAA Fisheries, Bluewater has investigated the feasibility of employing a pile cap and other sound attenuation devices including bubble curtains, contained air curtains, and sleeves to minimize the potential of acoustic harassment of marine mammals during the continuous 3 to 8 hour period during which active pile driving would be conducted. Review of each of these techniques has indicated deployment of such devices for such a short period of actual pile driving will have significant effects on Bluewater's current construction schedule and installation cost as well as other federal permit applications currently under review. The following provides a summary of the techniques evaluated and their overall effect on MDCF installation schedule, cost and permitting.

- **Pile Caps** – The placement of a softer material such as wood, nylon, or steel cable between the hammer and the pile being driven has proven to be successful in reducing underwater sound for short periods of time during pile driving (Caltrans 2009; Nehls et al 2007). However research has shown that caps only have a limited useful life as materials tend to mold to the pile or crack thereby reducing effectiveness of the cap as hammering progresses, likely resulting in the cap needing to be repositioned or replaced. Frequent stops and starts of actual pile-driving could result in full pile penetration not being achieved. Based on an estimate from Fluor's offshore piling experience, the corrective action and mitigation for a pile that cannot be driven to full penetration could add as much as 60 hours to the total construction time and exceed the maximum estimated continuous active pile driving of 8 hours.

  Pending receipt of all applicable permits Bluewater's intent is to install the MDCF during the month of October. Extending Bluewater's proposed construction period beyond the month of October potentially increases Bluewater's risk for construction delays due to weather. For example during Bluewater's geophysical and geotechnical survey activities conducted in October of 2009 inclement weather resulted in 15.5 days of survey delay.

- **Bubble Curtain** – A bubble curtain involves the placement of a ballasted flexible double tube or a rigid pipe ring either around the perimeter of the pile or around the larger construction area. The proposed MDCF monopile will be installed a depth of 30 to 40 feet. Research shows that bubble curtains have proven to be effective in reducing under water sound in shallow water areas (less than 30 feet of water) (Nehls et al 2007). At deeper water depths and areas affected by wave action and currents, the use of bubble curtains have had limited success (Nehls et al 2007). At the MDCF site, given the oceanic currents in the and a water depth of 30 to 40 feet, it is very doubtful that a bubble curtain would be effective.

  At the Delaware MDCF site, Bluewater has determined that placement of a bubble curtain would likely require the support of divers, which would require at least one additional day of pre- and post-construction activity to set up and remove the device from the construction site.

  In addition to the increase in construction cost and schedule, the operation of the bubble curtain will require the use of a diesel-driven generator which has not been accounted for in the in the air permit application currently under review by the U.S. Environmental Protection Agency (EPA) for this solar- and wind-powered MDCF. Modification to the air permit at this stage in the application review process would cause Bluewater to miss its already narrow construction window.

- **Contained Air Curtain** – A contained air curtain is similar to the conventional bubble curtain described above; however, the air curtain is surrounded by a fabric sleeve to better control the vertical dispersion of the air bubbles. Contained air curtains have proven to be effective in reducing under water sound in water depths of less than 30 feet (Reyff 2003, as presented in Nehls et al 2007). Despite some effectiveness in reducing under water sound attenuation, such devices can be difficult to install and will be prone to snagging (Nehls et al 2007).

  Similar to the standard bubble curtain, the placement of such a device will require the support of divers, result in an additional day of pre- and post-construction activity, and require the use of a diesel-driven generator which has not been accounted for in Bluewater's air permit application currently under review by the EPA.

  As stated previously Bluewater's construction plan, schedule and budget do not currently include, nor do they require the support of divers.

- **Sleeves** – Sleeves are devices made from insulated rigid materials that are known to impede sound attenuation in water (e.g., steel tube with foam insulation). To install the sleeve, it is hoisted and fitted over the pile foundation and secured to the bottom by anchor weights. Research on sleeves has indicated some success in water depths less than 30 feet (Nehls et al 2007).

  As with both bubble and contained air curtains, a sleeve can be difficult to install, is prone to snagging, will require the support of divers and will likely add one day to the pre-and post-construction support activities.

  Bluewater estimates that to procure and employ the use of a sleeve to support 3 to 8 hours of continuous active pile driving would extend installation vessel time at sea by several days.

As detailed in Attachment 1, Bluewater intends to conduct acoustic monitoring in coordination with MMS during the 3 to 8 hours of continuous active pile driving. The purpose of this acoustic monitoring plan is two-fold: first to provide real-time acoustic data to MMOs for the direct purpose of protecting marine mammals from acoustic harassment; and second to collect both near and far-field baseline sound attenuation data from pile driving activities on the outer continental shelf (OCS) for which relatively little data currently exists. Collection of such baseline acoustic data is critical to achieving a better understanding of actual sound propagation from construction activities in the deepwater waters of the OCS and the actual potential affects of future wind turbine foundations installation activities might have on marine biological species. Given the short period of active pile driving (3 to 8 hours) associated with the installation of the MDCF, the use of sound attenuation devices would effectively eliminate the ability of both Bluewater and MMS to collect this important baseline information. Bluewater does however understand the importance of minimizing impacts to marine mammals and other marine species and is committed to working with NOAA Fisheries and other agencies to use the baseline data collected during the installation of Delaware MDCF to further evaluate both techniques and technologies that could be employed to effectively minimize underwater sound attenuations during future MDCF and/or wind turbine foundation installation activities on the OCS.

Bluewater strongly feels that the disadvantages of employing a sound attenuation device during pile driving activities outweigh the potential advantages in terms of schedule, cost, and baseline data collection needs. Bluewater is committed to employing mitigation and monitoring methods during the 3 to 8 hours of continuous active pile driving including a safety exclusion zone with field verification of that zone, dedicated MMOs on both the pile-driving vessel and the vessel used for noise monitoring, ramp-up and shut-down procedures, and time-of-day restrictions to effectively minimize and/or avoid impacts to marine mammals.

14.2 Reporting

Bluewater will provide the following reports as necessary during construction activities:

- After any re-establishment of the exclusion zone, a report to the MMS and NOAA Fisheries detailing the field-verification measurements within seven days (see Attachment 1 for details concerning field verification protocols). This includes information, such as: a detailed account of the levels, durations, and spectral characteristics of the impact and vibratory pile driving sounds; and the peak, rms, and energy levels of the sound pulses and their durations as a function of distance, water depth, and tidal cycle. MMS should be notified within 24 hours whenever any new exclusion zone is implemented by Bluewater.
- Any observed significant behavioral reactions (e.g., fleeing the area) or injury or mortality to any marine mammals or sea turtles must be reported to NOAA Fisheries and MMS within 24 hours of observation.
- As specified under the terms of Lease Number OCS-A-0474, Exhibit B issued by the MMS Lease of Submerged Lands on the OCS, a final technical report will be submitted within 120 days after completion of the pile-driving and construction activities will be provided to MMS and NOAA Fisheries that provides full documentation of methods and monitoring protocols, summarizes the data recorded during monitoring, estimates the number of listed marine mammals and sea turtles that may have been taken during construction activities, and provides an interpretation of the results and effectiveness of all monitoring tasks.

15.0 RESEARCH

All marine mammal data collected by Bluewater Wind during pile driving will be provided to NOAA, MMS, the Delaware Department of Natural Resources and Environmental Control (DNREC), and other interested government agencies, and be made available upon request to educational institutions and environmental groups. These organizations could use the data collected during this period to study ways to reduce incidental taking and evaluate its effects.

All hydroacoustic data and resulting transmission loss rates collected during Safety Zone Field Verification by Bluewater Wind during pile driving (see Attachment 2) will be provided to NOAA, MMS, the DNREC, and other interested government agencies, and be made available upon request to educational institutions and environmental groups. These organizations could use the data collected during this period to study ways to reduce incidental taking from pile driving noise and evaluate its effects.

Furthermore, Bluewater would welcome an opportunity to discuss with any interested agency or research organization the implementation of the marine mammal protection guidelines that will employed during pile driving so that those guidelines can be calibrated and fine-tuned as necessary to protect marine mammals within the requirements of the law while allowing pile driving – necessary, in this case, for the construction of an offshore meteorological tower and ultimately a wind park – to efficiently go forward.

16.0 LIST OF PREPARERS

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17.0 REFERENCES

ACSonline (American Cetacean Society). 2004. "Cetacean Fact Pack." Site visited February 12, 2005. http://www.ACSonline.org/factpack/index.html

Barlas, M.E. 1999. The distribution and abundance of harbor seals (*Phoca vitulina concolor*) and gray seals (*Halichoerus grypus*) in southern New England, Winter 1998- Summer 1999. Master's thesis, Boston University.

California Department of Transportation (Caltrans). 2009. Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish. February 2009. 298 pages.

CETAP (Cetacean and Turtle Assessment Program). 1982. A Characterization of Marine Mammals and Turtles in the Mid- and North Atlantic Areas of the U.S. Outer Continental Shelf. Final Report of the Cetacean and Turtle Assessment Program, University of Rhode Island, Kingston, Rhode Island. U.S. Department of the Interior, Bureau of Land Management, Washington, D.C. Contract AA551-CT-48. 450 pp.

Clark, C.W. 1995. Application of U.S. Navy underwater hydrophone arrays for scientific research on whales. Rep. Int. Whal. Commn 45:210-212.

Continental Shelf Associates, Inc. 2004. Geological and Geophysical Exploration for Mineral Resources on the Gulf of Mexico Outer Continental Shelf, Final Programmatic Environmental Assessment, OCS EIS/EA, MMS 2004-054, prepared by Continental Shelf Associates, Jupiter, FL, for the U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA, July. Available at: http://www.gomr.mms.gov/PDFs/2004/2004-054.pdf.

CRI, DEWI, ITAP (2004): Standardverfahren zur Ermittlung und Bewertung der Belastung der Meeresumwelt durch die Schallimmission von Offshore-Windenergieanlagen. Project 0327528A final report. The German Federal Environment Ministry

Garrison, L. P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp.

Garrison, L. P. and P. M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp.

GeoMarine. 2009. Marine Mammal Monitoring During Geophysical Surveys in Support of the Construction of a Meteorological Data Collection Facility for the Bluewater Delaware Offshore Wind Park (MMS Lease Block 6325). Final Report to NOAA Fisheries, October 2009.

Greater Gabbard Marine Engineers. 2010. Personal communication.

DoN (Department of the Navy). 2007a. Navy OPAREA Density Estimates (NODE) for the Northeast OPAREAs: Boston, Naragansett Bay, and Atlantic City. Final report. Contract number N62470-02-D-9997, CTO 0045. Norfolk, Virginia: Atlantic Division, Naval Facilities Engineering Command. Prepared by Geo-Marine, Inc., Plano, Texas.

DoN. 2007b. Navy OPAREA Density Estimates (NODE) for the Southeast OPAREAs: VACAPES, CHPT, JAX/CHASN, and Southeastern Florida & AUTEC-Andros. Final report. Contract number N62470-02-D-9997, CTO 0060. Norfolk, Virginia: Atlantic Division, Naval Facilities Engineering Command. Prepared by Geo-Marine, Inc., Plano, Texas.

ISD, DEWI, ITAP (2007): Standardverfahren zur Ermittlung und Bewertung der Belastung der Meeresumwelt durch die Schallimmission von Offshore-Windenergieanlagen. Project 0329947 final report. The German Federal Environment Ministry

ITAP, unpublished data as presented in: Nehls, G., Betke, K., Eckelmann, S. & Ros. M. 2007. Assessment and costs of potential engineering solutions for the mitigation of the impacts of underwater noise arising from the construction of offshore windfarms. BioConsult SH report, Husum, Germany. On behalf of COWRIE Ltd.

Katona, S.K., V.R. Rough, and D. Richardson. 1993. A Field Guide to the Whales and Seals from Cape Cod to Newfoundland. 4th Edition, revised. Smithsonian Institution Press, Washington, D.C.

Kraus, S.D., P.K. Hamilton, R.D. Kenney, and C.K. Slay. 2001. Reproductive parameters of the North Atlantic right whale. J. Cetacean Res. Manage. (Special Issue) 2:231-236.

Marine Mammal Center. 2002. “Harbor Seal.” Site visited February 21, 2005. Accessed at: http://www.tmmc.org/learning/education/pinnipeds/harborseal.asp

Mayo, C.A. and M.K. Marx. 1990. “Feeding behaviour of northern right whales, *Eubalaena glacialis*, in Cape Cod Bay, and associated zooplankton characteristics”. Canadian Journal of Zoology. 68:2214-2220.

McLellan, W.M., A.S. Friedlaender, J.G. Mead, C.W. Potter, and D.A. Pabst. 2003. Analysing 25 years of bottlenose dolphin (*Tursiops truncatus*) strandings along the Atlantic coast of the USA: do historic records support the coastal migratory stock hypothesis? J. Cetacean Res. Manage. 4:297-304.

Mead, J. G. 1989. Beaked whales of the genus Mesoplodon. Pages 349-430 in: S.H. Ridgway and R. Harrison, (eds.) Handbook of marine mammals, Vol. 4: River Dolphins and toothed whales. Academic press, San Diego.

Minerals Management Service (MMS). 2009. Lease of Submerged Lands for Alternative Energy Activities on the Outer Continental Shelf. Lease Number OCS-A-0474 Issued by the Minerals Management Service. November 2009.

MMS. 2008. Issuance of Non-Competitive Leases for Wind Resource Data Collection on the Northeast Atlantic Outer Continental Shelf Biological Assessment. Issued by the Minerals Management Service for Consultation with the U.S. Fish and Wildlife Service and NOAA Fisheries. December 2008.

Nedwell J R , Parvin S J, Edwards B, Workman R , Brooker A G and Kynoch J E. 2003. Measurement and interpretation of underwater noise during construction and operation of offshore windfarms in UK waters. Subacoustech Report No. 544R0738 to COWRIE Ltd. ISBN: 978-0-9554279-5-4.

Nehls, G., Betke, K., Eckelmann, S. & Ros. M. 2007. Assessment and costs of potential engineering solutions for the mitigation of the impacts of underwater noise arising from the construction of offshore windfarms. BioConsult SH report, Husum, Germany. On behalf of COWRIE Ltd.

New Jersey Department of Environmental Protection (NJDEP). 2009. Ocean/Wind Power Ecological Baseline Studies, Revised Interim Report. Prepared by Geo-Marine, Inc. for the New Jersey Department of Environmental Protection, Division of Science, Research and Technology. Trenton, New Jersey. 313 pp. NJER 09-012.

NOAA Fisheries. 2001. Stock structure of coastal bottlenose dolphins along the Atlantic coast of the US. NMFS/SEFSC Report prepared for the Bottlenose Dolphin Take Reduction Team. Available from: Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

NOAA. 2009. Letter to Dr. James J. Kendall, Minerals Management Service, and Mr. Frank J. Cianfrani, U.S. Army Corps or Engineers, Regarding Non-Competitive Leases for Wind Resource Data Collection on the Northeast Outer Continental Shelf. Letter issued in response to a request for consultation pursuant to section 7 of the Endangered Species Act (ESA) of 1973, dated May 14, 2009.

NOAA. 2006. "Small Takes of Marine Mammals Incidental to Specified Activities; Rim of the Pacific (RIMPAC) Antisubmarine Warfare (ASW) Exercise Training Events Within the Hawaiian Islands Operating Area (OpArea)," Federal Register 71 (No.78).

Parvin, S.J., Nedwell, J.R., Workman, R. (2006a): Underwater noise impact modelling in support of the London Array, Greater Gabbard and Thanet offshore wind farm developments. Subacoustech Report No. 710R0515

Parvin, S.J., Nedwell, J.R. (2006b): Underwater noise survey during impact piling to construct the Burbo Bank Offshore Wind Farm. Subacoustech Report No. 726R0103. Interim report for COWRIE project no. ACO-04-2002

Pierson, M.O., J.P. Wagner, V. Langford, P. Birnie, and M.L. Tasker. 1998. Protection from, and mitigation of, the potential effects of seismic exploration on marine mammals. Chapter 7 In: M.L. Tasker and C. Weir (eds.), Proceedings of the seismic and marine mammals workshop, London, 23–25 June 1998.

Reeves, R.R., B.S. Stewart, P.J. Clapham, J.A. Powell. 2002. Guide to Marine Mammals of the World. National Audubon Society.

Richardson, W.J., C.R. Greene Jr, C.I. Malme, and D.H. Thomson. 1995. Marine Mammals and Noise. Academic Press. San Diego CA.

Schulkin, M. and Mercer, J.A. 1985. “Colossus Revisited: A Review and Extension of the Marsh-Schulkin Shallow Water Transmission Loss Model,” University of Washington Applied Physics Laborotory, APL-UW 8508.

Shoop, C.R. and R.D.Kenney.1992. Seasonal Distributions and Abundances of Loggerhead and Leatherback Sea Turtles in Waters of the Northeastern United States. Herpetological Monographs, Vol. 6, (1992), pp. 43-67.

Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene Jr., D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas, and P.L. Tyack. 2007. Marine mammal noise exposure criteria: initial scientific recommendations. Aquat. Mamm. 33(4):411-522.

Urick, R.J. 1983. Principles of underwater sound, 3rd Ed. McGraw-Hill, New York, NY. 423 p.

U.S. FWS (United States Fish and Wildlife Service). 1997. Significant Habitats and Habitat Complexes of the New York Bight Watershed. United States Fish and Wildlife Service, Southern New England – New York Bight Coastal Ecosystems Program. Charlestown, Rhode Island. November 1997.

U.S. Department of the Interior, Minerals Management Service. 2007. Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf, Final Environmental Impact Statement, October 2007. OCS Report MMS 2007-046. Available at: http://www.ocsenergy.anl.gov/.

Waring, G.T., R.M. Pace, J.M. Quintal, C.P. Fairfield, and K. Maze-Foley, Editors. 2004. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments—2003. NOAA Technical Memorandum NMFS-NE-182.

Waring, G.T., E. Josephson, C.P. Fairfield, and K. Maze-Foley (Eds.). 2006. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments—2005. NOAA Technical Memorandum NMFS-NE-194.

Waring GT, Josephson E, Maze-Foley K, and Rosel PE, editors. 2009. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments -- 2009. NOAA Tech Memo NMFS NE 213; 528 p.

Weir, C.R. and S.J. Dolman. 2007. Comparative review of the regional marine mammal mitigation guidelines implemented during industrial seismic surveys, and guidance towards a worldwide standard. J. Int. Wildl. Law and Policy. 10(1):1-27.

Wells, R.S. and M.D. Scott. 2002. Bottlenose Dolphins *Tursiops truncatus* and *T. aduncus*. Pp. 122-128. In W.F. Perrin, B. Wursig, and J.G.M. Thewissen, eds. Encyclopedia of Marine Mammals. Academic Press, San Francisco, CA.

Yeung, C. 1999. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-430, 26 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, 43 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149

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ATTACHMENT 1

Underwater Noise Measurement Survey Protocol

PRIVILEGED AND CONFIDENTIAL
MAY CONTAIN PROPRIETARY
OR PROJECT SENSITIVE INFORMATION

Protocol for a Hydroacoustic Workplan during Construction of the Meteorological Data Collection Facility for the Bluewater Delaware Offshore Wind Park
April 25, 2010

Intruduction

On behalf of Bluewater Wind LLC, through its entity Bluewater Wind Delaware LLC ("Bluewater Wind" or "Bluewater"), Tetra Tech EC, Inc presents the following protocol for a hydroacoustic workplan for the measurement of the underwater radiated noise from marine piling during construction of the Bluewater Wind Meteorological Data Collection Facility, Salisbury Area (NJ 18-05), OCS Blocks 6325 Offshore Delaware (Draft Report or Report). The goal of this workplan is to meet the data collection and reporting objectives for underwater sound testing, as required under the terms of Lease Number OCS-A-0474, Exhibit B issued by the U.S. Department of the Interior (DOI) Minerals Management Service (MMS) Lease of Submerged Lands on the Outer Continental Shelf (OCS).

II.5.B.Reqirements for Pile Driving: The following measures will be implemented by the Lessee during the conduct of pile-driving activities related to meteorological towers.

a. **Establishment of Exclusion Zone:** A preliminary 1,000 meter (1,640.4 feet) radius exclusion zone for listed marine mammals and sea turtles will be established around each pile-driving site in order to reduce the potential for serious injury or mortality of these species. Once piling driving begins, the actual sound generated will be measured per requirements provided in II.5.B.b of this lease and a new reduced or expanded exclusion zone will be established based on the results of these field verified measurements. This new exclusion zone will be established based on data collected in the field and used to calculate the actual distance from the pile driving source where underwater sound levels are anticipated to equal 160 dB re 1 uPa root-mean-square (rms) impulse. Based on the outcome of the field-verified sound levels and the calculated or measured distances as noted above, the Lessee may either: (1) retain the 1,000 meter (1,640.4 feet) zone or (2) establish a new zone based on field verified measurements demonstrating the distance from the pile-driving source where underwater sound pressure levels (SPLs) are anticipated to equal the received 160 dB re 1 uPA rms (impulse). Any new exclusion-zone radius must be based on the most conservative measurement (i.e., the largest safety zone configuration).

b. **Field Verification of Exclusion Zone:** Field verification of the exclusion zone will be conducted by the Lessee during the first three pile strikes following completion of the ramp up. The results of the measurements from the first three strikes after ramp up can then be used to establish a new exclusion zone which is greater than or less than the 1,000 meters (1640.4 feet) depending on the results of the field tests.

Objectives

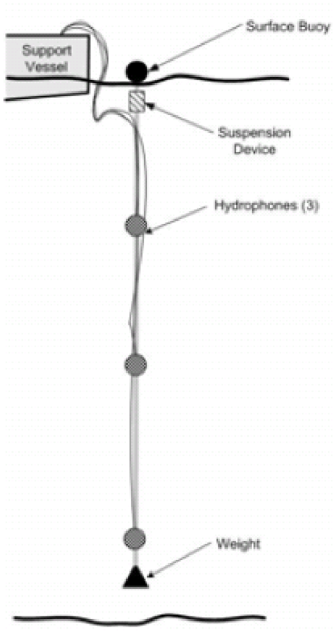
Tetra Tech will design and execute, with the use of subcontractors as necessary, an underwater noise monitoring survey to collect, analyze, and record underwater acoustic data during MDCF construction, in accordance with provisions of the MMS lease agreement. In order to quantify the underwater sound from a pile-driving event, three main measurement instrumentation components are required: (1) hydrophones and signal conditioning, (2) data acquisition and processing, digital recording, and a real-time display system and (3) equipment measuring distance including a geographic positioning system (GPS) measurement system. Further details of the individual measurement components and proposed methodologies are described in the following sections.

Tetra Tech will measure and record underwater sound levels during MDCF construction by collecting short term underwater sound measurements at set distances and hydrophone water depths during MDCF pile driving. The underwater sound survey and data analysis has the following three objectives:

(1) Establish a test methodology using precision measurement instrumentation to field verify the marine mammal safety and exclusion zones by collecting and analyzing real-time underwater acoustic data during pile driving, as required under section II.5.B.a of the lease agreement.

(2) Provide a digital sound recording of acoustic measurements completed during pile driving for possible future off-line evaluation and analysis.

(3) Use the received sound data collected at multiple locations to estimate site specific underwater sound transmission loss decay rates in the immediate project study area. These data can be used to further develop a site-specific underwater sound propagation methodology for use in future environmental studies in support of permitting. Once the step transfer function is known, the underwater noise level can be predicted from measured values at similar offshore sites, even if there is variation in pile diameter, impact force, and water depth (i.e., during construction of other MDCF sites or wind turbine array).



Reference: Draft ANSI Standard S12.64- 200X
Revision 12, May 21, 2009

Approach

A methodology that has been developed for the measurement of marine piling radiated noise, which is designed to record the time dependant, spatial and spectral characteristics of the radiated sound field. Underwater construction noise measurements will be performed outside the acoustic near-field at linear distances ranging from approximately 200 meters (or as close as practical, in accordance with any applicable safety standards), and up to and in excess of 1,000 meters from the MDCF platform to document the distance to the 180 dBL threshold. Near-field acoustic measurements (e.g., 10 to 20 meters from pile driving) are typically limited to the study of fish mortality and are not a requirement under the lease agreement. Several methods of instrument deployment were considered. To maximize the number of spot measurement locations and reduce the effects of hydrostatic pressures and resulting extraneous noise from a stationary fixed system due to current flow, the hydrophones will be deployed directly from a workboat which is free to move along a transect in a radial direction away from the pile location. Immediately prior to the fieldwork program, a sound velocity profile will be taken using a current-temperature-depth (CTD) sounder. In the shallow coastal waters, the water is typically well mixed and isothermal, but seasonal variations may occur.

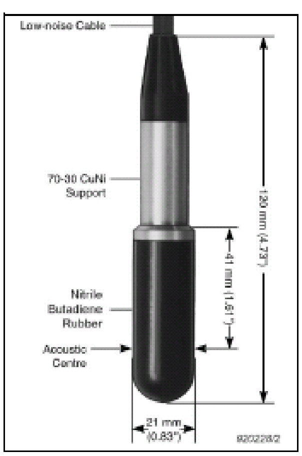
It will be required that the vessel's engines, depth sounder, generator, and other equipment that may contaminate the sound signal will be shut down prior to hydrophone deployment. The position of the vessel relative to the MDCF platform will be monitored by GPS over the entire duration of the measurement period. The hydrophone and buoy system will be deployed over the side vessel such that it drifts away from the vessel. The hydrophone will be deployed into the water column by securing it to an anti-heave buoy to locate the hydrophone at a constant distance below the surface. The line will be weighted at the lower end to maintain a vertical profile below the surface. At a minimum, two hydrophones will be deployed per measurement period. One hydrophone will be situated at the approximated 1/3 of the average depth of the water column at the test site and the second at 2/3 of the average depth. A background noise data set shall be assigned to each measurement run, when possible, in order to compare the measured level pile driving to the background noise at the approximate time of the test. The overall measurement uncertainties will be evaluated from a combination of components which describe random errors (where the uncertainty may be estimated from the measurement repeatability), and errors caused by effects that may introduce a systematic bias into the measurements.

Real-Time Acoustic Measurement Instrumentation

A specialized technical approach is required when collecting underwater sound levels in coastal waters and the open ocean. For monitoring pile driving sound with high sound energy content and rapid onset rates, a carefully designed, calibrated, and field tested hydro acoustic measurement system is requisite to handle peak sound loads. The system must also be capable of performing a frequency spectrum analysis, (data that is required by the lease agreement and that may also be needed when assessing noise impacts on marine mammals during wind turbine array construction, discussed in the EIS). Measurements will be completed using a measurement chain that is field calibrated immediately prior and following each measurement period using a hydrophone calibrator, with a laboratory calibration certification traceable to National Institute of Standards and Technology (NIST).

Underwater sound pressure level measurements will be made within the initial Exclusion Zone radii to assess status with criteria levels at multiple distances. Resultant measurement data will provide information about duration and amplitude of acoustic noise levels during pile driving. The signal analyzer will be programmed to measure, data log, and display the and peak values (L_{peak}), sound exposure levels (SELs), as well as sound energy averaged over defined as the time interval between accumulation of 5% and 95% of the total sound energy, referred to as the $RMS_{90\%}$ using the impulse (I) time constant (32 measurements per second).

Data will be analyzed on a real-time basis with results immediately communicated to the construction operations manager and/or onboard marine spotter. If measured levels exceed (or are less than) the expected Exclusion Zone threshold level, a revised radius will be established and the NMFS approved observer will be advised of the expanded (or reduced) zone necessary for observation of marine mammals. MMS will be notified within 24 hours whenever any new exclusion zone is implemented by the Lessee. A +/- 2% margin of error on all distance calculations for the placement of the sound measurement



Hydrophone Type 8104
A wide-range standard measuring transducer for making absolute sound measurements over the frequency range 0.1 Hz to 120 kHz with a receiving sensitivity of −205 dB re 1 V/μPa. It can also be used as a sound transmitter (projector) which makes it ideal for calibration purposes by the reciprocity, calibrated-projector and comparison methods. The main features of Type 8104 are shown in Fig. 2.

Reference: Bruel & Kjaer Technical Specifications, October, 2006

instrumentation will be applied. To meet this accuracy requirement, all distance measurements will be made with a GPS, which has a stated precision of +/- 1 meter.

To support the ongoing acoustic monitoring needs of the Project, Tetra Tech will have three (3) Bruel & Kjaer model BK8104 or Reson model TC4010 broadband hydrophones with factory calibration certificates and sensitivity specifications. The TC4010 and BK8104 hydrophones are more sensitive than most other hydrophones, even at the extremes of its frequency range. With a dynamic range in excess of 90 dB, makes it one of the few hydrophones that are suitable for the measurement of noise with a highly sloped spectrum, such as shallow water background noise. The hydrophones will be equipped with extended length integrated water blocked cables suitable for use in the general area of the New Jersey and Delaware MDCF sites. These units will have water proof connectors for signal input following conditioning directly to multichannel real time frequency analyzers capable of 1/3 octave and Fast Fourier Transform spectra analysis with data measured in the frequency range of 20 Hz to 20 kHz. The underwater sound levels will also be recorded with calibration tones recorded immediately prior to each measurement period, for reference purposes. The sampling rate will be set to a minimum of 12 k samples per second (sps). A general rule of thumb is that the playback of a digital sound recording will provide accurate reproduction of frequency content up to 0.48 times the recording sample rate. Thus, a 12 k sample rate would provide a recording having good fidelity over the entire range of pile driving sound, with principal sound energy generally found below 2,000 Hz.

Fixed Sound Recording Units

Fixed static recording units capable of recording the entire piling sequence will be deployed at a distance of 2 to 5 kilometers. In conjunction with the vessel-deployed system which will focus on data collection in proximity, the fixed units will provide empirical data and recordings of the entire piling sequence to assess changes in the source and variations in the temporal and spectral characteristics over time. Such changes may be due to changes in hammer energy, pile penetration depth, sediment composition, etc. The full piling sequence data from the fixed recording unit will be used to correct for the variations in source level during the time periods when work-boat measurements were not being made. The data from the autonomous recording unit would not be available for review until after the piling sequences have been completed and will be used to assess site specific transmission losses and provide further verification of the acoustic modeling methodology used in the Bluewater IHA application and future permitting actions.

Tetra Tech is currently coordinating with the MMS to conduct joint acoustic monitoring both near- and far-field sound pressure levels. The purpose of this combined acoustic monitoring plan is two-fold: first to provide real-time acoustic data to MMOs for the direct purpose of protecting marine mammals from acoustic harassment; and second to collect both near- and far-field baseline sound attenuation data from pile driving activities on the outer continental shelf OCS, for which relatively little data currently exists. Collection of such baseline acoustic data is critical to better understand the actual sound propagation from construction activities in the deep waters of the OCS and the actual potential affects of future MDCF construction and wind turbine foundation installation activities might have on marine biological species.

Schedule and Reporting

The target mobilization date for the Delaware MDCF tower construction has not been finalized. The number of days of hydrophone monitoring at the MDCF site is not known. Following completion of the sound survey, sound measurement data and recordings will be immediately downloaded in the field for subsequent analysis at the Tetra Tech Boston office. Measured sound levels would be correlated to field log books and all necessary engineering calculations completed, including the calculations of individual

$RMS_{90\%}$ values and estimates for cumulative exposure. Two separate deliverables will be associated with this proposed scope of work. See sections II.5.C.a and d. below

II.5.C. <u>Reporting for Construction Activities</u>: The following must be submitted during construction:

a. **Field Verification Measurements:** After any re-establishment of the exclusion zone, the Lessee shall provide a report to the Lessor and NMFS detailing the field-verification measurements within 7 days. This includes information, such as: a detailed account of the levels, durations, and spectral characteristics of the impact and vibratory pile driving sounds; and the peak, rms, and energy levels of the sound pulses and their durations as a function of distance, water depth, and tidal cycle. MMS should be notified within 24 hours whenever any new exclusion zone is implemented by the Lessee.

d. **Final Technical Report:** A final technical report will be provided by Lessee to the Lessor, NMFS, and USFWS, as well as the New Jersey Department of Environmental Protection (DEP) or the Delaware Department of Environmental Control (DNREC) within 120 days after completion of the pile-driving and construction activities. The report will provide full documentation of methods and monitoring protocols, summarize the data recorded during monitoring, estimate the number of listed marine mammals and sea turtles that may have been taken during construction activities, and provide an interpretation of the results and effectiveness of all monitoring tasks.

Within 7 days following completion of the field data collection, a report summarizing the acoustic data will be submitted including a time history plot for each measurement period. Relevant phases for a detailed acoustic analysis are defined as times of typical and extreme acoustic noise emission. For each relevant time period, third octave spectra of the single event sound pressure level shall be evaluated for frequencies ranging from 10 Hz to 20 kHz. This spans the entire frequency range over which pile driving sounds are of interest with principal energy found below 2,000 Hz. The duration of the total acoustic noise emissions during pile driving, pressure of a single impulse and a series of impulses will be reported. Sound survey methodology and pertinent results from the acoustic survey will also be included in the Final Technical Report, due within 120 days after completion of pile-driving and construction activities.

Statement of Qualifications of Personnel

The driving of large steel shell piles has been found to result in high underwater sound pressures that may be lethal to fish and potentially dangerous to marine mammals. Tetra Tech has unique experience in measuring and assessing the impacts of underwater sounds on the marine environment and has made presentations of the sound pressures from these activities to a number of agencies on the behalf of offshore development companies including several offshore LNG ports and wind energy projects. The Project Manager is Jennifer Ghiloni and proposed protocol will be conducted under the direction of Erik Kalapinski, INCE, Lead Acoustic Engineer, assisted by highly qualified science and engineering staff experienced in the design and deployment of precision underwater noise measurement systems. Resultant data are routinely used in the assessment of compliance with regulatory limits and the determination of potential behavioral response of marine life.