Application for Incidental Harassment Authorization for the Non-Lethal Taking of Marine Mammals - Neptune LNG Deepwater Port

29 June 2016

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List of Abbreviations

CETAP	Cetacean and Turtle Assessment Program
CFR	Code of Federal Regulations
dB	decibel(s)
DEIS	Draft Environmental Impact Statement
DP	dynamically positioned/dynamic positioning
DSV	dive support vessel
DWP	Deepwater Port
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ESA	Endangered Species Act
fath	fathom(s)
FEIS	Final Environmental Impact Statement
FWC	Florida Fish and Wildlife Commission
HDD	horizontal directional drilling
hp	horsepower
Hz	Hertz
IHA	Incidental Harassment Authorization
kHz	kilohertz
km	kilometer(s)
LNG	liquefied natural gas
LOA	Letter of Authorization
m	meter(s)
MARAD	U.S. Maritime Administration
mg/L	milligram(s) per liter
MMO	Marine Mammal Observer
MMPA	Marine Mammal Protection Act
mmscfd	million standard cubic feet per day
MRA	Marine Resources Assessment
nm	nautical mile(s)
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OCS	Outer Continental Shelf
OPR	Office of Protected Resources
PAM	passive acoustic monitoring
PLEM	pipeline end manifold
PBR	potential biological removal
PSO	protected species observers
rms	root mean square
ROD	Record of Decision
ROV	Remotely Operated Vehicle
SPL	sound pressure level
SPUE	sightings per unit effort
SRV	shuttle regasification vessel
STL	submerged turret loading
TECO	Tampa Electric Company
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service
ZOI	Zone of Influence

The information provided in this document is submitted in response to the requirements of 50 CFR § 216.104.

1.1 BACKGROUND

Neptune LNG LLC (Neptune LNG or "Applicant") own and operate the Neptune Deepwater Port (DWP) located in federal waters of the Outer Continental Shelf (OCS), within blocks NK 19-04 6525 and NK 19-04 6575. The DWP is located approximately 22 miles (35.4 km) northeast of Boston, Massachusetts, in water depths ranging from 125 to 250 ft (38 to 76 m; **Figure 1-1**). The DWP consists of two mooring and unloading buoys and a pipeline that receives natural gas from "shuttle and regasification vessels" (SRVs), then through a flexible riser that connects to a 24-inch subsea flowline and ultimately into a 24-inch gas transmission line. The 24-inch gas transmission line connects the DWP pipeline system to the existing 30-inch Algonquin HubLine gas pipeline. As each SRV arrives, the regasification process of converting liquefied natural gas (LNG) into natural gas is initiated. The natural gas is transferred from the SRV through the unloading buoy, within the jurisdiction of the Commonwealth of Massachusetts.

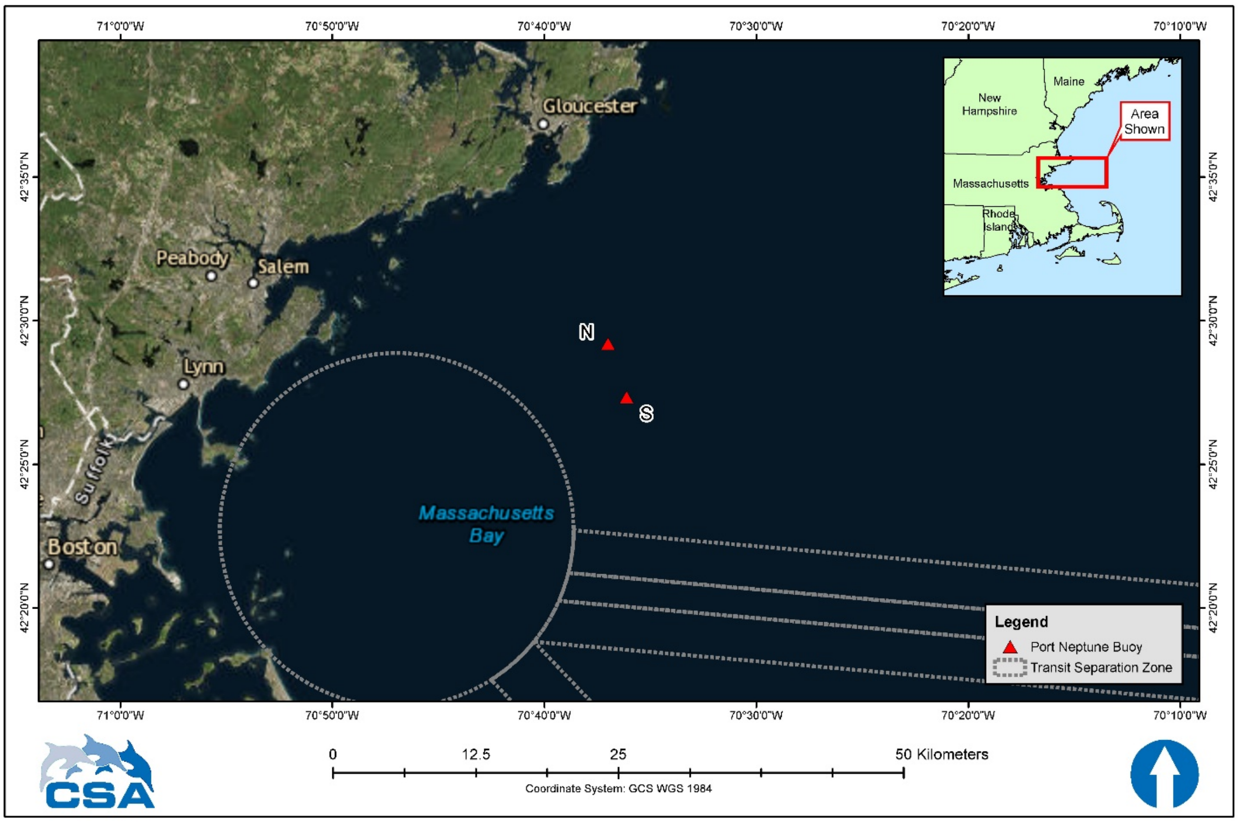

Figure 1-1. Location of the Neptune DWP.

The Neptune DWP was commissioned in 2009-2010 for import of LNG into the New England region. Several Incidental Harassment Authorizations (IHAs) have been issued previously to the Applicant. Neptune LNG submitted its first complete application to the National Marine Fisheries Service (NMFS) on December 27, 2007, for the take of small numbers of marine mammals, by harassment, incidental to the construction phase of the Neptune LNG DWP infrastructure. In June 2008, NMFS issued a 1-year

IHA to Neptune LNG for the construction of the Port (73 FR 33400, June 12, 2008). This authorization expired on June 30, 2009. NMFS issued a second 1-year IHA to Neptune LNG for the completion of construction and beginning of Port operations on June 26, 2009 (74 FR 31926, July 6, 2009), which expired on June 30, 2010. On July 12, 2010, NMFS issued a third IHA to Neptune LNG based on the request in its March 11, 2010, application (75 FR 41440, July 16, 2010). The active IHA (76 FR 34157, June 13, 2011) is effective through July 2016. Under this most recent IHA, Neptune LNG conducted limited port operations which involved only an 11-day repair activity in 2011. No other port operations have been conducted since that time.

Multiple acoustic assessments (Laurinolli et al., 2005; Samsung, 2009; Gaboury and Carr, 2009; LGL, 2009), submitted as part of these IHA applications, provide detail regarding the acoustic effects of DWP construction, operation, maintenance, unscheduled maintenance, and decommissioning. Noise modeling conducted for these noise acoustic assessments applied to all activities and vessels anticipated throughout the life of the DWP. The anticipated operational life of the DWP was 25+ years; however, due to changes in the natural gas market, the Applicant suspended port operations and will subsequently decommission the DWP. The decommissioning activities will likely exceed the expiration date of the existing LOA. Therefore, the Applicant is requesting an IHA for DWP decommissioning and unscheduled maintenance activities, herein termed “proposed activities”, which may be necessary between expiration of the existing LOA (July 2016) through the completion of decommissioning activities.

With this application, Neptune LNG is seeking a fourth IHA for maintenance and decommissioning activities between July 12, 2016 and July 12, 2017. These dates are applied for with the understanding that the Applicant is requesting coverage for maintenance and repair activities only in 2016 as is covered under the current IHA that expires on July 11, 2016. Decommissioning activities will not begin before May 1, 2017. On 25 March 2016, Neptune LNG provided formal notice to the United States Maritime Administration (MARAD) of its intention to decommission the Neptune DWP and has subsequently met with MARAD and the US Coast Guard to discuss the process for decommissioning and permitting is moving forward for those 2017 activities.

1.2 ACTIVITIES CONSIDERED IN APPLICATION

1.2.1 Unscheduled Maintenance

Although unscheduled maintenance is not expected for the application period, the current LOA (July 2011) included unscheduled maintenance activities; therefore, the Applicant is including this activity as part of the small numbers take request to ensure consistency between Applications. Unscheduled maintenance activities requiring limited excavation to access the pipeline, or cathodic protection maintenance, are authorized by the Federal Energy Regulatory Commission (FERC). Unplanned maintenance would be relatively minor and of short duration. Example unscheduled maintenance activities may include repair of flange or valve leaks, replacing faulty pressure transducers, or unscheduled maintenance on valves. These minor unscheduled maintenance activities will be completed within a few days to several weeks, depending on the nature of the problem.

Should any unplanned maintenance be required, a dive support vessel (DSV) would be the primary vessel used to complete the activities in the timeliest manner. The category of DSV and corresponding support vessels would be dictated by the type of work required, the water depth at the work location, vessel availability, and expected duration of the maintenance or repair.

Typical maintenance is not expected to exceed 30 days of vessel activity within the project area. The National Oceanic and Atmospheric Administration (NOAA) determined that a 14-day period was appropriate for evaluating the potential take associated with a maintenance activity at the Neptune DWP.

(NOAA Fisheries – Federal Register Vol. 76, No. 113, pp 34157 – 34176, June 13, 2011). Maintenance activities will only occur during 2016.

1.2.2 Decommissioning

Decommissioning will begin in 2017. The decommissioning plan consists of abandoning the pipeline and removal of the remaining components from the seafloor. Decommissioning of the facility was approved as part of the original Port licensing process and is addressed in the current operational Prevention, Monitoring, and Mitigation Plan (PMMP) (E&E 2010). Decommissioning activities will be pursued as planned maintenance activities and will comply with all regulatory requirements and guidelines. The decommissioning activities are described in the following section. Decommissioning will begin no earlier than May 1 2017. Details regarding each task and subtask and their corresponding durations are listed in **Table 3-1** in **Section 3.0**

1.2.2.1 Isolation and Closure of Hot Tap and Removal of Tie-in Spool

To isolate the DWP pipeline that extends from the Algonquin HubLine, the valve attached to the hot tap must be uncovered and closed. The Hot Tap fitting and 20-inch valve will be left in place. As illustrated in **Figure 1-2**, all other components, which include the check valve and associated support clamps, will be removed. Once the spool and structural clamps are removed, a blind flange will be installed and the assembly will be covered with sand bags and concrete mats.

In order to verify that the 20-inch Tap Valve closes properly and does not leak, the 16-inch Tie-in Spool between the Transition Manifold and the Hot Tap valve must be depressurized. The 16” Tie-in spool is approximately 100 feet in length and contains an estimated volume of 6000 standard cubic feet of natural gas. The depressurization of the 16-inch Tie-in Spool will be accomplished by installation of a high pressure hose to a blow-down valve on the Hot Tap Assembly. The venting hose will be run to the surface and connected to a flare stack positioned on the barge supporting this operation where the gas in the spool will be flared off at the hot-tap location.

Neptune LNG has collaborated with Algonquin to confirm their requirements for the final disposition and configuration of the Hot Tap Assembly that will remain attached to the HubLine pipeline once the DWP has been decommissioned.

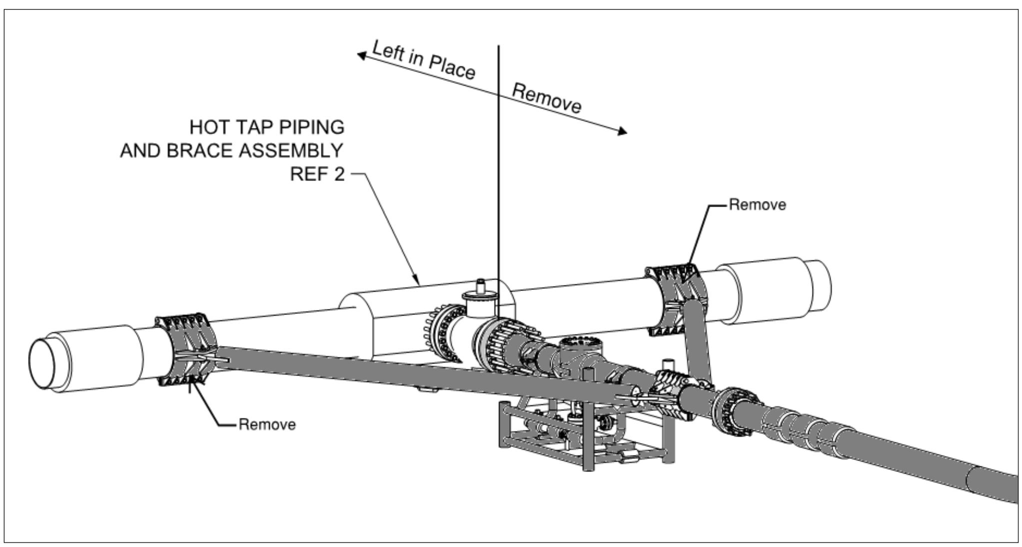

Figure 1-2. Hot tap assembly (Source: Neptune LNG).

1.2.2.2 Pipeline Decommissioning and Abandonment

In accordance with safety provisions and with 49 CFR Section 192.727, Neptune LNG intends to decommission and abandon the pipeline in place. The pipeline lies in water depths ranging between 260 feet (Mean Low Low Water [MLLW]) at the South Buoy and 122 feet (MLLW) at the Hot Tap. The last pressure reading obtained from the pipeline was 793 psig. The total length of the pipeline is approximately 13.1 miles and presently contains approximately 12 million standard cubic feet of natural gas.

The pipeline decommissioning includes depressurization of the pipeline by installation of a high-pressure hose to a blow-down valve on the pipeline end manifold (PLEM) adjacent to the South Buoy location. The venting hose will be connected to a flare/vent stack positioned on the vessel supporting this operation. The gas in the pipeline to be removed during decommissioning will be flared off from the pipeline.

Temporary pig (a “pig” is an industry is a tool that is sent down a pipeline, propelled by the pipeline contents, to conduct maintenance or inspection activities) launchers and receivers will be installed at each end of the pipeline. Once the pipeline has been depressurized, a bi-directional poly pig will be launched and propelled using seawater to flood the pipeline. Any remaining gas will continue to be combusted at the surface through the flare stack.

The volume of untreated, filtered seawater required to flood the pipeline is approximately 1.5 million gallons. The intake screen will be sized to ensure the intake velocity does not exceed 0.5 feet per second, will have slots cut and will be placed strategically in the water column to minimize entrainment of sea life in accordance with Section 3.2.3 of the PMMP. The flow rate during the flooding activity will range between 1500 and 3000 gallons per minute.

Later in the decommissioning process, once the PLEMS, Transition Manifold and associated spools have been removed, each end of the pipeline will be plugged, buried and covered with concrete mats.

1.2.2.3 Disconnection and Removal of Risers and Umbilicals

Once the pipeline has been depressurized and flooded, the risers and umbilicals will be disconnected and removed. The contractor will verify that the riser has been depressurized and the umbilical has been disconnected from the buoy and PLEM. The riser will be cut utilizing a hydraulic sheer, or an ROV-mounted cutting wheel. Once cut, the riser will be recovered to the work vessel and properly disposed of at an appropriate onshore disposal facility. The riser and umbilical assembly is shown in **Figure 1-3** (South Buoy described below; similar activities are performed at the North Buoy).

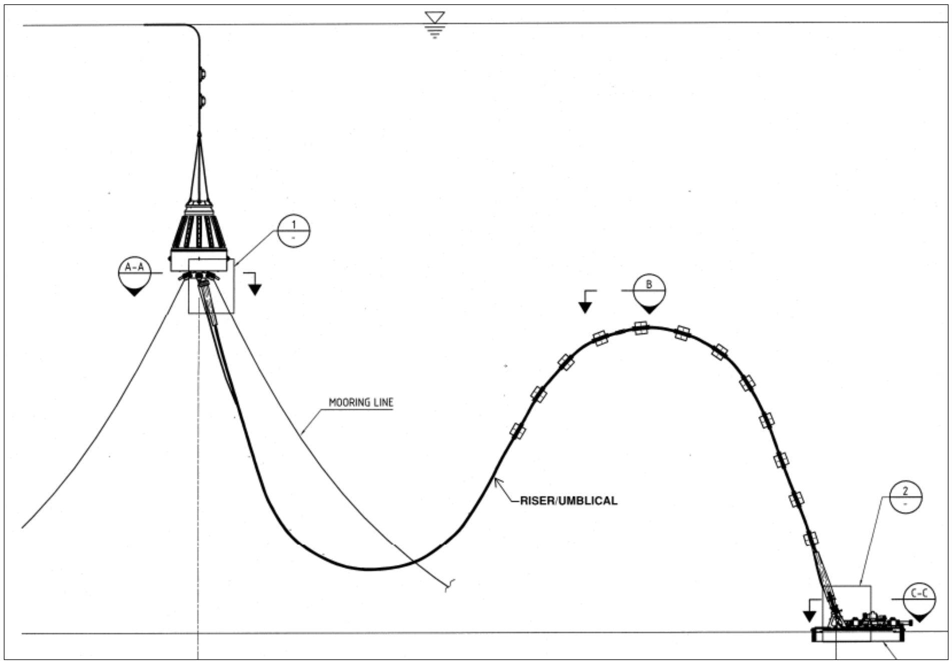

Figure 1-3. Riser and umbilical assembly (Source: Neptune LNG).

1.2.2.4 Removal of STL Buoys

The removal methodology for submerged turret loading (STL) buoys outlined below is applicable to the South Buoy; similar procedures and activities will be performed at the North Buoy. The STL Buoy (**Figure 1-4**) removal plan involves cutting each of the eight mooring lines that connect the buoy to the piles. A hydraulic shear or ROV-mounted cutting wheel will be deployed to cut each mooring line close to the buoy, freeing the buoy for retrieval. The contractor will attach the proper rigging to either lift the buoy onto the work vessel or to tow the buoy to a quayside facility for salvage. The process will be repeated for each buoy.

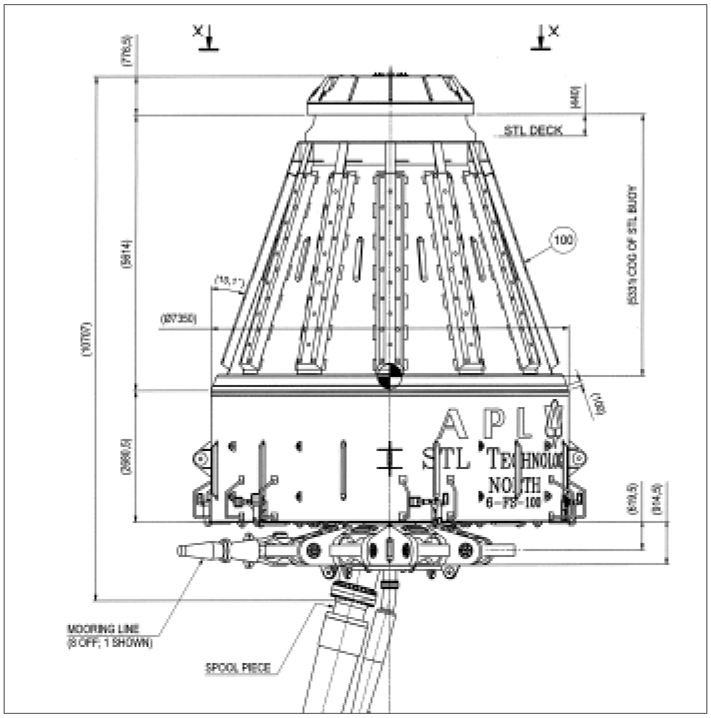

Figure 1-4. Submerged turret loading (STL) buoy (Source: Neptune LNG).

1.2.2.5 Removal and Abandonment of Suction Piles

A review of the engineering challenges and environmental impacts associated with the reverse installation methodology for the removal and recovery of the suction piles was conducted by Neptune LNG and project consultants. The purpose of the review was to determine the most environmentally responsible and safest manner to decommission the suction piles considering several factors, including minimizing environmental impacts and maintaining personnel safety. The reverse installation method involves attaching a crane to the lifting points of the STL buoy and attaching a pump to the suction pile receptacle located on the top of each suction pile. Sea water is pumped into the pile while the crane on the HLV applies a lifting load. The potential failures of the reverse installation method include the inability to achieve the required internal pressurization or the inability to produce a flowrate capable of achieving and maintaining the necessary pressure to unseat each suction anchor.

A potentially immitigable risk could occur during this operation if a suction pile becomes lodged in a partially removed condition in which pumping water into the pile no longer produces internal pressure and the lifting forces exceed the capacity of the crane or the lifting pad eyes. A partially removed suction pile potentially jeopardizes the safety of the diving personnel and HLV and results in a significant seafloor obstruction. Based on the review, Neptune LNG plans to abandon the suction piles in place and to cover the suction piles with trawl protectors.

1.2.2.6 Removal of Mooring Lines (Anchor Chain and Wire Rope)

DWP mooring lines are comprised of anchor chain and wire rope (**Figure 1-5**). The anchor chains will be cut free and recovered to the surface separately, or will be recovered while still attached to the suction pile. If the suction pile cannot be removed, the anchor chain will be cut as close to the suction pile as practical and recovered. The wire rope that attaches the chain to the buoy will also be recovered and properly disposed of on shore. This process will be repeated for all 16 mooring lines as detailed in **Table 1-1**. Chain and wire rope table entries correspond to (A) and (B), respectively, in **Figure 1.4**.

Table 1-1. Length and weights of chain and wire rope slated for removal.

Line	Chain		Wire Rope	
	Chain Length (A)(m)	Chain Weight in Air (Te)	Wire Rope Length (m)	Wire Rope Weight in Air (Te)
N1	675	265.1	150	12.86
N2	1,070	420.3	150	12.86
N3	675	265.1	150	12.86
N4	675	265.1	150	12.86
N5	450	176.7	150	12.86
N6	375	147.2	150	12.86
N7	375	147.2	150	12.86
N8	470	184.5	150	12.86
S1	675	265.1	150	12.86
S2	675	265.1	150	12.86
S3	675	265.1	150	12.86
S4	690	270.9	150	12.86
S5	520	204.3	150	12.86
S6	375	147.2	150	12.86
S7	845	331.9	150	12.86
S8	825	324.1	150	12.86

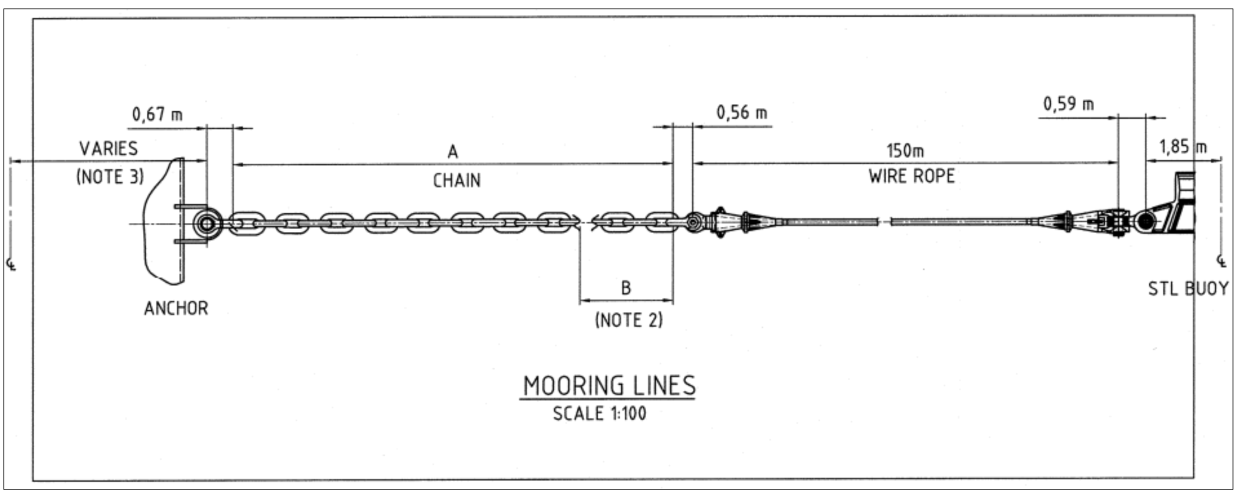

Figure 1-5. Mooring line detail (Source: Neptune LNG).

1.2.2.7 Removal of PLEMs and Transition Manifold

The port consisted of three manifolds, including the South PLEM, North PLEM and the Transition Manifold with a protection cover. Each PLEM has been outfitted with a Hazard Buoy which warns surface vessels of their presence. The details of each manifold and associated spools that will be removed and recovered are provided in the **Figures 1-6** through **1-8**. Both The PLEMs and the Transition Manifold (including and associated spools) will only be removed once the pipeline has been flooded and the riser/umbilical has been detached. All recovery will be done using the crane aboard the DSV and parts staged on the anchored barge to be taken to shore via a tug.

Removal of North and South PLEM and Tie-In Spools

The South PLEM will be removed once the two tie-in spools have been disconnected (**Figure 1-6**). The end of the pipeline will be plugged and covered with concrete mats. The South PLEM and tie-in spools will be recovered and properly disposed of on shore via a tug and barge.

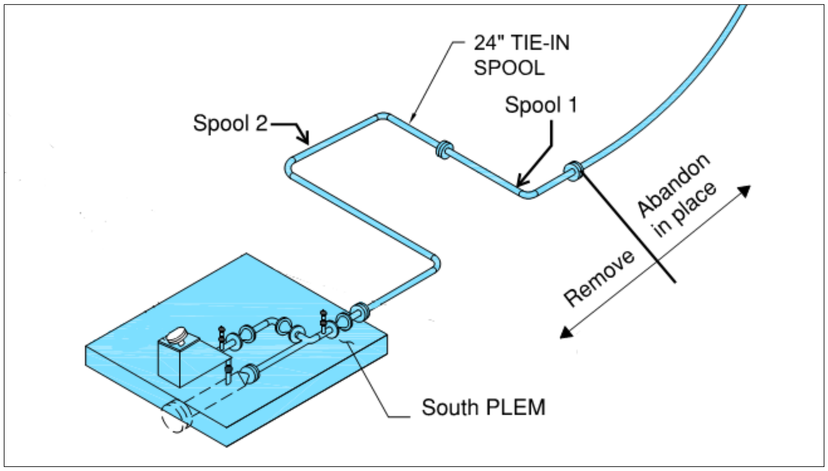

Figure 1-6. South pipeline end manifold (PLEM) and tie-in spools (Source: Neptune LNG).

The North tie-in spool (**Figure 1-7**) will be disconnected from the pipeline and PLEM and recovered. A plug will be placed on the remaining tie-in flange and covered with concrete mats. The North PLEM and tie-in spools will be recovered and properly disposed of on shore.

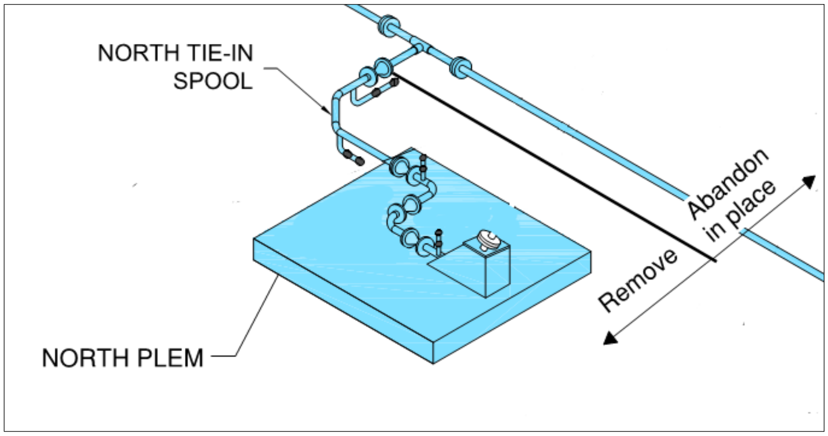

Figure 1-7. North pipeline end manifold (PLEM) and tie-in spool (Source: Neptune LNG).

Disconnection and Removal of Transition Manifold and Tie-In Spools

The components that will be removed in conjunction with the Transition Manifold include the 24-inch Tie-in Spool, the 16-inch Tie-in Spool, and the Projection Cover as shown in **Figure 1-8**, below. Once disconnected, the end of the pipeline will be plugged or otherwise sealed and covered with concrete mats. The Transition Manifold, Protection Cover, Hazard Buoy, and tie-in spools will be recovered and properly disposed of on shore.

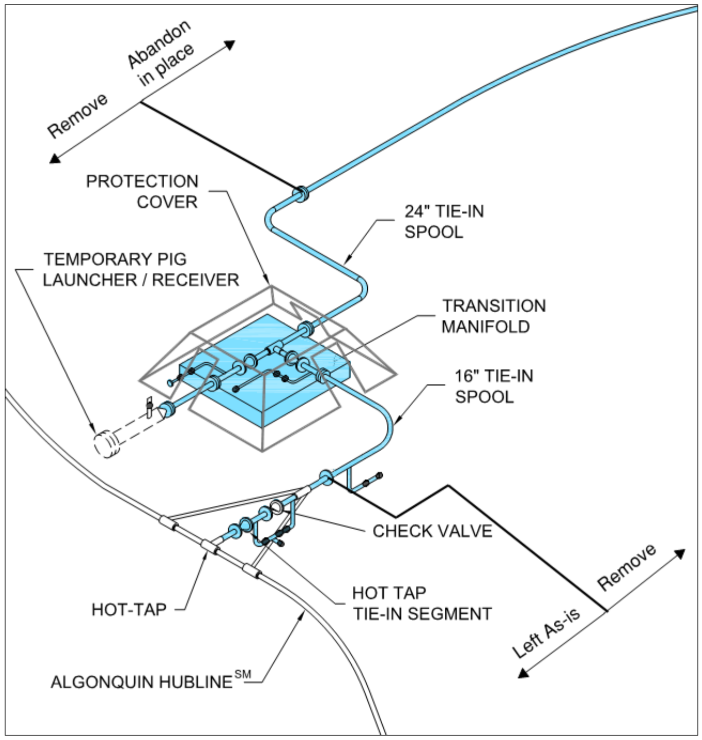

Figure 1-8. Transition manifold and associated components (Source: Neptune LNG).

1.2.2.8 Removal of Seafloor Position Transponders

The two transponders, one located at each buoy position, will be recovered and properly disposed of on shore.

1.2.2.9 As Left Survey

Once all of the activities defined in the decommissioning plan have been completed, an "As Left Survey" of the seabed will be performed. The survey will also confirm that there is no debris associated with the DWP left behind.

A final drawing of the survey will be prepared illustrating the final contours and seabed elevation in the area where each component was removed as well as any infrastructure that has been left in place.

1.3 VESSEL ACTIVITY

The planned scenario for the duration of all proposed activities would include the mobilization of a DSV, a tug, an anchored barge, and intermittent use of a crew vessel with the DSV being a dynamically positioned (DP) vessel. All vessels will transit and operate in accordance with the measures employed to reduce noise and ship strike risk as described in **Section 11.0** of this document. There is the outside possibility that a heavy lift vessel (HLV) would be required during decommissioning. The specifications of an appropriate HLV are similar to that of the DSV and would be performing the same duties as a DSV; therefore, the two vessels are considered under the single DSV category for this application. Only one DSV or HLV vessel is expected to be working at any one time. However, in the unlikely event that two DSVs (or one DSV and one HLV) are necessary at the same time, they will remain at least 1000m from one another and will each maintain their own mitigation.

Details of vessel type, activity, and duration for the proposed activity are provided in **Table 1-2**. In general, the DSV will transit to either the STL buoy or PLEMs and complete all work at the site prior to moving to the next location. The support tug will anchor the barge and will occasionally be required for barge handling activities when equipment transport and/or staging are required. The crew/supply vessel would be used intermittently for personnel and supply transfers. A survey vessel would be used for a brief period of time (<5 days) at the end of the project.

Neptune LNG is presently engaged in a contractor selection process for decommissioning and therefore cannot make definitive statements regarding the specific construction equipment that will perform the work. However, the specifications of a representative DSV that would be used for the proposed activity are located in **Table 1-2**.

The information provided below and in **Table 1-3** is intended to describe the type of equipment anticipated.

Dive Support Vessel (DSV)

This vessel will operate in DP mode and will support all diving and ROV operations required to perform the work. This vessel will perform the pipeline depressurization and flooding operations, minor excavation activities, and recover the tie-in spools and PLEMs.

Support Barge and Tug

One or more support barges and associated tugs may also be required to stage recovered components for transport to a dockside facility for proper disposal.

Survey Vessel

Once all decommissioning activities are completed and all the components have been recovered a small survey vessel will perform an "As Left Survey".

Specifications and operational usage of representative vessels during unscheduled maintenance or decommissioning are listed in **Table 1-2**. The anticipated DSV used for the proposed activities is depicted in **Figure 1-9**. All vessels would be supported from an onshore base (specific location to be determined) located between Quincy, Massachusetts, and Gloucester, Massachusetts.

Figure 1-9. Proposed dive support vessel, *Subsea7 Falcon* (Source: http://www.subsea7.com/content/dam/subsea7/documents/whatwedo/fleet/diving/Seven%20Falcon.pdf.)

Table 1-2. Expected vessel specifications for all proposed activities.

Vessel	Auxiliary Equipment/Comments	Activities	Number Used During Activities	Operational Usage
Barge	--	Stage recovered components for transport to a dockside facility for proper disposal.	1	Intermittent –50% load or less
Tug	--	Stage recovered components for transport to a dockside facility for proper disposal.	1	
Crew Boat	--	Project support	1	Intermittent
Survey Vessel	Side scan and single beam echosounder	Perform an “As Left Survey” after decommissioning	1	12 hours/day operating (daylight only) for 5 days or less at the end of the project
Dive Support Vessel (**Figure 1-9**)	Length: 120 m Bow Tunnels: • 2× 1,500 kW Retractable Azimuth Thrusters: • 1× 1,500 kW aft • 2× 1,500 kW forward	Perform the pipeline depressurization and flooding operations, minor excavation activities, and removal of tie-in spools and pipeline end manifolds (PLEMs)	1	24 hours/day; maximum 10 weeks at 50% load or less

1.4 SOUND ANALYSIS OF PROPOSED ACTIVITIES

1.4.1 Regulatory Criteria

This analysis applies noise exposure criteria currently being utilized by NOAA Fisheries, Office of Protected Resources (OPR) to the proposed decommissioning and unscheduled maintenance activities. The NOAA Fisheries acoustic criteria were purposely developed to be protective of all marine mammal species from exposure to high sound pressure levels, primarily under the regulatory requirements of the Marine Mammal Protection Act (MMPA).

The Marine Mammal Protection Act (MMPA) defines two levels of harassment. Level A harassment is statutorily defined as any act of pursuit, torment or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild. The NOAA Fisheries defines the zone of injury as the range of received sound pressure levels (SPL). For cetaceans, the SPL threshold for a continuous source is from 180 linear decibels (dB) referenced to 1 microPascal (re 1 µPa) root mean square (rms), or (180 dB re l µPa rms. The SPL threshold for injury for pinnipeds is 190 dB re l µPa rms.

The MMPA defines Level B harassment as any act of pursuit, torment or annoyance that has the potential to disturb a marine mamma1 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 Level B harassment as exposure to 160 dB re 1 µPa rms from an impulsive noise source averaged over the duration of the signal, and exposure to 120 dB re 1 µPa rms from a continuous noise source or an intermittent non-pulsed source.

These current “interim” criteria (NOAA, 2005) are currently under review and revision as proposed “draft” criteria (NOAA, 2016). These draft acoustic exposure criteria are based on the best available science and account for species’ frequency sensitivities; however, the thresholds determined in the draft criteria are not currently being applied to regulatory authorizations. The zone of impact (ZOI) for species using the 2016 draft criteria would be smaller for the project that the ZOI calculated using the current interim criteria. However, due to the lack of regulatory action for the 2016 draft criteria, this IHA application is based on the currently applied, interim, noise criteria. It is acknowledged, however, that NOAA Fisheries (2015) has explicitly stated that the current, interim criteria have the disadvantage of not accounting for important attributes of exposure such as duration, sound frequency, or rate of repetition. Therefore, should the newly proposed criteria take effect before the end of the Applicant’s IHA term, there would be no additional Level A or Level B exposures from unplanned unscheduled maintenances or decommissioning of the Neptune DWP. In fact, there would be a significant reduction in predicted exposures if the draft criteria are applied. The corresponding Level A and Level B criteria for the interim and proposed draft regulatory levels are summarized in **Table 1-3**.

Table 1-3. Summary of interim (2005) and draft (2016) regulatory levels for Level A and Level B acoustic exposure.

Functional Hearing Group	Level B Harassment				Level A Harassment		
	Impulsive Sources		Non-Impulsive Sources		Interim Criteria	Draft Criteria	
	Interim Criteria[1]	Draft Criteria[2]	Interim Criteria[1]	Draft Criteria[2] (frequency weighted)	All Sources[1]	Impulsive Sources[2]	Non-Impulsive Sources[2] (frequency weighted)
Low-frequency cetaceans	160	224_{peak} 177 SEL_{cum}	120	187 SEL_{cum}	180	230_{peak} 192 SEL_{cum}	230_{peak} 207 SEL_{cum}
Mid-frequency cetaceans	160	224_{peak} 172 SEL_{cum}	120	179 SEL_{cum}	180	230_{peak} 187 SEL_{cum}	230_{peak} 199 SEL_{cum}
High-frequency cetaceans	160	196_{peak} 139 SEL_{cum}	120	151 SEL_{cum}	180	202_{peak} 154 SEL_{cum}	202_{peak} 171 SEL_{cum}
Phocid Pinnipeds (Underwater)	160	224_{peak} 171 SEL_{cum}	120	181 SEL_{cum}	190	230_{peak} 186 SEL_{cum}	230_{peak} 201 SEL_{cum}
Otariid Pinnipeds (Underwater)	160	224_{peak} 188 SEL_{cum}	120	198 SEL_{cum}	190	230_{peak} 203 SEL_{cum}	230_{peak} 218 SEL_{cum}

[1] Levels given in dB re 1 µPa rms.
[2] Peak levels given in dB re 1 µPa and cumulative SEL given in dB re 1 $\mu Pa^2 \cdot s$.

1.4.2 Vessel Noise Assessment

Extensive acoustic modeling and *in situ* measurements were conducted as part of three previous Neptune DWP IHA/LOA applications. The 2011 Final Rule (76 FR 34157, June 13, 2011) included, or referred to, results from modeling performed to predict received levels of underwater sound that could result from the construction, operation and decommissioning of the Neptune DWP. In the 2005 noise assessment and modeling report, Laurinolli et al., 2005, the assessment concluded that the predicted received levels resulting from construction would be applicable to major unscheduled maintenances and decommissioning. The report went on to conclude that noise from decommissioning is expected to result primarily from the operation of the vessels required to perform the activities, producing and is expected to produce similar noise levels to construction; therefore, decommissioning was not, specifically modeled.

The following discussion summarizes the previous modeling findings from the construction and operational vessels in order to provide context to the vessels being used in the proposed activity. The noise fields utilized to assess construction (pipelaying) scenarios used a surrogate, multi-vessel activity scenario which included the *Castoro II* lay barge, two tugs, one DP survey vessel working on the flowline between the North and South buoys, and SRVs to access the DWP (Laurinolli et al., 2005). The use of DP vessels similar to a DSV was not included in this model. In the 2011 Final Rule (76 FR 34157, June 13, 2011), NOAA Fisheries acknowledged that the radius for the repair and maintenance incorrectly assumed that those activities would be comparable to construction. Therefore, the radius and associated ZOI are likely overestimated for repair and maintenance activities. A supplementary modeling report (Gaboury and Carr, 2009), was conducted for further analysis of SRVs operating at the DWP. The results of these modeling efforts showed the 120 dB re 1 uPa radii as follows:

- Maintenance and repair (as modeled for construction) extended to 7.05 km (156.1 km^2 area);
- SRVs using DP thrusters for docking extended to 3.75 km (44.18 km^2 area);
- SRVs positioning at the Port buoy which considered four thrusters operating at 100% load; extended to 3.65 km (50.8 km^2 area); and
- SRVs maintaining position which considered two stern thrusters operating at 100% load extended to 2.48 km (23.3 km^2 area).

In the revised Neptune DWP IHA Application submitted in 2010 (E&E, 2010), Appendix C.2 provided underwater noise measurements for an HN1688 LNG Shuttle and Regasification Vessel (SRV) (Samsung, 2009). The SRV was 280 m in length and equipped with two 2,000-kW bow thrusters and two, 1,200-kW stern thrusters. During these measurements, the SRV operated with both stern thrusters at 100% load. The broadband SPL measurements at 1,000, 2,000, and 3,000m from the source were 135.7, 131.2, and 128.6 dB re 1uPa, respectively.

Additionally, noise modeling was conducted for port operations at the Northeast Gateway (NEG) deepwater port located adjacent to the Neptune DWP. The NEG port was issued an LOA in 2015 (81 FR 744, January 7, 2016) for port operations, maintenance, and repairs. Included in the LOA application were was sound pressure level (SPL) assessments of Energy Bridge Regasification Vessels (EBRVs) using thrusters. The EBRVs were modeled and measured to calculate the maximum 160 dB and 120 dB contours for a potential unscheduled maintenance activity using a DP vessel. The results showed that SPLs fall below 160 dB re 1uPa at less than 5m from the source and below 120 dB re 1 uPa at 3,500 m from the source.

Comparatively, the class of DSV that will be used in the proposed activity of the Neptune DWP were not previously modeled for construction or operations. The construction vessels modeled for construction and DP vessels for operations, in general, were larger, and employed greater thruster horsepower (hp) than the anticipated DSV used for the proposed activity. The DSV potentially selected for the Neptune DWP decommissioning activities is described in **Table 1-2**. A 50% load level is anticipated for the DSV conducting all proposed activities. For DSV modeling of the proposed activities, a proxy DSV with similar specifications, and whose sound profile has been documented (MacGillivray, 2006), was used to determine acoustic threshold isopleths (**Table 1-4**).

Table 1-4. Source specifications for a proxy DSV, HLV, and tug; including Propulsion Power, Length, Draft, Source Location, and broadband source levels (SL).

Noise Source	Source Description2	Activity	Proxy Source	Modeled Broadband SL (dB re 1 µPa·m)
Dive Support Vessel	Propulsion Power = 7,400 bhp Thruster Power = 5,032 bhp Length = 107.2 m Draft = 6.6 m	Dynamic Positioning	*Fu Lai*	177.9
Heavy Lift Vessel	Propulsion Power = 11,586 bhp Thruster Power = 6,169 bhp Length = 144.2 m Draft = 7.5 m	Holding Position	*Fu Lai*	177.9
Marshalling Tug	Propulsion Power = 2,640 bhp Length = 31.6 m, Draft = 4.1 m	Holding Position	*Fu Lai*	174.9

Source: MacGillivray, 2006.
bhp = brakes per horsepower.

Verification modeling of these proxy sources was conducted to confirm the noise isopleths around the areas of activity specifically identified in the proposed activity (South Buoy and Transition Manifold) were consistent with previous modeling and therefore were acceptable for determining the threshold contours.

Methodology

Acoustic propagation modeling for the proposed activity was completed using a version of the Range Dependent Acoustic Model (RAM). This model considers range and depth along with seasonal sound velocity and geoacoustic properties of the seafloor. This model is based on the U.S. Navy's Standard Split-Step Fourier Parabolic Equation. Sound propagation is calculated using radial planes radiating as an outgoing wave equation centered at the sound source. Eight evenly spaced radials were computed along cardinal compass points; and depth and range dependent transmission loss was calculated independently. The spatial sampling of the acoustic environment along model traverses used a 50 m range step. Frequency dependence of the sound propagation characteristics was treated by computing acoustic transmission loss at the center frequencies of all 1/3 octave bands between 10 Hz and 2 kHz. Received sound pressure levels in each band was computed by applying frequency-dependent transmission losses to the corresponding 1/3 octave band source levels. The highest 1/3 octave band level at each interval was used as the received level at that range. The resultant received levels were compared to the 160 to 100 dB re 1 µPa thresholds at 10-dB increments. In order to extrapolate ZOI spatial extent, the range to each threshold was also analyzed to determine the 95th percentile radius for each noise threshold level. Given a regularly gridded spatial distribution of modeled received levels, the 95th percentile radius was defined as the radius of a circle that encompasses 95% of the grid points whose value was equal to or greater than the threshold value. This definition is meaningful in terms of impact because, regardless of the geometrical shape of the noise footprint for a given threshold level, it always provides a range beyond which no more than 5% of a uniformly distributed population would be exposed to sound at or above that level. Note that for scenarios involving spreads of vessels, the center of this circle was taken to be the geometric center of the vessel positions.

Acoustic Environment

<u>Sound Speed Profile</u>

Sound speed data used for this modeling were obtained from the Generalized Digital Environmental Model Variable Resolution (GDEM-V) database published by the U.S. Naval Oceanographic Office (NOO; 2003), which contains globally gridded ocean temperature and salinity data for each month of the year. The database has specialized extraction routines that use this information to compute sound speeds to various depths for the user-specified month and geographic location. For this study, sound speeds were computed using GDEM - V for the month of July at a location within the Massachusetts Bay (at 42°28’09” North Latitude; and 70°36’22” West Longitude); and sound speed profile data are summarized in **Table 1-5**, below.

Table 1-5. Sound speed ($m \cdot s^{-1}$) profiles used as model input (From: Naval Oceanographic Office, 2003).

Season	Depth					
	1 m	50 m	100 m	150 m	200 m	250 m
Spring	1,479.7	1,468.6	1,469.9	1,473.7	1,478.7	1,480.4
Summer	1,509.6	1,479.0	1,473.8	1,476.3	1,479.9	1,481.2
Fall	1,494.6	1,485.8	1,477.3	1,477.6	1,479.9	1,484.0

Geoacoustics

Underwater sound propagation is strongly influenced by the geoacoustic parameters of the seabed, which include the density, seismic P-wave and S-wave speeds, and the seismic wave-attenuation of seabed materials. Each of these parameters is taken into account when calculating propagation loss; geoacoustic profile data are and is summarized in **Table 1-6**, below.

Table 1-6. Geoacoustic profile data.

Depth[a]	Description	Density ($g \cdot cm^{-3}$)	P-wave		S-wave	
			Velocity ($m \cdot s^{-1}$)	Attenuation ($dB \cdot \lambda^{-1}$)	Velocity ($m \cdot s^{-1}$)	Attenuation ($dB \cdot \lambda^{-1}$)
0 to 35	Sand, silt, clay[b]	1.596	1,579	0.17	310	5.4
>35	Sedimentary rock[b]	2.4	3,500	0.17	310	5.4

[a] Meters below seafloor (MBSF).
[b] Laurinolli et al., 2005.

Source Characterization

Source level measurements were unavailable for the vessels which may be used during unscheduled maintenance and decommissioning. Therefore, a literature review was conducted in order to identify source level measurements from similar equipment performing similar operations. Source levels for these proxy vessels were used as model input parameters. **Table 1-7** and **Figure 1-10** provide modeled 1/3 octave band source levels for the proxy vessels employed in the model scenarios.

Table 1-7. 1/3 octave frequency spectrum source levels for the proxy dive support vessel (DSV) operating in dynamic positioning (DP).

Broadband Level: 177.9 dB	
Frequency (Hz)	Band Level (dB re 1µPa @ 1m)
10.0	157.9
12.5	155.0
16.0	150.8
20.0	147.2
25.0	149.2
31.5	152.8
40.0	161.0
50.0	155.2
63.0	158.3
80.0	159.1
100.0	158.6
125.0	164.2
160.0	163.6
200.0	163.8
250.0	166.2
315.0	167.4
400.0	167.9
500.0	168.3
630.0	168.1
800.0	167.7
1000.0	164.3
1250.0	160.8
1600.0	160.1
2000.0	162.4

Proxy source levels presented in this table are based on measurements of the DSV *Fu Lai* (MacGillivray, 2006) operating on DP.

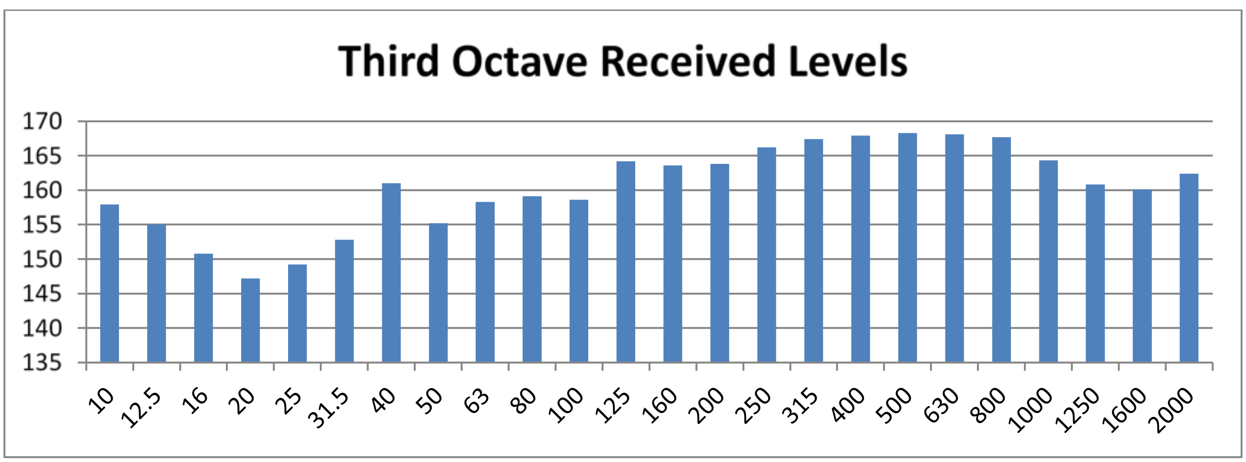

Figure 1-10. Distribution of 1/3 octave band source levels for the proxy DSV.

Model Results

The model results provide an estimated range to specific received sound levels radiating out from the source. Modeling provides information regarding how the sound sources of the vessels will propagate in the given environment and thereby provides the calculated distances where an animal could encounter threshold SPLs. Sound propagates differently depending on multiple environmental factors (e.g., depth, sediment type, temperature) and different frequencies will propagate to variable ranges; therefore the actual SPL isopleths will vary within the environment. The 95% SPL radius was used as the ensonified area in which a marine mammal anywhere in the water column could potentially be exposed to specified SPLs. Radii to threshold values of 110 to 160 dB re 1 µPa are shown in **Table 1-8** below for the DSV and support tug operating at the South Buoy and the Transition Manifold locations. **Table 1-8** lists the radius, based on the 95th percentile predicted levels averaged over all receiver depths.

Table 1-8. Modeled 95th percentile radii for vessel scenarios working at the South Buoy and Transition Manifold.

Location	95th Percentile Radius (km)					
	160 dB re 1 µPa	150 dB re 1 µPa	140 dB re 1 µPa	130 dB re 1 µPa	120 dB re 1 µPa	110 dB re 1 µPa
DSV and tug scenario						
South Buoy	<0.01	<0.02	0.07	0.33	3.45	15.47
Transition Manifold	<0.01	<0.01	0.05	0.28	3.12	14.63

DSV = dive support vessel.

The received sound field based on the 95th percentile radii for the DSV operating at the south buoy and transition manifold are shown in **Figure 1-11** and **Figure 1-12**, below.

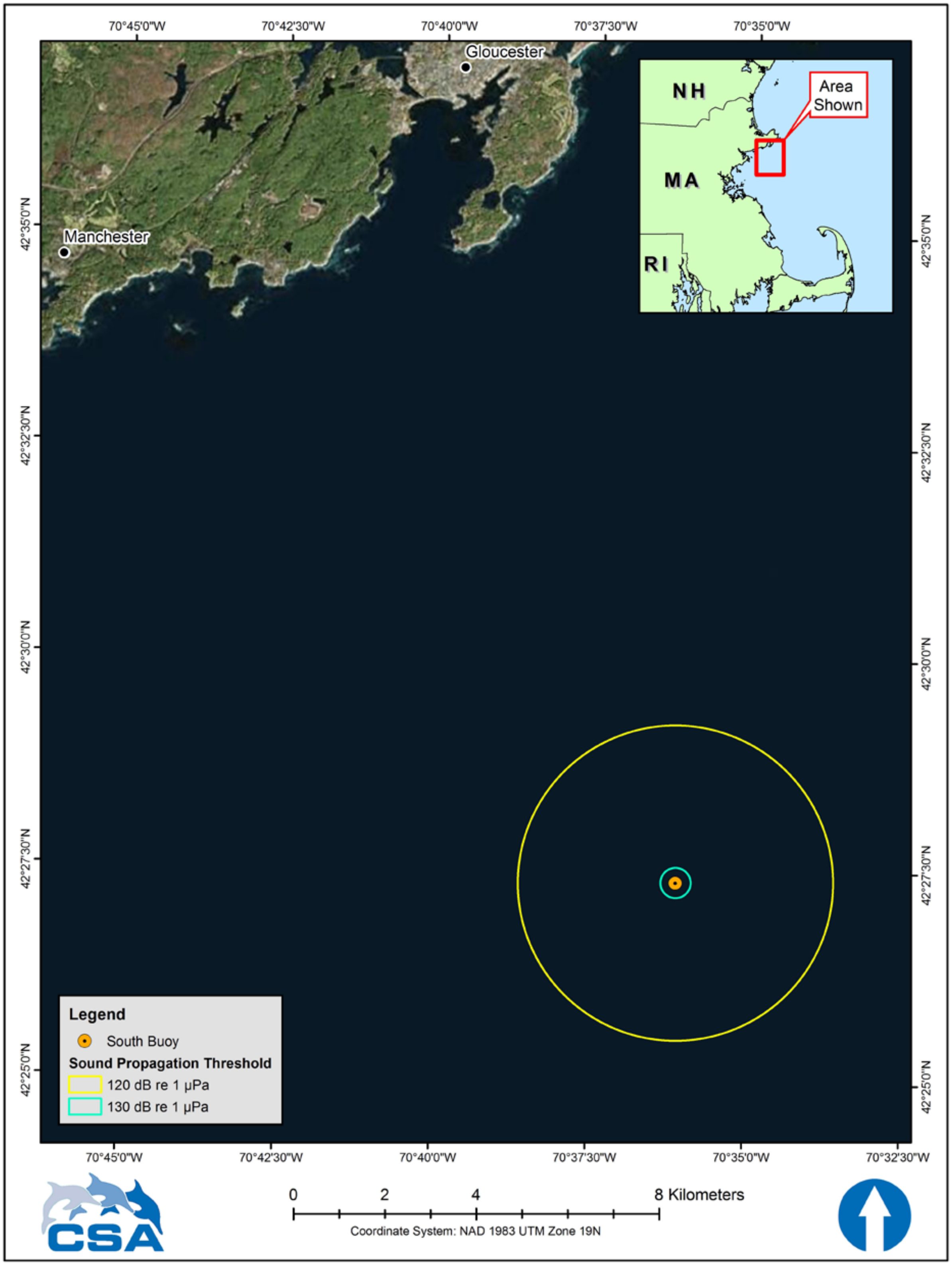

Figure 1-11. 95th percentile 120 dB and 130 dB radii at the South STL Buoy. The 130dB isopleth is provided for reference purposes only and does not represent any impact threshold..

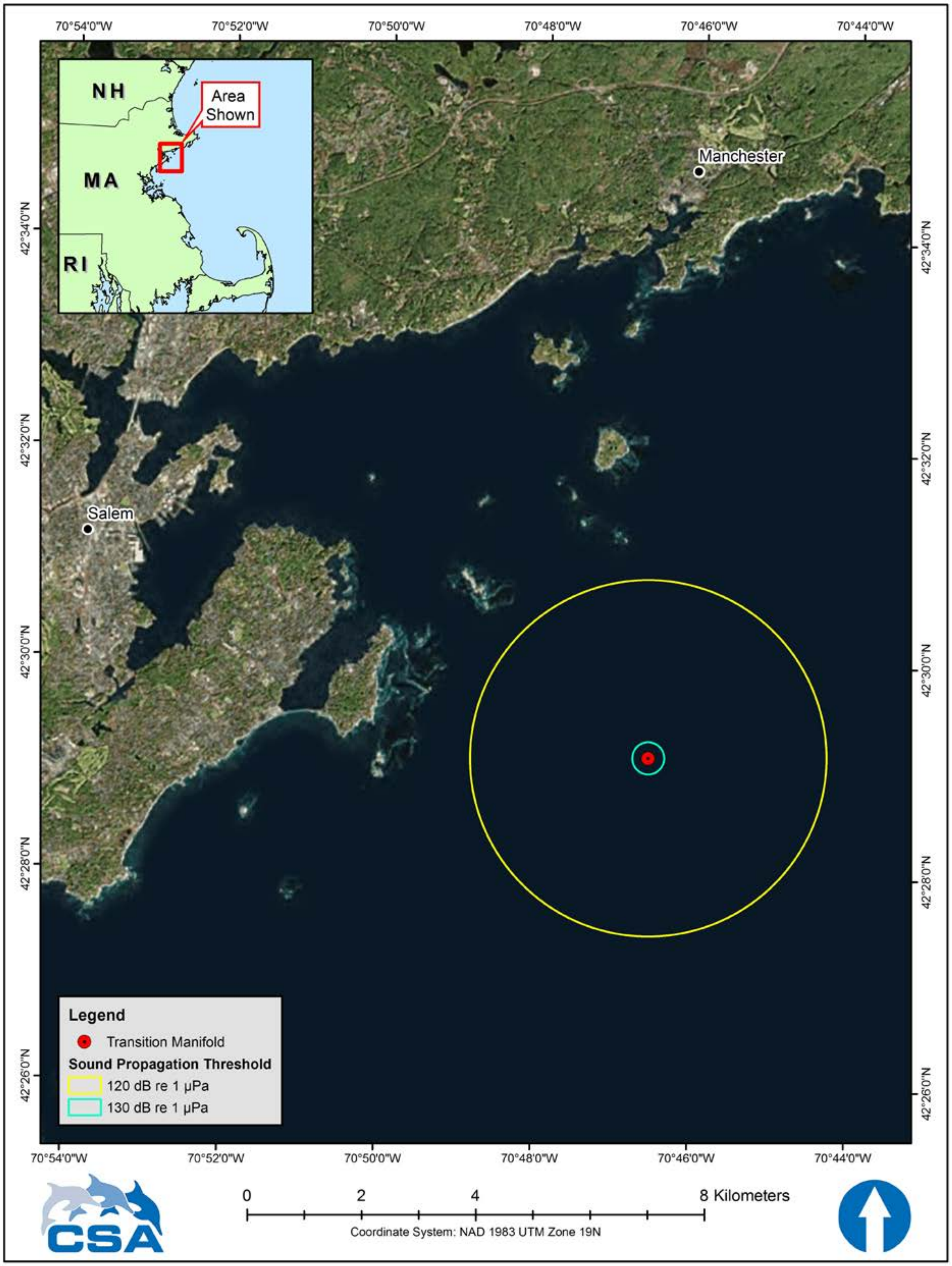

Figure 1-12. 95th percentile 120 dB and 130 dB radii at the Transition Manifold. The 130dB isopleth is provided for reference purposes only and does not represent any impact threshold

As shown in **Figure 1-13** below, the modeled propagation of radiated sound generally follows the contours of the seafloor with some shadowing around prominent structures. The reflection of the sound off the sea surface also causes alternating areas of higher and lower received levels due to combining and separating of individual sound paths. In the far field, the effects of surface reflection become less prominent due to increasing water depth and attenuation caused by a greater difference in surface and deep water temperatures.

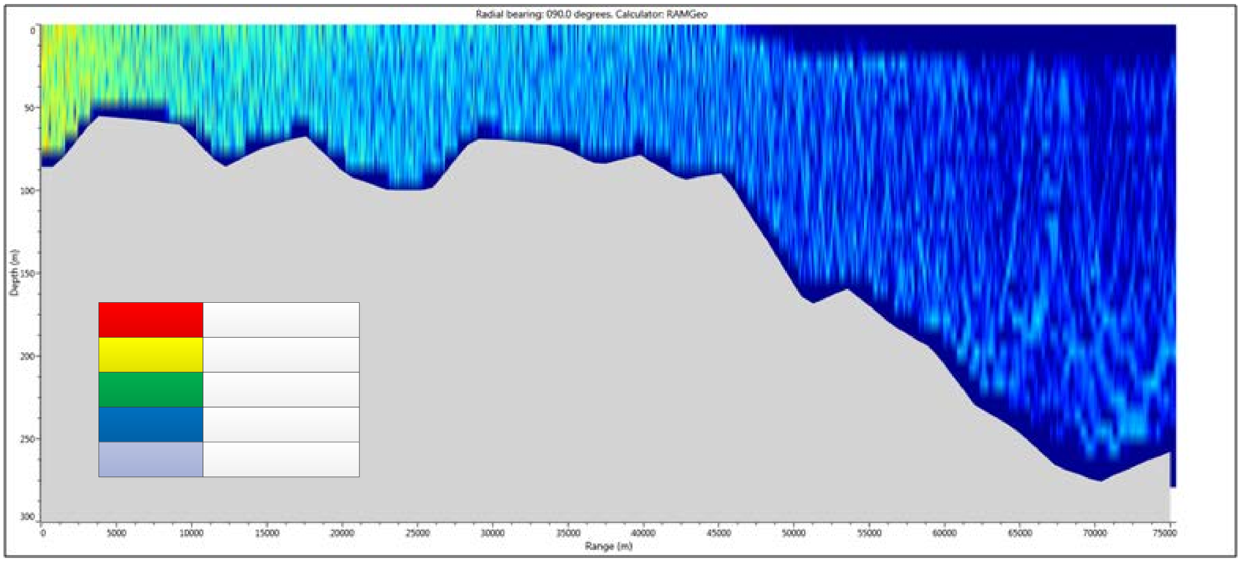

Figure 1-13. Modeled sound propagation at 90° radius.

This section addresses the NOAA Fisheries IHA requirement to identify the dates and duration of such activity and the specific geographic region where it will occur.

2.1 SPECIFIC GEOGRAPHIC REGION

The Neptune DWP is located in the federal waters of the Outer Continental Shelf (OCS) within blocks NK 19-04 6525 and NK 19-04 6575, approximately 22 miles (35.4 km) northeast of Boston, Massachusetts, in water depths ranging from 125 to 250 ft (**Figure 2-1**). The Neptune DWP consists of two mooring and unloading buoys and a pipeline that receives natural gas from "shuttle and regasification vessels" (SRVs). The natural gas is transferred from the SRV through the unloading buoy then through a flexible riser that connects to a 24-inch subsea flowline and ultimately into a 24-inch gas transmission line. The 24-inch gas transmission line connects the DWP pipeline system to the existing 30-inch Algonquin HubLine gas pipeline. A portion of the pipeline and the connection to the Algonquin HubLine are located within the jurisdiction of the Commonwealth of Massachusetts. All decommissioning and potential unscheduled maintenance work will take place at the North and South buoys and at the Hot Tap in succession with limited transit between locations. The geographic coordinates of the STL buoys are listed in **Table 2-1** and the geographic coordinates of each suction pile are listed in **Table 2-2**.

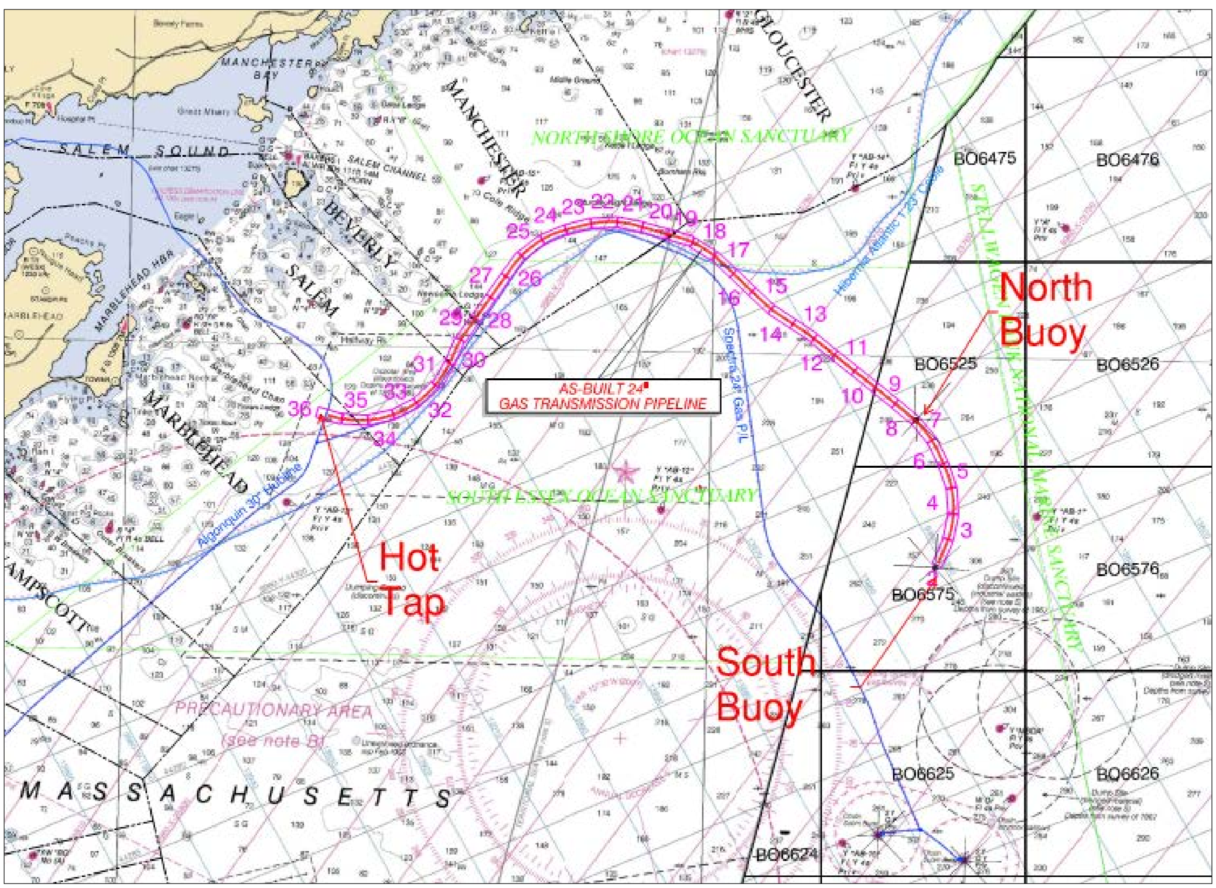

Figure 2-1. Mapped locations of the Neptune DWP facilities with the locations of the buoys and hot tap noted.

Table 2-1. Geographic location of the Neptune DWP north and south buoys.

	Latitude:	Longitude:
North Buoy	N 42˚29’12.61”	W 70˚36’29.77”
South Buoy	N 42˚27’20.70”	W 70˚36’07.28”

Table 2-2. Geographic location of the Neptune DWP suction piles.

Pile No	Position (US)	
	E (ft)	N (ft)
N1	1206666.98	15439222
N2	1209438.72	15439501
N3	1209405.85	15436713
N4	1208735.54	15434845
N5	1206862.25	15434697
N6	1205669.5	15435390
N7	1205138.6	15436531
N8	1205343.98	15437951
S1	1208432.49	15427870
S2	1210231.6	15426980
S3	1210868.51	15425063
S4	1210012.47	15423210
S5	1208103.78	15423116
S6	1207005.13	15424169
S7	1205070.19	15425472
S8	1206198.28	15427603

2.2 CONSTRUCTION DATES AND DURATION

Preliminary Schedule

Decommissioning of the DWP will begin no earlier than 1 May 2017. Due to the expiration on the current maintenance LOA, there remains the possibility that unscheduled maintenance and repair activities could occur between 12 July 2016 and 30 November 2016; however no activities are planned. The schedule listed in **Table 2-3** is for decommissioning of the DWP.

Table 2-3. Sequence and duration of decommissioning activities.

Activity in Order of Occurrence	Subtasks for Completion	Total Duration
Hot Tap Tie In		5 Days
	Mobilize DSV on location.	
	Divers close hot tap valve and isolate tie-in spool.	
	Spool is depressurized.	
	Divers disconnect spools and check valve, assembly brought to surface.	
	Divers will install a blind flange on the Hot Tap spool and remove brace clamps from Hubline Pipeline.	
	Divers will install sand bags over the Hot Tap Valve and cover the area with concrete mats.	
Pipeline Decommissioning		1 week.
	Barge will set up at South PLEM location.	
	DSV will set up at Transition Manifold Location.	
	Install temporary pig launcher, with preloaded poly pigs, on Transition Manifold.	
	DSV relocates to South PLEM.	
	Install temporary pig receiver on South PLEM.	
	Set up flare on barge and connect high pressure hose between flare and pig receiver.	
	Perform pipeline depressurization, flaring gas.	
	Once pipeline has been depressurized, pipeline flooding will commence. DSV will transition to Transition Manifold location.	
	A pig will be launched from the Transition Maniflold and propelled with untreated, filtered seawater.	
	Flooding of the pipeline is completed once the pig is received at the South PLEM.	
	The temporary pig receiver and pig will be removed and recovered from the South PLEM.	
	The temporary pig launcher will be removed and recovered from the Hot Tap Transition Manifold.	
Risers and Umbilicals		1 week.
	DSV is positioned at South Buoy	
	A clump weight will be installed on the Riser near the PLEM cut point.	
	Hydraulic shears or an ROV cutting tool is deployed to cut the Riser near the bottom of the buoy and near the PLEM.	
	The cut Riser and disconnected umbilical will be recovered to the vessel.	
	The vessel will transition to the North Buoy and repeat the steps.	
STL Buoy Removal		4 days (2 days each buoy)
	A hold back weight will be deployed and rigged to the STL Buoy to stabilize the buoy prior to cutting of mooring lines.	
	The vessel crane or a tow line will be attached to the STL Buoy.	
	Hydraulic shears or an ROV cutting tool will be deployed to cut each of the eight mooring lines near the STL Buoy.	
	The STL Buoy will either be recovered to the vessel or towed to a dockside facility.	
	The vessel will transition to the North Buoy and repeat the steps.	

Table 2-3. (Continued).

Activity in Order of Occurrence	Subtasks for Completion	Total Duration
Suction Piles		32 days.
	The DSV will position at one of the suction pile locations	
	Trawl protectors will be transported to the field to rendezvous with the DSV.	
	The trawl protectors will be lowered to the seafloor and placed over each respective suction pile	
	Divers will secure the trawl protectors to the seabed using gravity based screw anchors or similar method.	
	The DSV will transition to the North Buoy and repeat steps.	
Mooring lines – anchor chain – wire rope		16 days
	The DSV will mobilize to one of the suction pile locations.	
	Divers or an ROV will cut the anchor chain as close to the suction pile as practical.	
	The DSV will attach to the end of the chain and recover the chain and wire rope to the vessel.	
	The vessel will repeat the anchor chain and wire recovery for all remaining suction piles.	
North and South PLEMS/Tie-in Spools		2 days each
	The DSV will mobilize to the South PLEM location.	
	Divers will disconnect spools 1 and 2 and recover spools to the surface	
	Divers will plug the end of the 24-inch pipeline and cover with mats.	
	Divers or the ROV will attach rigging to the South PLEM and the vessel will recover the PLEM.	
	The DSV will mobilize to the North PLEM location.	
	Divers will unbolt the North Tie-in spool and recover spool to the vessel.	
	Divers will plug the “Tee” end of the 24-inch pipeline and cover with mats.	
	Divers or the ROV will attach rigging to the North PLEM and the vessel will recover the PLEM.	
Decommissioning Transition Manifold		2 days
	The DSV will mobilize to the Transition Manifold location.	
	Divers to remove and recover access doors/panels on the protective cover.	
	Divers will unbolt 24-inch Tie-in spools and recover spools.	
	Divers will plug the end of the 24-inch pipeline and cover with mats.	
	Divers or the ROV will attach rigging to the protective cover and the vessel will recover the cover.	
	Divers or the ROV will attach rigging to the Transition Manifold and recover the manifold.	
Recovery of Seafloor Position Transponders		1 day
As-left Survey		3 days
Final Documentation		90 days

3.0 Species and Numbers of Marine Mammals

There 20 species of marine mammal that potentially occur within the waters of the DWP (**Table 3-1**). Of these 20, 15 marine mammal species, consisting of cetaceans and pinnipeds, are known to reside, traverse, or occasionally visit Massachusetts Bay and Stellwagen Bank NMS; therefore, they may be affected by operations. This information is based on NOAA stock assessment reports (SARs) (Waring et al., 2015), Stellwagen Bank Final Management Plan (NOAA, 2010), and regional survey records (Cetacean and Turtle Assessment Program [CETAP] 1982, Atlantic Marine Assessment Program for Protected Species [AMAPPS] 2010-2014, North Atlantic Right Whale Sighting Survey [NARWSS], 2003-2013). All marine mammal species within U.S. waters are protected under the Marine Mammal Protection Act (MMPA) of 1972.

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

The MMPA prohibits, with certain exceptions, the "take" of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the U.S. *Take* is defined under the MMPA as "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal" (16 U.S.C. 1362). Some marine mammal species or specific stocks (defined as a group of nonspecific individuals that are managed separately (Waring et al., 2015) may be designated as *strategic* under the MMPA, which requires the jurisdictional agency (NMFS or FWS) to impose additional protection measures. A stock is considered strategic if:

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

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

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

The marine mammals with distributions or records that include the general activity region include species that are also protected under the Endangered Species Act and those that have been identified as a strategic stock under the MMPA. Six marine mammal species that occur in the western North Atlantic Ocean are federally listed as endangered under the ESA (Waring et al., 2015). These include five mysticete (i.e., baleen) whales (North Atlantic right whale, blue whale, fin whale, sei whale, and humpback whale), one odontocete (i.e., toothed) whale (sperm whale) (Waring et al., 2015); (**Table 3-1**). The remaining eight non-listed species include one mysticete whale, nine odontocetes (eight dolphins and one porpoise), and four pinnipeds (seals). The expected occurrence of each species is based on the following criteria and/or on the habitat models (e.g. Best et al., 2012, Roberts et al,) for the specific project area and for species available in the model analyses:

- Common – Occurring consistently in moderate to large numbers
- Fairly Common – Occurring in low to moderate numbers on a regular basis or seasonally
- Uncommon – Occurring in low numbers or on an irregular basis
- Rare – Records for some years but limited
- Not expected – Not recorded in the area but records exist for adjacent waters

Table 3-1. Species potentially occurring within the proposed activity area.

Species	MMPA Stock[1]	ESA/Stock status[2]	Best Population[3]	Occurrence in Activity Area[4]	Seasonal Occurrence in Activity Area[4]
ORDER CETACEA					
Suborder Mysticeti (Baleen whales)					
Family Balaenidae					
Eubalaena glacialis (North Atlantic right whale)	Western Atlantic	E	476	Uncommon	Jan-Jul (year round)
Family Balaenopteridea					
Balaenoptera musculus (Blue whale)	Western North Atlantic	E	440[5]	Rare	Apr-Oct
Balaenoptera physalus (Fin whale)	Western North Atlantic	E	1,618	Fairly Common	Apr-Oct
Megaptera novaeangliae (Humpback whale)	Gulf of Maine	E	823	Common	Apr-Oct
Balaenoptera acutorostrata (Minke whale)	Canadian East Coast	NS	20,741	Uncommon	Apr-Oct
Balaenoptera borealis (Sei whale)	Nova Scotia Stock	E	357	Rare	May-Jun
Suborder Odontoceti (Toothed whales and dolphins)					
Family Physeteridae					
Physeter macrocephalus (Sperm whale)	North Atlantic	E	2,288	Not Expected	Pelagic
Family Phocoenidae					
Phocoena phocoena (Harbor porpoise)	Gulf of Maine / Bay of Fundy	NS	79,833	Uncommon	Year round
Family Delphinidae					
Tursiops truncatus (Bottlenose dolphin)	Western North Offshore Atlantic	NS	77,532	Rare	Summer-Fall
Orcinus orca (Killer whale)	Western North Atlantic	NS	Unk[6]	Rare	Jul-Sep

Table 3.1 (Continued).

Species	MMPA Stock[1]	ESA/Stock status[2]	Best Population[3]	Occurrence in Activity Area[4]	Seasonal Occurrence in Activity Area[4]
Globicephala melas (Long-finned pilot whale)	Western North Atlantic	NS	5,636	Rare	Year round
Grampus griseus (Risso's dolphin)	Western North Atlantic	NS	18,250	Rare	Spring-Summer-Fall
Stenella coeruleoalba (Striped dolphin)	Western North Atlantic	NS	54,807	Not expected	Year round
*Lagenorhynchus acutus (*Atlantic white-sided dolphin)	Western North Atlantic	NS	48,819	Uncommon	Year round
Lagenorhynchus albirostris (Atl white-beaked dolphin)	Western North Atlantic	NS	2,003	Not expected	--
Delphinus delphis (Short beaked common dolphin)	Western North Atlantic	NS	173.486	Uncommon	Fall-Winter
ORDER Pinnipedia					
Family Phocidae					
Halichoerus grypus (Grey seal)	Western North Atlantic	NS	Unk[6]	Uncommon	Winter-Spring
Phoca vitulina (Harbor seal)	Western North Atlantic	NS	75,834	Fairly Common	Sept-May
Cystophora cristata (Hooded seal)	Western North Atlantic	NS	Unk[6]	Not expected	Jan-May
Phoca groenlandica (Harp Seal)	Western North Atlantic	NS	Unk[6]	Not expected	Jan-May

1 MMPA = Marine Mammal Protection Act; Stock = defined as a group of nonspecific individuals that are managed separately.
2 E = ESA listed as endangered; NS = MMPA listed as "non-strategic" stock.
3 Best population estimate "NBest" from Table 1 of the Waring et al. (2015) or individual stock assessment reports
4 Occurrence and Season(s) in Proposed Survey Area from NMFS Stock Assessment Reports (Waring et al., 2015), Duke Habitat Model (Best et al., 2012) and Stellwagen Bank Management Plan (DOC 2010)
5 Best abundance estimates are not available for the U.S populations of this species, Minimum estimates from Waring et al 2015 were used.
6 Abundance estimates are not available for U.S. populations of this species.

Of the 20 species listed in **Table 3-1,** five of those species can be considered primarily outside the geographic range of the proposed activity area; and are not expected to be affected at any level by the proposed activities. These extralimital species include: striped dolphin, Atlantic white-beaked dolphin, sperm whale, hooded seal, and harp seal. The bottlenose dolphin and killer whale are also highly unlikely to occur within the proposed activity area; however, given their wide distribution and transient behavior, they remain in the group of species potentially affected by proposed activities. Neptune LNG; therefore, requests an IHA for Level B disturbance for the 14 species listed below and described in the following sections.

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

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

- Low-frequency cetaceans: 7 Hz and 25 kHz;
- Mid-frequency cetaceans: 150 Hz and 160 kHz;
- High-frequency cetaceans: 200 Hz and 180 kHz; and,
- Phocid pinnipeds (true seals): 75 Hz to 100 kHz.

4.1 BALEEN WHALES (MYSTICETI)

4.1.1 North Atlantic right whale (*Eubalaena glacialis*)

The North Atlantic right whale is the only member of the mysticete family Balaenidae found in North Atlantic waters. It is medium in size when compared to other mysticete species, with adult sizes ranging from 14 to 17 m (46 to 56 ft) (NMFS – OPR, 2015).

North Atlantic right whales inhabit the waters off Massachusetts throughout the year, but their presence is highest in the Massachusetts Bay area during the winter/spring months. The right whales that occur in this region are part of the Western Atlantic stock. The North Atlantic right whale is listed as endangered and is considered one of the most endangered large whale species in the world. (Jefferson et al., 2011). The most recent SAR estimates a population size of only 455 individuals (Waring et al., 2015) which has recovered only slightly from the estimated 100 individuals in the 1930s just prior to the species being afforded protection (Reeves, 2001).

Right whales are skim feeders relying primarily on zooplankton, including copepods, euphausiids, and cyprids. There are seven areas identified where North Atlantic right whales congregate seasonally (Waring et al., 2015), such as:

- The coastal waters of the southeastern United States;
- The Great South Channel;
- Jordan Basin;
- Georges Basin along the northeastern edge of Georges Bank;
- Cape Cod and Massachusetts Bays;
- Bay of Fundy; and
- Roseway Basin on the Scotian Shelf.

Several of these congregation areas correlate with seasonal copepod concentrations (Pendleton et al., 2009). New England waters are a primary feeding habitat for the North Atlantic right whale during late winter through spring with feeding moving into deeper and more northerly waters during summer and fall. Less is known regarding winter distributions, however it is understood that; calving takes place during this time in coastal waters of the southeastern United States. Recent passive acoustic studies have detected right whale calls in Massachusetts Bay and the Gulf of Maine throughout the year, indicating a more persistent presence of right whales within the region throughout much of the year than once thought (Clark et al., 2010; Morano et al., 2012; Mussoline et al., 2012). NOAA Fisheries' final rule (76 FR 76 FR 34157, June 13, 2011) provides the information in **Table 4-1** regarding right whale calls detected on autonomous recorders near the Neptune DWP.

Table 4-1. Summary of North Atlantic right whale call data collected on autonomous recording buoys (ABs) from a recording array deployed near the Neptune Deepwater Port from January to September 2010.

AB Detection Records	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Number of ABs with a detection	8	10	10	10	10	5	8	8	8
Total number of detections for all ABs	328	573	3,874	2,786	1,538	34	64	112	189
Highest number of detections on a single day	58	103	1,059	255	186	8	26	35	43
Number of days with no recorded detections	5	2	0	0	1	14	16	9	11

The major threat to the stock is human-caused mortality through incidental fishery entanglement that averaged 3.65 incidents per year (2008-2012) and ship strikes that averaged 0.9 incident records per year; based on data from 2008 through 2012. The SAR for North Atlantic right whales sets the Potential Biological Removal (PBR) level at 0.9; therefore, any mortality or serious injury for this stock can be considered significant. The Western North Atlantic stock is considered strategic by NOAA because the average annual human-related mortality and serious injury exceeds PBR, and because the North Atlantic right whale is an endangered species.

Seasonal Management Areas (SMAs) for reducing ship strikes of the North Atlantic right whale have also been designated in the U.S. and Canada. All vessels greater than 19.8 m (65 ft) in overall length must operate at speeds of 10 knots (kn) or less within these areas during specified time periods. In 2009, NMFS received a petition to expand the critical habitat, and the agency is continuing its ongoing rulemaking process. In January 2016, two additional units comprising 29,763 nmi^2 of marine habitat were designated as critical habitat.

The North Atlantic right whale underwent a NOAA 5-year review in 2012, which resulted in no change to its listing status. There are six federal rulemakings associated with the North Atlantic right whale:

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

The Neptune DWP falls within the area of critical habitat designation for this species. Vessel noise resulting from the proposed activity has the potential to disturb right whales. Right whales are low-frequency cetaceans that vocalize using a number of distinctive call types, most of which have peak acoustic energy below 500 Hz. Some vocalizations will occasionally reach up to 4 kHz. One typical right whale vocalization is the “up call”; a short sweep that rises from roughly 50 Hz to 440 Hz over a period of 2 seconds. These up calls are characteristic of right whales and are used by research and monitoring programs for species presence. A characteristic “gunshot” call is believed to be produced by male right whales. These pulses can reach source levels of 174 to 192 dB_{rms} re 1 μPa with frequency range from 50 to 2,000 Hz (Parks, 2005; Parks and Tyack, 2005). Other tonal calls range from 20 to 1,000 Hz and have source levels between 137 and 162 dB_{rms} re 1 μPa. These low-frequency signals can be masked by human activities including vessel noise. Studies have shown that right whales increase their call amplitude with a rise in background noise, indicating that right whales may attempt to modify their vocalizations to compensate for increased noise within their acoustic environment (Parks et al., 2011). Rolland et al. (2012) correlated noise pollution to an increase in stress-related fecal hormone metabolites in North Atlantic right whales, suggesting that noise pollution may affect the recovery of the species.

4.1.2 Blue whale (*Balaenoptera musculus*)

The blue whale is the largest cetacean, although its size range overlaps with that of fin and sei whales. The species is currently divided into five subspecies (Committee on Taxonomy, 2015). The northern hemisphere subspecies (*B. m. musculus*) is known to occur within the proposed survey area. Most adults of this subspecies are 23 to 27 m (75 to 90 ft) in length (Jefferson et al., 2011, NMFS-OPR, 2015).

The blue whale is listed as an endangered species, species-wide and range-wide. Blue whales in the North Atlantic were exploited heavily up through the 1920s at which time catch rates began to decrease. A full assessment of present status has not been carried out; although available evidence suggests that they are increasing in numbers at least in the area of the central North Atlantic (Waring et al., 2015). They remain rare; however, in the northeastern Atlantic they were once common. At present, there are an estimated 1,000 individuals off Iceland and several hundred in the Gulf of St Lawrence (http://iwc.int/status). There are insufficient data to determine the status of the Western North Atlantic stock and population within the U.S. A minimum abundance estimate of 440 is provided in Waring et al 2015. This stock is listed under the MMPA as strategic and depleted under the MMPA, because the species is listed as endangered under the ESA (Waring et al., 2015). There is no designated critical habitat for this species within the proposed survey area. Blue whales are included in this discussion due to their range but due to exceptional low probability of occurrence, are not considered further in the take estimation.

The blue whale is considered by NMFS as an occasional visitor in U.S. Atlantic exclusive economic zone (EEZ) waters, which may represent the current southern limit of its feeding range (Waring et al., 2015). In the western North Atlantic Ocean, the blue whale's range extends from the Arctic to Cape Cod, Massachusetts, although it is frequently sighted off eastern Canada (e.g., Newfoundland) (Waring et al., 2015). Using U.S. Navy asset hydrophone arrays, Clark and Gagnon (2002) identified blue whales as far south as Bermuda (but rarely farther south). In general, the blue whale's range and seasonal distribution is governed by the availability of prey (NMFS OPR, 2015).

Blue whales produce some of the most powerful biological sounds in the ocean and at very low frequencies, often below the threshold of human hearing. Typical vocalizations include long pulses, buzzes, and rasps typically in the 15 to 40 Hz range (Richardson et al., 1995), often below the threshold of human hearing. Blue whale calls exhibit some geographic variations in separate populations (Stafford et al., 2001); although they are generally the same, there are distinct geographic variations that might help scientists distinguish separate populations.

4.1.3 Humpback whale (*Megaptera novaeangliae*)

The humpback whale is robust and medium-sized mysticete, and adults range from 15 to 18 m (50 to 60 ft) in length. Humpback whales are distinguished from all other cetaceans by their long flippers, which are approximately one-third the length of the body (Jefferson et al., 2008). One species of the humpback whale is currently recognized (Committee on Taxonomy, 2013).

Humpback whales occur in Massachusetts Bay from March through November, with peak abundance between April and October along the 100-m isopleth from the northwestern slope of Georges Bank, south to the Great South Channel, to Stellwagen Bank and Jeffreys Ledge. The humpbacks occurring within the activity area are part of the Gulf of Maine stock. The overall Atlantic population (including the Gulf of Maine stock) is estimated to be between 10,400 and 12,582, depending on the calculation methodology, with the Gulf of Maine stock estimated at 823 individuals (Waring et al., 2015). Humpback whales have a worldwide distribution and follow a migratory pattern of feeding in the high latitudes during summers and spending winters in the lower latitudes for calving and mating. The Gulf of Maine stock follows this pattern with winters spent in the Caribbean and West Indies; although acoustic recording show a small number of males persisting in Stellwagen Bank throughout the year (Vu et al., 2012). Humpback whales are listed as endangered throughout their range. The Gulf of Maine stock is a strategic stock because of the endangered status, and because the annual human-related mortality and serious injury exceeds the PBR (Waring et al., 2015). No critical habitat has been designated for the humpback whale.

A status review of the humpback whale was undertaken by NOAA in 2015 (Bettridge et al., 2015) to identify taxonomic units such as distinct population segments (DPS) and assess the extinction risk of these units. To be considered a DPS, a population, or group of populations, must be "discrete" from the remainder of the taxon to which it belongs; and "significant" to the taxon to which it belongs. Information on distribution, ecological situation, genetics, and other factors is used to evaluate a population's discreteness and significance. This review process resulting in the identification of a "West Indies" DPS which includes the Gulf of Maine stock. The West Indies DPS was considered not to be at risk of extinction.

Humpback whales are largely piscivorous while in New England waters, feeding primarily on herring, sand lance, and other small fishes as well as Euphausids in the Gulf of Maine (Waring et al., 2015, NMFS-OPR, 2015). Humpbacks show fidelity to feeding sites (Stevick et al., 2006); however, local distribution is driven by prey availability and bathymetry resulting in the whales transiting widely throughout their feeding habitat between spring and fall in search of prey. Humpback sightings were reported during mitigation observations conducted for both Neptune and NEG DWP activities reported humpbacks

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

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

4.1.4 Fin whale (*Balaenoptera physalus*)

Fin whales are a widely distributed species found in all oceans of the world and they are the most common large baleen whale species in the Gulf of Maine / Massachusetts Bay area. The fin whale is the second largest cetacean (NMFS-OPR, 2015). It is divided into three subspecies, including the northern fin whale (*B. p. physalus*), southern fin whale (*B. p. quoyi*), and pygmy fin whale (*B. p. patachonica*) (Committee on Taxonomy, 2013). The northern fin whale subspecies is found within the proposed survey area. Adult fin whales in the northern hemisphere may reach a length of approximately 24 m (80 ft). Fin whales accounted for 46% of the large whales sighted during aerial surveys along the continental shelf (CETAP 1982) between Cape Hatteras and Nova Scotia from 1978 to 1982. Fin whales are also the most observed cetacean species during whale-watching activities in the northeastern United States. The fin whales that occur with the proposed activity area are part of the Western North Atlantic stock of fin whales. This is considered a strategic stock because fin whales are listed as endangered throughout their range. In 2011, NOAA undertook a five5-year status review of the fin whale and determined that there should be no change in its listing status. There is no designated critical habitat for the fin whale (NMFS-OPR, 2015). The best population abundance estimate is 1,618 (minimum population estimate for this stock is 1,234) individuals (Waring et al., 2015).

Fin whales transit between summer feeding grounds in the high latitudes and the wintering, calving, or mating habitats in low latitudes or offshore; however, acoustic records indicate that fin whale populations may be less migratory than other mysticetes whose populations make distinct annual migrations (Watkins et al., 2000). Even though some whales overwinter near Cape Cod, their abundance near Stellwagen Bank peaks between April and October. New England waters represent a major feeding ground for fin whales and, like humpbacks, they show feeding site fidelity. Seipt et al. (1990) reported that 45% of fin whales sighted on the Massachusetts Bay area feeding grounds were re-sighted in multiple years. Fin whales typically feed on sea lance, capelin, krill, herring, copepods, and squid in deeper waters near the edge of the continental shelf (90 to 180 m), but will migrate towards coastal areas following prey distribution. Generally, fin whale habitat utilization patterns are very similar to those of humpack whales in New England waters with Cashes Ledge, Platts Bank, Stellwagen Bank, and Jefferys Ledge heavily utilized during the summer (DOC, 2010). Inter abundances are also expected to be high on Stellwagen Bank and Jefferys Ledge, based on acoustic records.

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

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

4.1.5 Sei whale (*Balaenoptera borealis*)

Sei whales are a widespread species throughout the world’s temperate, subpolar, subtropical, and tropical oceans. The sei whale is the third largest cetacean (following the blue and fin whales), with adult length ranging from 16 to 20 m (52 to 66 ft) (NMFS-OPR, 2015). It is very similar in appearance to fin and Bryde’s whales. Two subspecies of sei whales are currently recognized (Committee on Taxonomy, 2013). The northern sei whale (*B. b. borealis*) is known to occur within the proposed activity area. The sei whales occurring in the proposed activity area are part of the Nova Scotia stock (formerly the Western North Atlantic stock). Sei whales are most common in deeper waters along the continental shelf edge (Waring et al., 2015) but will forage occasionally in shallower, inshore waters. There is no designated critical habitat for this species.

Sei whales are most abundant in Northeastern US waters during spring, with sightings concentrated along the eastern and southwestern margins of Georges Bank in the area of Hydrographer Canyon (CETAP, 1982). The sei whale feeds primarily on euphausiids and copepods, but will also prey upon fish, and local abundance is largely driven by prey availability. The occurrence and abundance of sei whales on feeding grounds may shift dramatically from one year to the next.

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

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

4.1.6 Minke whale (*Balaenoptera acutorostrata*)

The minke whale is a small mysticete that is divided into two species: the common minke whale and the Antarctic minke whale. The common minke whale is further divided into three subspecies (Committee on Taxonomy, 2013). The subspecies *B. a. acutorostrata* occurs within the North Atlantic. Adult common minke whales reach a length of 8.8 m (29 ft) (Jefferson et al., 2008, NMFS-OPR, 2015). Generally, minke whales occupy warmer waters during winter and travel north to colder regions in summer, with some animals migrating as far as the ice edge. The minke whales that occur within the activity area are part of the Canadian East Coast stock, which is one of four stocks in the North Atlantic. This stock is not considered strategic under the MMPA because minke whales are not listed as threatened or endangered. The best population estimate for the Canadian East Coast stock is 20,741 individuals (Waring et al., 2015).

Minkes are frequently observed in coastal or shelf waters in the Massachusetts Bay area from April through October. Stellwagen Bank is heavily used by minke whales, along with humpback and fin whales, owing to their piscivorous feeding habitats where prey includes sand lance and herring. Minke whales remain in the southern Gulf of Maine in very low densities throughout the winter (DOC 2010; Weinrich and Sardi, 2005).

Like other baleen whales, threats to minke whales include ship strikes and fisheries interactions. However, unlike the larger whales, minkes are more susceptible to bycatch threats from bottom trawls, lobster trap/pot, gillnet and purse seine fisheries. During the period from 2008 to 2012, the average annual minimum detected human-caused mortality, and serious injury was 9.9 minke whales per year. This number was composed of 1.6 whales per year from US fisheries bycatch, 7.1 whales per year from U.S. and Canadian entanglement data, and 1.2 per year from ship strikes (Waring et al., 2015). Additionally, minke whales continue to be hunted as part of an ongoing whaling industry in the northeastern North Atlantic, the North Pacific, and Antarctic (Reeves et al., 2002).

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

4.2 TOOTHED WHALES (ODONTONCETI)

4.2.1 Long-finned pilot whale (*Globicephala melas*)

Pilot whales attain a body length of 7.2 m (24 ft) (short-finned pilot whale) and 6.7 m (22 ft) (long-finned pilot whale) (Jefferson et al., 2008, NMFS-OPR, 2015). There are two species of pilot whale in the Western North Atlantic, long-finned (*G. melas*) and short-finned (*G. macrorhynchus*). The species overlap, are difficult to tell apart, and parameters that define their distributions are not well differentiated.

However, it is generally accepted that pilot whale sightings above approximately 42° N are most likely long-finned pilot whales (Waring et al., 2015). Additionally, in the northern extent of the ranges, long-finned pilot whales occupy inshore areas, whereas short-finned pilot whales remain in offshore habitats. Therefore, the pilot whales that occur within the proposed activity area are long-finned pilot whales that are part of the Western North Atlantic stock. Pilot whales are not listed as threatened or endangered, and the Western North Atlantic stock is not considered strategic under the MMPA. The best population estimate for the Western North Atlantic stock of long-finned pilot whales is 5,636 individuals (Waring et al., 2015).

Long-finned pilot whales occur over the continental slope in high densities during winter and spring then move inshore and into shelf waters during summer and autumn following prey populations of squid and mackerel (Reeves et al., 2002). They will also readily feed on other fish, cephalopods, and crustaceans. Pilot whales are common in central and northern Georges Bank, Great Soutb Channel, Stellwagen Bank, and Gulf of Maine during the summer and early fall (May and October) (DOC, 2010). Pilot whales are highly social and vocal and are typically observed in groups of 10 to 20 surface-active individuals.

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

Pilot whales also demonstrate a propensity to mass strand; however, the role that human activities play in these strandings is not known. From 2008 to 2012, 37 long-finned and 7 undetermined pilot whales stranded between Maine and Florida. Bioaccumulated toxins are also a potential source of human-caused source of mortality in pilot whales. Polychlorinated biphenyls (PCBs) and chlorinated pesticides (DDT, DDE, dieldrin, etc.), have been found in pilot whale blubber (Muir et al., 1988; Weisbrod et al., 2000); and bioaccumulation levels of these toxins were more similar in whales from the same stranding group than from animals within the same sex or age category (Weisbrod et al., 2000).

Pilot whales are acoustic mid-frequency specialists and therefore, are not as likely to be affected by the low-frequency noise generated by vessels as baleen whales. Pilot whales echolocate and produce tonal calls. The calls of the long-finned pilot whale range from 1 to 8 kHz with a mean duration of about 1 second. The calls can be varied with seven categories identified (level, falling, rising, up-down, down-up, waver, and multi-hump) and are likely associated with specific social activities (Vester et al., 2014).

4.2.2 Harbor porpoise (*Phocoena phocoena*)

The harbor porpoise is the only porpoise species found in the Atlantic. It is a small, stocky cetacean with a blunt, short-beaked head. There are four subspecies, with *P. phocoena* residing in the North Atlantic (Committee on Taxonomy, 2013). This subspecies reaches a body length of 1.9 m (6 ft) (Jefferson et al., 2011). They commonly occur throughout Massachusetts Bay from September through April. During fall and spring, harbor porpoises are widely distributed along the east coast from New Jersey to Maine. During summer, the porpoises are concentrated in the northern Gulf of Maine and southern Bay of Fundy in water depths less than 150 m. In winter, densities increase in waters off New Jersey to North Carolina and decrease in the waters from New York to New Brunswick; however, specific migratory timing or routes are not apparent.

The harbor porpoises that occur in the proposed activity area comprise the Gulf of Maine/Bay of Fundy stock. This stock is not considered strategic under the MMPA because they are not listed as threatened or endangered and the annual human-related mortality rates do not exceed the PBR. In 2001, NOAA conducted a status review for the stock, mainly due to the level of bycatch in fisheries (Federal Register 66 FR 53195, October 19, 2001) .The determination from the review was that listing the harbor porpoise under the ESA was not warranted and the species was removed from the candidate list. The best abundance estimate for this stock is 79,883.

Harbor porpoise feed on small schooling fish such as mackerel, herring, and cod, as well as worms, squid, and sand eel. Their foraging habits, and habitats, make this species particularly susceptible to mortality in bottom-set gill nets (NMFS-OPR, 2015). The average estimated human-caused mortality or serious injury for this stock is 640 harbor porpoises per year, derived from both US and Canadian fisheries observer records. In 2010, a final rule was published for the exiting Harbor Porpoise Take Reduction Plan (Plan) in the Federal Register (75 FR 7383 February 19, 2010; and 75 FR 12698, March 17, 2010) to address closure areas and timing based on bycatch rates.

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

4.2.3 Atlantic white-sided dolphin (*Lagenorhynchus acutus*)

The Atlantic white-sided (AWS) dolphin is robust and attains a body length of approximately 2.8 m (9 ft) (Jefferson et al., 2008, NMFS-OPR, 2015). It is characterized with a strongly “keeled” tail stock and distinctive color pattern. The AWS dolphin occurs primarily along the 100-m depth contour within temperate and subpolar waters of the North Atlantic. Seasonally, the AWS dolphin occupies northern, inshore waters during summer and southern, offshore waters in the winter. AWS dolphins occupy waters from Georges Bank to Jeffreys Ledge in low numbers from January to May and in high numbers from June through September. The AWS dolphins that potentially occur in the proposed activity area are all part of the Western North Atlantic stock. The Western North Atlantic stock inhabits waters from central West Greenland to North Carolina (about 35°N) (Waring et al., 2015). There is some evidence supporting the division of the Western Atlantic population into three separate stocks; however, this has not been established. The estimated average annual human-related mortality does not exceed the PBR for this stock and the AWS dolphin is not listed as threatened or endangered; therefore the stock is not considered strategic under the MMPA. The best abundance estimate for the Western North Atlantic AWS dolphin stock is 48,819.

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

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

4.2.4 Killer whale (*Orcinus orca*)

The killer whale is the largest member of the dolphin family (6.7 to 9.1 m) and is the most widely distributed cetacean species (NMFS-OPR, 2015). Killer whales are most abundant in colder waters and mildly temperate waters. They occur in both offshore and coastal habitats following selected food sources. Killer whales are considered uncommon or rare in U.S Atlantic waters (Waring et al., 2015). Sightings within the proposed activity area would be considered very rare. Killer whales that might visit or transit Massachusetts Bay are part of the Western North Atlantic stock. Within the North Atlantic, its range extends from the Arctic ice-edge to the West Indies. While their occurrence is unpredictable throughout the U.S. Atlantic EEZ, they do occur in fishing areas, perhaps coincident with tuna, in warm seasons (Katona et al., 1988; DOC 2010). In an extensive analysis of historical whaling records, Reeves and Mitchell (1988) plotted the distribution of killer whales in offshore and mid-ocean areas. Their results suggest that the offshore areas need to be considered in present-day distribution, movements, and stock relationships.

Although fisheries interactions are a potential threat to killer whales, there were no observed mortalities or serious injuries in U.S. fisheries between 2008 and 2012. Adult killer whales are not highly susceptible to vessel strikes, although there is one record reported for British Columbia, Canada, in the Large Whale Ship Strike Database. The stock is not listed as threatened or endangered and is not considered strategic under the MMPA. There are not sufficient data available for a population abundance estimate for this stock.

4.2.5 Short-beaked common dolphin (*Delphinus delphis*)

The common dolphin may be one of the most widely distributed species of cetaceans, as it is found worldwide in temperate, tropical, and subtropical seas. Two species have been recognized: the long-beaked common dolphin (*Delphinus capensis*) and the short-beaked common dolphin; however, the short-beaked common dolphin is the only species that occurs within the northern Atlantic. Common dolphins attain a body length of 2.5 m (8.2 ft) (Jefferson et al., 2008, NMFS-OPR, 2015).

Short-beaked common dolphins within the northwestern Atlantic are classified within one stock (Western North Atlantic stock) under the MMPA (Waring et al., 2015). The best population estimate for this stock is 173,486. The species is not listed as threatened or endangered under the ESA, and the stock is not classified as a strategic or depleted stock.

Common dolphins are distributed in waters off the northeastern U.S. coast (CETAP 1982, Waring et al., 2015; Hamazaki, 2002). They occur from Cape Hatteras northeast to Georges Bank (35° to 42° N) during mid-January to May and move as far north as the Scotian Shelf from mid-summer to autumn (Selzer and Payne, 1988). Off the northeast coast, they are particularly common along shelf edges with sharp relief typical of seamounts, banks and escarpments (Reeves et al., 2002).

Common dolphins aggregate in large schools numbering in the hundreds, although the typical group size is 30 or fewer (Reeves et al., 2002). The short-beaked common dolphin feeds on small schooling fish and squid. Short-beaked common dolphins are subject to bycatch in gillnets, pelagic trawls, and longline fisheries. During 2008 to 2012, an estimated average of 298 common dolphins were taken each year in fisheries activities.

4.2.6 Bottlenose dolphin (*Tursiops truncatus*)

Adult bottlenose dolphins range in length from 1.8 to 3.8 m (5.9 to 12.5 ft). Within the western North Atlantic, including the proposed survey area, there are two distinct bottlenose dolphin forms, or ecotypes:

coastal and offshore. The two forms are genetically and morphologically distinct, though regionally variable (Jefferson et al., 2008, NMFS-OPR, 2015).

The bottlenose dolphin is not listed as threatened or endangered under the Endangered Species Act. Bottlenose dolphins within the western North Atlantic are separated into 13 management stocks, consisting of three migratory population stocks and 10 resident population stocks. In North America, bottlenose dolphins are found in surface waters with temperatures ranging from 50 to 90 of (10 to 32°C) (Reeves et al., 2002). The bottlenose dolphin most likely to be encountered at the proposed activity area is Western North Offshore Atlantic stock. The bottlenose dolphin is not listed as threatened or endangered and the stock is not considered strategic under the MMPA. The best population estimate of bottlenose dolphins for the stock is 77,532 individuals (Waring et al., 2015). Although this is a common species throughout the Atlantic, occurrence within the activity area is expected to be uncommon due to their offshore behavior.

Bottlenose dolphins feed on a large variety of organisms, include pelagic, mesopelagic, and sessile fish, rays, cephalopods, and crustaceans; and will readily exploit whatever local prey sources are available. (Reeves et al., 2002). The propensity to exploit easy food sources makes them susceptible to impacts through human interactions. A primary threat to all bottlenose dolphin population is mortality as bycatch in fishing gear, gillnets, purse seines, and shrimp trawls (Waring et al., 2015).

4.2.7 Risso's dolphin (*Grampus griseus*)

Risso's dolphins are large dolphins with characteristic blunt head and light coloration, often with extensive scarring. Adults reach body lengths of over 3.8 m (12.5 ft) (Jefferson et al., 2008, NMFS-OPR, 2015)

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

Risso's dolphins are widely distributed in tropical and temperate seas. In the Northwest Atlantic they occur from Florida to eastern Newfoundland (Leatherwood et al., 1976; Baird and Stacey, 1990). Risso's dolphins occur along the continental shelf edge from Cape Hatteras to Georges Bank during spring, summer, and autumn. In winter, they occur in oceanic (slope) waters within the MAB (Waring et al., 2014). The majority of sightings during the 2011 surveys occurred along the continental shelf break with generally lower sighting rates over the continental slope (Palka 2012).

4.3 PINNIPEDS

The mammalian suborder Pinnipedia includes the following three recognized families:

- Phocidae (earless seals or true seals);
- Otaridae (eared or fur seals and sea lions); and
- Odobenidae (walrus).

There are two species of seals that may occur within the proposed activity area: the harbor seal (*Phoca vitulina*) and the grey seal (*Halichoerus grypus)*. Both of these species are phocid seals.

4.3.1 Harbor seal (*Phoca vitulina*)

The harbor seal is found in all nearshore waters of the Atlantic Ocean and adjoining seas north of 30°N (Waring et al., 2015). In the western North Atlantic, they are distributed from eastern Canada to southern New England and New York, and occasionally to the Carolinas (Payne and Selzer, 2006). Harbor seals are the most abundant seals in the eastern United States. Harbor seals are not listed as threatened or endangered. The harbor seals within the activity area are part of the single Western North Atlantic stock which is not considered strategic under the MMPA. The best population estimate for this stock is 75,834.

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

Fisheries interactions are common, and harbor seals are legally killed in Canada, Norway, and the United Kingdom to protect fish farms or local fisheries (Reeves et al., 2002). They are also susceptible to bycatch in gillnets, trawls, and purse seines. For the period from 2008 to 2012, the average human-caused mortality and serious injury to harbor seals was 441 per year, of which 431 of these takes occurred in fisheries.

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

4.3.2 Gray seals (*Halichoerus grypus*)

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

Gray seals will aggregate in large numbers breed, molt, and rest. Gray seals will exploit a variety of available food sources and will feed both in shallow coastal habitats and offshore (NMFS-OPR, 2015). Typical prey items include cephalopods, sessile, and small schooling fish (i.e., herring, alewife, flounder, redfish, cod, yellowtail flounder, sand eel, and hake), and crustaceans. Gray seals will go on extensive dives to depths to 475 m to capture food (NMFS-OPR, 2015). Gray seals are susceptible to bycatch and fisheries interactions and, like the harbor seal, are legally killed in some countries to protect fisheries resources. The gray seal is also taken commercially outside the U.S. In the U.S., the average estimated human-caused mortality and serious injury between 2008 and 2012 was 4,533 seals per year.

5.0 Type of Incidental Take Requested

Neptune LNG requests an IHA pursuant to Section 101 (a)(5)(D) of the MMPA for incidental take of small numbers by Level B harassment during decommissioning and unanticipated unscheduled maintenances of the Neptune deep water port in Massachusetts Bay. Activities are scheduled to take place between July 2016 and July 2017 with the understanding that the applicant is requesting coverage for maintenance and repair activities only in 2016 as is covered under the current IHA that expires on July 11, 2016. Decommissioning activities will not begin before May 1, 2017. Proposed vessel activities, as outlined in **Section 1.0**, have the potential to impact marine mammals within the activity area from sounds generated by the vessel during unscheduled maintenances and decommissioning. Level A (injury) takes are not anticipated due to the fact that maximum source levels will not reach, or propagate appreciably, to Level A threshold levels. No lethal or take by serious injury is anticipated, given the nature of the planned operations and the mitigation measures that are planned (**Sections 11.0** and **13.0**). Behavioral reactions (Level B harassment), such as avoidance and temporary displacement behavior are possible for some individual or groups of marine mammals near vessels that are actively utilizing dynamic positioning thrusters. It is expected that the severity of behavioral effects will vary with the duration and load of the thruster use, the behavior of the animal at the time of reception of the stimulus, as well as the distance and received level of the sound. Potential impacts will be further mitigated through a visual and acoustic monitoring program and vessel activity management program; both of which are fully described in **Section 11.0**.

6.0 Numbers of Marine Mammals that Might be Taken

Neptune LNG is seeking authorization for potential "taking" of small numbers of marine mammals under the jurisdiction of NOAA Fisheries in the proposed region of activity, as described in **Section 2.0**. The 15 species potentially taken are described in **Section 4.0**. Each species has a geographic distribution that encompasses the activity area and has at least a minimal potential to occur within Massachusetts Bay.

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

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

The only anticipated impacts to marine mammals are associated with noise and are limited to the use of DP thrusters during dive and component removal operations. Unscheduled maintenance activities are not anticipated; however the applicant is requesting this activity be included in the IHA in the event it is needed to ensure the safety of the DWP and pipeline. The decommissioning activities are not expected to "take" more than a small number of marine mammals or have more than a negligible effect on their populations based on their seasonal density and distribution and their known reactions to exposure to such underwater sound sources. During thruster use, marine mammals may be temporarily disturbed or displaced from a localized area within the resultant ensonified field. The estimated ensonified area is described in **Section 1.5.2**, Vessel Noise Assessment.

The information contained in this section of the application relies on the noise modeling analysis completed by CSA Ocean Sciences Inc. as well as past modeling conducted for Neptune DWP construction and operation conducted by JASCO Applied Sciences (Laurinolli et al., 2005; Gaboury and Carr, 2009) for the previous three IHA/LOAs that were issued to Neptune LNG for similar DWP activities.

NMFS recognizes three kinds of sound: continuous, intermittent (or transient), and impulsive. All the maintenance and decommissioning sound sources of potential concern are continuous. All sources of concern will be stationary, thus the ensonified region will remain relatively stationary. The positioning (maneuvering) and station-keeping (weathervaning) of a DSV using thrusters is continuous with the power required (load) dependent upon sea state, current and wind conditions. The maximum anticipated load for the DSV or HLV is 50% as optimal and safe working parameters would not be met if environmental conditions required higher load levels on the DP vessels.

Thruster noise has the potential for behavioral modification (i.e., Level B take) by producing noise levels >120 dB re 1 µPa @1 m for any marine mammal occurring within the ensonified zone. This ensonified area is known as the zone of influence (ZOI) because it is the area in which there is an exposure potential at levels that may influence the hearing or behavior of a marine mammal. Mere exposure to a threshold level does not necessarily result in a take. Rather, exposure to a certain threshold level indicates that a marine mammal has the potential to be taken given that the exposure is of sufficient duration to induce a temporary threshold shift or within appropriate context to illicit a reaction. Although not all exposures result in takes, it is reasonable to take a conservative approach when estimating takes to ensure that the potential number of animals taken is not underestimated while providing accurate results that are representative of the true potential impacts. Estimated take numbers are calculated by multiplying the areal extent of the ZOI (based on the underwater noise propagation modeling results) by the expected marine mammal densities (i.e., estimated numbers per unit area).

6.1 ZONE OF INFLUENCE

Different maintenance and decommissioning activities will use the same class of DP vessels and will operate at the same locations; the only difference between various activities will be the duration of each of those operations. Maintenance activities or unscheduled maintenance operations are not expected; however, a single, 14-day unscheduled maintenance/maintenance activity is assessed in this application as a precautionary measure. The resulting noise isopleths using a representative DSV are applicable to all operations that could be conducted between July 2016 and July 2017 as detailed in **Section 1.5.2**.

Decommissioning is addressed as one of the activities in the NOAA Biological Opinion (BiOp) for MARAD's issuance of a license for Neptune LNG to own and operate the Neptune DWP (dated July 12, 2010). In this BiOp, the maximum distance for the average 120 dB contour (for a continuous source) was 11 km, produced by the pipe lay (transient) vessel. Suction pile installation, which will be reversed for decommissioning, produced source levels of 138 dB re 1 µPa and resulted in a 120 dB radius of less than 300m. Measurements for a LNG carrier at one of the Neptune DWP buoys, using all four thrusters at 100%, produced source levels of 187.9 dB re 1 µPa and resulted in a modeled 120 dB contour of approximately 5 to 6 km. The same vessel operating only two thrusters at 100% load produced source levels of 183.2 dB re 1 µPa and resulted in a modeled 120 dB contour of 1 to 4 km. Similarly, modeling conducted for DP EBRV operations at the adjacent Northeast Gateway (NEG) deepwater port produced a 120 dB contour of 2.6 km. Subsequent *in situ* measurements were conducted at the NEG DWP buoy during an EBRV docking event using thrusters. These measurements showed a maximum 120 dB contour of 3.5 km. Comparable DSVs to those proposed for Neptune decommissioning were not identified in previous modeling efforts. Consequently, a DSV was modeled for this assessment (see **Section 1.5.2** for details). A source level of 178.0 dB re 1 µPa was used for a DSV using all thrusters during DP. This source level was used based on DSV field measurements conducted by JASCO for a DSV on DP (MacGillivray, 2006).

The results of the modeled underwater analysis for a 2-week duration unscheduled maintenance or a 10-week decommission during summer are as follows:

- Proposed activities will produce continuous sound from a stationary location;
- The 120 dB isopleth is located at an estimated 3.45 km from South Buoy or from the Hot Tap;
- Although noise propagation from the Hot Tap produces a smaller distance to the 120dBisopleth (3.12 km), the more conservative distance from the South Buoy was used for ZOI calculations to ensure that the number of days at the Hot Tap was not over-estimated which could result in an underestimate of noise exposures. The resultant ZOI is estimated at 37.4 km^2;
- The 180 dB Level A thresholds will not be realized during the proposed activities; and

- Mitigation measures will provide the means of affecting the least practicable adverse impact on marine mammal species or stocks and their habitat.

6.2 DENSITY ESTIMATION

The density calculation methodology applied to take estimates for this application is derived from the model results produced by Roberts et. al., (2016) for the east coast region. These files are available as raster files from the NOAA website: http://cetsound.noaa.gov/cda. In order to determine cetacean densities for take estimates, the grid cells that included the ZOI for the hot tap, north, and south buoys were selected for months 5 through 10. The estimated mean monthly abundance for each species for each month was an average of months 5 through 10 (**Table 6-1**). Monthly values were not modeled for some species (e.g. killer whale) therefore only the single value was reported. Estimates provided by the models are based on a grid cell size of 100 km^2; therefore, model grid cell values were divided by 100 to determine animals km^{-2}. Gray seal and harbor seal densities are not provided in the Roberts et. al. (2016) models. Seal densities were derived from the Strategic Environmental Research and Development Program (SERDP) using the Navy Oparea Density Estimate (NODE) model for the Northeast Opareas. (Best et. al., 2102).

Table 6-1. Estimated species densities (animals km^{-2})

Species	Mean May-October densities
North Atlantic right whale	0.000017
Fin whale	0.0034
Humpback whale	0.0032
Minke whale	0.0033
Sei whale	0.000036
Long-finned Pilot whale	0.0019
Atlantic white-sided dolphin	0.039
Bottlenose dolphin	0.003
Common dolphin	0.0071
Risso’s dolphin	0.000044
Harbor porpoise	0.104
Gray seal	0.027
Harbor seal	0.097
Killer whale	0.0000089

Based on these densities, the estimated number of marine mammal takes per year was determined. Calculations were based on (1) a DSV operating thrusters for 70 days at the Hot Tap or either Buoy during decommissioning; and (2) a DSV operating for 14 days at a Buoy during maintenance. Calculations were based on the following formulas:

Estimated Take (decommissioning) = D × ZOI × 70
Estimated Take (maintenance/unscheduled maintenance) = D × ZOI × 14
Total take (for proposed activity) = D × ZOI × 84

6.3 ESTIMATE OF POTENTIAL TAKES BY HARASSMENT FOR DWP MAINTENANCE AND DECOMMISSIONING

The most reasonable and conservative estimate of potential takes by Level B harassment from the proposed activities has been calculated for 15 marine mammal species. All work will be conducted between 1 May and 30 November. The ZOI was calculated after careful review of the sound source data from previous IHA/LOA applications for Neptune DWP and the adjacent NEG DWP in addition to DSV modeling for this estimate. The 95th percentile 120 dB isopleth was determined to be 3.45 km from the source vessel which creates a 37.4 km^2 ZOI.

There are no Level A takes expected. There is the potential for Level B takes (behavioral modification) for 12 marine mammal species, including North Atlantic right whale, fin whale, humpback whale, minke whale, sei whale, long-finned pilot whale, Atlantic white-sided dolphin, harbor porpoise, short-beaked common dolphin, bottlenose dolphin, Risso's dolphin, killer whale, gray seal and harbor seal.

The take estimates have been divided into unscheduled maintenance activities that are not planned but could potentially take place prior to May 1, , 2017 (**Table 6-2)**; and decommissioning activities that would only take place between May 1, 2017 and November 1, 2017 (**Table 6-3**).

Table 6-2. Estimated Level B takes from unscheduled maintenance activities

Species	Estimated population (Waring et al., 2015)	Density	Estimated Takes	% Population	Stock
North Atlantic right whale (*Eubalaena glacialis*)	476	0.000017	1	0.21	Western Atlantic
Fin whale (*Balaenoptera physalus*)	1,618	0.0034	2	0.12	Western North Atlantic
Minke whale (*Balaenoptera acutorostrata*)	20,741	0.0033	2	0.009	Canadian East Coast
Sei whale (*Balaenoptera borealis*)	357	0.000036	1	0.28	Nova Scotia
Atlantic white-sided dolphin (*Lagenorhynchus acutus*)	48,819	0.039	21	0.043	Western North Atlantic
Long-finned pilot whale (*Globicephala melas*)	5,636	0.0019	2	0.035	Western North Atlantic
Harbor porpoise (*Phocoena phocoena*)	79,883	0.104	55	0.068	Gulf of Maine / Bay of Fundy
Bottlenose dolphin (*Tursiops truncatus*)	77,532	0.0030	2	0.002	Western North Offshore Atlantic
Short beaked common dolphin (*Delphinus delphis)*	173,486	0.00706	4	0.002	Western North Atlantic
Risso's dolphin (*Grampus griseus*)	18,250	0.000044	1	0.005	Western North Atlantic
Killer whale (*Orcinus orca*)	No Estimate Available	0.0000089	1	Insufficient data	Western North Atlantic
Harbor seal (*Phoca vitulina*)	75,834	0.097	51	0.067	Western North Atlantic
Gray Seal (*Halichoerus grypus)*	505,000	0.027	15	0.002	Western North Atlantic

Table 6-3. Estimated Level B takes from decommissioning activities

Species	Estimated population (Waring et al., 2014)	Density	Estimated Takes	% Population	Stock
North Atlantic right whale (*Eubalaena glacialis*)	476	0.000017	1	0.21	Western Atlantic
Fin whale (*Balaenoptera physalus*)	1,618	0.0034	10	0.61	Western North Atlantic
Minke whale (*Balaenoptera acutorostrata*)	20,741	0.0033	9	0.043	Canadian East Coast
Sei whale (*Balaenoptera borealis*)	357	0.000036	1	0.28	Nova Scotia
Atlantic white-sided dolphin (*Lagenorhynchus acutus*)	48,819	0.039	103	0.21	Western North Atlantic
Long-finned pilot whale (*Globicephala melas*)	5,636	0.0019	6	0.1	Western North Atlantic
Harbor porpoise (*Phocoena phocoena*)	79,883	0.104	273	0.34	Gulf of Maine / Bay of Fundy
Bottlenose dolphin (*Tursiops truncatus*)	77,532	0.0030	8	0.01	Western North Offshore Atlantic
Short beaked common dolphin (*Delphinus delphis)*	173,486	0.00706	19	0.01	Western North Atlantic
Risso's dolphin (*Grampus griseus*)	18,250	0.000044	1	0.005	Western North Atlantic
Killer whale (*Orcinus orca*)	No Estimate Available	0.0000089	1	Insufficient data	Western North Atlantic
Harbor seal (*Phoca vitulina*)	75,834	0.097	254	0.33	Western North Atlantic
Gray Seal (*Halichoerus grypus)*	505,000	0.027	71	0.014	Western North Atlantic

The resulting take estimates for the entire proposed activity are presented in **Table 6-4.**

Table 6-4. Estimated Level B takes from all proposed activities

Species	Estimated population (Waring et al., 2014)	Density	Estimated Takes	% Population	Stock
North Atlantic right whale (*Eubalaena glacialis*)	476	0.000017	2	0.004	Western Atlantic
Fin whale (*Balaenoptera physalus*)	1,618	0.0034	12	0.007	Western North Atlantic
Minke whale (*Balaenoptera acutorostrata*)	20,741	0.0033	11	<0.001	Canadian East Coast
Sei whale (*Balaenoptera borealis*)	357	0.000036	2	0.005	Nova Scotia
Atlantic white-sided dolphin (*Lagenorhynchus acutus*)	48,819	0.039	124	0.002	Western North Atlantic
Long-finned pilot whale (*Globicephala melas*)	5,636	0.0019	8	0.001	Western North Atlantic
Harbor porpoise (*Phocoena phocoena*)	79,883	0.104	328	0.004	Gulf of Maine / Bay of Fundy
Bottlenose dolphin (*Tursiops truncatus*)	77,532	0.0030	10	<0.001	Western North Offshore Atlantic
Short beaked common dolphin (*Delphinus delphis)*	173,486	0.00706	23	<0.001	Western North Atlantic
Risso’s dolphin (*Grampus griseus*)	18,250	0.000044	2	<0.001	Western North Atlantic
Killer whale (*Orcinus orca*)	No Estimate Available	0.0000089	2	Insufficient data	Western North Atlantic
Harbor seal (*Phoca vitulina*)	75,834	0.097	305	0.004	Western North Atlantic
Gray Seal (*Halichoerus grypus)*	505,000	0.027	86	<0.001	Western North Atlantic

6.4 SUMMARY OF TAKE ESTIMATES

Under this IHA, the applicant is requesting approval for the incidental take of marine mammals associated with planned decommissioning operations, slated to occur over a 70-day period. In addition, there is also the potential for maintenance activities to occur prior to May, 1 2017 that would not be authorized under the existing IHA (76 FR 34157, June 13, 2011). Although no maintenance is expected; the applicant has included the remainder of 2016 in the estimated incidental take for potential maintenance activity occurring over a 14-day period. Take estimates were projected based on marine mammal presence, calculated density estimates, and activity-specific noise source propagation characteristics.

Due to the projected noise characteristics of proposed activities, no Level A take was predicted. There are no scheduled or unscheduled maintenance activities planned for the July 2016 to July 2017 period; therefore, the likelihood of any takes occurring as a result of maintenance operations are extremely low. For conservative purposes; however, a single unscheduled maintenance or maintenance event has been included in the take estimates. Once decommissioning is completed, there will be no further activity expected at the Neptune DWP.

The nature of Level B harassment allows the same animal to be exposed, or “taken,” multiple times. Therefore, both the number of takes and the affected population percentages represent the maximum potential take numbers. Limited numbers of marine mammals may realize behavioral modification, or Level B take. A total of 15 different marine mammal species may realize behavioral modification from decommissioning activities. The numbers of individuals in the take estimates of the proposed combined activity range from 2 to 328.

7.1 POTENTIAL EFFECTS OF ACOUSTIC SOUND SOURCES ON MARINE MAMMALS

Underwater noise sources in the proposed survey include active acoustic sound sources such as airguns, as well as continuous (non-pulsed) vessel-related noise. Noise, either natural or anthropogenic, can adversely affect marine life in various ways. Four zones of influence from noise are offered by Richardson et al. (1995) and summarized by Gordon et al. (2004), including (1) zone of audibility – the area within which the sound is both above the animal's hearing threshold and detectable above background noise; (2) zone of responsiveness – the region within which behavioral reactions in response to the sound occur; (3) zone of masking – the area within which the sound may mask biologically significant sounds; and (4) zone of hearing loss, discomfort, or injury – the area within which the sound level is sufficient to cause threshold shifts or hearing damage.

Overall, the potential for impacts of noise from proposed decommissioning -related sound sources on marine mammals may be highly variable and highly dependent on the specific circumstances of a given situation, such as the different types and characteristics of sound sources, and differences in sound propagation depending on the physical environment. Biological factors, such as the hearing range of the marine mammal species present (broad range and most sensitive frequencies), what animals are doing at the time of exposure (i.e., searching for mates, feeding, resting), individual hearing loss, animals' previous exposure to noise type, life history stage, reproductive status, health status, etc. all contribute to the impacts of noise on marine mammals. Studies on the reactions of animals to noise have shown widely varied responses, depending on the individual, age, gender, and the activity in which the animals were engaged as well as variables in defining cumulative or aggregate effects (Fleishman et al., 2015)

The range of potential effects from noise, in order of decreasing severity and modified slightly from the four zones initially outlined by Richardson et al. (1995) above, includes death, non-auditory physiological effects, auditory injury–hearing threshold shift, masking, and stress and disturbance, including behavioral response (Richardson et al., 1995; National Research Council [NRC], 2003, Board, 2005; Nowacek et al., 2004; Southall et al., 2007). The following discussion addresses the range of potential effects noted above, with the exception of death and physiological effects, which have been combined.

7.1.1 Death and Non-Auditory Physiological Effects

Direct physical injury, which might result in death, may occur from exposure to high levels of sound or, more commonly, to shock waves associated with sound-producing events such as in-water explosions.

Given the sound sources, limited sound pressure levels (SPLs), and durations, it is not likely that the proposed activity would generate sounds loud enough to cause direct mortality (Det Norske Veritas Energy, 2007).

7.1.2 Auditory Injuries – Hearing Threshold Shift

The minimum sound level an animal can hear at a specific frequency is called the hearing threshold at that frequency. Sounds above a hearing threshold are accommodated until a certain level of sound intensity or duration is reached. Too much exposure at a certain level might cause a shift in the animal's hearing thresholds within a certain frequency range. Following exposure, the magnitude of the hearing impairment, or threshold shift, normally decreases over time following cessation of noise exposure.

Threshold shifts can be temporary (TTS) or permanent (PTS) and are defined as follows, as adapted from Southall et al. (2007) and Finneran et al. (2005):

- TTS – the mildest form of hearing impairment; exposure to strong sound results in a non-permanent (reversible) elevation in hearing threshold, making it more difficult to hear sounds; TTS can last from minutes or hours to days; the magnitude of the TTS depends on the level and duration of the noise exposure, among other considerations.
- PTS – permanent elevation in hearing threshold; no data are currently available regarding noise levels that might induce PTS in marine mammals; PTS is attributed to exposure to very high peak pressures and short rise times, or very prolonged or repeated exposures to noise strong enough to elicit TTS.

Several important factors relate to the type and magnitude of hearing loss, including exposure level, frequency content, duration, and temporal pattern of exposure. A range of mechanical effects (e.g., stress or damage to supporting cell structure, fatigue) and metabolic processes (e.g., inner ear hair cell metabolism such as energy production, protein synthesis, and ion transport) within the auditory system underlie both TTS and PTS. The minimum SPL or sound exposure level (SEL) necessary to cause permanent hearing impairment is higher than the level that induces TTS, although there are insufficient data to determine the precise differential.

Thresholds for behavioral response for "continuous" (non-impulsive) sounds have been 120 dB_{rms} (for some but not all sound sources), based on the results of Malme et al. (1984) and Richardson et al. (1995). Southall et al. (2007) published a paper summarizing noise exposure results (i.e., SELs) and offered a series of new approaches to noise impact determinations for marine mammals. First, the marine mammals were segregated into the functional hearing groups (**Table 7-1**).

Table 7-1. Functional marine mammal hearing groups, associated auditory bandwidths, and marine mammal species present in the area of interest (From: Southall et al., 2007).

Functional Hearing Group	Estimated Auditory Bandwidth	Marine Mammal Species Potentially Affected in Proposed Activity Area
Low-frequency cetaceans	7 Hz to 22 kHz	North Atlantic right whale; blue whale; fin whale; humpback whale; sei whale; minke whale
Mid-frequency cetaceans	150 Hz to 160 kHz	bottlenose dolphin; killer whale; Risso's dolphin; long-finned pilot whale; common dolphin; Atlantic white-sided dolphin
High-frequency cetaceans	200 Hz to 180 kHz	harbor porpoise
Pinnipeds in water	75 Hz to 75 kHz	harbor seal; gray seal
Pinnipeds in air	75 Hz to 30 kHz	harbor seal; gray seal

Hz = hertz; kHz = kilohertz.

Second, sound sources were categorized into functional categories, based on their acoustic and temporal properties. Three sound types were characterized, including single and multiple pulses and non-pulses, with separation of sound types based on understanding of sound exposure, auditory fatigue, and acoustic trauma in terrestrial mammals and applicable damage risk criteria in humans.

The primary measure of sound used in the proposed new criteria is the received sound energy, not just in the single strongest pulse, but accumulated over time. Received sound energy over a period of time or, in this case, a series of pulsed sounds over a period of time, is the fundamental basis for the SEL metric. Southall et al. (2007) define SEL as "the dB level of the time integral of the squared-instantaneous sound pressure normalized to a 1-s period." The use of an SEL is advantageous because it can account for: 1) cumulative sound exposure; 2) sounds of differing duration; and 3) multiple sound exposures. It also allows for comparison between different sound exposures based on total energy (i.e., calculation of a single exposure "equivalent" value; Southall et al., 2007). This approach also assumes no recovery of hearing between repeated exposures. The most appropriate interval over which the received airgun pulse energy should be accumulated is not well defined. However, pending the availability of additional relevant information, recommendations suggest considering noise exposure over 24-hour periods (Southall et al., 2007).

Based on the existing NOAA noise criteria, exposures to continuous sound levels of 120 dB or greater have the potential to illicit TTS onset; however it is not expected that exposure durations would be met for TTS onset during the proposed activity. Survey protocols and underwater noise mitigation procedures (**Section 11.0**) would be implemented to decrease the potential for any marine mammal to be within the acoustic exclusion zone of an operating airgun array or other sound source, thereby avoiding the highest sound levels.

7.1.3 Masking

Noise can affect hearing and partially or completely reduce an individual's ability to effectively communicate; detect important predator, prey, and/or conspecific signals; and/or detect important environmental features associated with spatial orientation (Clark et al., 2009). Masking is defined as the obscuring of sounds of interest by other, stronger sounds, often at similar frequencies. Spectral, temporal, and spatial overlap between the masking noise and the sender/receiver determines the extent of interference; the greater the spectral and temporal overlap, the greater the potential for masking.

Naturally occurring ambient noise is produced from various sources, including wind, waves, precipitation, other animals, and (at frequencies above 30 kHz) thermal noise resulting from molecular agitation (Richardson et al., 1995). Background noise (natural and anthropogenic) can also include sounds from distant human activities (e.g., shipping), particularly in areas where heavy levels of shipping traffic are located. Ambient noise can produce masking, effectively interfering with the ability of an animal to detect a sound signal that it otherwise would hear. Under normal circumstances, in the absence of high ambient noise levels, an animal would hear a sound signal because it is above its absolute hearing threshold. Natural masking prevents a portion or all of a sound signal from being heard. Further masking of natural sounds can result when human activities produce high levels of background noise. Ambient noise is highly variable on continental shelves (Desharnais et al., 1999; Hatch et al., 2012; Merchant et al., 2014; Huveneers et al., 2016), effectively creating a high degree of variability in the range at which marine mammals can detect anthropogenic sounds.

Masking is a natural phenomenon to which marine mammals have adapted through various mechanisms (e.g., dominant frequency shift; increasing source levels). However, the production of strong sounds at frequencies that are important to marine mammals necessarily increases the severity and frequency of masking. Toothed whales have the ability to facilitate the detection of sounds in the presence of background noise. There is evidence that some odontocetes can shift the dominant frequencies of their echolocation signals from a frequency range containing excessive ambient noise toward frequencies with less noise (Tyack and Janick, 2013; Hotchkin and Parks, 2013; Baumann-Pickering et al., 2015). Several baleen whale species are also known to modify their calls in the presence of elevated sound levels (Mussoline, 2012; Parks et al., 2011; Fristrup et al., 2003; Melcon et al., 2012). While data exist that demonstrate adaptation among odontocetes to reduce the effects of masking at high frequencies, there are fewer data sources available regarding corresponding mechanisms at moderate or low frequencies, or in other marine mammal groups (i.e., mysticetes). Clark et al. (2009) summarize the potential for acoustic masking on baleen whales from anthropogenic sounds, including shipping. Castellote et al. (2010), studying fin whales in the eastern Atlantic and western Mediterranean, documented the shortening of low-frequency (20-Hz) pulse duration, decreasing bandwidth, and decreasing center and peak frequencies as a result of masking from shipping (and seismic) activity. Directional hearing has been demonstrated at frequencies as low as 0.5 to 2 kHz in several marine mammals, including killer whales (see Richardson et al., 1995). This ability may be useful in reducing masking at these frequencies.

Vessels to be used during the proposed activity have the potential to mask marine mammal communication and monitoring of the environment around them, if an individual is present within the calculated distance from the source that would affect marine mammals, as defined by NOAA's acoustic guidelines, and the hearing sensitivity (ies) of the marine mammals present coincide with the frequency of the sound source being used. Survey protocols and underwater noise mitigation procedures (**Section 11.0**) would be implemented to decrease some of the potential risk for any marine mammal to be within the exclusion zone of an operating airgun array or other sound source, thereby reducing the potential for masking.

7.1.4 Stress, Disturbance, and Behavioral Responses

Stress in marine mammals resulting from noise exposure typically involves the sympathetic nervous system. Stress response in marine mammals is immediate, acute, and characterized by the release of the neurohormones norepinephrine and epinephrine (i.e., catecholamines) (Office of Navy Reasearch, 2009). Various researchers (e.g., Romano et al., 2004) have summarized available evidence for profound activity during stressors such as stranding or predation (Cowan and Curry, 2008; Mashburn and Atkinson, 2008; Eskesen et al., 2009). Romano et al. (2004) note that no quantitative approach to estimating changes in mortality or fecundity because of stress has been identified and that qualitative effects may include increased susceptibility to disease and early termination of pregnancy.

Disturbance can induce a variety of effects including subtle changes in behavior, more conspicuous dramatic changes in activities, and displacement. Disturbance is one of the main concerns of the potential impacts of manmade noise on marine mammals. There is a very wide range of possible behavioral responses to sound exposure, given that the sound is audible to the particular animal, including, in approximate order of increasing severity but decreasing likelihood, the following:

- none observable – animals can become less sensitive over repeated exposures;
- looking at the sound source or increased alertness;
- minor behavioral responses such as vocal modifications associated with masking;
- cessation of feeding or social interactions;
- temporary avoidance behavior, or displacement (emerging as one of the more common responses);
- modification of group structure or activity state; and/or
- habitat abandonment.

Behavioral reactions of marine mammals to sound are difficult to predict because reactions are dependent on numerous factors, including the species being evaluated; the animal's state of maturity, prior experience and exposure to anthropogenic sounds, current activity patterns, and reproductive state; time of day; and weather state (Wartzok et al., 2004). Severity of responses can vary depending on characteristics of the sound source (e.g., moving or stationary, number and spatial distribution of sound source[s], similarity to sounds produced by predators, and other relevant factors) (Richardson et al., 1995; Board, 2005; Southall et al., 2007; Bejder et al., 2009; Ellison et al., 2011). If a marine mammal reacts to an underwater sound by changing its behavior or moving to avoid a sound source, the impacts of that change may not be important to the individual, the stock, or the species as a whole. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on both individuals and the population could be important.

Baleen whales probably have better hearing sensitivities than odontocetes at lower sound frequencies and in several studies have been shown to react at received sound levels of approximately 120 dB re 1 μPa (e.g., 0.5 probability of avoidance by gray whales of a continuous noise source; Malme et al., 1988; also see Southall et al., 2007). Traveling blue and fin whales exposed to seismic noise from airguns have been reported to stop emitting redundant songs (McDonald et al., 1995; Clark and Gagnon, 2004). By contrast, Di Iorio and Clark (2010) found increased production of transient calls during seismic sparker operations, suggesting that blue whales respond to noise interference according to the context and the signal produced. They further postulated that animals engaged in near-term, proximate communication are probably afforded an advantage in acoustic behaviors that maintain the immediate social link; for animals engaged in long-term singing directed to a distant audience, information loss is minor if singing is temporarily interrupted. Di Iorio and Clark (2010) determined that blue whales changed their calling behavior in response to a low-frequency, low output sound source. North Atlantic right whales exhibited changes in diving behavior when exposed to noise below 135 dB re 1 μPa (Nowacek et al., 2004).

North Atlantic right whales exposed to high shipping noise increased call frequency (Parks et al., 2007), and some humpback whales responded to low-frequency active sonar playbacks by increasing song length (Miller et al., 2000; Fristrup et al., 2003). Porpoises avoid pingers with source levels of about 130 dB at distances of from 100 to 1,000 m (328 to 3,280 ft), depending on experience and environmental context (Gearin et al., 1996, 2000; Kraus et al., 1997; Laake et al., 1997, 1998; Barlow and Cameron, 1999; Cox et al., 2001; Ellison, 2011). Kastelein et al. (1997, 2001) found behavioral responses at lower levels. Williams et al. (2002a,b, 2009) found killer whales exhibited behavioral changes in the presence of a single vessel producing a received level of approximately 105 to 110 dB re 1 μPa. Toothed whales appear to exhibit a greater variety of reactions to manmade underwater noise than do baleen whales. Toothed whale reactions can vary from approaching vessels (e.g., to bow ride) to strong avoidance.

In summary, sound produced by vessels during the proposed activity has the potential to produce stress, disturbance, and behavioral responses in marine mammals if they are present within the range of the operational array. Survey protocols and underwater noise mitigation procedures (**Section 11.0**) would be implemented to decrease the potential for any marine mammal to be within the exclusion zone of an operating sound source, thereby reducing the potential for behavioral responses and injury (PTS/TTS) in close proximity to the sound source. However, beyond the exclusion zone, some behavioral responses may occur.

In general, the potential effects of noise on marine mammals include one or more behavioral responses, including masking, behavioral disturbance, and non-auditory physiological effects. These effects are summarized below.

- **Masking –** interference with the ability of an animal to simultaneously detect meaningful signals, due to the presence of another sound, often at a similar frequency. While masking is a natural phenomenon to which marine mammals must be adapted, the introduction of strong sound into the sea at frequencies important to marine mammals will inevitably increase the severity and the frequency of occurrence of masking. High levels of noise generated by anthropogenic activity may act to mask the detection of weaker biologically important sounds by some marine mammals. This masking would be more prominent for lower frequencies.

- **Disturbance** – manifested in several different ways, including subtle changes in behavior, more conspicuous dramatic changes in activity patterns, and displacement. Behavioral reactions to sound by marine mammals are difficult to predict because they are dependent on numerous factors including species, state of maturity, experience, current activity, reproductive state, time of day, and weather state. If a marine mammal does react to an underwater sound by changing its behavior or moving a small distance, the impacts of that change may not be important to the individual, the stock, or the species as a whole. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on the animals could be important.

- **Hearing Impairment** – adverse effects upon a marine mammal's hearing from sound exposure may be temporary or permanent. The minimum sound level necessary to cause permanent hearing impairment (i.e., PTS) is higher, by a variable and generally unknown amount, than the level that induces barely detectable temporary hearing loss or TTS. The level associated with the onset of TTS is often considered to be a level below which there is no danger of permanent damage. TTS is the mildest form of hearing impairment and is defined as the reversible elevation in auditory threshold that may occur following overstimulation by a loud sound. PTS is the more severe form of hearing impairment and is defined as the irreversible or permanent increase in the threshold of hearing at a specific frequency (above a previously established reference level).

- **Non-Auditory Physiological Effects** – a suite of physiological effects resulting from noise exposure, including stress, neurological effects, bubble formation, resonance effects, and other types of organ or tissue damage. It is possible that some marine mammal species (i.e., beaked whales) may be especially susceptible to injury and/or stranding when exposed to strongly pulsed sounds, particularly at higher frequencies. None of the activities associated with the Neptune DWP activities project will propagate sounds loud enough to cause physiological effects.

Disturbance and asking are expected to be the primary effects of sound associated with Neptune DWP decommissioning or unscheduled maintenance. There will be no overlap of unscheduled maintenance and decommissioning activities, and there will be no long-term operations or activities once the DWP is decommissioned.

8.0 Minimization of Adverse Effects to Subsistence Uses

This section addresses the NFMS requirement to identify methods to minimize adverse effects of the proposed activity on subsistence uses. There are no traditional subsistence hunting areas in the vicinity of Neptune DWP, and there are no activities related to the proposed Port that may affect the availability of a species or stock of marine mammals for subsistence uses. Consequently, there are no available methods to minimize potentially adverse effects to subsistence uses.

9.0 Effects to Marine Mammals from Loss or Modification of Habitat and the Likelihood of Restoration

This section addresses the NFMS requirement to characterize the short- and long-term impacts of the proposed activity on marine mammals associated with the predicted loss or modification of habitat and to address available methods and likelihood of restoration of lost or modified habitat. It is important to reiterate that the goal of the proposed activities is to fully decommission the Neptune DWP and therefore, long term impacts are not expected. The seabed is expected to return, at a minimum, to post-construction condition. Further, there will be no port operations to cause further disturbances.

Predicted impacts to marine mammal habitat have been summarized in the following sections.

9.1 SHORT-TERM IMPACTS

The proposed activities have the potential to affect marine mammal habitat in two ways. The primary impacts are expected to be:

- Localized seafloor disturbance from removal of installed components, temporarily affecting turbidity and soft and hard bottom communities that have recolonized the local area since the original construction and installation; and
- Increases in ambient noise levels from vessel activities.

Seafloor disturbance will produce minor, localized impacts to the benthic community. Removal of installed components will temporarily disturb a small portion of seafloor at the buoys, suction piles, and transfer manifold. Likewise, turbidity increases will produce minor, localized, and short-term impacts to water quality.

A variety of impact producing factors – noise, discharges, physical presence, lights, and turbidity – with the potential to temporarily affect marine mammal prey availability may be expected as a result of proposed activities. The cetaceans within the activity area feed on various pelagic and benthic fish species, cephalopods, and crustaceans. These prey items are expected to have recolonized the DWP facility since its commission. Elevated noise levels and movement of installed components may cause some species to leave the immediate area of operations. Displaced individuals are expected to return shortly after work at each location is completed.

Discharges will be localized near their source and are not expected to adversely affect fish or squid. While the physical presence of vessels, divers and ROVs will produce avoidance behavior, night lighting may serve to attract fishes and squid; neither physical presence nor night lighting are expected to adversely affect these prey species. The ability for prey and predator detection may be limited within turbidity plumes created by decommissioning. However, these plumes are expected to be localized and temporary, settling within hours of the cessation of activities.

No short-term impacts to potential prey items (fishes, cephalopods, crustaceans) are expected from the proposed activities. Similar to the construction activities, the removal of installed components will not create long-term habitat changes. During original construction, the most significant habitat alteration was caused by the pipeline installation. During the proposed activities, the pipeline will remain in place and no disturbance along the corridor will occur. Any marine mammals displaced by seafloor disturbance are expected to return shortly after the construction activity has been completed. Marine mammals could be indirectly affected by very localized disturbance-related changes in benthic prey availability. Loss or displacement of prey species is expected to be short term; affected benthic species, representing a small fraction of available food resources in the project area, are expected to recover soon after removal activities cease.

9.2 LONG-TERM IMPACTS

There will be no further operations at the Neptune DWP, therefore, no long-term impacts associated with loss or modification habitat and its effect on marine mammals are expected. Decommissioning activities are expected to occur over a 70-day period within the July 2016 to July 2017 timeframe; no long-term impacts to marine mammals resulting from habitat alteration are expected. Additionally, the early decommission of the Neptune DWP eliminates the potentially 20+ years of operational disturbance to marine mammals, thereby offering a net benefit.

10.0 Effects of Habitat Loss or Modification on Marine Mammals

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

10.1 SHORT-TERM IMPACTS

Short-term impacts on benthic communities will occur during the decommissioning and removal or abandonment of Neptune DWP components at the North and South Buoys and Transfer Manifold (hot tap). Proposed activities will temporarily disturb small localized areas around each installed component slated for removal. Activities will produce suspension of fine sediments and resettlement of suspended sediments in the area immediately adjacent to ongoing operations. Resettlement of suspended sediments will produce localized reductions in benthic growth, reproduction, and survival rates of indigenous fauna; if the sediment resettlement is significant, smothering of benthic flora and fauna may occur.

Recovery of soft bottom benthic communities adversely affected by the proposed activity is expected to take a period of weeks to several years and will mirror the recovery times demonstrated from the previous construction activities. Displaced organisms will return shortly after activities ceases, while disrupted communities will recolonize from the adjacent soft bottom communities through larval settlement and immigration of juvenile and adult invertebrates and fishes. Disturbance to hard bottom communities will be followed by recolonization, but at a slower rate than that expected in soft bottom areas. Overall, short-term impacts to benthic communities that may support fishes utilized by marine mammals will be localized. No significant short-term impacts to marine mammal habitat are expected, either through loss or modification.

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

10.2 LONG-TERM IMPACTS

There will be no further operations at the Neptune DWP following decommissioning, therefore, no long-term impacts to habitat are expected. Additionally, the early decommission of the Neptune DWP eliminates the potentially 20+ years of operational disturbance to marine mammal habitat, thereby offering a net benefit.

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

Neptune LNG has demonstrated a strong commitment to minimizing impacts to marine mammal species through one of the most comprehensive and progressive mitigation and monitoring programs implemented for Neptune DWP construction and monitoring purposes. Likewise, they will implement an equally comprehensive and progressive mitigation and monitoring program for decommissioning of the Neptune DWP. Neptune LNG developed a Marine Mammal Detection, Monitoring, and Response Plan (MMDMP) for construction activities in 2008 (E&E, 2007). This plan was carried over into the Neptune DWP commissioning, operations, and repair IHA (E&E, 2010). The MMDMP will provide the framework for mitigation and monitoring during the proposed activities. These measures include the following components:

- Visual and acoustic monitoring program;
- Safety/shutdown zones;
- Recording and reporting; and
- Vessel speed/area restrictions.

The mitigation protocols have been designed to provide both protection to marine mammals from exposure to the highest noise levels and contributions to noise characterization and species for the region. The mitigation measures will reduce the impact to individual species as well as species stocks by minimizing exposure to potentially disruptive noise levels. The mitigation measures will further reduce any potential ship strikes to large whales in the area.

Elements of the visual monitoring program, acoustic disturbance mitigation, and vessel strike avoidance are detailed in the following text. Complete details of the proposed mitigations are discussed in the Mitigation and Monitoring Plan included as **Appendix** of this application.

11.1 METHODS TO MINIMIZE NOISE EXPOSURE

A visual and acoustic monitoring program with associated mitigation measures will be implemented for all proposed activities. A detailed description of this program can be found in the Mitigation and Monitoring Plan in **Appendix A**. Independent monitoring personnel, termed Protected Species Observers (PSOs), will be employed on all DP vessels during proposed activities. For the purposes of this IHA/LOA, protected species will include those marine mammal and sea turtle species that may occur in the project area. PSOs employed for the project (1) will meet or exceed the requirements defined by the national standards for a protected species observer program and data management program model (Baker et al., 2013; (2) will have experience monitoring marine mammal species in the Northeast U.S. region; and (3) will be approved by and the National Marine Fisheries Service Office of Protected Resources (NMFS OPR) prior to service.

Daily monitoring will consist of first, accessing information from existing sighting and acoustic alert networks (Navigational Telex (NAVTEX), NOAA Weather Radio, and NOAA Right Whale Sighing Advisory SAS), project vessel captains, and shipboard PSOs. PSOs will conduct 24-hour monitoring to cover both daytime and night time activities. The monitoring zone will encompass the ZOI. While it is recognized that a >3 km radius is not adequately observable in all sea states, weather conditions, and noise conditions for all species, it is a reasonable distance for visual and/or acoustic observers to detect large whales that may be near the edge of the 120 dB contour. A safety zone of 1 km will be established in which activities are adjusted for marine mammal sightings to minimize noise exposure. At least two PSOs will be on watch aboard the DP vessel at all times including transit and stationary operations. Daytime PSOs will visually monitor the ZOI and will periodically check the acoustic detections on the PAM system. PSOs on duty during daylight hours (dawn to dusk) will look for marine mammal species using the unaided eye and hand-held binoculars. Nighttime PSOs will monitor a mast-installed thermal imaging camera, which has been used on NOAA marine mammal abundance surveys. Additionally, nighttime acoustic monitoring will be conducted through the deployment of site-specific PAM buoys and a real time, shipboard monitoring station which is fully described in **Appendix**.

The detection limits of the designated ZOI and safety zones will be determined (1) visually using a calibrated binocular reticle with sea state and visibility data; and (2) acoustically with a noise performance profile. These visual and acoustic calibration reports will be submitted within the first 48 hours of observation duties and will be updated with changes in operations and monitoring conditions.

If a marine mammal species is observed, the PSO will note and monitor the position (including relative bearing and estimated distance to the animal) until the animal is no longer detected. The PSO will continue to monitor for additional animals that may surface in the area; often, there are numerous animals that may surface at varying time intervals. Mitigation actions will be implemented as described in **Table 11-1**.

Table 11-1. Monitoring and mitigation measures related to detection distances for cetaceans and sea turtles.

<table>
<tr><th>Detection Distance</th><th>Whale</th><th>Dolphin</th><th>Turtle
(Visual only)</th></tr>
<tr><td rowspan="5">1,000 m
(Heighted alert area)</td><td>All project vessels alerted to potential mitigation actions. All vessels in transit confirm slow speed of 10 knots (kn) or less.</td><td rowspan="5">All project vessels alerted</td><td rowspan="5">All project vessels alerted</td></tr>
<tr><td>All project vessels in transit record speed and confirm 10 kn or less.</td></tr>
<tr><td>Unnecessary transit is postponed.</td></tr>
<tr><td>Non-DP vessels put dedicated, trained crew member on bridge watch.</td></tr>
<tr><td>DP vessel records thruster output and confirms that thruster power is at minimum safe output.</td></tr>
<tr><td rowspan="4">500 m (NARW)
100m
(Other whales)

(Active mitigation area)</td><td>All project vessels alerted to potential mitigation actions.</td><td rowspan="4">DP vessel records thruster output and confirms that thruster power is at minimum safe output</td><td rowspan="4">DP vessel records thruster output and confirms that thruster power is at minimum safe output</td></tr>
<tr><td>All vessels will cease non-critical movement and activities.</td></tr>
<tr><td>Non-DP vessels place dedicated, trained crew member on bridge watch.</td></tr>
<tr><td>Thrusters on DP vessels will reduce to minimum safe power output. Power output/load of each thruster that remains in operation is recorded.</td></tr>
</table>

Any power-down or activity changes recommended by the PSO due to a marine mammal species sighting within the ZOI must be maintained until the sighted animal(s) has exited the ZOI or is not re-acquired after 30 minutes. Records will be maintained of all marine mammal species detections in the area, including date and time, weather conditions, species identification, approximate distance from the operations, direction and heading, and behavioral observations. When animals are observed in the ZOI, additional information will be recorded, such as a shutdown, duration of the shutdown, behavior of the animal, and time spent in the safety zone, will be recorded. The PSOs also will identify and record large schools of fish, large pelagic fish, sea turtles, basking sharks, jellyfish aggregations, or other indicators of a biologically productive area. In the unanticipated event of injury or death to a listed species, re-initiation of consultation with NMFS OPR is required. If a take of a listed species occurs from activities, a report of the incident will be submitted NMFS OPR. All other dead or injured marine mammals will be reported to the marine mammal stranding hotline or to local stranding network contacts. All other dead or injured marine mammal incidents will be reported to the NMFS Greater Atlantic Region Fisheries Office (GARFO) vessel captains shall focus on reducing DP thruster power to the maximum extent practicable, taking into account vessel and Port safety, during the operation activities. Vessel captains will shut down thrusters whenever they are not needed. As part of the acoustic monitoring program, Neptune LNG will conduct continuous source level measurements during all activities.

11.2 METHODS TO MINIMIZE VESSEL STRIKE RISK

For cetaceans, the following actions will be taken to minimize vessel interactions with marine mammals. These vessel operations are derived from Neptune DWP (76 FR 34157, June 13, 2011) and NEG DWP (81 FR 744, January 7, 2016) mitigation measures issued by NOAA for marine mammal avoidance measures during port operations, and modified for application to the Neptune DWP and proposed decommissioning activities.

1. All vessel crew members will undergo environmental training. Crew members who will act as designated watch personnel during heightened awareness conditions will receive specialized observer training.
2. All vessel operation requirements, guidelines and mitigation requirements will be clearly posted on the bridge of all project vessels.
3. All vessels shall utilize the International Maritime Organization (IMO)-approved Boston Traffic Separation Scheme (TSS) on their approach to and departure from the Neptune DWP and/or the unscheduled maintenance/maintenance area at the earliest practicable point of transit in order to avoid the risk of whale strikes.
4. All vessels transiting to and from the project area shall report their activities to the mandatory reporting Section of the USCG to remain apprised of North Atlantic right whale movements within the area. All vessels entering and exiting the Mandatory Ship Reporting Area (MSRA) shall report their activities to WHALESNORTH. Vessel operators shall contact the USCG by standard procedures promulgated through the Notice to Mariner system. Information regarding the geographical boundaries and reporting details can be found at: http://www.fisheries.noaa.gov/pr/shipstrike/msr.htm
5. No vessels will transit from shore to project site during nighttime or when visibility does not allow observation of the safety zone, unless an emergency situation requires the vessel to transit during those times.
6. All vessels will consult Navigational Telex (NAVTEX), NOAA Weather Radio, the NOAA Right Whale Sighting Advisory System (SAS) or other means to obtain current large whale sighting information.
7. If marine mammal detection within 1000m of the activity was reported by PSOs, NAVTEX, NOAA Weather Radio, SAS and/or an acoustic monitoring buoy, all project vessels will employ "heightened awareness" protocols including posting a trained crew member on board all moving vessels.

8. If member of the crew visually detects a marine mammal within the ZOI, they will alert the lead PSO on watch who shall then relay the sighting information to the other vessels to ensure action(s) can be taken to avoid physical contact with marine mammals.
9. All project vessels will remain at least 500m away from any visually detected North Atlantic right whale and at least 100 m away from all other visually-detected whales unless an emergency situation requires that the vessel stay its course.
10. In the event that a North Atlantic Right Whale is visually observed within 1 km from the activities or a confirmed acoustic detection is reported on any two PAM buoys closest to the activity, all vessel transits shall be delayed, unless an emergency situation requires that departure is not delayed. This departure delay shall continue until either the observed whale has been confirmed as more than 500m from the activity or 30 minutes have passed without another confirmed detection.
11. In response to any whale sightings or acoustic detections, and taking into account exceptional circumstances, all vessels shall actively communicate with the lead PSO and will take appropriate actions to minimize the risk of striking whales.

12.0 Arctic Plan of Cooperation

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

This section addresses the NMFS IHA/LOA requirement to address:

1. The suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species; and
2. The level of taking or impacts on the population of marine mammals that are expected to be present while conducting activities and suggested means of minimizing burdens by coordinating such reporting requirements with other schemes already applicable to persons conducting such an activity.

NMFS also requires that monitoring plans include a description of the survey techniques that would be used to determine the movement and activity of marine mammals near the activity site(s), including migration and other habitat uses such as feeding.

The proposed Mitigation and Monitoring Plan for Neptune DWP included as **Appendix** of this application, outlines monitoring and reporting requirements.

For the Visual Monitoring Program, records will be maintained of all marine mammal species sightings in the area, including date and time, weather conditions, species identification, approximate distance from the vessel at first and last detection, closest point of approach to vessel, direction and heading in relation to vessels, behavioral observations, vessel activity, and thruster power. When animals are observed in the impact zone, the additional information regarding corrective actions taken will be recorded. Continuous acoustic monitoring will be conducted during the project and all sound data will be archived. As is the case with general visual monitoring, acoustic and thermal camera monitoring will record all applicable information.

In the unanticipated event of injury or death to a listed species, re-initiation of consultation with NMFS Office of Protected Resources (OPR) is required. If a take of a listed species occurs from activities, a report of the incident will be submitted NMFS OPR. All other dead or injured marine mammals will be reported to the marine mammal stranding hotline or to local stranding network contacts. All other dead or injured marine mammal incidents will be reported to the NMFS GARFO.

14.0 Research Recommendations

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

While no direct research on marine mammals or marine mammal stocks is expected from the Neptune decommissioning project, there is the opportunity for the proposed activity to contribute greatly to the noise characterization in the region and to specific sound source measurements. The planned acoustic monitoring program data can be correlated to on-going acoustic data collection in the area, thus providing regional as well as vessel- and project-specific comparisons. Additionally, information regarding the noise isopleths and animal activities may provide needed insight regarding acoustic exposure and the associated impacts. Measurements can be applied to other LNG activities.

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

15.0 List of Preparers

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Appendix

Monitoring and Mitigation Plan for Neptune Deepwater LNG Port Maintenance and Decommissioning

Monitoring and Mitigation Plan for

Neptune Deepwater LNG Port Maintenance and Decommissioning

15 May 2016

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Acoustic Monitoring and Mitigation Plan for Neptune Deepwater LNG Port Decommissioning

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1.0 Introduction

The Neptune Deepwater Port (DWP) is located in the federal waters of within the Outer Continental Shelf (OCS), within in blocks NK 19-04 6525 and NK 19-04 6575. The DWP is located approximately 22 miles (35.4 km) northeast of Boston, Massachusetts, in water depths ranging from 125 to 250 ft. (38 to 76 m; **Figure 1**). The DWP consists of two mooring and unloading buoys and a pipeline that receives natural gas from “shuttle and regasification vessels” (SRVs), then through a flexible riser that connects to a 24-inch subsea flowline and ultimately into a 24-inch gas transmission line. The 24-inch gas transmission line connects the DWP pipeline system to the existing 30-inch Algonquin HubLine gas pipeline. As each SRV arrives, the regasification process of converting liquefied natural gas (LNG) into natural gas is initiated. The natural gas is transferred from the SRV through the unloading buoy, within the jurisdiction of the Commonwealth of Massachusetts.

This document describes the mitigation and monitoring plan developed for the Neptune LNG port decommissioning activities. The document summarizes the existing permit conditions, past acoustic modeling results, and the potential sound sources to be used during port decommissioning.

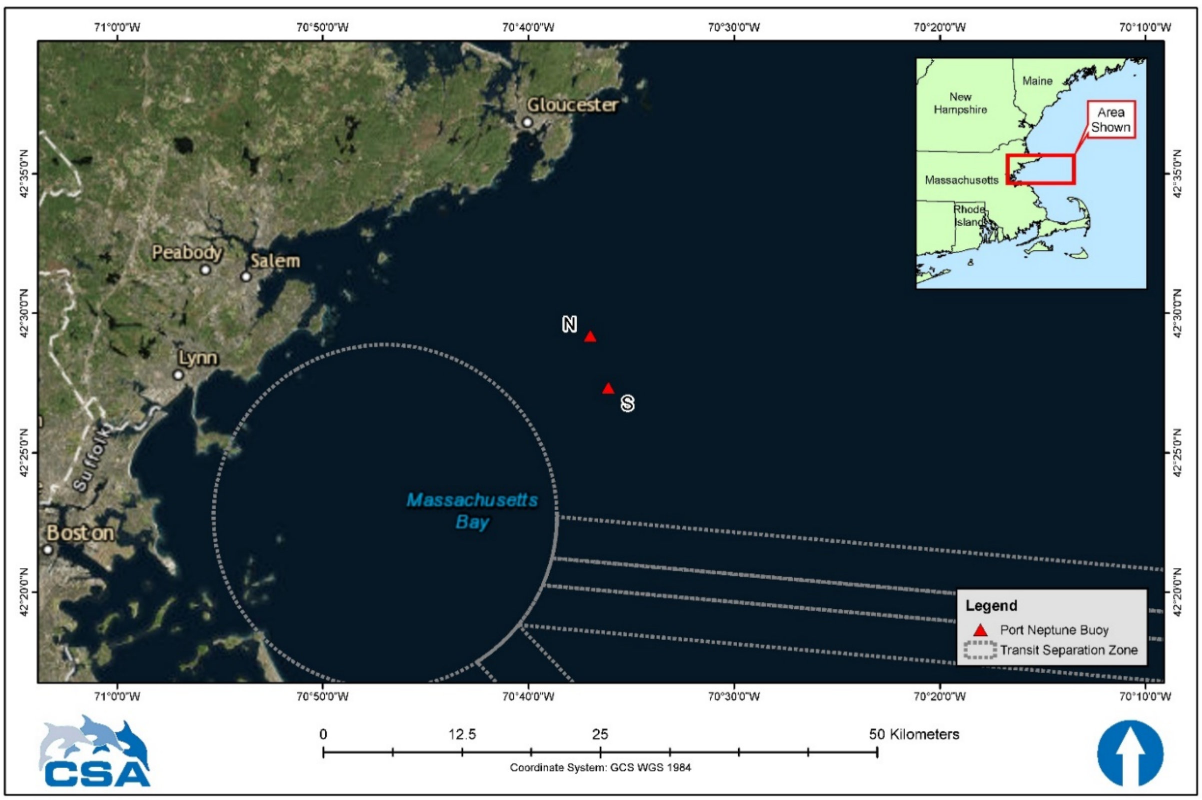

Figure 1. Location of North and South buoys for the Neptune liquefied natural gas port.

2.0 Marine Mammal Risks

Various natural and anthropogenic activities contribute sound to the ocean that creates a complex acoustic environment. The acoustic environment is comprised of concomitant sounds that create regional background, or ambient, noise conditions through which discrete signals must be sent and gathered by animals adapted to living in acoustically dominated habitats. Changes in the acoustic environment can, therefore, change an animal's ability to function within its given habitat. Noise generated by human activities may be introduced into the environment for a specific purpose. Examples of this include direct activities, such as navigational sonar and seismic exploration, or as a byproduct of indirect activities, such as shipping, construction, or industry. For purposes of understanding the sources and characteristics of the acoustic environment, ambient noise is generally divided into three frequency bands: low (10 to 500 Hz), medium (500 Hz to 25 kHz), and high (>25 kHz) (Hildebrand, 2009). Variations in the ambient noise level as a function of frequency can change by as much as 10 to 20 dB in a matter of days, minutes, or even seconds based on individual noise source variations (Richardson et al., 1995). Variations in environmental conditions and sound propagation can also cause changes in regional acoustic environments. The primary and secondary contributors to ambient noise in the low-frequency bands are shipping and the coupling of wind energy into the water during storm events, respectively (Richardson et al., 1995).

The sounds that animals hear and generate will vary in terms of dominant frequency, bandwidth, energy, temporal pattern, and directionality. In the particular case of marine mammals, anthropogenic noise can be viewed as a form of habitat fragmentation resulting in a loss of acoustic space that could otherwise be occupied by vocalizations or other acoustic cues important for cetacean ecology (Rice et al., 2014). Rather than competing with other species for an acoustic habitat in which to communicate, species must now compete with increasing anthropogenic sound for resource partitioning. A large portion of the noise from vessel traffic comes from vessel engines and propellers, and those sounds occupy the low-frequency bands in which most large whale calls and songs occur (Richardson et al., 1995). Primary acoustic habitat for a species will be focused within the vocal ranges for that species. Therefore, resource partitioning may be viewed on a frequency-band basis as well as an energy basis. Additionally, large- and small-scale temporal fluctuations (e.g., daily, seasonal) in the acoustic environment and vocalization pattern will contribute to an animal's acoustic resource use (Staaterman et al., 2014).

2.1 AUDITORY THRESHOLD SHIFTS

The minimum sound level an animal can hear within a specific frequency is called the hearing threshold. Too much exposure at a certain acoustic level might cause a shift in the animal's hearing thresholds within a specific frequency range. Exposure to high-amplitude sound sources within this frequency range may cause hearing impairment. The magnitude of the hearing impairment, or threshold shift, normally decreases over time following cessation of noise exposure. Threshold shifts can be temporary (temporary threshold shift [TTS]) or permanent (permanent threshold shift [PTS]) and are defined as follows (adapted from Finneran et al., 2005; Southall et al., 2007):

- TTS – the mildest form of hearing impairment; exposure to strong sound results in a non-permanent (reversible) elevation in hearing threshold, making it more difficult to hear sounds. TTS can last from minutes or hours to days; the magnitude of the TTS depends on the level and duration of the sound exposure, among other considerations.

- PTS – permanent elevation in hearing threshold. PTS is attributed to prolonged or repeated exposures to levels of sound strong enough to elicit an extreme magnitude of TTS.

The received sound levels that have the potential to invoke TTS or PTS in marine mammals are regulated by the National Oceanic and Atmospheric Administration (NOAA). NOAA classifies TTS and PTS as forms of harassment when assessing acoustic impacts to marine mammals. NOAA defines Level A harassment as the onset of PTS, which equates with an auditory injury; and Level B harassment as the onset of TTS, which is not considered to be an auditory injury. Level B harassment may also include the broad category of behavioral impacts which by and large occur at lower sound exposure levels (discussed in **Section 2.2**); however, threshold criteria for behavioral onset have not yet been developed. Therefore, behavioral impacts may also be taken into account in individual permit reviews. Only Level B takes have been permitted for all Neptune LNG activities. In February 2016, the National Marine Fisheries Service (NMFS) released the third draft of proposed noise criteria upon which impacts for permitting activities involving marine mammals would be based (**Table 1**) (NOAA, 2015). The dosage of sound pressure levels (SPLs) that a mammal receives (called the received level) provides the basis for potential mitigation and monitoring zones that are necessary to protect marine mammals from acoustic impacts (TTS and PTS) during decommissioning operations. While these threshold levels are still a proposed draft, they provide more scientifically based guidance than the interim threshold criteria (NOAA, 2005) originally used to inform the LOAs issued for Neptune LNG port activities. The new acoustic threshold criteria are anticipated to be accepted as final by NOAA later in 2016. Therefore, we have used these criteria as the best available science to develop the mitigation and monitoring plan. No Level A harassment potential is expected from decommissioning activities.

Table 1. Summary of interim (2005) and draft (2016) regulatory threshold sound pressure levels for Level A and Level B acoustic exposure.

Functional Hearing Group	Level B Harassment				Level A Harassment		
	Impulsive Sources		Non-Impulsive Sources		Interim Criteria	Draft Criteria	
	Interim Criteria[1]	Draft Criteria[2]	Interim Criteria[1]	Draft Criteria[2] (frequency weighted)	All Sources[1]	Impulsive Sources[2]	Non-Impulsive Sources[2] (frequency weighted)
Low-frequency cetaceans	160	224_{peak} 177 SEL_{cum}	120	187 SEL_{cum}	180	230_{peak} 192 SEL_{cum}	230_{peak} 207 SEL_{cum}
Mid-frequency cetaceans	160	224_{peak} 172 SEL_{cum}	120	179 SEL_{cum}	180	230_{peak} 187 SEL_{cum}	230_{peak} 199 SEL_{cum}
High-frequency cetaceans	160	196_{peak} 139 SEL_{cum}	120	151 SEL_{cum}	180	202_{peak} 154 SEL_{cum}	202_{peak} 171 SEL_{cum}
Phocid Pinnipeds (Underwater)	160	224_{peak} 171 SEL_{cum}	120	181 SEL_{cum}	190	230_{peak} 186 SEL_{cum}	230_{peak} 201 SEL_{cum}
Otariid Pinnipeds (Underwater)	160	224_{peak} 188 SEL_{cum}	120	198 SEL_{cum}	190	230_{peak} 203 SEL_{cum}	230_{peak} 218 SEL_{cum}

[1] Levels given in dB re 1µ Pa rms (root mean square).
[2] Peak levels given in dB re 1µ Pa and cumulative sound exposure level (SEL) given in dB re 1 µPa^2·s.

In the Letter of Authorization (LOA) dated July 2011, take estimates for Level B harassment were established based on the interim acoustic threshold criteria using the 120 dB re 1 µPa level. Using this threshold level, the authorized takes issued were as follows:

- North Atlantic right whale *(Eubalaena glacialis)*: 120 (average of 24 annually);
- Humpback whale *(Megaptera novaeangliae)*: 390 (average of 78 annually);
- Fin whale *(Balaenoptera physalus)*: 145 (average of 29 annually);
- Minke whale *(B. acutorostrata)*: 90 (average of 18 annually);
- Sei Whale *(B. borealis)*: 60 (average of 12 annually);
- Long-finned pilot whale *(Globicephala melas)*: 595 (average of 119 annually);
- Atlantic white-sided dolphin *(Lagenorhynchus acutus)*: 1,935 (average of 387 annually);
- Common dolphin *(Delphinus delphis)*: 100 (average of 20 annually);

- Bottlenose dolphin *(Tursiops truncatus)*: 50 (average of 10 annually);
- Risso's dolphin *(Grampus griseus)*: 100 (average of 20 annually);
- Killer whale *(Orcinus orca)*: 100 (average of 20 annually);
- Harbor porpoise *(Phocoena phocoena)*: 25 (average of 5 annually);
- Harbor seal *(Phoca vitulina)*: 25 (average of 15 annually); and
- Gray seal *(Halichoerus grypus)*: 15 (average of 15 annually).

The potential to meet or exceed any of these takes during decommissioning activities is highly unlikely even at the 120-dB isopleth. Using the updated exposure criteria, the potential for Level B takes falls to nearly zero for all of these species. **Section 3.1** describes the extent of the expected sound fields. **Section 6.3** provides estimates of potential take by harassment associated with DWP maintenance and decommissioning activities.

2.2 ACOUSTIC DISTURBANCE

In addition to TTS and PTS, disturbance can induce a variety of effects, including subtle changes in behavior, conspicuous dramatic changes in activities, and displacement. Southall (2014) identifies at least seven levels of response, including (in increasing severity and decreasing likelihood) no observable response, increased alertness, minor behavioral responses (e.g., vocal modifications associated with masking), cessation of feeding or social interaction, temporary avoidance behavior, modification of group structure or activity state, and habitat abandonment. If a marine mammal reacts to an underwater sound by changing its behavior or moving to avoid a sound source, the impacts of that change may not be important to the individual, the stock, or the species as a whole. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on individuals and the population could be important.

There is a considerable amount of literature available on the effects of anthropogenic sounds on marine mammals. Richardson et al. (1995) noted that most small- and medium-sized toothed whales exposed to prolonged or repeated underwater sounds are unlikely to be displaced unless the overall received level is at least 140 dB re 1 µPa, which is higher than the estimated received levels beyond 9 km of the project site. While a prediction of behavioral responses resulting from received SPLs is problematic due to the inconsistency of the data, several study results are available.

Mysticetes probably have better hearing sensitivities at lower frequencies than odontocetes and several studies suggest potential deflection from a received sound levels of approximately 120 dB re 1 µPa while migrating (Malme et al., 1988; Southall et al., 2007). North Atlantic right whales (NARWs) exhibited changes in diving behavior when exposed to noise below 135 dB re 1 µPa (Nowacek et al., 2004). Additionally, North Atlantic right whales exposed to high shipping noise increased call amplitude (Parks et al., 2011), and some humpback whales responded to low-frequency active sonar playbacks by increasing song length (Miller et al., 2000; Fristrup et al., 2003).

Behavioral responses to acoustic exposure generally are more variable, context-dependent, and less predictable than effects of noise exposure on hearing or physiology (Southall et al., 2007). There is no consensus on the appropriate noise exposure metric for assessing behavioral reactions, and thus it is recognized that many variables other than exposure level affect the nature and extent of responses to a particular stimulus (Ellison and Frankel, 2012; Southall et al., 2007).

2.3 VESSEL STRIKES

Vessel strikes pose a substantial risk to large whales (Laist et al., 2001; Van Waerebeek et al., 2007), with NARWs being particularly susceptible due to its congregations and movements in and around shipping lanes, near-shore behaviors, and time spent at the surface (Nowacek et al., 2004). In an effort to reduce NARW strikes, NMFS issued a Final Rule to reduce the severity and likelihood of vessel strikes to NARWs, which went into effect on December 9, 2008 (73 FR 60173; 10 October 2008).

Any ship operating in the decommissioning area has the potential to encounter large whales, including the NARW. Speed and operating restrictions for construction and port operation are outlined in the LOA dated July 11, 2011 and are provided for reference in **Section 3.0**. Adhering to these restrictions and implementing a heightened awareness monitoring when a NARW is detected within 3.5 km of the project site (described in **Section 3.2**) will minimize the risk of vessel strikes during decommission activities.

3.0 Mitigation and Monitoring

The potential acoustic risks to marine mammals during decommissioning activities are similar to those risks posed during construction activities due to the similarity of vessels used. Therefore, monitoring protocols will closely follow the construction LOA monitoring protocols (NOAA, 2009), which are more protective than the operational protocols stipulated in the recent LOA dated July 2011. Mitigation actions will follow construction and operational protocols stipulated in both the 2009 and 2011 LOAs and are detailed in **Sections 3.1** through **3.4.**

The approach to developing the monitoring plan for decommissioning activities will follow the conditions for the comparable vessels addressed within the construction LOA. The approach will consist of both visual and acoustic monitoring. Due to the risk of vessel interaction with the NARW, an enhanced, real-time acoustic alert system is recommended for implementing heightened awareness and precautionary actions whenever NARWs are acoustically detected within 3 km of the decommissioning operations. The monitoring will be conducted by shipboard personnel and independent Protected Species Observers (PSOs).

3.1 MITIGATION MEASURES (MAY 1 TO NOVEMBER 30)

(i). If a whale is detected within 0.6 mi (1 km) of any project vessel(or acoustically detected on 2 or more buoys), the vessel superintendent or on-deck supervisor will be notified immediately. The vessel's crew will be put on a heightened state of alert. The marine mammal will be monitored constantly to determine if it is moving toward the repair area.

(ii). Vessels will cease any movement in the area if a cetacean, other than a right whale is sighted within or approaching to a distance of 500m from the operating repair vessel. Vessels will cease any movement in the construction area if a right whale is sighted within or approaching to a distance of 100m from the operating vessel.

(iii). Vessels will cease all sound emitting activities, other than those required for safe operations, if a marine mammal other than a right whale is sighted within or approaching to a distance of 100m or if a right whale is sighted within or approaching to a distance of 500m, from the operating repair vessel.

(iv). Activities may resume after the marine mammal is positively reconfirmed outside the established zones or if the marine mammal has not been re-sighted in the established zones for 30 minutes.

(v). While under way, all project vessels will remain 500m away from right whales and 100m away from all other marine mammals to the extent physically feasible given navigational constraints.

(vi). All repair vessels 300 gross tons or greater will maintain a speed of 10 knots (18.5 km hr^{-1}) or less. Vessels less than 300 gross tons carrying supplies or crew between the shore and the repair site will contact the Mandatory Ship Reporting System (MSRS), the USCG, or the protected species observers (PSOs) at the repair site before leaving shore for reports of recent right whale sightings or active Dynamic Management Areas (DMAs) and consistent with navigation safety, restrict speeds to 10 knots (18.5 km hr^{-1}) or less within 5 mi (8 km) of any recent sighting location and within any existing DMA.

3.2 MITIGATION MEASURES (DECEMBER 1 TO APRIL 30)

If unplanned/emergency repair activities cannot be conducted between May 1 and November 30, then Neptune shall implement the following mitigation measures in addition to those listed in conditions 4(a)(i)-(vii) above to ensure the least adverse practicable impact on marine mammals:

(i). If on-board PSOs do not have at least 1-km visibility, they shall call for a shutdown of repair activities. If dive operations are in progress, then they shall be safely halted and brought on board until visibility is adequate to see a 1-km range. At the time of shutdown, the use of thrusters must be minimized to the lowest level needed to maintain personnel safety. If there are potential safety problems due to the shutdown, the captain must decide what operations can safely be shut down and shall document such activities in the data log.

(ii). Prior to leaving the dock to begin transit, the vessels must contact one of the PSOs on watch to receive an update of sightings within the visual observation area. If the PSO has observed a North Atlantic right whale within 30 minutes of the transit start, the vessel will hold for 30 minutes and again get a clearance to leave from the PSOs on board. PSOs will assess whale activity and visual observation ability at the time of the transit request to clear the barge for release.

(iii). Neptune or its contractor shall provide a half-day training course to designated crew members assigned to the transit barges and other support vessels. This course shall cover topics including, but not limited to, descriptions of the marine mammals found in the area, mitigation and monitoring requirements contained in this Authorization, sighting log requirements, and procedures for reporting injured or dead marine mammals. These designated crew members shall be required to keep watch on the bridge and immediately notify the navigator of any whale sightings. All watch crew shall sign into a bridge log book upon start and end of watch. Transit route, destination, sea conditions, and any protected species sightings/mitigation actions during watch shall be recorded in the log book. Any whale sightings within 1000 m) of the vessel shall result in a high alert and slow speed of 4 knots (7.4 km hr^{-1}) or less. A sighting of any whale within 500m, shall result in idle speed and/or ceasing all movement, not required for safe operations.

(iv). The material barges and tugs used for repair work shall transit from the operations dock to the work sites during daylight hours, when possible, provided the safety of the vessels is not compromised. Should transit at night be required, the maximum speed of the tug will be 5 knots (9.3 km hr^{-1}).

(v). Consistent with navigation safety, all repair vessels must maintain a speed of 10 knots (18.5 km hr^{-1}) or less during daylight hours. All vessels will operate at 5 knots or less at all times within 3.1 mi (5 km) of the repair area.

3.3 SPEED RESTRICTIONS IN SEASONAL MANAGEMENT AREAS (SMAS)

Repair vessels and shuttle regasification vessels (SRVs) shall transit at 10 knots (18.5 km/hr) or less in the following seasons and areas, which either correspond to or are more restrictive than the times and areas in NMFS' regulations at 50 CFR 224.105 that implement speed restrictions to reduce the likelihood and severity of ship strikes of right whales:

(i). CCB SMA from January 1 through May 15, which includes all waters in CCB, extending to all shorelines of the Bay, with a northern boundary of 42° 12' N. latitude;

(ii). Off Race Point SMA year round, which is bounded by straight lines connecting the following coordinates in the order stated: 42° 30' N. 69° 45' W.; thence to 42° 30' N. 70° 30' W.; thence to 42° 12' N. 70° 30' W.; thence to 42° 12' N. 70° 12' W.; thence to 42° 04' 56.5" N. 70° 12' W.; thence along mean high water line and inshore limits of COL REGS limit to a latitude of 41 ° 40' N.; thence due east to 41 0 41' N. 69° 45' W.; thence back to starting point; and

(iii). Great South Channel (GSC) SMA from April 1 through July 31, which is bounded by straight lines connecting the following, coordinates in the order stated:

- 42' 30' N. 69' 45' W.
- 41'40' N. 69'45' W.
- 4I'OO'N. 69' 05' W.
- 42' 09' N. 67' 08' 24" W.
- 42' 30' N. 67' 27' W.
- 42' 30' N. 69' 45' W.

3.4 ADDITIONAL MITIGATION MEASURES

(i). PSOs shall direct a moving vessel to slow to idle if a baleen whale is seen less than 0.6 mi (1 km) from the vessel.

(ii). Use of lights during repair or maintenance activities shall be limited to areas where work is actually occurring, and all other lights must be extinguished. Lights must be down shielded to illuminate the deck and shall not intentionally illuminate surrounding waters, so as not to attract whales or their prey to the area.

(iii). The holder of this Authorization must immediately suspend any repair and maintenance or operations activities if a dead or injured marine mammal is found in the vicinity of the project area, and the death or injury of the animal could be attributable to the LNG facility activities. Neptune must contact NMFS (telephone: 301-427-8401) and the Northeast Stranding and Disentanglement Program (telephone: 978-281-9351). Activities shall not resume until review and approval has been given by NMFS.

3.5 VISUAL MONITORING

The approach to developing the monitoring plan for decommissioning activities will follow the conditions for the comparable vessels addressed within the construction LOA. The approach will consist of both visual and acoustic monitoring. Due to the risk of vessel interaction with the NARW, an enhanced, real-time acoustic alert system is recommended for implementing heightened awareness and precautionary actions whenever NARWs are detected within 3 km of the decommissioning operations. The monitoring will be conducted by shipboard personnel and independent Protected Species Observers (PSOs).

1. Each dynamically positioned (DP) vessel will employ three professional PSOs. Two PSOs will conduct continual visual watches on a shift basis during all daylight hours. Daytime PSOs will monitor the acoustic alert program when not on active visual watch. During the night, one PSO will monitor the acoustic alert program and will scan the area around the vessel using a thermal imaging or similar enhancement device such as a mast-mounted FLIR™ or Seiche LLC thermal/high definition camera system for 15 minutes each hour.

All professional PSOs will be approved by NMFS prior to the start of the project, will have at least one full year of marine mammal observation experience in the U.S. Atlantic or U.S. Gulf of Mexico, and will have experience in acoustic monitoring and baleen whale detection.

Each non-DP vessel will designate one trained crew member to stand a dedicated watch during all vessel movement and during times of heightened awareness due to NARW detections within 3 km of the project site. All designated crew watch personnel will undergo a full day of project-specific mitigation and monitoring training alongside the professional PSOs.

PSOs will be responsible for advising vessel crew members on the required operating procedures and mitigation measures that are defined in the 2009 and 2011 LOAs, as appropriate. PSOs will be responsible for providing the required observation and detection data during the decommissioning activities.

3.6 ACOUSTIC MONITORING

Acoustic monitoring for cetacean calls will be conducted at night to substitute for visual monitoring during the day. The passive acoustic monitoring (PAM) buoys continuously record and analyze underwater sounds, including calling whales, throughout the entirety of the deployment period. The buoys can be operated in real time when bandwidth allows periodic transfer of data, or buoys can operate using auto detection capabilities. When the onboard software detects a whale call, the buoy sends the spectral data for the detected signal via radio link to a computer display or handheld device that is monitored by the PSO on duty. If a detection alert is received, the PSO will review the data and confirm that the signal is a whale call. Upon verification, the PSO will monitor the other buoys for call detections. If the PSO verifies detections from two other buoys, then it will be determined that a whale is within the heightened awareness area. Mitigation measures for acoustic detection of whales will be the same as those for visual detection described in **Sections 3.1** and **3.2**. Additionally, upon confirmation of a NARW within 3.5 km of the project site, all vessel captains will be immediately notified, crew PSOs will stand watch, vessel speeds will be reduced, unnecessary transits will be delayed, and the area will be visually and acoustically monitored until the PSO determines that normal operating procedures can be resumed.

3.7 EFFECTIVE MONTORING AREA

The establishment of an effective monitoring area described in this document was based on sound sources associated with activities that may result in the generation of acoustic noise due to unscheduled maintenance and decommissioning. Anticipated acoustic sound sources related to either of these activities will be limited to construction-related vessel DP thrusters used during station keeping. It has been estimated that the likely decommissioning scenario will include one dive support vessel (DSV) and one heavy lift vessel (HLV). The primary source of generated sound from both vessels would be the use of DP thrusters. **Table 2** summarizes the vessels used as proxy for modeling.

Table 2. Source specifications, including propulsion power, length, draft, source location, activity, proxy source and broadband source level (SL).

Noise Source	Source Description[2]	Activity	Proxy Source	Modeled Broadband SL (dB re 1 µPa·m)
Dive Support Vessel	Propulsion Power: 2,640 bhp Length: 31.6 m Draft: 4.1 m	DP	*Fu Lai*[1]	177.9 dB

[1] MacGillivray, 2006.
[2] bhp = brake horsepower.

The propagated noise from the sound sources described in **Table 2** and modeled in the noise assessment (LGL and JASCO, 2005) was used to generally estimate the monitoring zone requirements as well as to estimate the expected distances where TTS threshold isopleths would occur. Area coverage and average range of contours for decommissioning activities is shown in **Table 3**. Modeled range of the received noise level isopleths during Neptune decommissioning activities based on modeled sound source data from on-site construction operations.

Table 3. Expected propagation distances of sound pressure levels resulting from a DSV working at two locations within the project area.

Received Sound Level (dB re 1 µPa)	Average propagation distance (km)	
	Transmission Manifold	South Buoy
100	71.36	73.25
110	14.63	15.47
120	3.12	3.45
130	0.28	0.28
140	0.05	0.05
150	<0.01	<0.01
160	<0.01	<0.01

According to data collected in the Stellwagen Bank National Marine Sanctuary (NMS), the average source level of right whale up-calls in this area is 165 ± 3.5 dB re 1 µPa root-mean-square (rms) (Clark et al., 2010). Using these data and acoustic propagation loss models, maximum detection distances for right whale up-calls likely ranged from 6.7 to 8.7 km. Long-term acoustic monitoring within the Gulf of Maine (Bort et al., 2015) showed that NARWs were persistent in the area year round. Up-calls and gunshots occurred seasonally, with peaks of each call type occurring in November and December, respectively. Lowest total call frequencies took place between February and July.

To provide adequate acoustic monitoring of a mitigation zone, the signal strength of the caller must be greater than the background noise levels received by the detection system within the same frequency bands. Since 1996, an annual monitoring program conducted by National Undersea Research Center personnel in conjunction with the North Atlantic and Great Lakes Aquanaut Program during the summer months has provided some measurements of ambient noise levels in the Stellwagen Bank NMS (Scheifele and Darre, 2005; Aquanaut, 2004). Noise level data are reported at three frequencies (50, 100, and 500 Hz) for four individual measurement days during consecutive years (Scheifele and Darre, 2005). The preliminary data provided imply that ambient noise levels within the Stellwagen Bank NMS range from 50 to 100 dB re 1 µPa Hz^{-1}, depending on location, time of the measurement, and frequency.

The theoretical noise performance graph for the decommissioning site (**Figure 2**) shows that for a NARW, the call strength must exceed 130 dB re 1 µPa to be effectively detected within 3 km of the project site. As seen in **Figure 2**, even at 3.5 km, the spectral content of a NARW call between 30 and 800 Hz is well above the noise level produced by decommissioning activities. This allows for detection of calls at acoustic buoys located at 3 to 3.5 km.

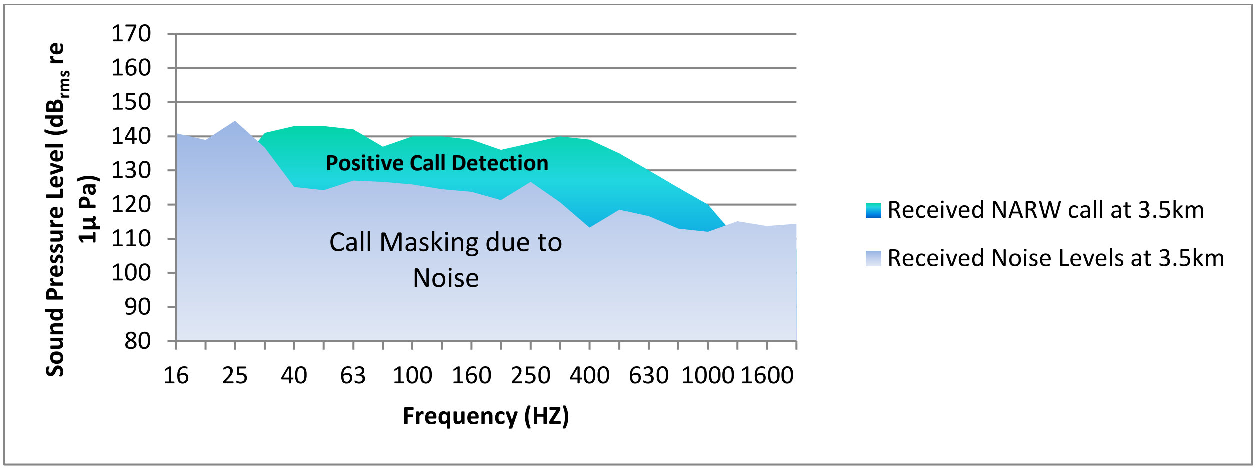

Figure 2. Noise performance graph depicts the predicted North Atlantic right whale (NARW) calls with the frequency and sound pressure levels that enable detection of a NARW at 3.5 km from the acoustic buoy under the masking conditions expected from vessel activity.

Given the ambient noise conditions and the contribution of noise during decommissioning, an effective range of 6.5 km has been adopted as the detection distance for a NARW upcall to be positively detected on one acoustic detection buoy. The 3.5 km is used as the detection distance for a NARW upcall to be positively detected on three acoustic detection buoys, located on a 3 km perimeter radial pattern around the decommissioning activities (**Figure 3**).

A single deployment of four acoustic buoys will adequately provide an effective acoustic monitoring area for the protection of marine mammal species and determine take estimates due to sound emitted by the decommissioning activities. This configuration provides a conservative detection range for NARWs within 3.5 km of the project area that would initiate heightened awareness mitigation actions. The coverage area also provides detection information within the permitted 120-dB isopleth that cannot be covered visually in order to meet LOA take reporting requirements. Finally, the monitoring program provides an acoustic record both for project sound sources and for marine species in the area.

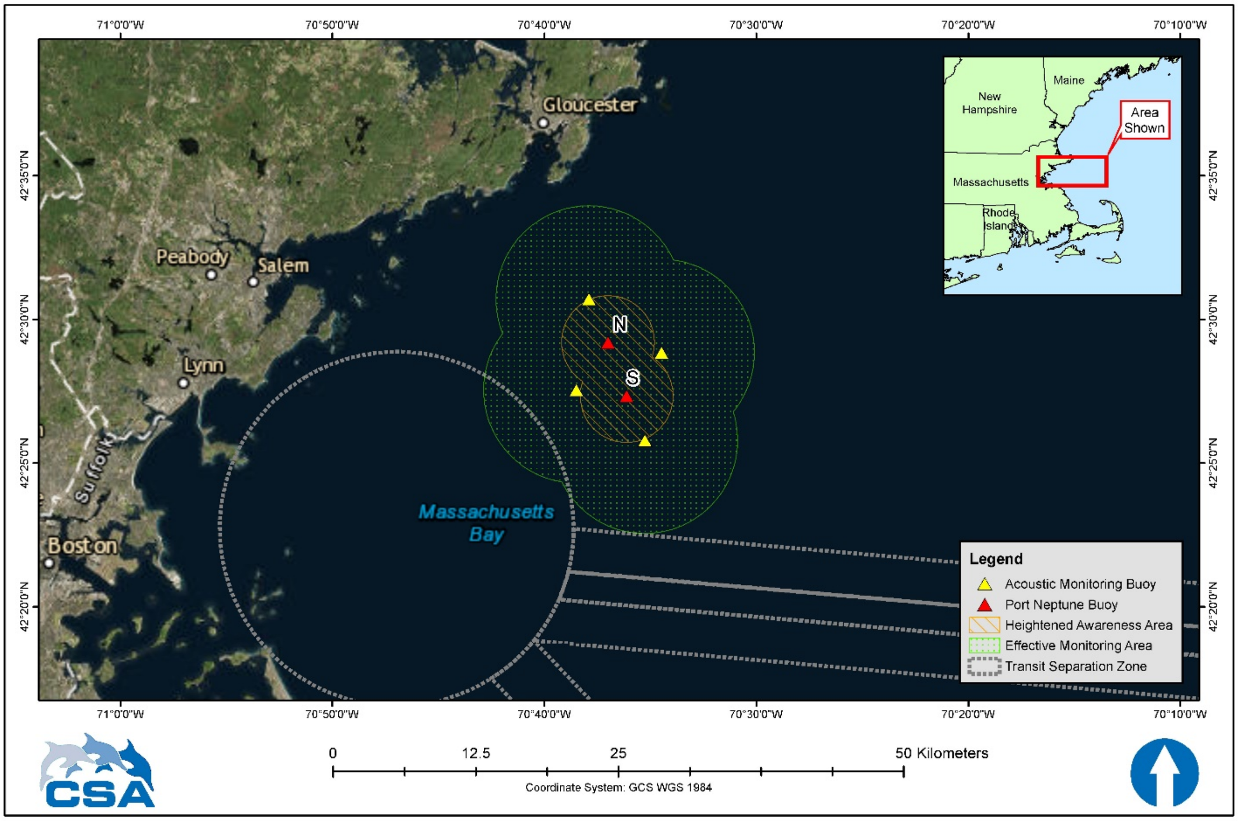

Figure 3. Location of North and South Buoys within the effective acoustic monitoring area and the heightened awareness area in which three acoustic buoys would receive a North Atlantic right whale (NARW) call indicating its likely presence within 3 km of the project area, thereby initiating a heightened awareness by watch crew and vessel personnel.

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