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DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RTID 0648-XA053

Take of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to the Hampton Roads Bridge-Tunnel Expansion Project, Hampton-Norfolk, Virginia

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Notice; proposed incidental harassment authorization; request for comments on proposed authorization and possible renewals.

SUMMARY: NMFS has received a request from the Hampton Roads Connector Partners (HRCP) for an authorization to take marine mammals incidental to the pile driving activities associated with the Hampton Roads Bridge-Tunnel (HRBT) Expansion Project. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is requesting comments on its proposal to issue an incidental harassment authorization (IHA) to incidentally take marine mammals during the specified activities. NMFS is also requesting comments on a possible one-year renewal that could be issued under certain circumstances and if all requirements are met, as described in *Request for Public Comments* at the end of this notice. NMFS will consider public comments prior to making any final decision on the issuance of the requested MMPA authorization and agency responses will be summarized in the final notice of our decision.

DATES: Comments and information must be received no later than [insert date 30 days after date of publication in the FEDERAL REGISTER].

ADDRESSES: Comments should be addressed to Jolie Harrison, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service. Physical comments should be sent to 1315 East-West Highway, Silver Spring, MD 20910 and electronic comments should be sent to *ITP.Egger@noaa.gov*.

Instructions: NMFS is not responsible for comments sent by any other method, to any other address or individual, or received after the end of the comment period. Comments received electronically, including all attachments, must not exceed a 25-megabyte file size. Attachments to electronic comments will be accepted in Microsoft Word or Excel or Adobe PDF file formats only. All comments received are a part of the public record and will generally be posted online at *https://www.fisheries.noaa.gov/permit/incidental-take-authorizations-under-marine-mammal-protection*-act without change. All personal identifying information (*e.g.*, name, address) voluntarily submitted by the commenter may be publicly accessible. Do not submit confidential business information or otherwise sensitive or protected information.

FOR FURTHER INFORMATION CONTACT: Stephanie Egger, Office of Protected Resources, NMFS, (301) 427-8401. Electronic copies of the application and supporting documents, as well as a list of the references cited in this document, may be obtained online at: *https://www.fisheries.noaa.gov/permit/incidental-take-authorizations-under-marine-mammal-protection-act*. In case of problems accessing these documents, please call the contact listed above.

SUPPLEMENTARY INFORMATION:

Background

The MMPA prohibits the "take" of marine mammals, with certain exceptions. Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 *et seq.*) direct the Secretary of Commerce (as delegated to NMFS) to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and either regulations are issued or, if the taking is limited to harassment, a notice of a proposed incidental take authorization may be provided to the public for review. Under the MMPA, ‘‘take’’ is defined as meaning to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal.

Authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s) and will not have an unmitigable adverse impact on the availability of the species or stock(s) for taking for subsistence uses (where relevant). Further, NMFS must prescribe the permissible methods of taking and other "means of effecting the least practicable adverse impact" on the affected species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such species or stocks for taking for certain subsistence uses (referred to in shorthand as "mitigation"); and requirements pertaining to the mitigation, monitoring and reporting of such takings are set forth. The definitions of all applicable MMPA statutory terms cited above are included in the relevant sections below.

National Environmental Policy Act

To comply with the National Environmental Policy Act of 1969 (NEPA; 42 U.S.C. 4321 *et seq*.) and NOAA Administrative Order (NAO) 216-6A, NMFS must review our proposed action (*i.e.*, the issuance of an incidental harassment authorization) with respect to potential impacts on the human environment.

These actions are consistent with categories of activities identified in Categorical Exclusion B4 (incidental harassment authorizations with no anticipated serious injury or mortality) of the Companion Manual for NOAA Administrative Order 216-6A, which do not individually or cumulatively have the potential for significant impacts on the quality of the human environment and for which we have not identified any extraordinary circumstances that would preclude this categorical exclusion. Accordingly, NMFS has preliminarily determined that the issuance of the proposed IHA qualifies to be categorically excluded from further NEPA review.

We will review all comments submitted in response to this notice prior to concluding our NEPA process or making a final decision on the IHA request.

Summary of Request

On September 18, 2019, NMFS received a request from the HRCP for an IHA to take marine mammals incidental to impact and vibratory pile driving activities associated with the HRBT, in Hampton and Norfolk, Virginia for one year from the date of issuance. The application was deemed adequate and complete on February 4, 2020. The HRCP request is for take of a small number of five species of marine mammals by Level A and B harassment. Neither the HRCP nor NMFS expects injury, serious injury or mortality to result from this activity and, therefore, an IHA is appropriate. The proposed activities are part of a larger project and the applicant has requested rulemaking and a letter of authorization for the other components of this project.

Description of Proposed Activity

Overview

The HRCP is working with the Virginia Department of Transportation (VDOT) and Federal and state agencies to advance the design, approvals, and multi-year construction of the Interstate (I)-64 HRBT Expansion project. The overall project will widen I-64 for approximately 9.9 miles along I-64 from Settlers Landing Road in Hampton, Virginia to the I-64/I-564 interchange in Norfolk, Virginia. The project will create an eight-lane facility with six consistent use lanes. The project will include full replacement of the North and South Trestle Bridges, two new parallel tunnels constructed using a Tunnel Boring Machine (TBM), expansion of the existing portal islands, and widening of the Willoughby Bay Trestle Bridges, Bay Avenue Trestle Bridges, and Oastes Creek Trestle Bridges. Also, upland portions of I-64 will be widened to accommodate the additional lanes, the Mallory Street Bridge will be replaced, and the I-64 overpass bridges will be improved. The proposed activities below are part of the overall project (see the applicant for additional details on the overall project). Only the activities relevelant to the Incidental Harassment Authorization (IHA) requested by HRCP are discussed below. This includes the following components:

- TBM Platform at the South Island;
- Conveyor Trestle at the South Island;
- Temporary trestles for jet grouting at the South Island;
- Temporary trestle for bridge construction at the North Shore;
- Mooring piles at the South Trestle (located at the South Island), North Island, and Willoughby Bay; and
- Installation and removal of piles for test pile program.

Pile installation methods will include impact and vibratory driving, jetting, and drilling with a down-the-hole (DTH) hammer. Pile removal techniques for temporary piles will include vibratory pile removal or cutting below the mud line. Installation of steel pipe piles could be 24-, 36-, or 42-inches (in) in diameter to support temporary work trestles, platforms, and moorings. Test piles would consist of 30-in square concrete or 54-in concrete cylinder piles. Only load test piles will be removed under this IHA. In-water pile installation using impact and vibratory driving, and drilling with a DTH hammer, and pile removal using a vibratory hammer, have the potential to harass marine mammals acoustically and could result in incidental takes of individual marine mammals. Jetting is not likely to result in take. During jetting, high-pressure water is sprayed out of the bottom of the pile to help penetrate dense sand layers and to allow pile driving with lower hammer impact energies (Caltrans 2015). The pressurized fluid would be used to temporary loosen soils thus reducing the resistance of the pile to sinking into the ground. Jetting woul be conducted at the surface of the seabed but rather at depth once sufficient resistance to pile driving has been met. Jetting would not be used to remove or displace surface sediments. The caisson will be driven using a vibratory hammer and the sediment and sand removed from the caisson prior to driving the permanent concrete pile. Vibratory hammering is accounted for takes of marine mammals.

Dates and Duration

The IHA application is requesting take that may occur from the pile driving and removal activities for one year after issuance. Work could occur at any point during the year, and will occur during the day. Pile installation may extend into evening or nighttime hours as needed to accommodate pile installation requirements (*e.g.*, once pile driving begins – a pile will be driven to design tip elevation). The overall number of anticipated days of pile installation is 312, based on a 6-day work week for one year. Pile installation can occur at variable rates, from a few minutes to several hours. The HRCP anticipate that 1 to 10 piles could be installed per day. In order to account for inefficiencies and delays, the HRCP have estimated an average installation rate of six piles per day for most components.

Specific Geographic Region

The HRBT is located in the waterway of Hampton Roads adjacent to the existing bridge and island structures of the HRBT in Virginia. Hampton Roads is located at the confluence of the James River, the Elizabeth River, the Nansemond River, Willoughby Bay, and the Chesapeake Bay (Figure 1). Hampton Roads is a wide marine channel that provides access to the Port of Virginia and several other deep water anchorages upstream of the project area (VDOT and FHWA 2016). Navigational channels are maintained by the U. S. Army Corps of Engineers within Hampton Roads to provide transit to the many ports in the region.

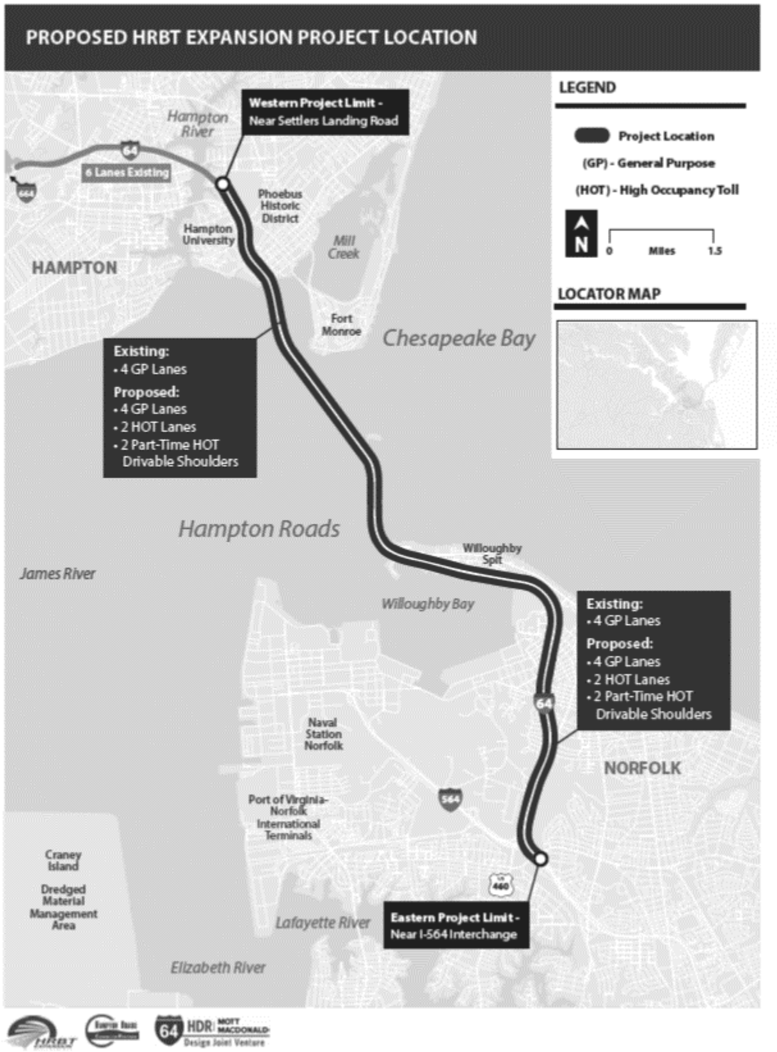

Figure 1. Project Area

The North Shore in Hampton contains estuarine intertidal sandy shore, estuarine intertidal reef, as well as submerged aquatic vegetation (SAV) in shallow estuarine open water. Along the North Trestle, there is estuarine open water with depths up to 15 feet below mean lower low water (MLLW).

The North Island is surrounded by estuarine intertidal sandy shore and rocky shore. There is a SAV bed to the east of the island. Estuarine open water depths are primarily less than 15 feet (ft) below MLLW, but drop to approximately 25 feet below MLLW near the southwest corner of the island expansion closer to the Hampton Creek Entrance Channel. The South Island is also surrounded by estuarine intertidal sandy shore and rocky shore, followed by estuarine open water. The proposed island expansion is mainly in deep water (15-30 ft below MLLW), with a pocket of deeper water approximately 35 ft below MLLW to the west.

The South Trestle is primarily located in estuarine open water with depths less than 15 ft below MLLW, with the exception of deep water (15-30 ft below MLLW) near the South Island approach. There is an estuarine intertidal sandy shore along the South Shore in Norfolk.

Willoughby Bay contains an estuarine intertidal sandy shore, with emergent and scrub/shrub wetlands along the shores. The bay between the shores is estuarine open water with depths up to 15 ft below MLLW.

Sediments in the project area are mostly fine and medium sands with various amounts of coarse sand and gravel, and low organic carbon content. In the Fort Wool Cove (a cove of the decommissioned island fortification located approximately 1 mile south of Fort Monroe in the mouth of Hampton Roads, which sits near Willoughby Beach and Willoughby Spit, adjacent to the HRBT), sediments are fine and very fine sands with various amounts of silt and clay. There is no naturally occurring rocky or cobble bottom present at or adjacent to the project.

Pile installation will occur in waters ranging in depth from less than 1 meter (m) (3.3 ft) near the shore to approximately 8 m (28 ft), depending on the structure and location. The majority of the piles will be in water depths of 3.6 – 4.6 m (12 – 15 ft).

Detailed Description of the Specific Activity

Three methods of pile installation are anticipated and expected to result in take of marine mammals. These include use of vibratory, impact, and DTH hammers. More than one installation method will be used within a day. Most piles will be installed using a combination of vibratory (ICE 416L or similar) and impact hammers (S35 or similar). Overall, steel pipe piles at the North Shore Work Trestle, Jet Grouting Trestle, and TBM Platform would be installed using the vibratory hammer approximately 80 percent of the time and impact hammer approximately 20 percent of the time, while all mooring piles and steel pipe piles at Conveyor Trestle would be installed using the vibratory hammer approximately 90 percent and the impact hammer approximately 10 percent of the time. Depending on the location, the pile will be advanced using vibratory methods and then impact driven to final tip elevation. Where bearing layer sediments are deep, driving will be conducted using an impact hammer so that the structural capacity of the pile embedment can be verified. The pile installation methods used will depend on sediment depth and conditions at each pile location. Table 1 provides additional information on the pile driving operation including estimated pile driving times. The sum of the days of pile installation is greater than the anticipated number of days because more than one pile installation method will be used within a day.

Prior to installing steel pipe piles near shorelines protected with rock armor and/or rip rap (*e.g.*, South Island shorelines; North Shore shoreline), it will be necessary to temporarily shift the rock armoring that protects the shoreline to an adjacent area to allow for the installation of the piles. The rock armor should only be encountered at the shoreline and at relatively shallow depths below the mudline. The rock armor and/or rip rap will be moved and reinstalled near its original location following the completion of pile installation. Alternatively, the piles may be installed without moving the rock, by first drilling through the rock with a DTH hammer (*e.g.*, Berminghammer BH 80 drill or equivalent) to allow for the installation of the piles. A down-the-hole hammer uses both rotary and percussion-type drill devices. This device consists of a drill bit that drills through rock using both rotary and pulse impact mechanisms. This breaks up the rock to allow removal of the fragments and insertion of the pile. The pile is usually advanced at the same time that drilling occurs. Drill cuttings are expelled from the top of the pile using compressed air. It is estimated that a down-the-hole hammer will be used for approximately 1 to 2 hours per pile, when necessary. It is anticipated that approximately 5 percent of the North Shore Work Trestle piles, 10 percent of the Jet Grouting Trestle piles, 10 percent of the Conveyor Trestle piles, and 50 percent of the TBM Platform piles may require use of a down-the-hole hammer (Table 1).

Detailed descriptions of the project components for this IHA request are explained below.

Project Segments

The project design is divided into five segments (see also Figure 2) as follows:

- <u>Segment 1a (Hampton)</u> begins at the northern terminus of the Project in Hampton and ends at the north end of the north approach slabs for the north tunnel approach trestles. This segment has two interchanges and also includes improvements along Mallory Street to accommodate the bridge replacement over I-64. This segment covers approximately 1.2 miles along I-64;

- Segment 1b (North Trestle-Bridges) includes the new and replacement north tunnel approach trestles, including any approach slabs. This segment covers approximately 0.6 mile along I-64;

- Segment 2a (Tunnel) includes the new bored tunnels, the tunnel approach structures, buildings, the North Island improvements for tunnel facilities, and South Island improvements. This segment covers approximately 1.8 miles along I-64;

- Segment 3a (South Trestle-Bridge) includes the new South Trestle-Bridge and any bridge elements that interface with the South Island to the south end of the south abutments at Willoughby Spit. This segment covers approximately 1.2 miles along I-64;

- Segment 3b (Willoughby Spit) continues from the south end of the south approach slabs for the south trestle and ends at the north end of the north approach slabs for the Willoughby Bay trestles. This segment includes a modified interchange connection to Bayville Street, and has a truck inspection station for the westbound tunnels. This segment covers approximately 0.6 mile along I-64;

- Segment 3c (Willoughby Bay Trestle-Bridges) includes the entire structures over Willoughby Bay, from the north end of the north approach slabs on Willoughby Spit to the south end of south approach slabs near the 4th View Street interchange. This segment covers approximately 1.0 mile along I-64;

- Segment 3d (4th View Street Interchange) continues from the Willoughby Trestle-Bridges south, leading to the north end of the north approach slabs of I-64 bridges over Mason Creek Road along mainline I-64. This segment covers approximately 1.0 mile along I-64;

- Segment 4a (Norfolk-Navy) goes from the I-64 north end of the north approach slabs at Mason Creek Road to the north end of the north approach slabs at New Gate/Patrol

Road. There are three interchange ramps in this segment: westbound I-64 exit ramp to Bay Avenue, eastbound I-64 entrance ramp from Ocean Avenue, and westbound I-64 entrance ramp from Granby Street. The ramps in this segment are all on structure. This segment covers approximately 1.5 miles along I-64; and

- Segment 5a (I-564 Interchange) starts from the north end of the north approach slab of the New Gate/Patrol Road Bridge to the southern Project Limit. This segment runs along the Navy property and includes an entrance ramp from Patrol Road, access ramps to and from the existing I-64 Express Lanes, ramps to and from I-564, and an eastbound I-64 entrance ramp from Little Creek Road. This segment covers approximately 1.2 miles along I-64.

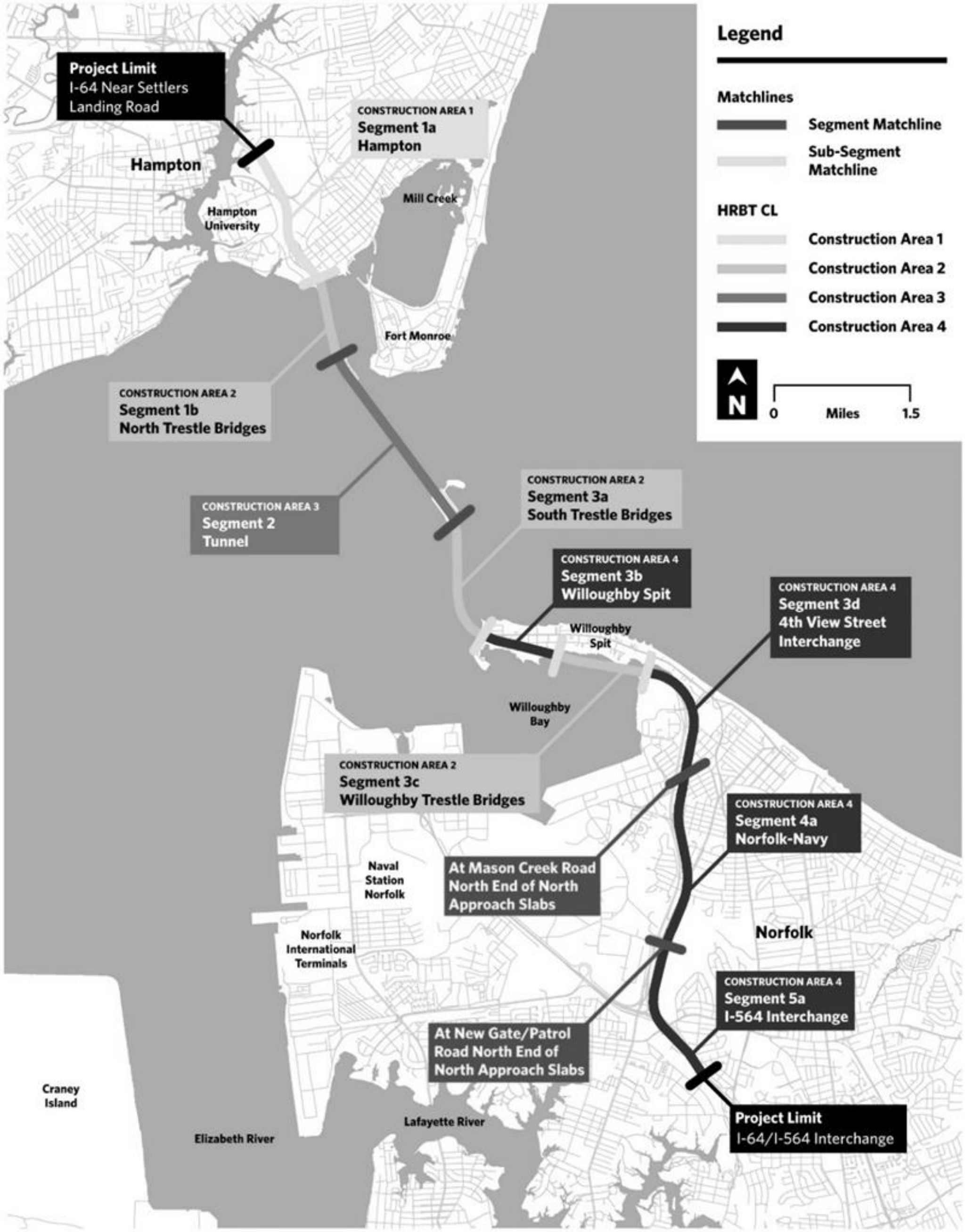

Figure 2-- HRBT Expansion Project Design Segments

However, the only the proposed in-water marine construction activities that have potential to affect marine mammals and result in take would occur at the following locations in the following segments:

- North Trestle-Bridges (Segment 1b);
- Tunnel - North Island and South Island (Segment 2a);
- South Trestle-Bridge (Segment 3a); and
- Willoughby Bay Trestle-Bridges (Segment 3c).

Approximately, 1070 piles (of all sizes) would be installed (only some removed) under this IHA (Table 1). For 36-in steel piles, 698 piles would be installed. For 42-in steel piles, 257 piles would be installed. For 24-in piles, 66 piles would be installed. For 54-in concrete cylinder piles, 33 piles would be installed. For 24-in or 30-in concrete square piles, 16 piles would be installed. Removal would only occur for piles as part of the test pile program (Table 1).

Project Components that are Likely to Result in Take of Marine Mammals.

Tunnel Boring Machine (TBM) Platform at the South Island (Segment 2a)

The HRCP is constructing the temporary TBM Platform or "quay" at the South Island to allow for the delivery, unloading, and assembly of the TBM components from barges to the Island. The large TBM components will be delivered by barge and then transferred to the platform using a Self- Propelled Modular Transport, crawler crane, sheerleg crane and/or other suitable equipment. The TBM Platform will also allow barge delivery and storage of concrete tunnel segments as the boring operation progresses. The concrete tunnel segments will be offloaded and moved using a combination of crawler cranes and a gantry crane installed on the

TBM Platform. The tunnel segments will be stored on the platform prior to delivery to the tunnel shaft for installation.

The TBM Platform is a steel structure founded on (216) 36-in diameter steel piles, with an overall area of approximately 0.40 acres (approximately 166 ft x 9 ft). The piles will be installed using a combination of vibratory and impact hammers except along the perimeter where down-the-hole hammering may be needed to install piles through the rock armor stone. The piles are 154 ft long and will have an average embedded length of approximately 140 ft. Table 1 provides additional information on the pile driving operation including estimated pile installation times and number of strikes necessary to drive a pile to completion.

The superstructure of the platform is set on top of the piles and consists of transverse and longitudinal beams below a 13/16-in- thick plate set on top of the beams. Rail beams will be installed on top of the plate and will support the gantry crane. A concrete slab may be placed on top of the steel plates or timber trusses.

Four mooring dolphins will be installed along the shoreline of the South Island in the areas adjacent to the TBM Platform. Each dolphin will consist of three 36-inch steel piles and will be installed with a combination of vibratory and impact hammers.

Conveyor Trestle at the South Island (Segment 2a)

Tunnel boring spoils and other related materials will be moved between the South Island and barges via a conveyor belt and other equipment throughout tunnel boring. The Conveyor Trestle will also be used for maintenance and mooring of barges and vessels carrying TBM materials and other project related materials.

The Conveyor Trestle is a steel structure founded on (84) 36-in diameter steel piles, with an overall area of approximately 0.42 acres (approximately 673 ft x 27 ft). The piles will be installed using a combination of vibratory (International Construction Equipment (ICE) 416L or similar) and impact hammers (S35 or similar). The piles are approximately 140 ft long and will have an average embedded length of approximately 100 ft. Table 1 provides additional information on the pile driving operation including estimated pile driving times and number of strikes necessary to drive a pile to completion.

Additionally, seven mooring dolphins will be installed along the outside edge of the Conveyor Trestle. Each dolphin will consist of (3) 36-in steel piles and will be installed with a combination of vibratory and impact hammers.

Temporary trestle for bridge construction at the North Shore Work Trestle (Segment 1b)

The temporary North Shore Work Trestle will support construction of the permanent eastbound North Trestle Bridge in the shallow water (< 4-6 ft MLW) closer to the North Shore, avoiding the need to dredge or deepen this area (which otherwise would have been required for barge access) and minimizing potential impacts to the adjacent submerged aquatic vegetation (SAV). The temporary North Shore Work Trestle is a steel structure founded on 194 36-in diameter steel piles with 30-40 ft spans sized to accommodate a 300-ton crane. The main portion of the work trestle will be approximately 1,130 ft long by 45 ft wide, with three approximately 80 ft x 30 ft fingers and an additional landing area approximately 150 ft x 45 ft, for a total overall approximate area of 1.49 acres.

Seven mooring dolphins will be installed at the southern end and along the outside edge of the work trestle. Each dolphin will consist of (3) 24-in steel piles. An additional (13) 42-in steel pipe piles will be installed along the outer edge of the work trestle to provide additional single mooring points for barges and vessels delivering material and accessing the trestle. The mooring dolphin piles and the single mooring point piles will be installed using a vibratory hammer.

Moorings at the North Island Expansion (Segment 2a)

Temporary moorings will be installed along the perimeter of the North Island Expansion area to support the construction of the Island expansion. Eighty 42-in steel pipe piles will be installed to provide mooring points for barges and vessels. The mooring point piles will be installed using a vibratory hammer.

Temporary trestles for jet grouting at the South Island (Segment 2a)

Unconsolidated soil conditions at the western edge of the South Island – along the centerline and depth of the proposed tunnel alignment – require ground improvements to allow tunnel boring to proceed safely and efficiently. Ground improvements will be achieved using deep injection or jet grouting to stabilize and consolidate the sediments along the proposed tunnel alignment and tunnel depth.

Two temporary work trestles will be constructed along either side of the proposed tunnel alignment to support jet grouting activity. Each trestle will be approximately 40 ft wide and extend approximately 1,000 ft west of the South Island shoreline, for a total overall approximate area of 1.84 acres. Two temporary Jet Grouting Trestles will be constructed, each will be founded on (102) 36-in diameter steel piles (a total of 204 steel piles) with 25 +/- feet spans sized to accommodate a 35-ton drill rig and support equipment.

Moorings at the South Trestle (Segment 3a)

Temporary moorings will be installed in the area of the South Trestle to support the construction of temporary work trestles and permanent trestle bridges. Six mooring dolphins will be installed and each will consist of (3) 24-in steel piles for a total of (18) 24-in piles. An additional (41) 42-in steel pipe piles will be installed along what will become the outer edge of the work trestle to provide additional single mooring points for barges and vessels delivering material and accessing the trestle. The mooring dolphin piles and the single mooring point piles will be installed using a vibratory hammer.

Mooring at Willoughby Bay (Segment 3c)

Temporary moorings will be installed in Willoughby Bay to support the construction of temporary work trestles and permanent trestle bridges. Six mooring dolphins will be installed – each consisting of (3) 24-in steel piles. An additional (50) 42-in steel pipe piles will be installed along what will become the outer edge of the work trestle to provide additional single mooring points for barges and vessels delivering material and accessing the trestle. The mooring dolphin piles and the single mooring point piles will be installed using a vibratory hammer. A total of 68 steel pipe piles will be driven, (50) 42-in piles and (18) 24-in piles.

An additional (50) 42-in steel pipe piles will be installed in Willoughby Bay to create moorings for additional staging of barges and safe haven for vessels in the event of severe weather. The moorings will be configured as (2) 2,000-ft long lines with a 42-in mooring pile every 80 ft. The piles will be installed using a vibratory hammer.

Installation and removal of piles for test pile program (Segments 1b, 2a, 3a, and 3c)

The HRCP will perform limited pile load testing to confirm permanent concrete pile design during April through June 2020. Test piles will be installed at the North Trestle (1 load test pile, 10 production test piles), South Trestle (2 load test piles, 20 production test piles) and at Willoughby Bay (1 load test pile, 15 production test piles) – test piles will be 30-in square concrete or 54-in concrete cylinder piles (see Table 1). Test piles will be set using temporary steel templates designed to support and position the test pile while being driven. Concrete test piles will be driven using an impact hammer. Test pile templates will be positioned and held in place using spuds (one at each corner of the template). The test pile templates and pile load test frame and supports will be installed using a vibratory hammer and proofed using an impact hammer to confirm sufficient load capacity. Test piles will be cut below the mudline and removed. The temporary test pile templates and load test frame and supports will be removed using a vibratory hammer.

Table 1--Pile Driving and Removal Associated with the HRBT Project that are Likely to Result in the Take of Marine Mammals

Project Component	Pile Size) / Type and Material	Total Number of Piles	Embedment Length (feet)	Number of Piles Down-the-Hole	Average Down-the-Hole Duration Per Pile (minutes)	Number of Piles Vibrated / Hammered	Average Vibratory Duration Per Pile (minutes)	Approximate # of Impact Strikes Per Pile	Number of Piles Per Day Per Hammer	Estimated Total Number of Hours of Installation	Number of Days of Installation
North Trestle (Segment 1b)											
North Shore Work Trestle	36-inch Steel Pipe	194	100	10	120	184	50	40	3	162	65
Moorings	42-inch Steel Pipe	36	60	-	-	36	30	-	6	18	6
Moorings	24-inch Steel Pipe	30	60	-	-	30	30	-	6	15	5
Test Pile Program (Load Test Piles)	54-inch Concrete Cylinder Pipe	1	140	-	-	1		2,100	1	2	1
Test Pile Program (Production Piles)	54-inch Concrete Cylinder Pipe	10	140	-	-	10	-	2,100	1	20	10

Project Component	Pile Size) / Type and Material	Total Number of Piles	Embedment Length (feet)	Number of Piles Down-the-Hole	Average Down-the-Hole Duration Per Pile (minutes)	Number of Piles Vibrated / Hammered	Average Vibratory Duration Per Pile (minutes)	Approximate # of Impact Strikes Per Pile	Number of Piles Per Day Per Hammer	Estimated Total Number of Hours of Installation	Number of Days of Installation
North Island (Segment 2a)											
Moorings	42-inch Steel Pipe	80	60	-	-	80	30	-	6	40	13
Willoughby Bay (Segment 3c)											
Moorings	42-inch Steel Pipe	50	60	-	-	50	30	-	6	25	9
Moorings	24-inch Steel Pipe	18	60	-	-	18	30	-	6	9	3
Moorings (Safe Haven)	42-inch Steel Pipe	50	60	-	-	50	30	-	6	25	9
Test Pile Program (Load Test Piles)	24-inch or 30-inch Concrete Square Pipe	1	140	-	-	1		2,100	1	2	1
Test Pile Program (Production Piles)	24-inch or 30-inch Concrete Square Pipe	15	140	-	-	15	-	2,100	1	30	15
South Trestle (Segment 3a)											
Moorings	42-inch Steel Pipe	41	60	-	-	41	30	-	6	21	7
Moorings	24-inch Steel Pipe	18	60	-	-	18	30	-	6	9	3
Test Pile Program (Load Test Piles)	54-inch Concrete Cylinder Pipe	2	140	-	-	2		2,100	1	4	2
Test Pile Program (Production Piles)	54-inch, Concrete Cylinder Pipe	20	140	-	-	20	-	2,100	1	40	20
South Island (Segment 2a)											

Project Component	Pile Size) / Type and Material	Total Number of Piles	Embedment Length (feet)	Number of Piles Down-the-Hole	Average Down-the-Hole Duration Per Pile (minutes)	Number of Piles Vibrated / Hammered	Average Vibratory Duration Per Pile (minutes)	Approximate # of Impact Strikes Per Pile	Number of Piles Per Day Per Hammer	Estimated Total Number of Hours of Installation	Number of Days of Installation
TBM Platform	36-inch Steel Pipe	216	140	108	120	108	60	60	2	216	108
Jet Grouting Trestle	36-inch Steel Pipe	204	100	20	120	184	50	40	3	170	68
Conveyor Trestle	36-inch Steel Pipe	84	100	8	120	76	50	40	3	70	28
Total		**1,070**									

Proposed in-water marine construction activities that have potential to affect marine mammals will occur at the following locations in Construction Areas 2 and 3 (Figure 2):

- North Trestle-Bridges (Segment 1b);
- Tunnel - North Island and South Island (Segment 2a);
- South Trestle-Bridge (Segment 3a); and
- Willoughby Bay Trestle-Bridges (Segment 3c).

Proposed mitigation, monitoring, and reporting measures are described in detail later in this document (please see *Proposed Mitigation* and *Monitoring and Reporting* section).

Description of Marine Mammals in the Area of Specified Activities

Sections 3 and 4 of the application summarize available information regarding status and trends, distribution and habitat preferences, and behavior and life history, of the potentially affected species. Additional information regarding population trends and threats may be found in NMFS's Stock Assessment Reports (SARs; *https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessments*) and more general information about these species (*e.g.*, physical and behavioral descriptions) may be found on NMFS's website (*https://www.fisheries.noaa.gov/find-species*).

Table 2 lists all species or stocks for which take is expected and proposed to be authorized for this action, and summarizes information related to the population or stock, including regulatory status under the MMPA and ESA and potential biological removal (PBR), where known. For taxonomy, we follow Committee on Taxonomy (2019). PBR is defined by the MMPA as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population (as described in NMFS's SARs). While no mortality is anticipated or authorized here, PBR and annual serious injury and mortality from anthropogenic sources are included here as gross indicators of the status of the species and other threats.

Marine mammal abundance estimates presented in this document represent the total number of individuals that make up a given stock or the total number estimated within a particular study or survey area. NMFS's stock abundance estimates for most species represent the total estimate of individuals within the geographic area, if known, that comprises that stock. For some species, this geographic area may extend beyond U.S. waters. All managed stocks in this region are assessed in NMFS's United States Atlantic and Gulf of Mexico Marine Mammal Stock Assessments (SARs). All values presented in Table 2 are the most recent available at the time of publication and are available in the draft 2019 SARs (*https://www.fisheries.noaa.gov/national/marine-mammal-protection/draft-marine-mammal-stock-assessment-reports*).

Table 2--Marine Mammal Species Likely To Occur Near the Project Area

Common name	Scientific name	Stock	ESA/MMPA status; Strategic (Y/N)[1]	Stock abundance (CV, N_{min}, most recent abundance survey)[2]	PBR	Annual M/SI[3]
Order Cetartiodactyla – Cetacea – Superfamily Mysticeti (baleen whales)						

Family Balaenopteridae (rorquals)						
Humpback whale[4]	*Megaptera novaeangliae*	Gulf of Maine	-,-; N	896 (.42; 896; 2012)	14.6	9.7
Superfamily Odontoceti (toothed whales, dolphins, and porpoises)						
Family Delphinidae						
Bottlenose dolphin	*Tursiops spp.*	WNA Coastal, Northern Migratory	-,-; Y	6,639 (0.41; 4,759; 2011)	48	6.1-13.2
		WNA Coastal, Southern Migratory	-,-; Y	3,751 (0.06; 2,353; 2011)	23	0-14.3
		Northern North Carolina Estuarine System	-,-; Y	823 (0.06; 782; 2013)	7.8	0.8-18.2
Family Phocoenidae (porpoises)						
Harbor porpoise	*Phocoena phocoena*	Gulf of Maine/Bay of Fundy	-, -; N	79,833 (0.32; 61,415; 2011)	706	256
Order Carnivora – Superfamily Pinnipedia						
Family Phocidae (earless seals)						
Harbor seal	*Phoca vitulina*	WNA	-; N	75,834 (0.1; 66,884, 2012)	2,006	345
Gray seal	*Halichoerus grypus*	WNA	-; N	27,131 (0.19, 23,158, 2016)	1,359	5,688

1 - Endangered Species Act (ESA) status: Endangered (E), Threatened (T)/MMPA status: Depleted (D). A dash (-) indicates that the species is not listed under the ESA or designated as depleted under the MMPA. Under the MMPA, a strategic stock is one for which the level of direct human-caused mortality exceeds PBR or which is determined to be declining and likely to be listed under the ESA within the foreseeable future. Any species or stock listed under the ESA is automatically designated under the MMPA as depleted and as a strategic stock.
2- NMFS marine mammal stock assessment reports online at: *https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports*. CV is coefficient of variation; Nmin is the minimum estimate of stock abundance. In some cases, CV is not applicable
3 - These values, found in NMFS's SARs, represent annual levels of human-caused mortality plus serious injury from all sources combined (*e.g.*, commercial fisheries, ship strike). Annual M/SI often cannot be determined precisely and is in some cases presented as a minimum value or range. A CV associated with estimated mortality due to commercial fisheries is presented in some cases.
4 - 2018 U.S. Atlantic SAR for the Gulf of Maine feeding population lists a current abundance estimate of 896 individuals. However, we note that the estimate is defined on the basis of feeding location alone (*i.e*., Gulf of Maine) and is therefore likely an underestimate.

As indicated above, all five species (with seven managed stocks) in Table 2, temporally and spatially co-occur with the activity to the degree that take is reasonably likely to occur, and we have proposed authorizing it. All species that could potentially occur in the proposed project area are included in Table 3-1 of the application. While North Atlantic right whales (*Eubalaena glacialis*), minke whales (*Balaenoptera acutorostrata acutorostrata*), and fin whales

(*Balaenoptera physalus*) have been documented in the area, the temporal and/or spatial occurrence of these whales is such that take is not expected to occur, and they are not discussed further beyond the explanation provided here.

Based on sighting data and passive acoustic studies, the North Atlantic right whale could occur off Virginia year-round (DoN 2009; Salisbury *et al*., 2016). They have also been reported seasonally off Virginia during migrations in the spring, fall, and winter (CeTAP 1981, 1982; Niemeyer *et al*., 2008; Kahn *et al*., 2009; McLellan 2011b, 2013; Mallette *et al*., 2016a, b, 2017, 2018a; Palka *et al*., 2017; Cotter 2019). Right whales are known to frequent the coastal waters of the mouth of the Chesapeake Bay (Knowlton *et al*., 2002) and the area is a seasonal management area (1 November – 30 April) mandating reduced ship speeds out to approximately 20 nautical miles for the species; however, the project area is further inside the bay.

North Atlantic right whales have stranded in Virginia, one each in 2001, 2002, 2004, 2005: three during winter (February and March) and one in summer (September) (Costidis *et al*., 2017, 2019). In January 2018, a dead, entangled North Atlantic right whale was observed floating over 60 miles offshore of Virginia Beach (Costidis *et al*., 2019). All North Atlantic right whale strandings in Virginia waters have occurred on ocean-facing beaches along Virginia Beach and the barrier islands seaward of the lower Delmarva Peninsula (Costidis *et al*., 2017).

Due to the low occurrence of North Atlantic right whales in the project area, NMFS is not proposing to authorize take of this species.

Fin whales have been sighted off Virginia (Cetacean and Turtle Assessment Program (CeTAP) 1981, 1982; Swingle *et al*., 1993; DoN 2009; Hyrenbach *et al*., 2012; Barco 2013; Mallette *et al*., 2016a, b; Aschettino *et al*., 2018; Engelhaupt *et al*., 2017, 2018; Cotter 2019), and in the Chesapeake Bay (Bailey 1948; CeTAP 1981, 1982; Morgan *et al*., 2002; Barco 2013;

Aschettino *et al*., 2018); however, they are not likely to occur in the project area. Sightings have been documented around the Chesapeake Bay Bridge Tunnel (CBBT) during the winter months (CeTAP 1981, 1982; Barco 2013; Aschettino *et al*., 2018).

Eleven fin whale strandings have occurred off Virginia from 1988 to 2016 mostly during the winter months of February and March, followed by a few in the spring and summer months (Costidis *et al*., 2017). Six of the strandings occurred in the Chesapeake Bay (three on eastern shore; three on western shore) with the remaining five occurring on the Atlantic coast (Costidis *et al*., 2017. Documented strandings near the project area have occurred: February 2012, a dead fin whale washed ashore on Oceanview Beach in Norfolk (Swingle *et al*., 2013); December 2017, a live fin whale stranded on a shoal in Newport News and died at the site (Swingle *et al*., 2018); February 2014, a dead fin whale stranded on a sand bar in Pocomoke Sound near Great Fox Island, Accomack (Swingle *et al*., 2015); and, March 2007, a dead fin whale near Craney Island, in the Elizabeth River, in Norfolk (Barco 2013).

Only stranded fin whales have been documented in the project area; no free-swimming fin whales have been observed. Due to the low occurrence of fin whales in the project area, NMFS is not proposing to authorize take of this species.

Minke whales have been sighted off Virginia (CeTAP 1981, 1982; Hyrenbach *et al*. 2012; Barco 2013; Mallette *et al*., 2016a, b; McLellan 2017; Engelhaupt *et al*., 2017, 2018; Cotter 2019), near the CBBT (Aschettino *et al*., 2018) and in the project area although the sightings in the project area are known from strandings (Jensen and Silber 2004; Barco 2013; DoN 2009). In August 1994, a ship strike incident involved a minke whale in Hampton Roads (Jensen and Silber 2004; Barco 2013). It was reported that the animal was struck offshore and was carried inshore on the bow of a ship (DoN 2009). Twelve strandings of minke whales have occurred in Virginia waters from 1988 to 2016 (Costidis *et al*., 2017). There have been six minke whale stranding from 2017 through 2020 in Virginia waters.

Because all minke whale occurrences in the project area are due to strandings, NMFS is not proposing to authorize take of this species.

Cetaceans

Humpback Whale

The humpback whale is found worldwide in all oceans. Humpbacks occur off southern New England in all four seasons, with peak abundance in spring and summer. In winter, humpback whales from waters off New England, Canada, Greenland, Iceland, and Norway migrate to mate and calve primarily in the West Indies (including the Antilles, the Dominican Republic, the Virgin Islands and Puerto Rico), where spatial and genetic mixing among these groups occurs.

Migrating humpback whales utilize the mid-Atlantic as a migration pathway between calving/mating grounds to the south and feeding grounds in the north (Hayes *et al*. 2019), but it may also be an important winter feeding area for juveniles. Since 1989, observations of juvenile humpbacks in the mid-Atlantic have been increasing during the winter months, peaking from January through March (Swingle *et al*., 1993). Biologists theorize that non-reproductive animals may be establishing a winter feeding range in the mid-Atlantic since they are not participating in reproductive behavior in the Caribbean. Swingle *et al*. (1993) identified a shift in distribution of juvenile humpback whales in the nearshore waters of Virginia, primarily in winter months. Identified whales using the mid-Atlantic area were found to be residents of the Gulf of Maine and Atlantic Canada (Gulf of St. Lawrence and Newfoundland) feeding groups; suggesting a mixing of different feeding populations in the Mid-Atlantic region.

Humpback whales are the only large cetaceans that are likely to occur in the project area and could be found there at any time of the year. The project area is not within normal humpback whale feeding or migration areas; however, they could occur in the Project area in relatively small numbers seasonally during migrations (Aschettino *et al*., 2017b). Sightings have been reported off Virginia during the fall and winter (CeTAP 1981, 1982; Swingle *et al*., 1993; Barco *et al*., 2002; McLellan 2011a; Engelhaupt *et al*., 2014, 2015, 2016, 2017, 2018; Aschettino *et al*., 2015, 2016, 2017a, 2018, 2019; Mallette *et al*., 2016a, b, 2017, 2018a, b; McAlarney *et al*., 2017, 2018; Northeast Fisheries Science Center and Southeast Fisheries Science Center (NEFSC and SEFSC) 2019) and most recently, the spring (Aschettino *et al*., 2019; Cotter, 2019). Humpback whales are known to frequent the coastal waters of the mouth of the Chesapeake Bay during the winter months (Aschettino *et al*,. 2015, 2016, 2017a, b, 2018; Movebank, 2019), and on the rare occasion, inshore of the CBBT (Perkins and Beamish, 1979; Aschettino *et al*., 2017b, 2018; Movebank, 2019). Humpback whales could use the Chesapeake Bay area year-round based off sighting and stranding data (DoN, 2009; Aschettino *et al*., 2015, 2016, 2017a, 2018, 2019). Baseline occurrence and behavior data for humpback whales in the Hampton Roads mid-Atlantic region was collected via satellite tags; these data show site fidelity to the Chesapeake Bay area (Aschettino *et al*., 2018, 2019) and movement in and around the project area (Movebank, 2019).

Vessel collisions and entanglements can cause serious injuries to humpback whales. Thirty-seven humpback whale strandings have occurred in Virginia from 1988 to 2016 (Costidis *et al*., 2017). Humpback whale strandings or entanglements have been recorded in every month of the year with April having the highest number of strandings (Costidis *et al*., 2017). Twenty-seven of the 37 strandings occurred on ocean-facing beaches; however, some have occurred within the lower Chesapeake Bay (Barco, 2013; Costidis *et al*., 2017). Since January 2016, elevated humpback whale mortalities have occurred along the Atlantic coast from Maine through Florida. The event has been declared a UME with 117 strandings recorded of which 23 strandings occurred in the waters of Virginia and seven of which occurred in or near the mouth of the Chesapeake Bay. Partial or full necropsy examinations have been conducted on approximately half of the known cases. A portion of the whales have shown evidence of pre-mortem vessel strike; however, this finding is not consistent across all of the whales examined so more research is needed. NOAA is consulting with researchers that are conducting studies on the humpback whale populations, and these efforts may provide information on changes in whale distribution and habitat use that could provide additional insight into how these vessel interactions occurred. More detailed information is available at: *https://www.fisheries.noaa.gov/national/marine-life-distress/2016-2019-humpback-whale-unusual-mortality-event-along-atlantic-coast.* Three previous UMEs involving humpback whales have occurred since 2000, in 2003, 2005, and 2006.

Bottlenose Dolphin

The bottlenose dolphin occurs in temperate and tropical oceans throughout the world, ranging in latitudes from 45° N to 45° S (Blaylock, 1985). In the western Atlantic Ocean there are two distinct morphotypes of bottlenose dolphins, an offshore type that occurs along the edge of the continental shelf as well as an inshore type. The inshore morphotype can be found along the entire United States coast from New York to the Gulf of Mexico, and typically occurs in waters less than 20 m deep (NOAA Fisheries, 2016a). Bottlenose dolphins found in Virginia are representative primarily of either the northern migratory coastal stock, southern migratory coastal stock, or the Northern North Carolina Estuarine System Stock (NNCES).

The northern migratory coastal stock is best defined by its distribution during warm water months when the stock occupies coastal waters from the shoreline to approximately the 20-m isobath between Assateague, Virginia, and Long Island, New York (Garrison *et al*., 2017b). The stock migrates in late summer and fall and, during cold water months (best described by January and February), occupies coastal waters from approximately Cape Lookout, North Carolina, to the North Carolina/Virginia border (Garrison *et al*., 2017b). Historically, common bottlenose dolphins have been rarely observed during cold water months in coastal waters north of the North Carolina/Virginia border, and their northern distribution in winter appears to be limited by water temperatures. Overlap with the southern migratory coastal stock in coastal waters of northern North Carolina and Virginia is possible during spring and fall migratory periods, but the degree of overlap is unknown and it may vary depending on annual water temperature (Garrison *et al*., 2016). When the stock has migrated in cold water months to coastal waters from just north of Cape Hatteras, North Carolina, to just south of Cape Lookout, North Carolina, it overlaps spatially with the Northern North Carolina Estuarine System (NNCES) Stock (Garrison *et al.*, 2017b).

The southern migratory coastal stock migrates seasonally along the coast between North Carolina and northern Florida (Garrison *et al*., 2017b). During January–March, the southern migratory coastal stock appears to move as far south as northern Florida. During April–June, the stock moves back north past Cape Hatteras, North Carolina (Garrison *et al*., 2017b), where it overlaps, in coastal waters, with the NNCES stock (in waters ≤1 km from shore). During the warm water months of July–August, the stock is presumed to occupy coastal waters north of Cape Lookout, North Carolina, to Assateague, Virginia, including the Chesapeake Bay.

The NNCES stock is best defined as animals that occupy primarily waters of the Pamlico Sound estuarine system (which also includes Core, Roanoke, and Albemarle sounds, and the Neuse River) during warm water months (July–August). Members of this stock also use coastal waters (≤1 km from shore) of North Carolina from Beaufort north to Virginia Beach, Virginia, including the lower Chesapeake Bay. A community of NNCES dolphins are likely year-round Bay residents (E. Patterson, NMFS p*ers. comm*).

Bottlenose dolphins are consistently seen in Virginia waters from May through October (Barco *et al*., 1999; Costidis *et al*., 2017; Cotter, 2019) and are regularly sighted from early spring through late fall with sightings and stranding events in Virginia waters all months of the year (Swingle *et al*., 2010, 2011, 2012, 2013, 2014; DolphinWatch 2019). Sightings have been reported off Virginia and near the project area during the summer, fall, and winter (CeTAP,, 1981, 1982; Hohn 1997; Torres *et al*., 2005; NEFSC and SEFSC 2012, 2013, 2016; Barco 2013, 2014; Garrison 2013; DiMatteo 2014; Roberts *et al*., 2016; Engelhaupt *et al*., 2014, 2015, 2016, 2017, 2018; Palka *et al*., 2017; Mallette *et al*., 2016a, b, 2017, 2018a, b; McAlarney *et al*., 2017, 2018; DolphinWatch 2019).

Harbor Porpoise

The harbor porpoise is typically found in colder waters in the northern hemisphere. In the western North Atlantic Ocean, harbor porpoises range from Greenland to as far south as North Carolina (Barco and Swingle, 2014). They are commonly found in bays, estuaries, and harbors less than 200 meters deep (NOAA Fisheries, 2017c). Harbor porpoises in the United States are made up of the Gulf of Maine/Bay of Fundy stock. Gulf of Maine/Bay of Fundy stock are concentrated in the Gulf of Maine in the summer, but are widely dispersed from Maine to New

Jersey in the winter. South of New Jersey, harbor porpoises occur at lower densities. Migrations to and from the Gulf of Maine do not follow a defined route (NOAA Fisheries, 2016c).

The inland waters of Virginia are considered to be part of the normal habitat of the harbor porpoise (Polacheck *et al.*, 1995; DoN 2009). Sightings have been reported off Virginia (DoN 2009; Hyrenbach *et al*., 2012) and they regularly occur in the Chesapeake Bay (Prescott and Fiorelli 1980; Polacheck *et al.*, 1995; DoN 2009). A few sightings have occurred near the HRBT (M. Cotter, HDR Inc., pers. comm. May 2019 as cited in the application). There are documented sightings near the project area during the spring and winter, although, most of these sightings are known from stranding data (Polacheck *et al*., 1995; Cox *et al*., 1998; Morgan *et al*., 2002; Swingle *et al*., 2007; Barco 2013).

Pinnipeds

Harbor Seal

The harbor seal occurs in arctic and temperate coastal waters throughout the northern hemisphere, including on both the east and west coasts of the United States. On the east coast, harbor seals can be found from the Canadian Arctic down to Georgia (Blaylock, 1985). Harbor seals occur year-round in Canada and Maine and seasonally (September-May) from southern New England to New Jersey (NOAA Fisheries, 2016d). The range of harbor seals appears to be shifting as they are regularly reported further south than they were historically. In recent years, they have established haulout sites in the Chesapeake Bay including on the portal islands of the Chesapeake Bay Bridge Tunnel (CBBT) (Rees *et al.*, 2016, Jones *et al*., 2018).

Harbor seals are the most common seal in Virginia (Barco and Swingle, 2014). Harbor seal presence in Virginia waters is seasonal, with individuals arriving in January and February (winter) and extending into April and May (spring) (Costidis *et al*., 2017). They can be seen resting on the rocks around the portal islands of the CBBT from December through April. Seal observation surveys conducted at the CBBT recorded 112 seals during the 2014/2015 season, 184 seals during the 2015/2016 season, 308 seals in the 2016/2017 season and 340 seals during the 2017/2018 season. Smaller numbers of harbor seals have been known to occasionally haul out on the rocks near the HRBT (Danielle Jones, Naval Facilities Engineering Command Atlantic, pers. comm., April 2019 as cited in the application) and at Hopewell up the James River (Blaylock 1985; DoN 2009). Sightings have been reported off Virginia and near the project area during the winter and spring (Barco, 2013; Rees *et al*., 2016; Jones *et al*., 2018; Ampela *et al*., 2019).

Gray Seal

The gray seal occurs on both coasts of the Northern Atlantic Ocean and is divided into three major populations (NOAA Fisheries, 2016b). The western north Atlantic stock occurs in eastern Canada and the northeastern United States, occasionally as far south as North Carolina. Gray seals inhabit rocky coasts and islands, sandbars, ice shelves and icebergs (NOAA Fisheries, 2016b). In the United States, gray seals congregate in the summer to give birth at four established colonies in Massachusetts and Maine (NOAA Fisheries, 2016b). From September through May, they disperse and can be abundant as far south as New Jersey. The range of gray seals appears to be shifting as they are regularly being reported further south than they were historically (Rees *et al*., 2016).

Gray seals are uncommon in Virginia and the Chesapeake Bay. Only 15 gray seal strandings were documented in Virginia from 1988 through 2013 (Barco and Swingle, 2014). They are rarely found resting on the rocks around the portal islands of the CBBT from December through April alongside harbor seals. Seal observation surveys conducted at the CBBT recorded one gray seal in each of the 2014/2015 and 2015/2016 seasons while no gray seals were reported during the 2016/2017 and 2017/2018 seasons (Rees *et al.*, 2016, Jones *et al*., 2018). Sightings have been reported off Virginia and near the project area during the winter and spring (Barco 2013; Rees *et al*., 2016; Jones *et al.*, 2018; Ampela *et al.*, 2019).

Marine Mammal Habitat

No ESA-designated critical habitat overlaps with the project area. A migratory Biologically Important Area (BIA) for North Atlantic right whales is found offshore of the mouth of the Chesapeake Bay but does not overlap with the project area. As previously described, right whales are rarely observed in the Bay and sound from the proposed in-water activities are not anticipated to propagate outside of the Bay to the area associated with the BIA.

Marine Mammal Hearing

Hearing is the most important sensory modality for marine mammals underwater, and exposure to anthropogenic sound can have deleterious effects. To appropriately assess the potential effects of exposure to sound, it is necessary to understand the frequency ranges marine mammals are able to hear. Current data indicate that not all marine mammal species have equal hearing capabilities (*e.g.*, Richardson *et al*., 1995; Wartzok and Ketten, 1999; Au and Hastings, 2008). To reflect this, Southall *et al.* (2007) recommended that marine mammals be divided into functional hearing groups based on directly measured or estimated hearing ranges on the basis of available behavioral response data, audiograms derived using auditory evoked potential techniques, anatomical modeling, and other data. Note that no direct measurements of hearing ability have been successfully completed for mysticetes (*i.e*., low-frequency cetaceans). Subsequently, NMFS (2018) described generalized hearing ranges for these marine mammal hearing groups. Generalized hearing ranges were chosen based on the approximately 65 decibel (dB) threshold from the normalized composite audiograms, with the exception for lower limits for low-frequency cetaceans where the lower bound was deemed to be biologically implausible and the lower bound from Southall *et al.* (2007) retained. Marine mammal hearing groups and their associated hearing ranges are provided in Table 3.

Table 3--Marine Mammal Hearing Groups (NMFS, 2018)

Hearing Group	Generalized Hearing Range*
Low-frequency (LF) cetaceans (baleen whales)	7 Hz to 35 kHz
Mid-frequency (MF) cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales)	150 Hz to 160 kHz
High-frequency (HF) cetaceans (true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* & *L. australis*)	275 Hz to 160 kHz
Phocid pinnipeds (PW) (underwater) (true seals)	50 Hz to 86 kHz
Otariid pinnipeds (OW) (underwater) (sea lions and fur seals)	60 Hz to 39 kHz

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

The pinniped functional hearing group was modified from Southall *et al*. (2007) on the basis of data indicating that phocid species have consistently demonstrated an extended frequency range of hearing compared to otariids, especially in the higher frequency range (Hemilä *et al*., 2006; Kastelein *et al*., 2009; Reichmuth and Holt, 2013).

For more detail concerning these groups and associated frequency ranges, please see NMFS (2018) for a review of available information. Five marine mammal species (3 cetacean and 2 phocid pinniped) have the reasonable potential to co-occur with the proposed survey activities. Please refer to Table 2. Of the cetacean species that may be present, one is classified as low-frequency (humpback whale), one is classified as mid-frequency (bottlenose dolphin) and one is classified as high-frequency (harbor porpoise).

Potential Effects of Specified Activities on Marine Mammals and their Habitat

This section includes a summary and discussion of the ways that components of the specified activity may impact marine mammals and their habitat. The *Estimated Take by Incidental Harassment* section later in this document includes a quantitative analysis of the number of individuals that are expected to be taken by this activity. The *Negligible Impact Analysis and Determination* section considers the content of this section, the *Estimated Take by Incidental Harassment* section, and the *Proposed Mitigation* section, to draw conclusions regarding the likely impacts of these activities on the reproductive success or survivorship of individuals and how those impacts on individuals are likely to impact marine mammal species or stocks.

Description of Sound Sources

The marine soundscape is comprised of both ambient and anthropogenic sounds. Ambient sound is defined as the all-encompassing sound in a given place and is usually a composite of sound from many sources both near and far. The sound level of an area is defined by the total acoustical energy being generated by known and unknown sources. These sources may include physical (*e.g.,* waves, wind, precipitation, earthquakes, ice, atmospheric sound), biological (*e.g.,* sounds produced by marine mammals, fish, and invertebrates), and anthropogenic sound (*e.g.,* vessels, dredging, aircraft, construction).

The sum of the various natural and anthropogenic sound sources at any given location and time—which comprise "ambient" or "background" sound—depends not only on the source levels (as determined by current weather conditions and levels of biological and shipping activity) but also on the ability of sound to propagate through the environment. In turn, sound propagation is dependent on the spatially and temporally varying properties of the water column and sea floor, and is frequency-dependent. As a result of the dependence on a large number of varying factors, ambient sound levels can be expected to vary widely over both coarse and fine spatial and temporal scales. Sound levels at a given frequency and location can vary by 10-20 dB from day to day (Richardson *et al.* 1995). The result is that, depending on the source type and its intensity, sound from the specified activity may be a negligible addition to the local environment or could form a distinctive signal that may affect marine mammals.

In-water construction activities associated with the project would include impact pile driving, vibratory pile driving, vibratory pile removal, and drilling with a DTH hammer. The sounds produced by these activities fall into one of two general sound types: impulsive and non-impulsive. Impulsive sounds (*e.g.*, explosions, gunshots, sonic booms, impact pile driving) are typically transient, brief (less than 1 second), broadband, and consist of high peak sound pressure with rapid rise time and rapid decay (ANSI 1986; NIOSH 1998; NMFS 2018). Non-impulsive sounds (*e.g.* aircraft, machinery operations such as drilling or dredging, vibratory pile driving, and active sonar systems) can be broadband, narrowband or tonal, brief or prolonged (continuous or intermittent), and typically do not have the high peak sound pressure with raid rise/decay time that impulsive sounds do (ANSI 1995; NIOSH 1998; NMFS 2018). The distinction between these two sound types is important because they have differing potential to cause physical effects, particularly with regard to hearing (*e.g.*, Ward 1997 in Southall *et al.* 2007).

Impact hammers operate by repeatedly dropping a heavy piston onto a pile to drive the pile into the substrate. Sound generated by impact hammers is characterized by rapid rise times and high peak levels, a potentially injurious combination (Hastings and Popper 2005). Vibratory hammers install piles by vibrating them and allowing the weight of the hammer to push them into the sediment. Vibratory hammers produce significantly less sound than impact hammers.

Peak sound pressure levels (SPLs) may be 180 dB or greater, but are generally 10 to 20 dB lower than SPLs generated during impact pile driving of the same-sized pile (Oestman *et al.*, 2009). Rise time is slower, reducing the probability and severity of injury, and sound energy is distributed over a greater amount of time (Nedwell and Edwards, 2002; Carlson *et al.*, 2005). A DTH hammer is used to place hollow steel piles or casings by drilling. A DTH hammer is a drill bit that drills through the bedrock using a pulse mechanism that functions at the bottom of the hole. This pulsing bit breaks up rock to allow removal of debris and insertion of the pile. The head extends so that the drilling takes place below the pile. The pulsing sounds produced by DTH hammers were previously thought to be continuous. However, the Chesapeake Tunnel Joint Venture (CTJV) conducted sound source verification (SSV) monitoring and the most significant finding was that the DTH hammer created an impulsive sound as the equipment was employed at the Parallel Thimble Shoal Tunnel Project in Virginia Beach, Virginia (Denes *et al.* 2019).

The likely or possible impacts of HRCP's proposed activity on marine mammals could involve both non-acoustic and acoustic stressors. Potential non-acoustic stressors could result from the physical presence of the equipment and personnel; however, any impacts to marine mammals are expected to primarily be acoustic in nature. Acoustic stressors include effects of heavy equipment operation during pile installation.

Acoustic Impacts

The introduction of anthropogenic noise into the aquatic environment from pile driving is the primary means by which marine mammals may be harassed from CTJV's specified activity. In general, animals exposed to natural or anthropogenic sound may experience physical and psychological effects, ranging in magnitude from none to severe (Southall *et al.* 2007). Exposure to in-water construction noise has the potential to result in auditory threshold shifts and behavioral reactions (*e.g.*, avoidance, temporary cessation of foraging and vocalizing, changes in dive behavior) and/or lead to non-observable physiological responses such an increase in stress hormones ((Richardson *et al.* 1995; Gordon *et al.* 2004; Nowacek *et al.*2007; Southall *et al.* 2007; Gotz *et al.* 2009). Additional noise in a marine mammal's habitat can mask acoustic cues used by marine mammals to carry out daily functions such as communication and predator and prey detection. The effects of pile driving noise on marine mammals are dependent on several factors, including, but not limited to, sound type (*e.g.*, impulsive vs. non-impulsive), the species, age and sex class (*e.g.*, adult male vs. mom with calf), duration of exposure, the distance between the pile and the animal, received levels, behavior at time of exposure, and previous history with exposure (Wartzok *et al.* 2004; Southall *et al.* 2007). Here we discuss physical auditory effects (threshold shifts), followed by behavioral effects and potential impacts on habitat.

Richardson *et al.* (1995) described zones of increasing intensity of effect that might be expected to occur, in relation to distance from a source and assuming that the signal is within an animal's hearing range. First is the area within which the acoustic signal would be audible (potentially perceived) to the animal, but not strong enough to elicit any overt behavioral or physiological response. The next zone corresponds with the area where the signal is audible to the animal and of sufficient intensity to elicit behavioral or physiological responsiveness. Third is a zone within which, for signals of high intensity, the received level is sufficient to potentially cause discomfort or tissue damage to auditory or other systems. Overlaying these zones to a certain extent is the area within which masking (*i.e.*, when a sound interferes with or masks the ability of an animal to detect a signal of interest that is above the absolute hearing threshold) may occur; the masking zone may be highly variable in size.

We describe the more severe effects (*i.e.*, permanent hearing impairment, certain non-auditory physical or physiological effects) only briefly as we do not expect that there is a reasonable likelihood that HRCP's activities would result in such effects (see below for further discussion). NMFS defines a noise-induced threshold shift (TS) as a change, usually an increase, in the threshold of audibility at a specified frequency or portion of an individual's hearing range above a previously established reference level (NMFS 2018). The amount of threshold shift is customarily expressed in dB. A TS can be permanent or temporary. As described in NMFS (2018), there are numerous factors to consider when examining the consequence of TS, including, but not limited to, the signal temporal pattern (*e.g.*, impulsive or non-impulsive), likelihood an individual would be exposed for a long enough duration or to a high enough level to induce a TS, the magnitude of the TS, time to recovery (seconds to minutes or hours to days), the frequency range of the exposure (*i.e.,* spectral content), the hearing and vocalization frequency range of the exposed species relative to the signal's frequency spectrum (*i.e.*, how animal uses sound within the frequency band of the signal; *e.g.*, Kastelein *et al.* 2014b), and the overlap between the animal and the source (*e.g.,* spatial, temporal, and spectral).

Permanent Threshold Shift (PTS)—NMFS defines PTS as a permanent, irreversible increase in the threshold of audibility at a specified frequency or portion of an individual's hearing range above a previously established reference level (NMFS 2018). Available data from humans and other terrestrial mammals indicate that a 40 dB threshold shift approximates PTS onset (see Ward *et al.*, 1958, 1959; Ward, 1960; Kryter *et al.*, 1966; Miller, 1974; Ahroon *et al.*, 1996; Henderson *et al.*, 2008). PTS levels for marine mammals are estimates, as with the exception of a single study unintentionally inducing PTS in a harbor seal (Kastak *et al.*, 2008), there are no empirical data measuring PTS in marine mammals largely due to the fact that, for various ethical reasons, experiments involving anthropogenic noise exposure at levels inducing PTS are not typically pursued or authorized (NMFS, 2018).

Temporary Threshold Shift (TTS)—A temporary, reversible increase in the threshold of audibility at a specified frequency or portion of an individual's hearing range above a previously established reference level (NMFS 2018). Based on data from cetacean TTS measurements (see Southall *et al.*, 2007), a TTS of 6 dB is considered the minimum threshold shift clearly larger than any day-to-day or session-to-session variation in a subject's normal hearing ability (Schlundt *et al.*, 2000; Finneran *et al.*, 2000, 2002). As described in Finneran (2016), marine mammal studies have shown the amount of TTS increases with cumulative sound exposure level (SELcum) in an accelerating fashion: At low exposures with lower SELcum, the amount of TTS is typically small and the growth curves have shallow slopes. At exposures with higher SELcum, the growth curves become steeper and approach linear relationships with the noise SEL.

Depending on the degree (elevation of threshold in dB), duration (*i.e.*, recovery time), and frequency range of TTS, and the context in which it is experienced, TTS can have effects on marine mammals ranging from discountable to serious (similar to those discussed in auditory masking, below). For example, a marine mammal may be able to readily compensate for a brief, relatively small amount of TTS in a non-critical frequency range that takes place during a time when the animal is traveling through the open ocean, where ambient noise is lower and there are not as many competing sounds present. Alternatively, a larger amount and longer duration of TTS sustained during time when communication is critical for successful mother/calf interactions could have more serious impacts. We note that reduced hearing sensitivity as a simple function of aging has been observed in marine mammals, as well as humans and other taxa (Southall *et al.*, 2007), so we can infer that strategies exist for coping with this condition to some degree, though likely not without cost.

Currently, TTS data only exist for four species of cetaceans (bottlenose dolphin, beluga whale (*Delphinapterus leucas*), harbor porpoise, and Yangtze finless porpoise (*Neophocoena asiaeorientalis*)) and five species of pinnipeds exposed to a limited number of sound sources (*i.e.*, mostly tones and octave-band noise) in laboratory settings (Finneran, 2015). TTS was not observed in trained spotted (*Phoca largha*) and ringed (*Pusa hispida*) seals exposed to impulsive noise at levels matching previous predictions of TTS onset (Reichmuth *et al.*, 2016). In general, harbor seals and harbor porpoises have a lower TTS onset than other measured pinniped or cetacean species (Finneran, 2015). Additionally, the existing marine mammal TTS data come from a limited number of individuals within these species. No data are available on noise-induced hearing loss for mysticetes. For summaries of data on TTS in marine mammals or for further discussion of TTS onset thresholds, please see Southall *et al.*, (2007), Finneran and Jenkins (2012), Finneran (2015), and Table 5 in NMFS (2018).

Behavioral Harassment—Behavioral disturbance may include a variety of effects, including subtle changes in behavior (*e.g.*, minor or brief avoidance of an area or changes in vocalizations), more conspicuous changes in similar behavioral activities, and more sustained and/or potentially severe reactions, such as displacement from or abandonment of high-quality habitat. Disturbance may result in changing durations of surfacing and dives, number of blows per surfacing, or moving direction and/or speed; reduced/increased vocal activities; changing/cessation of certain behavioral activities (such as socializing or feeding); visible startle response or aggressive behavior (such as tail/fluke slapping or jaw clapping); avoidance of areas where sound sources are located. Pinnipeds may increase their haul out time, possibly to avoid in-water disturbance (Thorson and Reyff, 2006). Behavioral responses to sound are highly variable and context-specific and any reactions depend on numerous intrinsic and extrinsic factors (*e.g.,* species, state of maturity, experience, current activity, reproductive state, auditory sensitivity, time of day), as well as the interplay between factors (*e.g.,* Richardson *et al.* 1995; Wartzok *et al.*, 2003; Southall *et al.*, 2007; Weilgart 2007; Archer *et al.*, 2010). Behavioral reactions can vary not only among individuals but also within an individual, depending on previous experience with a sound source, context, and numerous other factors (Ellison *et al.*, 2012), and can vary depending on characteristics associated with the sound source (*e.g.,* whether it is moving or stationary, number of sources, distance from the source). In general, pinnipeds seem more tolerant of, or at least habituate more quickly to, potentially disturbing underwater sound than do cetaceans, and generally seem to be less responsive to exposure to industrial sound than most cetaceans. Please see Appendices B-C of Southall *et al.* (2007) for a review of studies involving marine mammal behavioral responses to sound.

Habituation can occur when an animal's response to a stimulus wanes with repeated exposure, usually in the absence of unpleasant associated events (Wartzok *et al.*, 2003). Animals are most likely to habituate to sounds that are predictable and unvarying. It is important to note that habituation is appropriately considered as a “progressive reduction in response to stimuli that are perceived as neither aversive nor beneficial,” rather than as, more generally, moderation in response to human disturbance (Bejder *et al.*, 2009). The opposite process is sensitization, when an unpleasant experience leads to subsequent responses, often in the form of avoidance, at a lower level of exposure.

As noted above, behavioral state may affect the type of response. For example, animals that are resting may show greater behavioral change in response to disturbing sound levels than animals that are highly motivated to remain in an area for feeding (Richardson *et al.*, 1995; NRC, 2003; Wartzok *et al.*, 2003). Controlled experiments with captive marine mammals have showed pronounced behavioral reactions, including avoidance of loud sound sources (Ridgway *et al.*, 1997; Finneran *et al.*, 2003). Observed responses of wild marine mammals to loud pulsed sound sources (typically seismic airguns or acoustic harassment devices) have been varied but often consist of avoidance behavior or other behavioral changes suggesting discomfort (Morton and Symonds 2002; see also Richardson *et al.*, 1995; Nowacek *et al.*, 2007).

Available studies show wide variation in response to underwater sound; therefore, it is difficult to predict specifically how any given sound in a particular instance might affect marine mammals perceiving the signal. If a marine mammal does react briefly to an underwater sound by changing its behavior or moving a small distance, the impacts of the change are unlikely to be significant to the individual, l*et al*one the stock or population. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on individuals and populations could be significant (*e.g.,* Lusseau and Bejder 2007; Weilgart 2007; NRC 2005). However, there are broad categories of potential response, which we describe in greater detail here, that include alteration of dive behavior, alteration of foraging behavior, effects to breathing, interference with or alteration of vocalization, avoidance, and flight.

Changes in dive behavior can vary widely, and may consist of increased or decreased dive times and surface intervals as well as changes in the rates of ascent and descent during a dive (*e.g.,* Frankel and Clark 2000; Costa *et al.*, 2003; Ng and Leung 2003; Nowacek *et al.*, 2004; Goldbogen *et al.* 2013a,b). Variations in dive behavior may reflect interruptions in biologically significant activities (*e.g.,* foraging) or they may be of little biological significance.

The impact of an alteration to dive behavior resulting from an acoustic exposure depends on what the animal is doing at the time of the exposure and the type and magnitude of the response.

Disruption of feeding behavior can be difficult to correlate with anthropogenic sound exposure, so it is usually inferred by observed displacement from known foraging areas, the appearance of secondary indicators (*e.g.,* bubble nets or sediment plumes), or changes in dive behavior. As for other types of behavioral response, the frequency, duration, and temporal pattern of signal presentation, as well as differences in species sensitivity, are likely contributing factors to differences in response in any given circumstance (*e.g.*, Croll *et al.*, 2001; Nowacek *et al.*, 2004; Madsen *et al.*, 2006; Yazvenko *et al.*, 2007). A determination of whether foraging disruptions incur fitness consequences would require information on or estimates of the energetic requirements of the affected individuals and the relationship between prey availability, foraging effort and success, and the life history stage of the animal.

Variations in respiration naturally vary with different behaviors and alterations to breathing rate as a function of acoustic exposure can be expected to co-occur with other behavioral reactions, such as a flight response or an alteration in diving. However, respiration rates in and of themselves may be representative of annoyance or an acute stress response. Various studies have shown that respiration rates may either be unaffected or could increase, depending on the species and signal characteristics, again highlighting the importance in understanding species differences in the tolerance of underwater noise when determining the potential for impacts resulting from anthropogenic sound exposure (*e.g.*, Kastelein *et al.*, 2001; 2005b, 2006; Gailey *et al.* 2007).

Marine mammals vocalize for different purposes and across multiple modes, such as whistling, echolocation click production, calling, and singing. Changes in vocalization behavior in response to anthropogenic noise can occur for any of these modes and may result from a need to compete with an increase in background noise or may reflect increased vigilance or a startle response. For example, in the presence of potentially masking signals, humpback whales and killer whales have been observed to increase the length of their songs (Miller *et al.*, 2000; Fristrup *et al.*, 2003; Foote *et al.*, 2004), while right whales have been observed to shift the frequency content of their calls upward while reducing the rate of calling in areas of increased anthropogenic noise (Parks *et al.*, 2007b). In some cases, animals may cease sound production during production of aversive signals (Bowles *et al.*, 1994).

Avoidance is the displacement of an individual from an area or migration path as a result of the presence of a sound or other stressors, and is one of the most obvious manifestations of disturbance in marine mammals (Richardson *et al.*, 1995). For example, gray whales *(Eschrictius robustus*) are known to change direction—deflecting from customary migratory paths—in order to avoid noise from seismic surveys (Malme *et al.*, 1984). Avoidance may be short-term, with animals returning to the area once the noise has ceased (*e.g.*, Bowles *et al.*, 1994; Goold 1996; Stone *et al.*, 2000; Morton and Symonds, 2002; Gailey *et al.*, 2007). Longer-term displacement is possible, however, which may lead to changes in abundance or distribution patterns of the affected species in the affected region if habituation to the presence of the sound does not occur (*e.g.*, Blackwell *et al.*, 2004; Bejder *et al.*, 2006; Teilmann *et al.*, 2006).

A flight response is a dramatic change in normal movement to a directed and rapid movement away from the perceived location of a sound source. The flight response differs from other avoidance responses in the intensity of the response (*e.g.*, directed movement, rate of travel). Relatively little information on flight responses of marine mammals to anthropogenic signals exist, although observations of flight responses to the presence of predators have occurred (Connor and Heithaus, 1996). The result of a flight response could range from brief, temporary exertion and displacement from the area where the signal provokes flight to, in extreme cases, marine mammal strandings (Evans and England, 2001). However, it should be noted that response to a perceived predator does not necessarily invoke flight (Ford and Reeves, 2008), and whether individuals are solitary or in groups may influence the response.

Behavioral disturbance can also impact marine mammals in more subtle ways. Increased vigilance may result in costs related to diversion of focus and attention (*i.e.,* when a response consists of increased vigilance, it may come at the cost of decreased attention to other critical behaviors such as foraging or resting). These effects have generally not been demonstrated for marine mammals, but studies involving fish and terrestrial animals have shown that increased vigilance may substantially reduce feeding rates (*e.g.*, Beauchamp and Livoreil 1997; Fritz *et al.*, 2002; Purser and Radford 2011). In addition, chronic disturbance can cause population declines through reduction of fitness (*e.g.,* decline in body condition) and subsequent reduction in reproductive success, survival, or both (*e.g.*, Harrington and Veitch, 1992; Daan *et al.* 1996; Bradshaw *et al.*, 1998). However, Ridgway *et al.* (2006) reported that increased vigilance in bottlenose dolphins exposed to sound over a five-day period did not cause any sleep deprivation or stress effects.

Many animals perform vital functions, such as feeding, resting, traveling, and socializing, on a diel cycle (24-hour cycle). Disruption of such functions resulting from reactions to stressors such as sound exposure are more likely to be significant if they last more than one diel cycle or recur on subsequent days (Southall *et al.*, 2007). Consequently, a behavioral response lasting less than one day and not recurring on subsequent days is not considered particularly severe unless it could directly affect reproduction or survival (Southall *et al.*, 2007). Note that there is a difference between multi-day substantive behavioral reactions and multi-day anthropogenic activities. For example, just because an activity lasts for multiple days does not necessarily mean that individual animals are either exposed to activity-related stressors for multiple days or, further, exposed in a manner resulting in sustained multi-day substantive behavioral responses.

Stress responses—An animal's perception of a threat may be sufficient to trigger stress responses consisting of some combination of behavioral responses, autonomic nervous system responses, neuroendocrine responses, or immune responses (*e.g.*, Seyle 1950; Moberg 2000). In many cases, an animal's first and sometimes most economical (in terms of energetic costs) response is behavioral avoidance of the potential stressor. Autonomic nervous system responses to stress typically involve changes in heart rate, blood pressure, and gastrointestinal activity. These responses have a relatively short duration and may or may not have a significant long-term effect on an animal's fitness.

Neuroendocrine stress responses often involve the hypothalamus-pituitary-adrenal system. Virtually all neuroendocrine functions that are affected by stress—including immune competence, reproduction, metabolism, and behavior—are regulated by pituitary hormones. Stress-induced changes in the secretion of pituitary hormones have been implicated in failed reproduction, altered metabolism, reduced immune competence, and behavioral disturbance (*e.g.*, Moberg 1987; Blecha 2000). Increases in the circulation of glucocorticoids are also equated with stress (Romano *et al.* 2004).

The primary distinction between stress (which is adaptive and does not normally place an animal at risk) and distress is the cost of the response. During a stress response, an animal uses glycogen stores that can be quickly replenished once the stress is alleviated. In such circumstances, the cost of the stress response would not pose serious fitness consequences.

However, when an animal does not have sufficient energy reserves to satisfy the energetic costs of a stress response, energy resources must be diverted from other functions. This state of distress will last until the animal replenishes its energetic reserves sufficient to restore normal function.

Relationships between these physiological mechanisms, animal behavior, and the costs of stress responses are well-studied through controlled experiments and for both laboratory and free-ranging animals (*e.g.*, Holberton *et al.* 1996; Hood *et al.* 1998; Jessop *et al.* 2003; Krausman *et al.* 2004; Lankford *et al.* 2005)., Stress responses due to exposure to anthropogenic sounds or other stressors and their effects on marine mammals have also been reviewed (Fair and Becker 2000; Romano *et al.*, 2002b) and, more rarely, studied in wild populations (*e.g.*, Romano *et al.*, 2002a). For example, Rolland *et al.*, (2012) found that noise reduction from reduced ship traffic in the Bay of Fundy was associated with decreased stress in North Atlantic right whales. These and other studies lead to a reasonable expectation that some marine mammals will experience physiological stress responses upon exposure to acoustic stressors and that it is possible that some of these would be classified as "distress." In addition, any animal experiencing TTS would likely also experience stress responses (NRC, 2003).

Masking—Sound can disrupt behavior through masking, or interfering with, an animal's ability to detect, recognize, or discriminate between acoustic signals of interest (*e.g.*, those used for intraspecific communication and social interactions, prey detection, predator avoidance, navigation) (Richardson *et al.* 1995). Masking occurs when the receipt of a sound is interfered with by another coincident sound at similar frequencies and at similar or higher intensity, and may occur whether the sound is natural (*e.g.*, snapping shrimp, wind, waves, precipitation) or anthropogenic (*e.g.*, pile driving, shipping, sonar, seismic exploration) in origin. The ability of a noise source to mask biologically important sounds depends on the characteristics of both the noise source and the signal of interest (*e.g.*, signal-to-noise ratio, temporal variability, direction), in relation to each other and to an animal's hearing abilities (*e.g.*, sensitivity, frequency range, critical ratios, frequency discrimination, directional discrimination, age or TTS hearing loss), and existing ambient noise and propagation conditions.

Masking of natural sounds can result when human activities produce high levels of background sound at frequencies important to marine mammals. Conversely, if the background level of underwater sound is high (*e.g.* on a day with strong wind and high waves), an anthropogenic sound source would not be detectable as far away as would be possible under quieter conditions and would itself be masked. Busy ship channels traverse Thimble Shoal. Commercial vessels including container ships and cruise ships as well as numerous recreational frequent the area, so background sound levels near the project area are likely to be elevated, although to what degree is unknown.

The frequency range of the potentially masking sound is important in determining any potential behavioral impacts. For example, low-frequency signals may have less effect on high-frequency echolocation sounds produced by odontocetes but are more likely to affect detection of mysticete communication calls and other potentially important natural sounds such as those produced by surf and some prey species. The masking of communication signals by anthropogenic noise may be considered as a reduction in the communication space of animals (*e.g.*, Clark *et al.*, 2009) and may result in energetic or other costs as animals change their vocalization behavior (*e.g.*, Miller *et al.*, 2000; Foote *et al.*, 2004; Parks *et al.*, 2007b; Di Iorio and Clark 2009; Holt *et al.*, 2009). Masking can be reduced in situations where the signal and noise come from different directions (Richardson *et al.*, 1995), through amplitude modulation of the signal, or through other compensatory behaviors (Houser and Moore 2014). Masking can be tested directly in captive species (*e.g.,* Erbe 2008), but in wild populations it must be either modeled or inferred from evidence of masking compensation. There are few studies addressing real-world masking sounds likely to be experienced by marine mammals in the wild (*e.g.,* Branstetter *et al.,* 2013).

Masking affects both senders and receivers of acoustic signals and can potentially have long-term chronic effects on marine mammals at the population level as well as at the individual level. Low-frequency ambient sound levels have increased by as much as 20 dB (more than three times in terms of SPL) in the world's ocean from pre-industrial periods, with most of the increase from distant commercial shipping (Hildebrand 2009). All anthropogenic sound sources, but especially chronic and lower-frequency signals (*e.g.,* from vessel traffic), contribute to elevated ambient sound levels, thus intensifying masking.

Underwater Acoustic Effects

Potential Effects of Pile Driving Sound

The effects of sounds from pile driving might include one or more of the following: Temporary or permanent hearing impairment, non-auditory physical or physiological effects, behavioral disturbance, and masking (Richardson *et al.* 1995; Gordon *et al.* 2003; Nowacek *et al.* 2007; Southall *et al.* 2007). The effects of pile driving on marine mammals are dependent on several factors, including the type and depth of the animal; the pile size and type, and the intensity and duration of the pile driving sound; the substrate; the standoff distance between the pile and the animal; and the sound propagation properties of the environment. Impacts to marine mammals from pile driving activities are expected to result primarily from acoustic pathways. As such, the degree of effect is intrinsically related to the frequency, received level, and duration of the sound exposure, which are in turn influenced by the distance between the animal and the source. The further away from the source, the less intense the exposure should be. The substrate and depth of the habitat affect the sound propagation properties of the environment. In addition, substrates that are soft (*e.g.,* sand) would absorb or attenuate the sound more readily than hard substrates (*e.g.,* rock), which may reflect the acoustic wave. Soft porous substrates would also likely require less time to drive the pile, and possibly less forceful equipment, which would ultimately decrease the intensity of the acoustic source.

In the absence of mitigation, impacts to marine species could be expected to include physiological and behavioral responses to the acoustic signature (Viada *et al.* 2008). Potential effects from impulsive sound sources like impact pile driving can range in severity from effects such as behavioral disturbance to temporary or permanent hearing impairment (Yelverton *et al.* 1973). Due to the nature of the pile driving sounds in the project, behavioral disturbance is the most likely effect from the proposed activity. Marine mammals exposed to high intensity sound repeatedly or for prolonged periods can experience hearing threshold shifts. Note that PTS constitutes injury, but TTS does not (Southall *et al.* 2007).

Non-auditory Physiological Effects

Non-auditory physiological effects or injuries that theoretically might occur in marine mammals exposed to strong underwater sound include stress, neurological effects, bubble formation, resonance effects, and other types of organ or tissue damage (Cox *et al.* 2006; Southall *et al.* 2007). Studies examining such effects are limited. In general, little is known about the potential for pile driving to cause non-auditory physical effects in marine mammals. Available data suggest that such effects, if they occur at all, would presumably be limited to short distances from the sound source and to activities that extend over a prolonged period. The available data do not allow identification of a specific exposure level above which non-auditory effects can be expected (Southall *et al.* 2007) or any meaningful quantitative predictions of the numbers (if any) of marine mammals that might be affected in those ways. We do not expect any non-auditory physiological effects because of mitigation that prevents animals from approach the source too closely. Marine mammals that show behavioral avoidance of pile driving, including some odontocetes and some pinnipeds, are especially unlikely to incur non-auditory physical effects.

Disturbance Reactions

Responses to continuous sound, such as vibratory pile installation, have not been documented as well as responses to pulsed sounds. With both types of pile driving, it is likely that the onset of pile driving could result in temporary, short term changes in an animal's typical behavior and/or avoidance of the affected area. These behavioral changes may include (Richardson *et al.* 1995): Changing durations of surfacing and dives, number of blows per surfacing, or moving direction and/or speed; reduced/increased vocal activities; changing/cessation of certain behavioral activities (such as socializing or feeding); visible startle response or aggressive behavior (such as tail/fluke slapping or jaw clapping); avoidance of areas where sound sources are located; and/or flight responses (*e.g.,* pinnipeds flushing into water from haul-outs or rookeries). Pinnipeds may increase their haul out time, possibly to avoid in-water disturbance (Thorson and Reyff 2006). If a marine mammal responds to a stimulus by changing its behavior (*e.g.*, through relatively minor changes in locomotion direction/speed or vocalization behavior), the response may or may not constitute taking at the individual level, and is unlikely to affect 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 animals, and if so potentially on the stock or species, could potentially be significant (*e.g.*, Lusseau and Bejder 2007; Weilgart 2007).

The biological significance of many of these behavioral disturbances is difficult to predict, especially if the detected disturbances appear minor. However, the consequences of behavioral modification could be expected to be biologically significant if the change affects growth, survival, or reproduction. Significant behavioral modifications that could potentially lead to effects on growth, survival, or reproduction include:

- Changes in diving/surfacing patterns (such as those thought to cause beaked whale stranding due to exposure to military mid-frequency tactical sonar);
- Habitat abandonment due to loss of desirable acoustic environment; and
- Cessation of feeding or social interaction.

The onset of behavioral disturbance from anthropogenic sound depends on both external factors (characteristics of sound sources and their paths) and the specific characteristics of the receiving animals (hearing, motivation, experience, demography) and is difficult to predict (Southall *et al.* 2007).

Auditory Masking

Natural and artificial sounds can disrupt behavior by masking. The frequency range of the potentially masking sound is important in determining any potential behavioral impacts. Because sound generated from in-water pile driving is mostly concentrated at low frequency ranges, it may have less effect on high frequency echolocation sounds made by porpoises. Any masking event that could possibly rise to Level B harassment under the MMPA would occur concurrently within the zones of behavioral harassment already estimated for vibratory and impact pile driving, and which have already been taken into account in the exposure analysis.

Airborne Acoustic Effects

Pinnipeds that occur near the project site could be exposed to airborne sounds associated with pile driving that have the potential to cause behavioral harassment, depending on their distance from pile driving activities. Cetaceans are not expected to be exposed to airborne sounds that would result in harassment as defined under the MMPA.

Airborne noise would primarily be an issue for pinnipeds that are swimming or hauled out near the project site within the range of noise levels elevated above the acoustic criteria. The known harbor seal haulouts at CBBT are 9.3 km away from the project area; however, smaller numbers of harbor seals have been known to occasionally haul out on the rocks near the HRBT (Danielle Jones, Naval Facilities Engineering Command Atlantic, pers. comm., April 2019 as cited in the application).

We recognize that pinnipeds in the water could be exposed to airborne sound that may result in behavioral harassment when looking with their heads above water or when hauled out. Most likely, airborne sound would cause behavioral responses similar to those discussed above in relation to underwater sound. For instance, anthropogenic sound could cause hauled out pinnipeds to exhibit changes in their normal behavior, such as reduction in vocalizations, or cause them to temporarily abandon the area and move further from the source. Animals that are hauled out would likely enter the water and be "taken" due to underwater sound above the behavioral harassment thresholds, which are in all cases larger than those associated with airborne sound. Thus, the behavioral harassment of these animals would already accounted for in these estimates of potential take. Therefore, we do not believe that authorization of incidental take resulting from airborne sound for pinnipeds is warranted, and airborne sound is not discussed further here.

Marine Mammal Habitat Effects

The area likely impacted by the project is relatively small compared to the available habitat for all impacted species and stocks, and does not include any ESA-designated critical habitat. As previously mentioned, no BIAs overlap with the project area. The HRCP's proposed construction activities would not result in permanent negative impacts to habitats used directly by marine mammals, but could have localized, temporary impacts on marine mammal habitat including their prey by increasing underwater SPLs and slightly decreasing water quality. Increased noise levels may affect acoustic habitat (see masking discussion above) and adversely affect marine mammal prey in the vicinity of the project area (see discussion below). During pile driving, elevated levels of underwater noise would ensonify areas near the project where both fish and mammals occur and could affect foraging success.

There are no known foraging hotspots or other ocean bottom structure of significant biological importance to marine mammals present in the marine waters of the project area. Therefore, the main impact issue associated with the proposed activity would be temporarily elevated sound levels and the associated direct effects on marine mammals, as discussed previously in this document. The primary potential acoustic impacts to marine mammal habitat are associated with elevated sound levels produced by impact, vibratory, and DTH pile installation in the project area. Physical impacts to the environment such as construction debris are unlikely.

In-water pile driving would also cause short-term effects on water quality due to increased turbidity.

In-Water Construction Effects on Potential Foraging Habitat

Pile installation may temporarily increase turbidity resulting from suspended sediments. Any increases would be temporary, localized, and minimal. In general, turbidity associated with pile installation is localized to about a 25-foot (7.6 m) radius around the pile (Everitt *et al.*, 1980). Large cetaceans are not expected to be close enough to the project activity areas to experience effects of turbidity, and any small cetaceans and pinnipeds could avoid localized areas of turbidity. Therefore, the impact from increased turbidity levels is expected to be discountable to marine mammals.

Essential Fish Habitat (EFH) for several species or groups of species overlaps with the project area including: Atlantic herring (*Clupea harengus*), King Mackerel (*Scomberomorus cavalla*), Spanish mackerel (*Scomberomorus maculatus*), and black sea bass (*Centropristus striata*). Use of soft start procedure and bubble curtains (during impact pile driving of 36-in steel piles at the Jet Grouting Trestle in water depths greater than 20 ft) will reduce the impacts of underwater acoustic noise to fish from pile driving activities. Avoidance by potential prey (*i.e.*, fish) of the immediate area due to the temporary loss of this foraging habitat is also possible. The duration of fish avoidance of this area after pile driving stops is unknown, but a rapid return to normal recruitment, distribution and behavior is anticipated. Any behavioral avoidance by fish of the disturbed area would still leave significantly large areas of fish and marine mammal foraging habitat in the nearby vicinity.

In-water Construction Effects on Potential Prey (Fish)—Construction activities would produce continuous (*i.e.*, vibratory pile driving) and pulsed (*i.e.* impact driving, DTH) sounds. Fish react to sounds that are especially strong and/or intermittent low-frequency sounds. Short duration, sharp sounds can cause overt or subtle changes in fish behavior and local distribution (summarized in Popper and Hastings 2009). Hastings and Popper (2005) reviewed several studies that suggest fish may relocate to avoid certain areas of sound energy. Additional studies have documented physical and behavioral effects of pile driving on fish, although several are based on studies in support of large, multiyear bridge construction projects (*e.g.*, Scholik and Yan 2001, 2002; Popper and Hastings, 2009). Sound pulses at received levels of 160 dB may cause subtle changes in fish behavior. SPLs of 180 dB may cause noticeable changes in behavior (Pearson *et al.*, 1992; Skalski *et al.*, 1992). SPLs of sufficient strength have been known to cause injury to fish and fish mortality (summarized in Popper *et al.*, 2014).

The most likely impact to fish from pile driving activities at the project area would be temporary behavioral avoidance of the area. The duration of fish avoidance of this area after pile driving stops is unknown, but a rapid return to normal recruitment, distribution and behavior is anticipated. In general, impacts to marine mammal prey species are expected to be minor and temporary.

In summary, given the relatively small areas being affected, pile driving activities associated with the proposed action are not likely to have a permanent, adverse effect on any fish habitat, or populations of fish species. Thus, we conclude that impacts of the specified activity are not likely to have more than short-term adverse effects on any prey habitat or populations of prey species. Further, any impacts to marine mammal habitat are not expected to result in significant or long-term consequences for individual marine mammals, or to contribute to adverse impacts on their populations.

Estimated Take

This section provides an estimate of the number of incidental takes proposed for authorization through this IHA, which will inform both NMFS' consideration of "small numbers" and the negligible impact determinations.

Harassment is the only type of take expected to result from these activities. Except with respect to certain activities not pertinent here, section 3(18) of the MMPA defines "harassment" as any act of pursuit, torment, or annoyance, which (i) has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment); or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B harassment).

Take of marine mammals incidental to HRCP's pile driving and removal activities could occur by Level A and Level B harassment, as pile driving has the potential to result in disruption of behavioral patterns for individual marine mammals. The proposed mitigation and monitoring measures are expected to minimize the severity of such taking to the extent practicable. As described previously, no mortality is anticipated or proposed for authorization for this activity. Below we describe how the take is estimated.

Generally speaking, we estimate take by considering: (1) acoustic thresholds above which NMFS believes the best available science indicates marine mammals will be behaviorally harassed or incur some degree of permanent hearing impairment; (2) the area or volume of water that will be ensonified above these levels in a day; (3) the density or occurrence of marine mammals within these ensonified areas; and, (4) and the number of days of activities. We note that while these basic factors can contribute to a basic calculation to provide an initial prediction of takes, additional information that can qualitatively inform take estimates is also sometimes available (*e.g.*, previous monitoring results or average group size). Below, we describe the factors considered here in more detail and present the authorized take estimates for each IHA.

Acoustic Thresholds

Using the best available science, NMFS has developed acoustic thresholds that identify the received level of underwater sound above which exposed marine mammals would be reasonably expected to be behaviorally harassed (equated to Level B harassment) or to incur PTS of some degree (equated to Level A harassment).

Level B Harassment – Though significantly driven by received level, the onset of behavioral disturbance from anthropogenic noise exposure is also informed to varying degrees by other factors related to the source (*e.g.*, frequency, predictability, duty cycle), the environment (*e.g.*, bathymetry), and the receiving animals (hearing, motivation, experience, demography, behavioral context) and can be difficult to predict (Southall *et al.*, 2007, Ellison *et al.*, 2012). Based on what the available science indicates and the practical need to use a threshold based on a factor that is both predictable and measurable for most activities, NMFS uses a generalized acoustic threshold based on received level to estimate the onset of behavioral harassment. NMFS predicts that marine mammals are likely to be behaviorally harassed in a manner we consider Level B harassment when exposed to underwater anthropogenic noise above received levels of 120 dB re 1 μPa (rms) for continuous (*e.g.*, vibratory pile-driving, drilling) and above 160 dB re 1 μPa (rms) for non-explosive impulsive (*e.g.*, impact pile driving seismic airguns) or intermittent (*e.g.*, scientific sonar) sources. The HRCP's proposed activities include the use of continuous, non-impulsive (vibratory pile driving) and impulsive (impact pile driving; DTH hammer) sources and therefore, the 120 and 160 dB re 1 μPa (rms) are applicable.

Level A Harassment - NMFS' *Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing* (Version 2.0) (Technical Guidance, 2018) identifies dual criteria to assess auditory injury (Level A harassment) to five different marine mammal groups (based on hearing sensitivity) as a result of exposure to noise. The technical guidance identifies the received levels, or thresholds, above which individual marine mammals are predicted to experience changes in their hearing sensitivity for all underwater anthropogenic sound sources, and reflects the best available science on the potential for noise to affect auditory sensitivity by:

- Dividing sound sources into two groups (*i.e.*, impulsive and non- impulsive) based on their potential to affect hearing sensitivity;
- Choosing metrics that best address the impacts of noise on hearing sensitivity, *i.e.*, sound pressure level (peak SPL) and sound exposure level (SEL) (also accounts for duration of exposure); and
- Dividing marine mammals into hearing groups and developing auditory weighting functions based on the science supporting that not all marine mammals hear and use sound in the same manner.

These thresholds were developed by compiling and synthesizing the best available science, and are provided in Table 4 below. The references, analysis, and methodology used in the development of the thresholds are described in NMFS 2018 Technical Guidance, which may be accessed at *https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technicalguidance*. HRCP's proposed activity includes the use of impulsive (impact pile driving, DTH drilling) and non-impulsive (vibratory pile driving) sources.

Table 4--Thresholds Identifying the Onset of Permanent Threshold Shift

	PTS Onset Acoustic Thresholds* (Received Level)	
Hearing Group	Impulsive	Non-impulsive
Low-Frequency (LF) Cetaceans	*Cell 1* $L_{pk,flat}$: 219 dB $L_{E,LF,24h}$: 183 dB	*Cell 2* $L_{E,LF,24h}$: 199 dB
Mid-Frequency (MF) Cetaceans	*Cell 3* $L_{pk,flat}$: 230 dB	*Cell 4* $L_{E,MF,24h}$: 198 dB

	$L_{E,MF,24h}$: 185 dB	
High-Frequency (HF) Cetaceans	*Cell 5* $L_{pk,flat}$: 202 dB $L_{E,HF,24h}$: 155 dB	*Cell 6* $L_{E,HF,24h}$: 173 dB
Phocid Pinnipeds (PW) (Underwater)	*Cell 7* $L_{pk,flat}$: 218 dB $L_{E,PW,24h}$: 185 dB	*Cell 8* $L_{E,PW,24h}$: 201 dB
Otariid Pinnipeds (OW) (Underwater)	*Cell 9* $L_{pk,flat}$: 232 dB $L_{E,OW,24h}$: 203 dB	*Cell 10* $L_{E,OW,24h}$: 219 dB

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

Note: Peak sound pressure (L_{pk}) has a reference value of 1 μPa, and cumulative sound exposure level (L_E) has a reference value of 1μPa^{2}s. In this Table, thresholds are abbreviated to reflect American National Standards Institute standards (ANSI 2013). However, peak sound pressure is defined by ANSI as incorporating frequency weighting, which is not the intent for this Technical Guidance. Hence, the subscript "flat" is being included to indicate peak sound pressure should be flat weighted or unweighted within the generalized hearing range. The subscript associated with cumulative sound exposure level thresholds indicates the designated marine mammal auditory weighting function (LF, MF, and HF cetaceans, and PW and OW pinnipeds) and that the recommended accumulation period is 24 hours. The cumulative sound exposure level thresholds could be exceeded in a multitude of ways (*i.e.*, varying exposure levels and durations, duty cycle). When possible, it is valuable for action proponents to indicate the conditions under which these acoustic thresholds will be exceeded.

Ensonified Area

Here, we describe operational and environmental parameters of the activity that will feed into identifying the area ensonified above the acoustic thresholds, which include source levels and transmission loss coefficient.

Sound Propagation

Transmission loss (TL) is the decrease in acoustic intensity as an acoustic pressure wave propagates out from a source. TL parameters vary with frequency, temperature, sea conditions, current, source and receiver depth, water depth, water chemistry, and bottom composition and topography. The general formula for underwater TL is:

$TL = B * \log_{10}(R_1/R_2)$, where

B = transmission loss coefficient (assumed to be 15)

R_1 = the distance of the modeled SPL from the driven pile, and

R_2 = the distance from the driven pile of the initial measurement.

This formula neglects loss due to scattering and absorption, which is assumed to be zero here. The degree to which underwater sound propagates away from a sound source is dependent on a variety of factors, most notably the water bathymetry and presence or absence of reflective or absorptive conditions including in-water structures and sediments. Spherical spreading occurs in a perfectly unobstructed (free-field) environment not limited by depth or water surface, resulting in a 6 dB reduction in sound level for each doubling of distance from the source (20*log(range)). Cylindrical spreading occurs in an environment in which sound propagation is bounded by the water surface and sea bottom, resulting in a reduction of 3 dB in sound level for each doubling of distance from the source (10*log(range)). As is common practice in coastal waters, here we assume practical spreading loss (4.5 dB reduction in sound level for each doubling of distance). Practical spreading is a compromise that is often used under conditions where water depth increases as the receiver moves away from the shoreline, resulting in an expected propagation environment that would lie between spherical and cylindrical spreading loss conditions.

Sound Source Levels

The intensity of pile driving sounds is greatly influenced by factors such as the type of piles, hammers, and the physical environment in which the activity takes place. There are source level measurements available for certain pile types and sizes from the similar environments recorded from underwater pile driving projects (*e.g.*, CALTRANS 2015) that were used to determine reasonable sound source levels likely result from the HRCP’s pile driving and removal activities (Table 5). HRCP has proposed to employ bubble curtains during impact pile driving of 36-in steel piles at the Jet Grouting Trestle in water depths greater than 20 ft. Therefore, a 7dB reduction of the sound source level will be implemented (Table 5).

Table 5--Predicted Sound Source Levels for all pile types

Method and Pile Type	Sound Source Level at 10 meters			Source
Vibratory Hammer	**dB rms**			
42-inch steel pile	168[a]			City and Borough of Sitka Department of Public Works 2017
36-inch steel pile	167[b]			DoN 2015
24-inch steel pile	161[c]			DoN 2015
Down-the-hole Hammer	**dB rms**	**dB SEL**	**dB peak**	
All pile sizes	180	164	190	Denes *et al*., 2019
Impact Hammer	**dB rms**	**dB SEL**	**dB peak**	
36-inch steel pile	193	183	210	Chesapeake Tunnel Joint Venture 2018
36-inch steel pile, attenuated*	186	176	203	DoN 2015; Chesapeake Tunnel Joint Venture 2018
54-inch concrete cylinder pile	176	174	192	MacGillivray *et al*., 2007
30-inch concrete square pile	176	174	192	MacGillivray *et al*., 2007
24-inch concrete square pile	176	166	188	Caltrans, 2015

SEL = sound exposure level; dB peak = peak sound level; rms = root mean square; DoN = Department of the Navy.
*SSLs are a 7 dB reduction for the usage of a bubble curtain.
[a] The SPL rms value of 168 dB is within 2 dB of Caltrans (2015) at 170 dB rms for 42-in piles.
[b] The SPL rms value of 167 is within 3 dB of Caltrans (2015) at 170 dB rms; however, the DoN (2015) incorporates a larger dataset and is better suited to this project.
[c] There is no Caltrans (2015) data available for this pile size. Caltrans is 155 dB rms for 12-in pipe pile or 170 dB rms for 36-in steel piles. The value of 161 dB rms has been also used in previous IHAs (*e.g.*, 82 FR 31400, 83 FR 12152, 84 FR 22453, and 84 FR 34134).

During pile driving installation activities, there may be times when multiple construction sites are active and hammers are used simultaneously. For impact hammering, it is unlikely that the two hammers would strike at the same exact instant, and therefore, the sound source levels will not be adjusted regardless of the distance between the hammers. For this reason, multiple impact hammering is not discussed further. For simultaneous vibratory hammering, the likelihood of such an occurrence is anticipated to be infrequent and would be for short durations on that day. In-water pile installation is an intermittent activity, and it is common for installation to start and stop multiple times as each pile is adjusted and its progress is measured. When two continuous noise sources, such as vibratory hammers, have overlapping sound fields, there is potential for higher sound levels than for non-overlapping sources. When two or more vibratory hammers are used simultaneously, and the sound field of one source encompasses the sound field of another source, the sources are considered additive and combined using the following rules (see Table 6): for addition of two simultaneous vibratory hammers, the difference between the two sound source levels (SSLs) is calculated, and if that difference is between 0 and 1 dB, 3 dB are added to the higher SSL; if difference is between 2 or 3 dB, 2 dB are added to the highest SSL; if the difference is between 4 to 9 dB, 1 dB is added to the highest SSL; and with differences of 10 or more decibels, there is no addition.

Table 6--Rules for Combining Sound Levels Generated during Pile Installation

Hammer Types	Difference in SSL	Level A Zones	Level B Zones
Vibratory, Impact	Any	Use impact zones	Use vibratory zone
Impact, Impact	Any	Use zones for each pile size and number of strikes	Use zone for each pile size
Vibratory, Vibratory	0 or 1 dB	Add 3 dB to the higher source level	Add 3 dB to the higher source level

	2 or 3 dB	Add 2 dB to the higher source level	Add 2 dB to the higher source level
	4 to 9 dB	Add 1 dB to the higher source level	Add 1 dB to the higher source level
	10 dB or more	Add 0 dB to the higher source level	Add 0 dB to the higher source level

Source: Modified from USDOT 1995, WSDOT 2018, and NMFS 2018b
Note: dB = decibels; SSL = sound source level.

For simultaneous usage of three or more continuous sound sources, such as vibratory hammers, the three overlapping sources with the highest SSLs are identified. Of the three highest SSLs, the lower two are combined using the above rules, then the combination of the lower two is combined with the highest of the three. For example, with overlapping isopleths from 24-, 36-, and 42-inch diameter steel pipe piles with SSLs of 161, 167, and 168 dB rms respectively, the 24- and 36-inch would be added together; given that 167 – 161 = 6 dB, then 1 dB is added to the highest of the two SSLs (167 dB), for a combined noise level of 168 dB. Next, the newly calculated 168 dB is added to the 42-inch steel pile with SSL of 168 dB. Since 168 – 168 = 0 dB, 3 dB is added to the highest value, or 171 dB in total for the combination of 24-, 36-, and 42-inch steel pipe piles (NMFS 2018b; WSDOT 2018). As described in Table 6, decibel addition calculations were carried out for all possible combinations of vibratory installation of 24-, 36- and 42-inch steel pipe piles throughout the project area (Table 7).

Table 7-- Possible Vibratory Pile Combinations for the Project

Method			**Vibratory**								
	Pile Diameter (Inches)		24	24+24	36	42	36+24	42+24	36+36	42+36	42+42
		SSL (dB)	161	164	167	168	168	169	170	171	171
Vibratory	24	161	**164**	**166**	**168**	**169**	**-**	**-**	**-**	**-**	**-**
	36	167	**168**	**169**	**170**	**171**	**171**	**-**	**172**	**-**	**-**
	42	168	**169**	**169**	**171**	**171**	**171**	**172**	**172**	**173**	**173**

SSL = Sound Source Level; dB = decibels.
"-" combination not valid, must compare lowest 2 values first, then highest value.

Level A Harassment

When the NMFS Technical Guidance (2016) was published, in recognition of the fact that ensonified area/volume could be more technically challenging to predict because of the duration component in the new thresholds, we developed a User Spreadsheet that includes tools to help predict a simple isopleth that can be used in conjunction with marine mammal density or occurrence to help predict takes. We note that because of some of the assumptions included in the methods used for these tools, we anticipate that isopleths produced are typically going to be overestimates of some degree, which may result in some degree of overestimate of Level A harassment take. However, these tools offer the best way to predict appropriate isopleths when more sophisticated 3D modeling methods are not available, and NMFS continues to develop ways to quantitatively refine these tools, and will qualitatively address the output where appropriate. For stationary sources (such as from vibratory pile driving), NMFS User Spreadsheet predicts the closest distance at which, if a marine mammal remained at that distance the whole duration of the activity, it would incur PTS. Inputs used in the User Spreadsheet (Tables 8 through 10), and the resulting isopleths are reported below (Table 11).

In the chance that multiple vibratory hammers would be operated simultaneously, to simplify implementation of Level A harassment zones, the worst-case theoretical scenarios were calculated for the longest anticipated duration of the largest pile size (42-in steel pile) that could be installed within a day (see Table 8). However, it would be unlikely that 6 sets of 3 piles could be installed in synchrony, but more likely that installations of piles would overlap by a few minutes at the beginning or end, throughout the day, so that during a 12-hour construction shift, there would be periods of time when 0, 1, 2, 3, or more hammers would be working.

Table 8--NMFS Technical Guidance (2018) User Spreadsheet Input to Calculate PTS Isopleths for Vibratory Pile Driving for All Locations

USER SPREADSHEET INPUT –Vibratory Pile Driving Spreadsheet Tab A.1 Vibratory Pile Driving Used.						
	24-in steel piles	36-in steel piles	36-in steel piles (at TBM platform)	42-in steel piles	42-in steel piles (multiple hammer event – 3 hammers simultaneously)	42-in steel piles (multiple hammer event – 2 hammers simultaneously)
Source Level (RMS SPL)	161	167	167	168	173	171
Weighting Factor Adjustment (kHz)	2.5	2.5	2.5	2.5	2.5	2.5
Number of piles within 24-hr period	6	6	2	6	6 (3 piles installed simultaneously, 6 piling events)	9 (2 piles installed simultaneously, 9 piling events)
Duration to drive a single pile (min)	30	50	60	30	30	30
Propagation (xLogR)	15	15	15	15	15	15
Distance of source level measurement (meters)+	10	10	10	10	10	10

Table 9--NMFS Technical Guidance (2018) User Spreadsheet Input to Calculate PTS Isopleths for Impact Pile Driving for the Jet Grouting Trestle with and without a Bubble Curtain

USER SPREADSHEET INPUT – Impact Pile Driving Spreadsheet Tab E.1-2 Impact Pile Driving Used for Jet Grouting Trestle		
	36-in steel piles	36-in steel piles (attenuated)
Source Level (SEL)	183	176*
Weighting Factor Adjustment (kHz)	2	2
Number of piles within 24-hr period	3	3
Number of strikes per pile	40	40
Propagation (xLogR)	15	15
Distance of source level measurement (meters)+	10	10

*The attenuated piles account for a 7dB reduction from the use of a bubble curtain.

Table 10--NMFS Technical Guidance (2018) User Spreadsheet Input to Calculate PTS Isopleths for Impact Pile Driving and DTH Drilling

USER SPREADSHEET INPUT – Impact Pile Driving Spreadsheet Tab E.1-2 Impact Pile Driving										
	North Trestle	**North Trestle, Willoughby Bay, and South Trestle Test Pile Program**			**South Island**		**DTH**			
	36-in steel piles	24-in concrete square	30-in concrete square	54-in concrete cylinder	**TBM Platform** 36-in steel piles	**Conveyor Trestle** 36-in steel piles	**TBM Platform** 36-in steel piles	**North Shore Work Trestle** 36-in steel piles	**Jet Grouting Trestle** 36-in steel piles	**Conveyor Trestle** 36-in steel piles
Source Level (SEL)	183	166	174	174	183	183	180	180	180	180
Weighting Factor Adjustment (kHz)	2	2	2	2	2	2	2	2	2	2
Number of piles within 24-hr period	3	1	1	1	2	3	2	3	3	3
Number of strikes per pile	40	2,100	2,100	2,100	60	40	50,400	50,400	50,400	50,400
Propagation (xLogR)	15	15	15	15	15	15	15	15	15	15
Distance of source level measurement (meters)+	10	10	10	10	10	10	10	10	10	10

Table 11--Level A Harassment Isopleths for both Vibratory and Impact Pile Driving

USER SPREADSHEET OUTPUT		PTS isopleths (meters)				PTS isopleths (km^2)			
		Level A harassment				Level A harassment			
Pile Type/Activity	Sound Source Level at 10 m	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid
Vibratory Pile Driving									
24-in steel pile installation (All Locations)	161 dB SPL	15	2	21	9	<0.01			
36-in steel pile installation (All Locations)	167 dB SPL	32	3	47	20	<0.01			
36-in steel pile installation (TMB Platform)	167 dB SPL	28	3	41	17	<0.01			

42-in steel pile installation (All Locations)	168 dB SPL	42	4	62	26	<0.10			
Impact Pile for the Jet Grouting Trestle									
36-in steel pile installation	183 dB SEL	243	9	290	130	0.11	<0.01	0.16	<0.10
36-in steel pile installation (attenuated)	176 dB SEL	83	3	99	45	0.014	<0.001	0.20	<0.01
Impact Pile Driving North Trestle									
36-in steel pile installation (North Shore Work Trestle)	183 dB SEL	243	9	290	130	0.19	<0.001	0.26	0.05
Impact Pile Driving for North Trestle, Willoughby Bay, and South Trestle Test Pile Program									
24-in concrete square pile installation/removal	166 dB SEL	121	5	144	65	0.05	<0.001	0.07	0.01
30-in concrete square pile installation/removal	174 dB SEL	412	15	490	221	0.53	<0.001	0.75	0.15
54-in concrete square pile installation/removal	174 dB SEL	412	15	490	221	0.53	<0.001	0.75	0.15
Impact Pile Driving for South Island									
36-in steel pile installation (TBM Platform)	183 dB SEL	243	9	290	130	0.11	<0.001	0.16	<0.10
36-in steel pile installation (Conveyor Trestle)	183 dB SEL	243	9	290	130	0.11	<0.001	0.16	<0.10
DTH Drilling									
36-in steel pile installation (TBM Platform)	180 dB SEL	1,171	42	1,395	627	2.437	<0.01	3.446	0.704
36-in steel pile installation (North Shore Work Trestle)	180 dB SEL	1,534	55	1,827	821	3.615	<0.01	4.790	1.548
36-in steel pile installation (Jet Grouting Trestle)	180 dB SEL	1,534	55	1,827	821	3.615	<0.01	5.908	1.548
36-in steel pile installation (Conveyor Trestle)	180 dB SEL	1,534	55	1,827	821	3.615	<0.01	5.908	1.548
Multiple Hammers - Vibratory Pile Driving (if occurs)*									
42-in steel pile installation (assumes 3 piles installed simultaneously, 6 piling events * 30 minutes each event in a 24-hr period)	173 dB SPL	89.6	7.9	132.5	54.5	0.025	0.0001	0.055	0.009
42-in steel pile installation (assumes 2 piles installed simultaneously, 9 piling events * 30 minutes each event in a 24-hr period)	171 dB SPL	86.4	7.7	127.8	52.5	0.023	0.0001	0.051	0.009

*SPLs were calculated by decibel addition as presented in Table 6 using the largest pile size (42-in steel piles) and possible combinations of two and three multiple hammer events. Please note: smaller piles may also have multiple hammer events; however, their SPLs would be smaller than the 42-in steel pipe pile scenarios so they are not presented here. The HRCP will be using the largest Level A isopleths calculated regardless of pile size during multiple hammering events.

For multiple hammering of 42-in steel pipe piles with a vibratory hammer on a single day, the calculated Level A harassment isopleth for the functional hearing groups would remain smaller than 100 m except for high-frequency cetaceans (*i.e.*, harbor porpoise). The Level A harassment isopleth for harbor porpoises would be 132.5 m and 127.8 m for the two scenarios (Table 11). It is unlikely that a harbor porpoise could accumulate enough sound from the installation of multiple piles in multiple locations for the duration required to meet these Level A harassment thresholds. Additionally, other combinations of pile sizes under multiple hammering with a vibratory hammer would result in Level A harassment thresholds smaller than 100 m. To be precautionary, a shutdown zone of 100 m would be implemented for all species for each vibratory hammer on days when it is anticipated that multiple vibratory hammers will be used regardless of pile size.

Level B Harassment

Utilizing the practical spreading loss model, underwater noise will fall below the behavioral effects threshold of 120 and 160 dB rms for marine mammals at the distances shown in Table 12 for vibratory and impact pile driving, respectively. Table 12 below provides all Level B harassment radial distances (m) and their corresponding areas (km^2) during HRCP's proposed activities.

Table 12--Radial Distances (meters) to Relevant Behavioral Isopleths and Associated Ensonified Areas (square kilometers (km^2)) Using the Practical Spreading Model

Location and Component	Method and Pile Type	Distance to Level B Harassment Zone (m)	Level B Harassment Zone (km^2)
Vibratory Hammer (Level B Isopleth = 120 dB)			
North Trestle			
Moorings	42-in steel piles	15,849	96.781
North Shore Work Trestle	36-in steel piles	13,594	85.525

Location and Component	Method and Pile Type	Distance to Level B Harassment Zone (m)	Level B Harassment Zone (km^2)
Moorings	24-in steel piles	5,412	25.335
	North Island		
Moorings	42-in steel piles	15,849	100.937
	South Island		
TBM Platform	36-in steel piles	13,594	81.799
Conveyor Trestle	36-in steel piles	13,594	81.799
Jet Grouting Trestle	36-in steel piles	13,594	81.799
	South Trestle		
Moorings	42-in steel piles	15,849	305.343
Moorings	24-in steel piles	5,412	55.874
	Willoughby Bay		
Moorings	42-in steel piles	15,849	5.517
Moorings	24-in steel piles	5,412	5.517
	Down-the-Hole Hammer (Level B Isopleth = 160 dB)		
North Shore Work Trestle	36-in steel piles	215	0.145
TBM Platform	36-in steel piles	215	0.087
Jet Grouting Trestle	36-in steel piles	215	0.087
Conveyor Trestle	36-in steel piles	215	0.087
	Impact Hammer (Level B Isopleth = 160 dB)		
	North Trestle		
North Shore Work Trestle	36-in steel piles	1,585	3.806
	South Island		
TBM Platform	36-in steel piles	1,585	0.087
Conveyor Trestle	36-in steel piles	1,585	0.087
Jet Grouting Trestle with Bubble Curtain	36-in steel piles	541*	0.012*
	North Trestle, South Trestle, Willoughby Bay		
Test Pile Program	54-in concrete cylinder piles	117	0.04

Location and Component	Method and Pile Type	Distance to Level B Harassment Zone (m)	Level B Harassment Zone (km^2)
Test Pile Program	30-in concrete square piles	117	0.04
Test Pile Program	24-in concrete square piles	117	0.04

dB = decibels; km^2 = square kilometers; TBM = Tunnel Boring Machine.

*Values smaller than other 36-in steel piles due to usage of a bubble curtain, resulting in a 7 dB reduction in dB rms, dB peak, and dB SEL.

In some cases, particularly during DTH drilling and the test pile program, the calculated Level A harassment isopleths are larger than the Level B harassment zones. This has occurred due to the conservative assumptions going into calculation of the Level A harassment isopleths. Animals will most likely respond behaviorally before they are injured, especially at greater distances and unlikely to accumulate noise levels over a certain period of time that would likely lead to PTS.

When multiple vibratory hammers are used simultaneously, the calculated Level B harassment zones would be larger than the Level B harassment zones reported in above in Table 12 depending on the combination of sound sources due to decibel addition of multiple vibratory hammers as discussed earlier (see Table 7). Table 13 shows the calculated distances to the Level B harassment zone for decibel levels resulting from the simultaneous installation of piles with multiple vibratory hammers using the data provided in Table 7. However, the actual monitoring zones applied during multiple vibratory hammer use are discussed in the *Proposed Monitoring and Reporting* section.

Table 13—Calculated Distances to Level B Harassment Zones for Multiple Hammer Additions

Combined SSL (dB)	Distance to Level B Harassment Zone (m)
163	7,356

164	8,577
165	10,000
166	11,659
167	13,594
168	15,849
169	18,478
170	21,544
171	25,119
172	29,286
173	34,145

Note: dB = decibels; SSL = sound source level.

Marine Mammal Occurrence and Take Calculation and Estimation

In this section, we provide the information about the presence, density, or group dynamics of marine mammals that will inform the take calculations. Potential exposures to impact and vibratory pile driving and removal for each acoustic threshold were estimated using local observational data. Take by Level A and B harassment is proposed for authorization.

Humpback whales

Humpback whales are more rare in the project area and density data for this species within the project vicinity are not available. Humpback whale sighting data collected by the U.S. Navy near Naval Station Norfolk and Virginia Beach from 2012 to 2015 (Engelhaupt *et al*. 2014, 2015, 2016) and in the mid-Atlantic (including the Chesapeake Bay) from 2015 to 2018 (Aschettino *et al*. 2015, 2016, 2017a, 2018) did not produce large enough sample sizes to calculate densities, or survey data were not collected during systematic line-transect surveys. Humpback whale densities have been calculated for populations off the coast of New Jersey, resulting in a density estimate of 0.000130 animals per square kilometer or one humpback whale within the area on any given day of the year (Whitt *et al*., 2015), which may be similar to the density of whales in the project area. Aschettino *et al*. (2018) observed and tracked two individual humpback whales in the Hampton Roads area of the project area (Movebank, 2019). The HRCP is estimating up to two whales may be exposed to project-related noise every two months. Pile installation/removal is expected to occur over a 12-month period; therefore, a total of 12 instances of take by Level B harassment of humpback whales is proposed. Due to the low occurrence of humpback whales and because large whales are easier to sight from a distance, we do not anticipate or propose take of humpback whales by Level A harassment.

Bottlenose dolphin

The expected number of bottlenose dolphins in the project area was estimated using daily sighting rates of marine mammals from vessel line-transect surveys near Naval Station Norfolk and adjacent areas near Virginia Beach, Virginia, from August 2012 through August 2015 (Engelhaupt *et al*., 2016). Many of the data from the Engelhaupt *et al*. (2016) study were collected from the coastal region outside Chesapeake Bay, where bottlenose dolphin numbers are greater than in the project area. For this analysis, only bottlenose dolphin sightings located west of 76°10' (76.16667°) were used, which includes the largest area that could be ensonified by project-related noise. Sighting rates (number of dolphins per day) were determined for each of the four seasons (Table 14). The number of sightings per season ranged from 5 in spring to 24 in fall; no bottlenose dolphins were sighted in the winter months. Bottlenose dolphin abundance was highest in the fall, with 24 sightings representing 245 individuals, followed by the spring (n = 156), and summer (n = 115). Therefore, the average daily sighting rate of bottlenose dolphins across spring, summer, and fall were averaged to estimate that 20.33 bottlenose dolphins per day potentially could be exposed to project-related noise (Table 14).

Table 14--Average Daily Sighting Rates of Bottlenose Dolphins within the Project Area

Season	Number of Sightings Per Season	Average Number of Dolphins Sighted Per Day
Spring, March – May	5	17.33
Summer, June – August	14	16.43
Fall, September – November	24	27.22
Winter, December – February	0	0.00
Average Dolphins: Spring, Summer, and Fall		**20.33**

Source: Engelhaupt *et al*., 2016

The number of days of pile installation is estimated to be 312 days. Therefore, the instances of take by Level B harassment proposed for this activity is 6,343 for bottlenose dolphins (20.33 bottlenose dolphins per day multiplied by 312 days). Because the Level A harassment zones are relatively small (a 55-m isopleth is the largest during DTH drilling of 36-in piles) and we believe the PSO will be able to effectively monitor the Level A harassment zones, we do not anticipate take by Level A harassment of bottlenose dolphins.

Harbor Seals

The expected number of harbor seals in the project area was estimated using systematic, land- and vessel-based survey data for in-water and hauled-out seals collected by the U.S. Navy at the CBBT rock armor and portal islands from November 2014 through May 2018 (Rees *et al*., 2016; Jones *et al*., 2018). The number of harbor seals sighted by month from 2014 through 2018, in the Chesapeake Bay waters, near the project area, ranged from 0 to 170 individuals (Table 15). Harbor seals are not expected to be present in the Chesapeake Bay during the months of June through October (Table 15 and Table 16).

Table 15-- Summary of Historical Harbor Seal Sightings by Month from 2014 to 2018

Number of Individual Harbor Seals

Month	2014	2015	2016	2017	2018	Monthly Average
January	-	-	33	120	170	**107.7**
February	-	39	80	106	159	**96**
March	-	55	61	41	0	**39.3**
April	-	10	1	3	3	**4.3**
May	-	3	0	0	0	**0.8**
June	Seals not expected to be present.					**0**
July	Seals not expected to be present.					**0**
August	Seals not expected to be present.					**0**
September	Seals not expected to be present.					**0**
October	Seals not expected to be present.					**0**
November	1	0	1	0	-	**0.5**
December	4	9	24	8	-	**11.3**

Source: Rees et al., 2016; Jones et al., 2018.
Note: Seal counts began in November 2014 and were collected for four field seasons (2014/2015, 2015/2016, 2016/2017, and 2017/2018) ending in May 2018. In January 2015, no surveys were conducted.

Table 16--Average Number of Individual Harbor Seal Sightings Summarized by Season

Season	Average Number of Individuals Per Season
Spring (March – May)	45
Summer (June – August)	0
Fall (September – November)	1
Winter (December – February)	215
Total Harbor Seals Per Year	**261**

Note: Data presented is from Table 15.

Using the above data, the total instances of take by Level B harassment for harbor seals is 261. The largest Level A harassment isopleth calculated from DTH drilling of 36-in steel pipe piles for harbor seals is 821 meters (Table 11). The area of this Level A harassment zone is 1.55 km^2, which is larger than the area of the Level B harassment zone (0.015 km^2). The known harbor seal haulouts at CBBT are 9.3 km away from the project area; however, smaller numbers of harbor seals have been known to occasionally haul out on the rocks near the HRBT (Danielle Jones, Naval Facilities Engineering Command Atlantic, pers. comm., April 2019 as cited in the application). It is unlikely that harbor seals using the CBBT haulouts will approach the project area within 821 m of pile installation and potentially incur Level A harassment. On approximately 21 percent of the pile driving days, the calculated Level A harassment zone would exceed the size of the calculated Level B harassment zone during DTH drilling. To account for any seals that may haul out on the rocks near HRBT, particularly during DTH drilling, HRCP requests 55 instances of take by Level A harassment of harbor seals as part of the 261 total instances of take requested. If any seals are hauled out on rocks near the HRBT, it is likely they will enter the water and be taken from Level B harassment in-water. Therefore, we are not proposing any in-air harassment takes for harbor seals.

Gray seals

The expected number of gray seals in the project area was estimated using systematic, land- and vessel-based survey data for in-water and hauled-out seals collected by the U.S. Navy at the CBBT rock armor and portal islands from 2014 through 2018 (Rees *et al*., 2016; Jones *et al.*, 2018). Seasonal numbers of gray seals in the Chesapeake Bay waters in the vicinity of the project area in previous years have been low (Table 17). Gray seals are not expected to be present in the Chesapeake Bay during the months of June through October (Table 17 and Table 18).

Table 17-- Summary of Historical Gray Seal Sightings by Month from 2014 to 2018

Number of Individual Gray Seals						
Month	**2014**	**2015**	**2016**	**2017**	**2018**	**Monthly Average**

January	-	0	0	0	0	**0**
February	-	1	1	0	1	**0.8**
March	-	0	0	0	0	**0**
April	-	0	0	0	0	**0**
May	-	0	0	0	0	**0**
June	Seals not expected to be present.					**0**
July	Seals not expected to be present.					**0**
August	Seals not expected to be present.					**0**
September	Seals not expected to be present.					**0**
October	Seals not expected to be present.					**0**
November	0	0	0	0	-	**0**
December	0	0	0	0	-	**0**

Source: Rees et al., 2016; Jones et al., 2018

Table 18--Average Number of Individual Gray Seal Sightings Summarized by Season

Season	Average Number of Individuals per Season
Spring (March – May)	0
Summer (June – August)	0
Fall (September – November)	0
Winter (December – February)	1

Note: Data generated from Table 17

Gray seals are expected to be very uncommon in the project area. The historical data indicate that approximately one gray seal has been seen per year. To be conservative, HRCP requests three instances of take by Level B harassment of gray seals during each winter month (December through February). Therefore, HRCP estimate that nine instances of take by Level B harassment of gray seals could occur (three gray seals per month multiple by three months = nine gray seals). Because of the unlikely to low occurrence of gray seals in the project area, we do not anticipate take by Level A harassment of gray seals.

Harbor Porpoise

Harbor porpoises are known to occur in the coastal waters near Virginia Beach (Hayes *et al*. 2019), and although they have been reported on rare occasions in the Chesapeake Bay, closer to Norfolk, they are rarely seen in the project area. Density data for this species within the Project vicinity do not exist or were not calculated because sample sizes were too small to produce reliable estimates of density. Harbor porpoise sighting data collected by the U.S. Navy near Naval Station Norfolk and Virginia Beach from 2012 to 2015 (Engelhaupt *et al*., 2014; 2015; 2016) did not produce enough sightings to calculate densities. One group of two harbor porpoises was seen during spring 2015 (Engelhaupt *et al*., 2016). Based on this data, it estimated that one group of two harbor porpoises could be exposed to project-related in-water noise each month during the spring (March–May) for a total of 6 instances of take by Level B harassment (*i.e*., one group of two individuals per month multiplied by three months = six harbor porpoises).

The largest calculated Level A harassment isopleth for high frequency cetaceans (*i.e*., harbor porpoises) extends 1,827 m during DTH drilling of 36-in steel pipe piles. The area of this Level A harassment zone is 5.9 km^2, which is larger than the area of the Level B harassment zone (0.015 km^2). Because of this disparity in sizes of the calculated zones, and because harbor porpoises are relatively difficult to observe, it is possible they may occur within the calculated Level A harassment zone without detection. As such, HRCP requests a small number of takes by Level A harassment for harbor porpoises during the project. On approximately 21 percent of the pile driving days, the calculated Level A harassment zone would exceed the size of the calculated Level B harassment zone during DTH drilling. It is anticipated that two harbor porpoises may enter the calculated Level A harassment zone during this time. Therefore, we propose to authorize a total of 2 instances of take by Level A harassment.

Table 19 below summarizes the proposed authorized take for all the species described above as a percentage of stock abundance.

Table 19--Proposed Take by Level A and B Harassment and as a Percentage of Stock Abundance

Species	Stock	Proposed Level A Takes	Proposed Level B Takes	Total Takes Proposed for Authorization	Percentage of Stock
Humpback whale	Gulf of Maine	0	12	12	Less than 2 percent
Harbor porpoise	Gulf of Maine/Bay of Fundy	2	4	6	Less than 1 percent
Bottlenose dolphin	WNA Coastal, Northern Migratory[a]	0	3,063	3,063	46.13
	WNA Coastal, Southern Migratory[a]	0	3,063	3,063	81.66
	NNCES[a]	0	216	216	26.25
Harbor seal	Western North Atlantic	55	206	261	Less than 1 percent
Gray seal	Western North Atlantic	0	9	9	Less than 1 percent

[a] Take estimates are weighted based on calculated percentages of population for each distinct stock, assuming animals present would follow same probability of presence in project area

Proposed Mitigation

In order to issue an IHA under Section 101(a)(5)(D) of the MMPA, NMFS must set forth the permissible methods of taking pursuant to such activity, and other means of effecting the least practicable impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such species or stock for taking for certain subsistence uses (latter not applicable for this action). NMFS regulations require applicants for incidental take authorizations to include information about the availability and feasibility (economic and technological) of equipment, methods, and manner of conducting such activity or other means of effecting the least practicable adverse impact upon the affected species or stocks and their habitat (50 CFR 216.104(a)(11)).

In evaluating how mitigation may or may not be appropriate to ensure the least practicable adverse impact on species or stocks and their habitat, as well as subsistence uses where applicable, we carefully consider two primary factors:

(1) the manner in which, and the degree to which, the successful implementation of the measure(s) is expected to reduce impacts to marine mammals, marine mammal species or stocks, and their habitat. This considers the nature of the potential adverse impact being mitigated (likelihood, scope, range). It further considers the likelihood that the measure will be effective if implemented (probability of accomplishing the mitigating result if implemented as proposed), the likelihood of effective implementation (probability implemented as proposed), and;

(2) the practicability of the measures for applicant implementation, which may consider such things as cost, impact on operations, and, in the case of a military readiness activity, personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity.

The following mitigation measures are included in the proposed IHAs:

Timing Restrictions

All work will be conducted during conditions of good visibility. If poor environmental conditions restrict full visibility of the shutdown zone, pile installation would be delayed.

Shutdown Zone for in-water Heavy Machinery Work

For in-water heavy machinery work other than pile driving, if a marine mammal comes within 10 m of such operations, operations shall cease and vessels shall reduce speed to the minimum level required to maintain steerage and safe working conditions.

Shutdown Zones

For all pile driving activities, HRCP will establish shutdown zones for a marine mammal species which correspond to the Level A harassment zones (see Table 11). The purpose of a shutdown zone is generally to define an area within which shutdown of the activity would occur upon sighting of a marine mammal (or in anticipation of an animal entering the defined area). HRCP will maintain a minimum 10 m shutdown zones for all pile driving activities where the calculated Level A harassment zone is less than 10 m as described in Table 11.

If multiple vibratory hammering occurs, a shutdown zone of 100 m would be implemented for all species for each vibratory hammer on days when it is anticipated that multiple vibratory hammers will be used regardless of pile size.

Bubble curtain

HRCP would use an air bubble curtain system during impact pile driving of 36-in steel pipe piles for the Jet Grouting Trestle. Bubble curtains would meet the following requirements: The bubble curtain must distribute air bubbles around 100 percent of the piling perimeter for the full depth of the water column. The lowest bubble ring must be in contact with the mudline and/or rock bottom for the full circumference of the ring, and the weights attached to the bottom ring shall ensure 100 percent mudline and/or rock bottom contact. No parts of the ring or other objects shall prevent full mudline and/or rock bottom contact. The bubble curtain must be operated such that there is proper (equal) balancing of air flow to all bubblers. HRCP would employ the bubble curtain during impact pile driving of all steel piles in water depths greater than 6 m (20 ft) at the Jet Grouting Trestle.

Soft start

HRCP would use soft start techniques when impact pile driving. Soft start requires contractors to provide an initial set of strikes at reduced energy, followed by a thirty-second waiting period, then two subsequent reduced energy strike sets. A soft start would be implemented at the start of each day's impact pile driving and at any time following cessation of impact pile driving for a period of thirty minutes or longer.

Non-authorized Take Prohibited

If a species enters or approaches the Level B harassment zone and that species is either not authorized for take or its authorized takes are met, pile driving and removal activities must shut down immediately using delay and shutdown procedures. Activities must not resume until the animal has been confirmed to have left the area or an observation time period of 15 minutes has elapsed.

Based on our evaluation of the HRCP's proposed measures, NMFS has determined that the proposed mitigation measures provide the means effecting the least practicable impact on the affected species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.

Proposed Monitoring and Reporting

In order to issue an IHA for an activity, Section 101(a)(5)(D) of the MMPA states that NMFS must set forth requirements pertaining to the monitoring and reporting of such taking. The MMPA implementing regulations at 50 CFR 216.104 (a)(13) indicate that requests for authorizations must include the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present in the proposed action area. Effective reporting is critical both to compliance as well as ensuring that the most value is obtained from the required monitoring.

Monitoring and reporting requirements prescribed by NMFS should contribute to improved understanding of one or more of the following:

- Occurrence of marine mammal species or stocks in the area in which take is anticipated (*e.g.*, presence, abundance, distribution, density);
- Nature, scope, or context of likely marine mammal exposure to potential stressors/impacts (individual or cumulative, acute or chronic), through better understanding of: (1) action or environment (*e.g.*, source characterization, propagation, ambient noise); (2) affected species (*e.g.*, life history, dive patterns); (3) co-occurrence of marine mammal species with the action; or (4) biological or behavioral context of exposure (*e.g.*, age, calving or feeding areas);
- Individual marine mammal responses (behavioral or physiological) to acoustic stressors (acute, chronic, or cumulative), other stressors, or cumulative impacts from multiple stressors;
- How anticipated responses to stressors impact either: (1) long-term fitness and survival of individual marine mammals; or (2) populations, species, or stocks;
- Effects on marine mammal habitat (*e.g.*, marine mammal prey species, acoustic habitat, or other important physical components of marine mammal habitat); and
- Mitigation and monitoring effectiveness.

Pre-Activity Monitoring

Prior to the start of daily in-water construction activity, or whenever a break in pile driving of 30 min or longer occurs, PSOs will observe the shutdown and monitoring zones for a period of 30 min. The shutdown zone will be cleared when a marine mammal has not been observed within the zone for that 30-min period. If a marine mammal is observed within the shutdown zone, pile driving activities will not begin until the animal has left the shutdown zone or has not been observed for 15 min. If the Level B harassment zone (*i.e.*, the monitoring zone) has been observed for 30 min and no marine mammals (for which take has not been authorized) are present within the zone, work can continue even if visibility becomes impaired within the monitoring zone. When a marine mammal permitted for Level B harassment take has been permitted is present in the monitoring zone, piling activities may begin and Level B harassment take will be recorded.

Monitoring Zones

The HRCP will establish monitoring zones for Level B harassment as presented in Table 12. The monitoring zones for this project are areas where SPLs are equal to or exceed 120 dB rms (for vibratory pile driving/removal) or 160 dB rms (for impact pile driving and DTH drilling). These zones provide utility for monitoring conducted for mitigation purposes (*i.e.*, shutdown zone monitoring) by establishing monitoring protocols for areas adjacent to the shutdown zones. Monitoring of the Level B harassment zones enables observers to be aware of and communicate the presence of marine mammals in the project area, and thus prepare for potential shutdowns of activity. The HRCP will also be gathering information to help better understand the impacts of their proposed activities on species and their behavioral responses. If the entire Level B harassment zone is not visible, Level B harassment takes will be extrapolated based upon the number of observed takes and the percentage of the Level B harassment zone that is not visible.

Multiple Hammer Level B Harassment Zones

Due to the likelihood of multiple active construction sites across the project area, it is possible that multiple vibratory hammers with overlapping sound fields may be in operation simultaneously during certain times throughout the duration of the Project. As described in the *Estimated Take* section, the decibel addition of continuous noise sources results in much larger zone sizes than a single vibratory hammer. Decibel addition is not a consideration when sound fields do not overlap. Willoughby Bay is largely surrounded by land, and sound will be prevented from propagating to other project construction sites (see Figure 1-1 and Figure 6-1 of the application). Therefore, Willoughby Bay will be treated as an independent site with its own sound isopleths and observer requirements when construction is taking place within the bay. Willoughby Bay is relatively small and will be monitored from the construction site by a single observer.

Additionally, the South Trestle is the only site where the sound will propagate into Chesapeake Bay (see Figure 6-1 of the application). Sound from other construction sites will not overlap with South Trestle and will not propagate into Chesapeake Bay. Therefore, the South Trestle also will be treated as an independent site with its own sound isopleths and observer requirements when construction is taking place. When the South Trestle site is active, an observer will be positioned on land to view as much of the Level B harassment zone as possible. If the entire Level B harassment zone is not visible, Level B harassment takes will be extrapolated based upon the number of observed takes and the percentage of the Level B harassment zone that is not visible.

If two or more vibratory hammers at the other three project sites (North Trestle, North Shore, South Island) are installing piles, there is potential for the sound fields to overlap when installation occurs simultaneously. If two piles that are 36-in or larger in diameter are simultaneously installed with vibratory hammers, the Level B Harassment zone can extend up to a 25 km radius to the southwest (see Figure 6-1, 171 dB isopleth of the application). However, the Level B harassment zones resulting from simultaneous use of multiple vibratory hammers are truncated in nearly all directions by the mainland and islands, which prevent propagation of sound beyond the confines of a core area (see Figure 11-1 (area outlined in red) of the application). The largest ensonified radii extend to the south into the James and Nansemond rivers, areas where marine mammal abundance is anticipated to be low and approaching zero. Therefore, HRCP will monitor a core area, called the Core Monitoring Area, during times when two or more vibratory hammers are simultaneously active at the other three project construction sites (North Trestle, North Shore, South Island). The Core Monitoring Area would encompass the area between the two bridge/tunnels, with observers positioned at key areas to monitor the geographic area between the bridges (see Figure 11-1 (area outlined in red) of the application). Depending on placement, the observers will be able to view west/southwest towards Batten Bay and the mouth of the Nansemond River. Marine mammals transiting the area will be located and identified as they move in and out of the Chesapeake Bay.

Visual Monitoring

Monitoring would be conducted 30 minutes before, during, and 30 minutes after all pile driving/removal activities. In addition, PSOs shall record all incidents of marine mammal occurrence, regardless of distance from activity, and shall document any behavioral reactions in concert with distance from piles being driven/removed. Pile driving/removal activities include the time to install, remove a single pile or series of piles, as long as the time elapsed between uses of the pile driving equipment is no more than thirty minutes.

Monitoring will be conducted by PSOs from land. The number of PSOs will vary from one or more, depending on the type of pile driving, method of pile driving and size of pile, all of which determines the size of the harassment zones. Monitoring locations will be selected to provide an unobstructed view of all water within the shutdown zone and as much of the Level B harassment zone as possible for pile driving activities. Monitoring locations may vary based on construction activity and location of piles or equipment.

In addition, PSOs will work in shifts lasting no longer than 4 hours with at least a 1-hour break between shifts, and will not perform duties as a PSO for more than 12 hours in a 24- hour period (to reduce PSO fatigue).

Monitoring of pile driving shall be conducted by qualified, NMFS-approved PSOs, who shall have no other assigned tasks during monitoring periods. The HRCP shall adhere to the following conditions when selecting PSOs:

- Independent PSOs shall be used (*i.e.*, not construction personnel);
- At least one PSO must have prior experience working as a marine mammal observer during construction activities;
- Other PSOs may substitute education (degree in biological science or related field) or training for experience;
- Where a team of three or more PSOs are required, a lead observer or monitoring coordinator shall be designated. The lead observer must have prior experience working as a marine mammal observer during construction; and

- The HRCP shall submit PSO CVs for approval by NMFS for all observers prior to monitoring. The HRCP shall ensure that the PSOs have the following additional qualifications:
- Visual acuity in both eyes (correction is permissible) sufficient for discernment of moving targets at the water's surface with ability to estimate target size and distance; use of binoculars may be necessary to correctly identify the target;
- Experience and ability to conduct field observations and collect data according to assigned protocols;
- Experience or training in the field identification of marine mammals, including the identification of behaviors;
- Sufficient training, orientation, or experience with the construction operation to provide for personal safety during observations;
- Writing skills sufficient to prepare a report of observations including but not limited to the number and species of marine mammals observed; dates and times when in-water construction activities were conducted; dates, times, and reason for implementation of mitigation (or why mitigation was not implemented when required); and marine mammal behavior;
- Ability to communicate orally, by radio or in person, with project personnel to provide real-time information on marine mammals observed in the area as necessary; and
- Sufficient training, orientation, or experience with the construction operations to provide for personal safety during observations.

Reporting of injured or dead marine mammals

In the event that personnel involved in the construction activities discover an injured or dead marine mammal, HRCP shall report the incident to the Office of Protected Resources

(OPR), NMFS and to the Greater Atlantic Region New England/Mid-Atlantic Regional Stranding Coordinator as soon as feasible. The report must include the following information:

- Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable);
- Species identification (if known) or description of the animal(s) involved;
- Condition of the animal(s) (including carcass condition if the animal is dead);
- Observed behaviors of the animal(s), if alive;
- If available, photographs or video footage of the animal(s); and
- General circumstances under which the animal was discovered.

Final report

The HRCP shall submit a draft report to NMFS no later than 90 days following the end of construction activities or 60 days prior to the issuance of any subsequent IHA for the project. PSO datasheets/raw sightings data would be required to be submitted with the reports. The HRCP shall provide a final report within 30 days following resolution of NMFS' comments on the draft report. Reports shall contain, at minimum, the following:

- Dates and times (begin and end) of all marine mammal monitoring;
- Construction activities occurring during each daily observation period, including how many and what type of piles were driven or removed and by what method (*i.e.*, impact or vibratory);
- Weather parameters and water conditions during each monitoring period (*e.g.*, wind speed, percent cover, visibility, sea state);
- The number of marine mammals observed, by species, relative to the pile location and if pile driving or removal was occurring at time of sighting;

- Age and sex class, if possible, of all marine mammals observed;
- PSO locations during marine mammal monitoring;
- Distances and bearings of each marine mammal observed to the pile being driven or removed for each sighting (if pile driving or removal was occurring at time of sighting);
- Description of any marine mammal behavior patterns during observation, including direction of travel and estimated time spent within the Level A and Level B harassment zones while the source was active;
- Number of individuals of each species (differentiated by month as appropriate) detected within the monitoring zone, and estimates of number of marine mammals taken, by species (a correction factor may be applied to total take numbers, as appropriate);
- Detailed information about any implementation of any mitigation triggered (*e.g.*, shutdowns and delays), a description of specific actions that ensued, and resulting behavior of the animal, if any;
- Description of attempts to distinguish between the number of individual animals taken and the number of incidences of take, such as ability to track groups or individuals;
- An extrapolation of the estimated takes by Level B harassment based on the number of observed exposures within the Level B harassment zone and the percentage of the Level B harassment zone that was not visible;and
- Submit all PSO datasheets and/or raw sighting data (in a separate file from the Final Report referenced immediately above).

Negligible Impact Analysis and Determination

NMFS has defined negligible impact as an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival (50 CFR 216.103). A negligible impact finding is based on the lack of likely adverse effects on annual rates of recruitment or survival (*i.e.*, population-level effects). An estimate of the number of takes alone is not enough information on which to base an impact determination. In addition to considering estimates of the number of marine mammals that might be “taken” through harassment, NMFS considers other factors, such as the likely nature of any responses (*e.g.*, intensity, duration), the context of any responses (*e.g.*, critical reproductive time or location, migration), as well as effects on habitat, and the likely effectiveness of the mitigation. We also assess the number, intensity, and context of estimated takes by evaluating this information relative to population status. Consistent with the 1989 preamble for NMFS’s implementing regulations (54 FR 40338; September 29, 1989), the impacts from other past and ongoing anthropogenic activities are incorporated into this analysis via their impacts on the environmental baseline (*e.g.*, as reflected in the regulatory status of the species, population size and growth rate where known, ongoing sources of human-caused mortality, or ambient noise levels).

Pile driving activities associated with the proposed HRCP project, as outlined previously, have the potential to disturb or displace marine mammals. The specified activities may result in take, in the form of Level B harassment (behavioral disturbance) or Level A harassment (auditory injury), incidental to underwater sounds generated from pile driving. Potential takes could occur if individuals are present in the ensonified zone when pile driving occurs. Level A harassment is only anticipated and proposed for harbor porpoises and harbor seals.

No serious injury or mortality is anticipated given the nature of the activities and measures designed to minimize the possibility of injury to marine mammals. The potential for these outcomes is minimized through the construction method and the implementation of the proposed mitigation measures. When impact pile driving is used, implementation of bubble curtains (during 36-in steel piles at the Jet Grouting Trestle in water depths greater than 20 ft), soft start and shutdown zones significantly reduce the possibility of injury. Given sufficient notice through use of soft starts (for impact driving), marine mammals are expected to move away from a sound source that is annoying prior to it becoming potentially injurious.

HRCP will use qualified PSOs stationed strategically to increase detectability of marine mammals, enabling a high rate of success in implementation of shutdowns to avoid injury for most species. PSOs will be stationed to provide a relatively clear view of the shutdown zones and monitoring zones. These factors will limit exposure of animals to noise levels that could result in injury.

HRCP's proposed pile driving activities are highly localized. Only a relatively small portion of the Chesapeake Bay may be affected. Localized noise exposures produced by project activities may cause short-term behavioral modifications in affected cetaceans and pinnipeds Moreover, the proposed mitigation and monitoring measures are expected to further reduce the likelihood of injury as well as reduce behavioral disturbances.

Effects on individuals that are taken by Level B harassment, on the basis of reports in the literature as well as monitoring from other similar activities, will likely be limited to reactions such as increased swimming speeds, increased surfacing time, or decreased foraging (if such activity were occurring) (*e.g.*, Thorson and Reyff 2006). Individual animals, even if taken multiple times, will most likely move away from the sound source and be temporarily displaced from the areas of pile driving, although even this reaction has been observed primarily only in association with impact pile driving. The pile driving activities analyzed here are similar to, or less impactful than, numerous other construction activities conducted along both Atlantic and Pacific coasts, which have taken place with no known long-term adverse consequences from behavioral harassment. Furthermore, many projects similar to this one are also believed to result in multiple takes of individual animals without any documented long-term adverse effects. Level B harassment will be minimized through use of mitigation measures described herein and, if sound produced by project activities is sufficiently disturbing, animals are likely to simply avoid the area while the activity is occurring.

In addition to the expected effects resulting from authorized Level B harassment, we anticipate that small numbers of harbor porpoises and harbor seals may enter the Level A harassment zones undetected, particularly during times of DTH drilling when the Level A harassment zones are large. It is unlikely that the animals would remain in the area long enough for PTS to occur. If any animals did experience PTS , it would likely only receive slight PTS, *i.e.* minor degradation of hearing capabilities within regions of hearing that align most completely with the energy produced by pile driving (*i.e.*, the low-frequency region below 2 kHz), not severe hearing impairment or impairment in the regions of greatest hearing sensitivity. If hearing impairment occurs, it is most likely that the affected animal’s threshold would increase by a few dBs, which is not likely to meaningfully affect its ability to forage and communicate with conspecifics. As described above, we expect that marine mammals would be likely to move away from a sound source that represents an aversive stimulus, especially at levels that would be expected to result in PTS, given sufficient notice through use of soft start.

The project is not expected to have significant adverse effects on marine mammal habitat. No important feeding and/or reproductive areas for marine mammals are known to be near the project area. Project activities would not permanently modify existing marine mammal habitat. The activities may cause some fish to leave the area of disturbance, thus temporarily impacting marine mammal foraging opportunities in a limited portion of the foraging range. However, because of the relatively small area of the habitat that may be affected, the impacts to marine mammal habitat are not expected to cause significant or long-term negative consequences.

In summary and as described above, the following factors primarily support our preliminary determination that the impacts resulting from this activity are not expected to adversely affect the species or stock through effects on annual rates of recruitment or survival:

- No mortality is anticipated or authorized;
- Limited Level A harassment exposures (harbor porpoises and harbor seals) are anticipated;
- The anticipated incidents of Level B harassment consist of, at worst, temporary modifications in behavior that would not result in fitness impacts to individuals;
- The specified activity and associated ensonifed areas are very small relative to the overall habitat ranges of all species and does not include habitat areas of special significance (BIAs or ESA-designated critical habitat); and
- The presumed efficacy of the proposed mitigation measures in reducing the effects of the specified activity.

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the proposed monitoring and mitigation measures, NMFS preliminarily finds that the total marine mammal take from the proposed activity will have a negligible impact on all affected marine mammal species or stocks.

Small Numbers

As noted above, only small numbers of incidental take may be authorized under Sections 101(a)(5)(A) and (D) of the MMPA for specified activities other than military readiness activities. The MMPA does not define small numbers and so, in practice, where estimated numbers are available, NMFS compares the number of individuals taken to the most appropriate estimation of abundance of the relevant species or stock in our determination of whether an authorization is limited to small numbers of marine mammals. Additionally, other qualitative factors may be considered in the analysis, such as the temporal or spatial scale of the activities.

The proposed take of four of the five marine mammal species/stocks comprises less than one-third of the best available stock abundance, with the exception of the bottlenose dolphin stocks. There are three bottlenose dolphin stocks that could occur in the project area. Therefore, the estimated dolphin takes by Level B harassment would likely be portioned among the western North Atlantic northern migratory coastal stock, western North Atlantic southern migratory coastal stock, and NNCES stock. Based on the stocks' respective occurrence in the area, NMFS estimated that there would be 216 takes from the NNCES stock, with the remaining takes evenly split between the northern and southern migratory coastal stocks. Based on consideration of various factors described below, we have determined the numbers of individuals taken would likely comprise less than one-third of the best available population abundance estimate of either coastal migratory stock. Detailed descriptions of the stocks' ranges have been provided in *Description of Marine Mammals in the Area of Specified Activities.*

Both the northern migratory coastal and southern migratory coastal stocks have expansive ranges and they are the only dolphin stocks thought to make broad-scale, seasonal migrations in coastal waters of the western North Atlantic. Given the large ranges associated with these two stocks it is unlikely that large segments of either stock would approach the project area and enter into the Bay. The majority of both stocks are likely to be found widely dispersed across their respective habitat ranges and unlikely to be concentrated in or near the Chesapeake Bay.

Furthermore, the Chesapeake Bay and nearby offshore waters represent the boundaries of the ranges of each of the two coastal stocks during migration. The northern migratory coastal stock is found during warm water months from coastal Virginia, including the Chesapeake Bay and Long Island, New York. The stock migrates south in late summer and fall. During cold water months dolphins may be found in coastal waters from Cape Lookout, North Carolina, to the North Carolina/Virginia. During January–March, the southern migratory coastal stock appears to move as far south as northern Florida. From April to June, the stock moves back north to North Carolina. During the warm water months of July–August, the stock is presumed to occupy coastal waters north of Cape Lookout, North Carolina, to Assateague, Virginia, including the Chesapeake Bay. There is likely some overlap between the northern and southern migratory stocks during spring and fall migrations, but the extent of overlap is unknown.

The Bay and waters offshore of the mouth are located on the periphery of the migratory ranges of both coastal stocks (although during different seasons). Additionally, each of the migratory coastal stocks are likely to be located in the vicinity of the Bay for relatively short timeframes. Given the limited number of animals from each migratory coastal stock likely to be found at the seasonal migratory boundaries of their respective ranges, in combination with the short time periods (~two months) animals might remain at these boundaries, it is reasonable to assume that takes are likely to occur only within some small portion of either of the migratory coastal stocks.

Both migratory coastal stocks likely overlap with the NNCES stock at various times during their seasonal migrations. The NNCES stock is defined as animals that primarily occupy waters of the Pamlico Sound estuarine system (which also includes Core, Roanoke, and Albemarle sounds, and the Neuse River) during warm water months (July–August). Members of this stock also use coastal waters (≤1 km from shore) of North Carolina from Beaufort north to Virginia Beach, Virginia, including the lower Chesapeake Bay. Comparison of dolphin photo-identification data confirmed that limited numbers of individual dolphins observed in Roanoke Sound have also been sighted in the Chesapeake Bay (Young, 2018). Like the migratory coastal dolphin stocks, the NNCES stock covers a large range. The spatial extent of most small and resident bottlenose dolphin populations is on the order of 500 km^2, while the NNCES stock occupies over 8,000 km^2 (LeBrecque *et al*., 2015). Given this large range, it is again unlikely that a preponderance of animals from the NNCES stock would depart the North Carolina estuarine system and travel to the northern extent of the stock's range. However, recent evidence suggests that there is like a small resident community of NNCES dolphins that inhabits the Chesapeake Bay year-round (E. Patterson, NMFS, pers. comm.).

Many of the dolphin observations in the Bay are likely repeated sightings of the same individuals. The Potomac-Chesapeake Dolphin Project has observed over 1,200 unique animals since observations began in 2015. Re-sightings of the same individual can be highly variable. Some dolphins are observed once per year, while others are highly regular with greater than 10 sightings per year (J. Mann, Potomac-Chesapeake Dolphin Project, pers. comm.). Multiple sightings of the same individual would considerably reduce the number of individual animals that are taken by Level B harassment. Furthermore, the existence of a resident dolphin population in the Bay would increase the percentage of dolphin takes that are actually re-sightings of the same individuals.

In summary and as described above, the following factors primarily support our preliminary determination regarding the incidental take of small numbers of the affected stocks of bottlenose dolphin:

- Potential bottlenose dolphin takes in the project area are likely to be allocated among three distinct stocks;
- Bottlenose dolphin stocks in the project area have extensive ranges and it would be unlikely to find a high percentage of any one stock concentrated in a relatively small area such as the project area or the Bay;
- The Bay represents the migratory boundary for each of the specified dolphin stocks and it would be unlikely to find a high percentage of any stock concentrated at such boundaries; and
- Many of the takes would likely be repeats of the same animals and likely from a resident population of the Bay.

Based on the analysis contained herein of the proposed activity (including the proposed mitigation and monitoring measures) and the anticipated take of marine mammals, NMFS preliminarily finds that small numbers of marine mammals will be taken relative to the population size of the affected species or stocks.

Unmitigable Adverse Impact Analysis and Determination

There are no relevant subsistence uses of the affected marine mammal stocks or species implicated by this action. Therefore, NMFS has determined that the total taking of affected species or stocks would not have an unmitigable adverse impact on the availability of such species or stocks for taking for subsistence purposes.

Endangered Species Act (ESA)

Section 7(a)(2) of the Endangered Species Act of 1973 (ESA: 16 U.S.C. 1531 *et seq*.) requires that each Federal agency insure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat. No incidental take of ESA-listed marine mammals are expected or proposed for authorization. Therefore, NMFS has determined that consultation under section 7 of the ESA is not required for this action.

Proposed Authorization

As a result of these preliminary determinations, NMFS proposed to issue an IHA to the HRCP for pile driving activities associated with the HRBT Expansion Project in Hampton-Norfolk, Virginia for a period of one year from the date of issuance, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated.

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