REQUEST FOR AUTHORIZATION
FOR THE INCIDENTAL HARASSMENT OF MARINE MAMMALS
RESULTING FROM SUBMARINE PIER 31 EXTENSION
AT
U.S. NAVAL SUBMARINE BASE NEW LONDON,
GROTON, CONNECTICUT
DECEMBER 2024 through NOVEMBER 2025

Submitted to:

Office of Protected Resources,
National Marine Fisheries Service,
National Oceanographic and Atmospheric Administration

Prepared by:

Naval Facilities Engineering Command Mid-Atlantic

Prepared for:

Naval Submarine Base New London

Revised January 2024

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EXECUTIVE SUMMARY

Pursuant to the Marine Mammal Protection Act (MMPA) Section 101(a)(5)(D), the United States Navy (Navy) is submitting to the National Marine Fisheries Service (NMFS) this request for an Incidental Harassment Authorization (IHA) for the incidental taking of marine mammal species during construction of an extension to the existing Pier 31, partial demolition of the existing Pier 31, and demolition of an existing small access ramp for Pier 17 (located north of Pier 17), referred to as the Pier 17 Stub. The proposed construction and demolition would occur at Naval Submarine Base (SUBASE) New London in Groton, Connecticut. The project would also include dredging required for proper, safe, and secure submarine maneuvering. The dredged material would be disposed of in an existing confined aquatic disposal cell located nearby and south of SUBASE. The Navy determined that noise from in-water construction activities has the potential to rise to the level of harassment under the MMPA.

The project would take approximately 2 years to complete, including 12 months of pile removal and installation activities. The estimated schedule for activities that may result in incidental taking of marine mammals is between December 2024 and November 2025.

If in-water activities are not completed within the year anticipated, a request for renewal would be submitted and received by NMFS no later than 60 days prior to the expiration date of the authorized IHA.

The Navy is seeking authorization for the potential Level A and Level B take of harbor seal *(Phoca vitulina)* and gray seals *(Halichoerus grypus atlantica)* and take by Level B only of Atlantic white-sided dolphin *(Legenorhyncus acutus)*, common dolphin (*Delphinus delphis)*, harbor porpoise *(Phocoena phocoena)*, and harp seal *(Pagophilus groenlandicus*) (Table ES-1).

Table ES-1 Total Underwater Incidental Take Estimates by Species

Species	***Level A (PTS onset)***			***Level B (Behavior)***		
	Individual Activities	***Concurrent Activities***	***Total Level A***	***Individual Activities***	***Concurrent Activities***	***Total Level B***
Atlantic white-sided dolphin	0	0	**0**	12[c]	0	**12**
Common dolphin	0	0	**0**	30[c]	0	**30**
Harbor porpoise	0	0	**0**	9	0	**9**
Harbor seal	8[a]	0	**8**	40	4	**44**
Gray seal	8[a]	0	**8**	40	4	**44**
Harp seal[b]	0	0	**0**	12	0	**12**
Total	16	0	**16**	143	8	**151**

Legend: PTS = permanent threshold shift

Notes: [a] 1 Level A take each of harbor and gray seals per day of impact pile driving of 36-inch steel piles = 8 takes, as requested by NMFS 12/21/23.

[b] Harp seal incidental takes are calculated for Long Island Sound. For the Thames River, harp seals are not usually present, but to guard against unauthorized incidental take, one Level B (behavioral) incidental take is added per month of construction when this species may occur (January through May).

[c] Take increased to average group size (NMFS, 2023).

The takes requested are expected to have a less than significant effect on individual animals and no effect on the populations of these species. Effects experienced by individual marine mammals are expected to be primarily limited to short-term disturbance of normal behavior or temporary displacement of animals near the source of the noise.

Other in-water construction activities such as barge repositioning do not have the potential to result in harassment under the MMPA. Dredging would not produce sound that would result in harassment of marine mammals and is not included in the acoustic modeling. Because dredging would be slow moving (less than 10 knots) and conspicuous to marine mammals, dredging and disposal activities pose negligible risks of physical injury. Only underwater sound associated with pile driving, extracting, and drilling would have the potential to harass marine mammals. Turbidity created during pile installation and extraction would temporarily impact the water column. However, turbidity would return to ambient conditions within 24 hours. Therefore, construction is not anticipated to affect the prey base or significantly affect other habitat features of marine mammals that would meet the definition of take.

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ACRONYMS AND ABBREVIATIONS

µPa	microPascal
CFR	Code of Federal Regulations
CT DEEP	Connecticut Department of Energy and Environmental Protection
CV	coefficient of variation
dB	decibels
dBA	A-weighted decibels
dB PEAK	peak sound level in dB
dB re 1 µPa^2-s	dB referenced to a pressure of 1 micropascal squared per second
ESA	Endangered Species Act
°C	degrees Celsius
Hz	hertz
IHA	Incidental Harassment Authorization
kHz	kilohertz
LMR	Living Marine Resources
m	meter
mg/L	milligram per liter
MLLW	mean lower low water
MMPA	Marine Mammal Protection Act
Navy	United States Department of the Navy
NAVFAC	Naval Facilities Engineering Command
NMFS	National Marine Fisheries Service
NMSDD	U.S. Navy Marine Species Density Database
NOAA	National Oceanic and Atmospheric Administration
PSO	Protected Species Observers
PTS	permanent threshold shift
R&D	research and development
re 1 µPa	referenced to a pressure of 1 micropascal
RMS	root mean square
sec	second
SEL	sound exposure level

SEL-s	single-strike sound exposure level
SEL_{cum}	cumulative SEL
SPL	sound pressure level
SPLpeak	peak sound pressure level
SPLrms	root mean square sound pressure level
sq km	square kilometer
SSN	nuclear-powered attack submarine
SUBASE	Naval Base Submarine Base New London
TL	transmission loss
TSS	total suspended solids
TTS	temporary threshold shift
U.S.	United States
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WFA	weighting factor adjustment
WSDOT	Washington State Department of Transportation

1 DESCRIPTION OF ACTIVITIES

A detailed description of the specific activity or class of activities that can be expected to result in incidental taking of marine mammals.

1.1 Introduction

The United States (U.S.) Department of the Navy (Navy) is requesting an Incidental Harassment Authorization (IHA) for the proposed construction of an extension to the existing Pier 31 at Naval Submarine Base (SUBASE) New London in Groton, Connecticut (**Figure 1-1**). The project would construct an 87-foot extension to the existing Pier 31. The longer pier would provide 2 berths for a new submarine platform that is approximately 80 feet longer than the existing submarines. There are no other piers at SUBASE New London that can accommodate the new submarine type. The existing Pier 31 would be partially demolished prior to construction of the extension. This project would also include the demolition of an existing small access ramp for Pier 17 (located north of Pier 17), referred to as Pier 17 Stub. Dredging would be required for proper, safe, and secure submarine maneuvering. The dredged material would be disposed of in an existing confined aquatic disposal cell located nearby and south of SUBASE.

The project would take approximately 2 years to construct, including 12 months of pile removal and installation activities. The estimated schedule for activities that may result in incidental taking of marine mammals is between December 2024 and November 2025.

Under the Marine Mammal Protection Act (MMPA) of 1972, as amended (16 U.S. Code Section 1371(a)(5)(D)), the Navy is requesting an IHA for pile driving activities that are expected to result in the incidental taking of marine mammals. Chapters 1 through 14 of this application cover the 14 specific items required for this application, as set out by 50 Code of Federal Regulations (CFR) 216.104 Submission of Requests.

If in-water activities are not completed within the year anticipated, a request for renewal would be submitted and received by the National Marine Fisheries Service (NMFS) no later than 60 days prior to the expiration date of the authorized IHA. The renewal request would include an explanation that the activities to be conducted under the requested renewal are identical to the activities analyzed under the initial IHA, are a subset of the activities, or include changes so minor that the changes do not affect the previous analyses, mitigation and monitoring requirements, or take estimates (with the exception of reducing the type or amount of take because only a subset of the initially analyzed activities remain to be completed under the renewal). The renewal request would also include a preliminary monitoring report showing the results of the required monitoring to date and an explanation showing that the monitoring results do not indicate impacts of a scale or nature not previously analyzed or authorized.

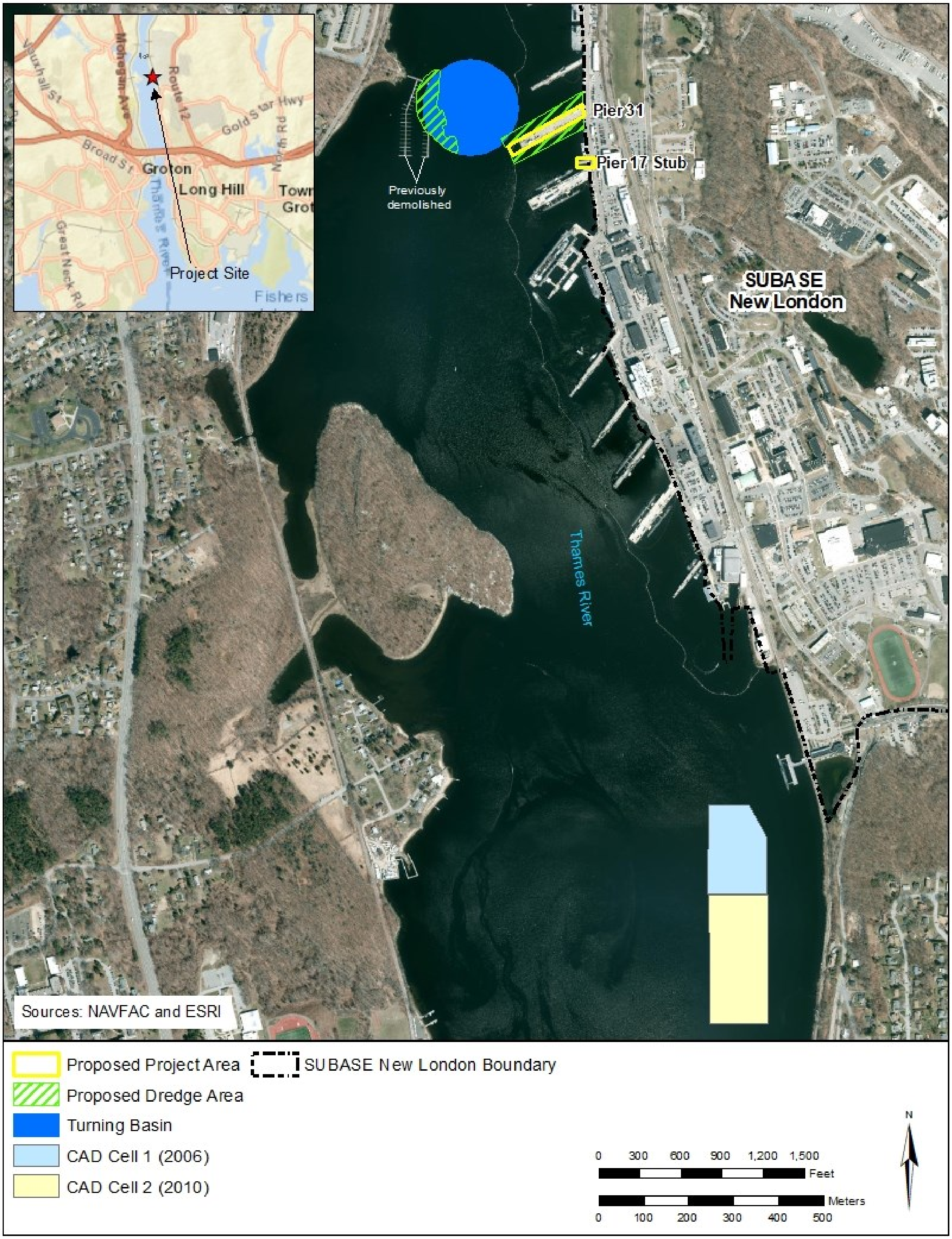

Figure 1-1 Project Location at Naval Submarine Base New London

1.2 Description of Activities

The project proposes to construct an extension of the existing Pier 31 that would require installation of twenty (20) 36-inch diameter steel pipe piles with a concrete deck, mooring fittings, an integrated composite fender system, and specialized equipment including fendering camels. The 36-inch steel pipe piles would be filled with concrete following installation. Prior to construction of the extension, the existing Pier 31 fendering system at the end of the pier and part of the deck would be partially demolished with the removal of twenty-eight (28) 16-inch diameter fiberglass reinforced plastic fender piles. Fender piles would be pulled using a crane and sling or would be extracted with a vibratory hammer if pulling is unsuccessful. Therefore, vibratory extraction is assumed for the analysis. After the extension is constructed, twenty-eight (28) 16-inch fiberglass reinforced plastic fender piles would be installed at the end of the pier. The existing fender system alongside the pier would be extended to the west to accommodate the larger submarines. The piles for the extended fender system would consist of twenty-eight (28) 16-inch fiberglass reinforced plastic piles (14 on each side of the pier). Demolition of Pier 17 Stub includes the extraction of twenty (20) 14-inch concrete-encased steel H-piles and pulling of 10 timber piles. If timber piles cannot be pulled, they would be cut at the mudline. After demolition, four (4) 16-inch fiberglass fender piles would be installed on the quaywall. Prior to the start of construction, a temporary work trestle supported by sixty (60) 14-inch steel H-piles may be installed by the construction contractor on either side of the Pier 31 extension site and then removed following completion of construction.

Pile installation would be accomplished mainly using a vibratory hammer with the last 20–40 feet set by impact driving. For a portion of the piles, an auger drill (rotary drill with spiral shaft that drills through loose rock or soft sediment) would be used inside the pipe casing to lift sediment; no rock drilling would be required.

Vibratory and impact installation/removal and auger drilling may result in the incidental take of marine mammals. Piles pulled with crane and sling or cut at the mudline would not produce underwater sound that would result in harassment of marine mammals. The construction and demolition locations are shown in plan view in **Figure 1-2**.

Dredging to remove sediment from around both sides of Pier 31 to a depth of -40 feet mean lower low water (MLLW) is proposed. As part of a proposed turning basin for vessels entering and exiting the extended Pier 31, an area adjacent to and west of the Thames River Federal Navigation Channel would be dredged to -36 feet MLLW (**Figure 1-2**). The total volume of approximately 44,000 cubic yards of dredged sediment would be disposed of in a nearby Navy-owned, federally authorized confined aquatic disposal cell located in Thames River south of SUBASE New London. Dredging would not produce sound that would result in harassment of marine mammals and is not included in the acoustic modeling. Because dredging would be slow moving (less than 10 knots) and conspicuous to marine mammals, dredging and disposal activities pose negligible risks of physical injury.

1.3 Concurrent Activities

Certain activities may occur at the same time, decreasing the total number of pile driving/extracting/drilling days. The contractor could be working in more than one area at a time. Activities that may occur concurrently are identified in Chapter 2 (see **Tables 2-1** and **2-2**), and noise generation from multiple sources is provided in Chapter 6.

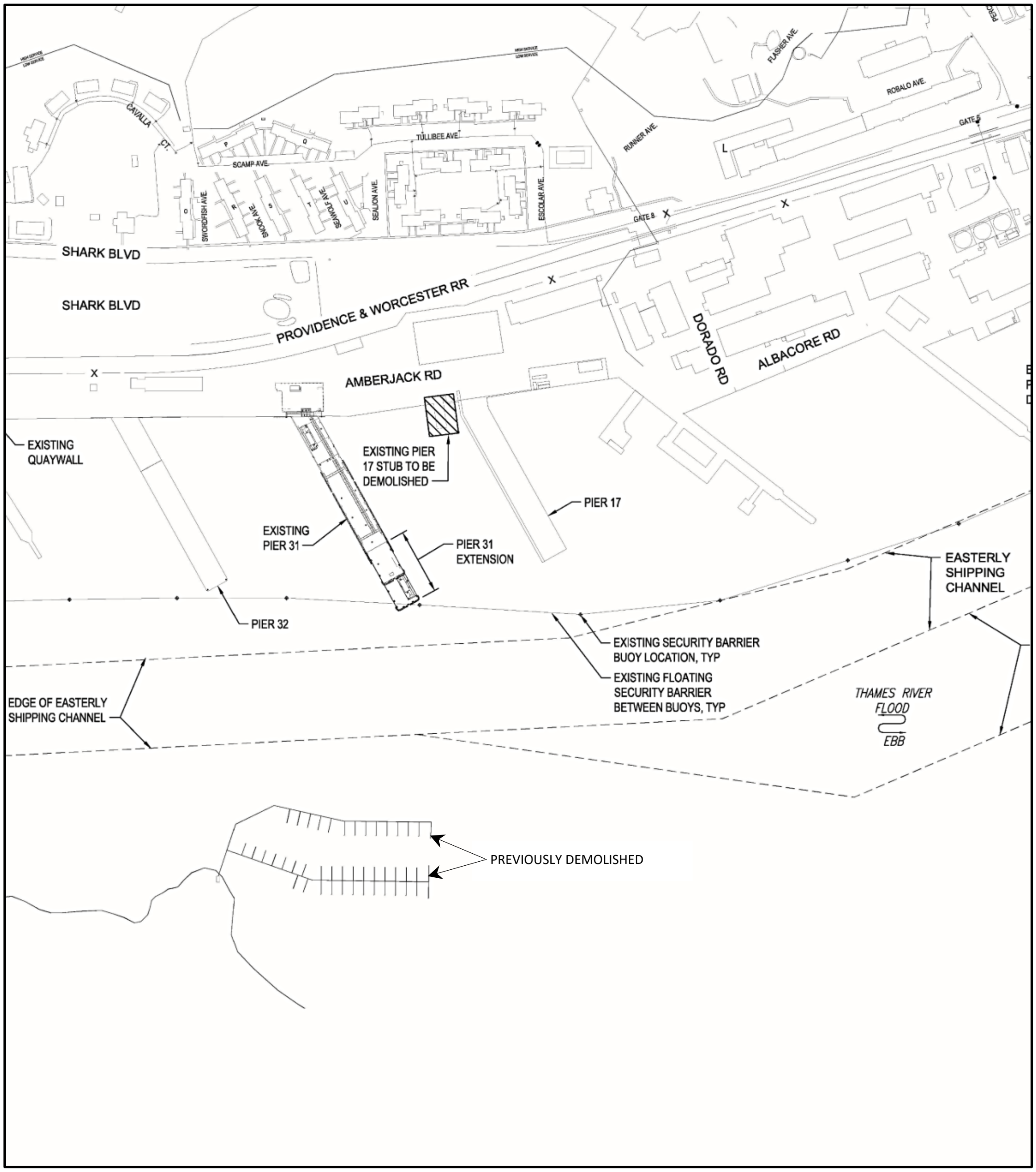

Figure 1-2 Plan View of Pier 31 Extension and Pier 17 Stub

2 DATES, DURATION, AND LOCATION OF ACTIVITIES

The dates and duration of such activity and the specific geographical region where it will occur.

2.1 Dates and Duration of Activities

The project would take up to two years to complete with in-water work completed within 12 months. The estimated schedule for activities that may result in incidental taking of marine mammals is from December 2024 to November 2025. The dates and duration of each activity are listed in **Table 2-1**. Activities that would occur concurrently are listed in **Table 2-2**. All in-water work would occur during daylight hours, typically between 7 a.m. and 5 p.m. All other activities associated with construction would not result in incidental take of marine mammals.

2.2 Project Location Description

The geographic region that would be affected by the project includes the Thames River and the nearshore area of Long Island Sound in Groton, Ledyard, Waterford, and New London, Connecticut. The maximum extent of the calculated ensonified area is presented in Chapter 6.

2.2.1 Bathymetric Setting

According to a 2022 bathymetric survey, water depths in the proposed project area range from -34 feet MLLW alongside existing Pier 31, to -40 feet MLLW in the federal navigation channel and between -10 feet and -36 feet MLLW in the proposed turning basin (Naval Facilities Engineering Systems Command [NAVFAC] Mid-Atlantic, 2023).

2.2.2 Tides, Circulation, Turbidity, Temperature, Salinity, and Dissolved Oxygen

The Thames River is tidally influenced, and the tides primarily drive the currents in the Thames River estuary (Navy, 2018). The average tidal range in the vicinity of New London is from 0.5 to 3.0 feet. The tidal currents follow the ebb and flow of the river and are generally not strong (e.g., -0.5 to 0.5 knots) (SUBASE New London, 2022). Current speeds are generally highest within the dredged channel (Commander, Navy Installations Command [CNIC], 2004). The *Seawolf*-class submarines homeporting project (Navy, 1995) provided an estimate of ambient suspended sediment concentrations in the Thames River at 5 milligrams per liter (mg/L). During storm conditions, concentrations increase beyond 20 mg/L. The SUBASE Pier 6 Replacement project used a background total suspended solids (TSS) concentration of 10 mg/L. Tetra Tech (2016) reported that TSS in the Thames River near the SUBASE ranged from 9 to 68 mg/L, which was considered to be a relatively high level of natural turbidity.

Water quality at New London shows seasonal variation in temperature, salinity, and dissolved oxygen. In the fall, temperatures near SUBASE range from 14 to 12 degrees Celsius (°C) surface to bottom, from a mixed water column due to wind activity. Temperatures drop significantly in the winter to a low of approximately 0.6°C with surface waters beginning to warm in the spring, leading to stratification and an approximate 6°C difference between surface and deep waters (Tetra Tech, 2016). Connecticut Department of Energy and Environmental Protection's (CT DEEP) trawl survey site at the mouth of the Thames River (site AC2013002), downriver from the proposed project area, recorded an average surface temperature of 15.9°C, and bottom temperatures of 14.3°C (CT DEEP, 2015 as cited in Tetra Tech, 2016) Temperatures recorded during the CT DEEP survey were taken earlier in the season, in mid-May, when temperatures were overall lower and showed signs of stratification (15.1–9.2°C) (Tetra Tech, 2016).

Table 2-1 Pile Driving Activity

Project Name and Location: Pier 31 Extension
Projected Start Date of In-Water Work: December 2024 – November 2025
Duration of In-Water Work: 12 Months

Activity (Dates)	*Pile Count[(a)]*	*Pile Type*	*Method of Installation/Removal*	*Piles Installed/Removed Per Workday*	*Total Pile Driving/Extraction Days*	*Average Hammer/Drill Operation (Seconds/ Strikes Per Pile)[(b)]*	*Average Hammer/Drill Operation (Seconds/ Strikes Per Day)*
Work Trestle - Installation (December 2024) *Concurrent with Pier 17 Stub Demo*	60	14-inch steel H-piles installation for temporary work trestle	Vibratory hammer	5	12	1,200 seconds	6,000 seconds
	60	14-inch steel H-piles installation for temporary work trestle	Impact hammer	4	15[(e)]	1,000 strikes	4,000 strikes
Pier 31 Partial Demolition (December 2024) *Concurrent with Work Trestle installation*	28	16-inch fiberglass reinforced, plastic fender piles	Pulled by crane & sling or by vibratory hammer extraction (if necessary)	2	14	1,200 seconds	2,400 seconds
Pier 17 Stub Demolition (December 2024) *Concurrent with Work Trestle installation*	20	14-inch concrete encased steel H-piles	Vibratory hammer	5	4	1,200 seconds	6,000 seconds
	10	Timber Piles	Pulled by crane & sling or cut at mudline (*No Acoustic Impact*)	5	2	NA	NA

Table 2-1 Pile Driving Activity (continued)

Project Name and Location: Pier 31 Extension
Projected Start Date of In-Water Work: December 2024 – November 2025
Duration of In-Water Work: 12 Months

Activity (Dates)	*Pile Count[(a)]*	*Pile Type*	*Method of Installation/Removal*	*Piles Installed/Removed Per Workday*	*Total Pile Driving/Extraction Days*	*Average Hammer/Drill Operation (Seconds/ Strikes Per Pile)[(b)]*	*Average Hammer/Drill Operation (Seconds/ Strikes Per Day)*
Pier 31 Extension Support Pile Installation (February-March 2025)	20[(d,e)]	36-inch x 250-ft steel pipe piles	Vibratory hammer to drive first 210 ft	0.17[(e)]	120	2,520 seconds	428 seconds
	20	36-inch x 250-ft steel pipe piles	Impact hammer to drive last 20-40 ft[(f)]	2.5[(f)]	8[(c)]	1,000 strikes	2,500 strikes[(g)]
	20	36-inch x 250-ft steel pipe piles	Auger drilling inside pipe casing to lift sediment (no rock drilling)	1	20	28,800 seconds	28,800 seconds
Pier 31 and Pier 17 Stub Quaywall Fender Pile Installation (October-November 2025)	60	16-inch fiberglass reinforced, plastic piles	Vibratory hammer	2	30	1,200 seconds	2,400 seconds
	60	16-inch fiberglass reinforced, plastic piles	Impact hammer to drive last 20-40 ft[(d)]	2.5[(e)]	24[(c)]	1,000 strikes	2,500 strikes
Work Trestle - Removal (November 2025)	60	14-inch steel H-piles Removal of temporary work trestle	Vibratory hammer	5	12	1,200 seconds	6,000 seconds

Notes: [a]Pile count total based on Pre-final 100% design plans. Pile Activity Table updated 7-10-23.
[b]Vibratory hammer measured in seconds per pile.
[c]Impact hammering is assumed to occur during nine months of the year (September to May) when seals are present. Vibratory hammering can occur at any time of year but for the purpose of Level B (behavioral) take calculations is assumed to occur on different days than impact hammering.
[d]Twenty (20) 36-inch, 250-ft long piles would be installed by vibratory hammer and finished by impact hammer.
[e]Assumes that each pile would be installed in increments of 0.17 per workday to allow for the welding, painting, and curing of pile sections and joins and repositioning of barges, resulting in a total installation rate of one pile per week.
[f]36-inch piles, 250 ft long, would be installed in a bent (groups of 5) to maximum depths achievable via vibratory means; then, the last 20-40 ft would be finished with an impact hammer. Each bent would be completed before moving to the next bent.
[g]Estimated 2.5 piles per workday and 2,500 strikes per day based on number of days an impact hammer would be used for pile driving, restrikes, and pile dynamic analysis tests.
Legend: ft = foot/feet; NA = Not Applicable.

Table 2-2 Concurrent Activity Scenarios

Months and Year	*Structure*	*Activities, pile sizes, and types per scenario*	*Equipment (Quantity)*	*Total Equipment Quantity*
December 2024	Temporary Work Trestle Install and Pier 17 Stub Demolition	Impact install/vibratory install of 14-inch steel H-piles and extracting 14-inch concrete-encased steel H-piles	Vibratory hammer (2), and Impact Hammer (1)	3
December 2024	Temporary Work Trestle Install, Pier 17 Stub Demolition, and Pier 31 Partial Demolition	Impact install/vibratory install of 14-inch steel H-piles, vibratory extracting 14-inch concrete encased steel H-piles, and vibratory extracting 16-inch fiberglass fender piles	Vibratory hammer (3), and Impact Hammer (1)	4
December 2024	Temporary Work Trestle Install and Pier 31 Partial Demolition	Impact install/vibratory install of 14-inch steel H-pile and extracting 16-inch fiberglass fender piles	Vibratory hammer (2), and Impact Hammer (1)	3

Salinity measured at the CT DEEP trawl survey site was higher in bottom waters (30 practical salinity units), with lower salinity (18.3 practical salinity units) in surface waters (CT DEEP, 2015 as cited in Tetra Tech, 2016). Since salty water is denser and sinks, tidal fluctuations, precipitation, and ice melt can affect surface salinity more substantially (Tetra Tech, 2016). A previous study performed by Soderberg and Bruno (1971) recorded salinity in the lower Thames River between 31.3 and 31.5 parts per thousand in the deeper half of the water column. During periods of high rainfall, salinity was recorded as low as 29.3 parts per thousand.

Dissolved oxygen stays above 76 percent in all seasons with the lowest levels occurring during the summer (Tetra Tech, 2016). Low dissolved oxygen in the Thames River estuary contributes to aquatic life impairment. Low dissolved oxygen conditions begin in Norwich Harbor, approximately 12 miles north of the project area, early in the season. As the summer progresses, the hypoxic zone expands 5 miles south and ascends higher into the water column. In the fall, as the temperature cools, the condition gradually recedes until it disappears entirely (U.S. Geological Survey, 2005).

2.2.3 Substrates and Habitats

According to the National Wetlands Inventory, the Thames River is "Estuarine and Marine Deepwater Habitat (E1UBL)" (U.S. Fish and Wildlife Service [USFWS], 2019). Habitats with this classification consist of "deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land" (Federal Geographic Data Committee, 2012).

A survey conducted at SUBASE New London found the nearshore sediment to be a homogeneous habitat consisting of silt and clay with some sand and shell hash with no evidence of submerged aquatic vegetation or other vegetation (Tetra Tech, 2016).

2.2.4 Ambient Sound

Underwater Sound

The ambient underwater soundscape refers to noise that already exists in the environment prior to the introduction of another noise-generating activity. Human generated sound sources in the affected area can include vessel noise and marine construction. Vessel traffic is extensive in the river, especially south of the project area in the highly developed downtown areas of Groton and New London. Large vessels, ferries in particular, frequently transit between the lower part of the river and destinations within Long Island Sound and elsewhere.

Acoustic monitoring was conducted during year 2 of Pier 32 construction in which background (ambient) underwater sound levels were measured for 18 days in the absence of construction activities (Navy, 2022). Underwater sound levels measured within the vicinity of Pier 32 ranged from 131.2 decibels (dB) cumulative sound exposure level (SELcum) referenced to a pressure of 1 micropascal squared per second (re 1 μPa^2-s) during conditions of low vessel activity to 145.8 dB SELcum re 1 μPa^2-s during conditions of high vessel activity. Underwater sound levels recorded down river from hydrophones at Pier 32 ranged from 112.9 dB SELcum re 1 μPa^2-s at a distance of 834 feet from the hydrophone to a sound level of 121.4 dB SELcum re 1 μPa^2-s 1,067 feet from the hydrophone (Navy, 2022).

Understanding the overall impact that the introduction of additional noise could have on the marine mammals present in the area requires knowing the background noise of an area. If background noise levels from vessels and other non-impulsive sources in the vicinity of the project exceed those of the National Oceanic and Atmospheric Administration (NOAA) Fisheries Service threshold for behavioral disturbance from non-impulsive sources (i.e., 120 dB or greater), then marine mammals would not be affected by any sound less than the existing ambient noise levels. As discussed above, ambient underwater noise within the vicinity of the piers typically exceeds the 120 dB threshold daily but can be lower in locations further down river from the installation (Navy, 2022).

Airborne Sound

The ambient noise level under existing conditions for mixed commercial and urban residential land uses in the project area is estimated to range from 60 A-weighted decibels (dBA) to 70 dBA during daytime hours (Connecticut Regulations Section 22a-69-1.8).

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3 MARINE MAMMAL SPECIES AND NUMBERS

The species and numbers of marine mammals likely to be found within the activity area.

Ten species have been documented either within the vicinity of the activity area or the mouth of the Thames River and extending into Long Island Sound. These include North Atlantic right whale *(Eubalaena glacialis)*, common minke whale *(Balaenoptera acutorostrata acutorostrata)*, fin whale *(Balaenoptera physalis)*, humpback whale *(Megaptera novaeangliae)*, Atlantic white-sided dolphin *(Legenorhyncus acutus)*, common dolphin (*Delphinus delphis)*, harbor porpoise *(Phocoena phocoena)*, harbor seal *(Phoca vitulina)*, gray seal *(Halichoerus grypus atlantica)*, and harp seal *(Pagophilus groenlandicus)*.

Because North Atlantic right whale, common minke whale, fin whale, and humpback whale, have such low densities in the mouth of the river, extending into Long Island Sound (**Table 3-1**) and would not occur in the Thames River (Northeast Ocean Data, 2023), no incidental takes are anticipated for these species, and they are not further evaluated in this IHA application.

Six species with densities and distribution in the activity area that indicate incidental take is reasonably foreseeable are evaluated in this application (**Table 3-1**). These species are not listed under the Endangered Species Act (ESA), but all are protected under the MMPA.

Table 3-1 includes estimated densities as well as season of occurrence within the proposed activity area for each species. Chapter 4 contains life history information for each species.

Table 3-1 Marine Mammals with Potential to Occur in the Thames River and/or Adjacent Long Island Sound

Species and Stock	***Stock Abundance***	***Relative Occurrence in Thames River***	***Relative Occurrence in Long Island Sound***	***Month(s) of Occurrence within the Western North Atlantic***	***Density in the Project Area (number/sq km)***
Species Occurring at Very Low Densities in Long Island Sound Only, No Incidental Takes Anticipated					
North Atlantic right whale *Western Atlantic Stock*	338[(a)]	Absent	Occasional	Year-round low densities	0.001[(b)]
Common Minke whale *Canadian East Coast Stock*	21,968[(a)] (CV = 0.31)	Absent	Occasional	Year-round low densities	0.00032[(b)]
Fin whale *Western North Atlantic Stock*	6,802[(a)] (CV = 0.24)	Absent	Occasional	Year-round low densities	0.0032[(b)]
Humpback whale *Gulf of Maine Stock*	1,396[(a)]	Absent	Occasional	Year-round low densities	0.0032[(b)]

Table 3-1 Marine Mammals with Potential to Occur in the Thames River and/or Adjacent Long Island Sound

Species and Stock	***Stock Abundance***	***Relative Occurrence in Thames River***	***Relative Occurrence in Long Island Sound***	***Month(s) of Occurrence within the Western North Atlantic***	***Density in the Project Area (number/sq km)***
Species for which Density and Distribution Indicate that Incidental Take is Reasonably Foreseeable					
Atlantic white-sided dolphin *Western North Atlantic Stock*	93,233[(a)] (CV = 0.71)	Absent	Occasional	Year-round low densities	0.022[(b)]
Common dolphin/short-beaked *western North Atlantic Stock*	172,974[(a)] (CV = 0.21)	Absent	Common	Mid-January to May	0.15[(b)]
Harbor porpoise *Gulf of Maine/Bay of Fundy*	95,543[(a)] (CV = 0.31)	Absent	Common	October to December	0.32[(b)]
Harbor seal *Western North Atlantic Stock*	61,336[(a)] (CV = 0.08)	Occasional	Common	September to late May	0.049/0.070[(c)]
Gray seal *Western North Atlantic Stock*	27,300[(a)] (CV = 0.22)	Occasional	Common	March to June	0.049/0.070[(c)]
Harp seal[(d)] *Western North Atlantic stock*	7,600,000[(a)]	Rare	Common	January to May	0.287[(e)]

Legend: CV = coefficient of variation; sq km = square kilometer.
Notes: [a]Hayes et al., 2022.
[b]Northeast Ocean Data, 2023.
[c]Navy, 2017, 2019a, combined densities provided for harbor seal and gray seal. The density 0.049 was used for each species occurring in the Thames River, and the density 0.070 was used for each species occurring in the entire harassment zone (Thames River + Long Island Sound), per approval from Navy.
[d]Navy, 2019a, it was assumed that one harp seal may be present in the Thames River during each month of pile driving activities.
[e]Navy, 2017, 2019a, density used for Long Island Sound as harp seals are expected to be rare in the Thames River.

Harbor seal and gray seal are expected to be more common in the Thames River as compared to harp seal. Densities for harbor and gray seal were derived from a combined density provided in the U.S. Navy Marine Species Density Database (NMSDD) (Navy, 2017). The density used for each species was determined to be 0.049 per square kilometer (sq km) in the Thames River and 0.070 per sq km in Long Island Sound. Harp seals are typically very rare in the Thames River but regularly occur in Long Island Sound. A density of 0.287 per sq km for harp seal was used for Long Island Sound (Navy, 2017).

Northeast Ocean Data (2023) was used to determine density data for Atlantic white-sided dolphin, common dolphin, and harbor porpoise. Densities are based on the most common occurrence within the vicinity of the mouth of the Thames River and south into Long Island Sound and extending to the west of Fishers Island (i.e., the furthest extent that underwater sound is expected to travel from project activities). Cetaceans are not expected to occur in the Thames River.

4 AFFECTED SPECIES STATUS AND DISTRIBUTION

A description of the status, distribution, and seasonal distribution (when applicable) of the affected species or stocks of marine mammals likely to be affected by such activities.

4.1 Atlantic White-Sided Dolphin

4.1.1 Status and Management

The Atlantic white-sided dolphin is a member of the family Delphinidae. They can measure up to 9 feet in length and reach a weight of 400 to 500 pounds. Atlantic white-sided dolphins have a lifespan of approximately 27 years and are named after their distinctive yellowish-tan streak on their sides (NOAA Fisheries, 2022a).

Based on the distribution of sightings, strandings, and incidental takes, there are possibly three population units: (1) Gulf of Maine, (2) Gulf of St. Lawrence, and (3) Labrador Sea populations (Palka et al., 1997). Until further research is conducted, the western North Atlantic stock of white-sided dolphins may contain multiple demographically independent populations where the animals in U.S. waters are part of the Gulf of Maine population (Hayes et al., 2022). The Atlantic white-sided dolphin is protected under the MMPA, but it is not listed under the ESA.

4.1.2 Distribution

Atlantic white-sided dolphins are found in the temperate waters of the North Atlantic and specifically off the coast of North Carolina to Maine in U.S. waters (NOAA Fisheries, 2022a). The Gulf of Maine population of white-sided dolphin primarily occurs in continental shelf waters from Hudson Canyon to Georges Bank, and in the Gulf of Maine and lower Bay of Fundy. From January to May, they occur in low numbers from Georges Bank to Jeffreys Ledge (off New Hampshire). They are most common from June through September from Georges Bank to lower Bay of Fundy, with densities declining from October through December (Hayes et al., 2022). On average, Atlantic white-sided dolphins occur in groups of 12 (NMFS, 2023).

4.1.3 Site-Specific Occurrence

The Navy conducted a 3-year marine mammal survey in the mouth of the Thames River to just north of SUBASE New London from 2017 through 2019, using line-transect methods. Atlantic white-sided dolphins have not been documented in the Thames River (Tetra Tech, 2019) but are likely to occur near the mouth of the river and out into Long Island Sound during the fall, with peak abundance in October (Northeast Ocean Data, 2023). Dolphins, in general, are rare in the Thames River but a wayward dolphin was observed in Norwich Marina (24 kilometers north of Long Island Sound) in July of 2022. The observation was reported to Mystic Aquarium and NMFS of what appeared to be a juvenile of undetermined species that may have strayed upriver looking for food (Associated Press, 2022).

4.2 Common Dolphin

4.2.1 Status and Management

The common dolphin is a member of the family Delphinidae and is one of the most abundant and familiar dolphins in the world. They occur primarily in areas of abundant prey in association with underwater ridges, seamounts, and continental shelves. Common dolphins have a distinctive color pattern or "hourglass" dark gray cape that extends along the back from the head to just below the dorsal fin where a "V" is visible on either side of the body, creating an hourglass. They are small, measuring under 6 feet long and weighing approximately 170 pounds (NOAA Fisheries, 2022b). The common dolphin is protected under the MMPA, but it is not listed under the ESA.

4.2.2 Distribution

The common dolphin is one of the most widely distributed species of cetaceans, found world-wide in temperate and subtropical seas. In the North Atlantic, they are common along the shoreline of Massachusetts. At-sea sightings have been concentrated over the continental shelf between the 100-meter and 2,000-meter isobaths over prominent underwater topography and east to the mid-Atlantic Ridge. The common dolphin can be found from Cape Hatteras northeast to Georges Bank from mid-January to May and in the Gulf of Maine from mid-summer to autumn (Hayes et al., 2022). On average, common dolphins occur in groups of 30 (NMFS, 2023).

4.2.3 Site-Specific Distribution

The short-beaked common dolphin has not been documented in the Thames River (Tetra Tech, 2019) but is likely to occur in Long Island Sound during mid-summer through fall with peak abundance in September (Northeast Ocean Data, 2023). As mentioned above for Atlantic white-sided dolphin, dolphins, in general, are rare in the Thames River but a wayward dolphin of undetermined species was observed in Norwich Marina (24 kilometers north of Long Island Sound) in July of 2022 (Associated Press, 2022).

4.3 Harbor Porpoise

4.3.1 Status and Management

The harbor porpoise is a member of the family Phocoenidae. Adult harbor porpoises range from 5 to 5.5 feet in length and can weigh up to 170 pounds. They are a toothed whale species and can be recognized by their small, robust, dark gray body with grayish-white sides, triangular dorsal fin, and short rostrum. Harbor porpoises are considered sexually dimorphic, with females being slightly larger than males (NOAA Fisheries, 2022c).

Based on genetic analysis, it is assumed that harbor porpoises in the U.S. and Canadian waters are divided into four populations, as follows: (1) Gulf of St. Lawrence, (2) Newfoundland, (3) Greenland, and (4) Gulf of Maine/Bay of Fundy (Hayes et al., 2022). The Gulf of Maine/Bay of Fundy Stock is likely to occur in the proposed project area. Harbor porpoise are protected under the MMPA, but it is not listed under the ESA.

4.3.2 Distribution

Harbor porpoises are found in northern temperate and subarctic coastal and offshore waters in both the Atlantic and Pacific Oceans. In the western North Atlantic, harbor porpoises are found in the northern Gulf of Maine and southern Bay of Fundy region in waters generally less than 150 meters deep, primarily during the summer (July to September). During fall (October to December) and spring (April to June), harbor porpoises are widely dispersed between New Jersey and Maine. Lower densities of harbor porpoise occur during the winter (January to March) in waters off New York to New Brunswick, Canada (Hayes et al., 2022).

4.3.3 Site-Specific Occurrence

Harbor porpoise have not been documented in the Thames River (Tetra Tech, 2019) but are likely to occur near the mouth of the river and out into Long Island Sound during the fall with peak abundance in December (Northeast Ocean Data, 2023).

4.4 Harbor Seal

4.4.1 Status and Management

Harbor seals are members of the "true seal" family Phocidae. Adults are sexually dimorphic, and males are generally larger than females. Adult harbor seals can reach up to 6 feet in length and weigh up to 285 pounds. As with other phocids, harbor seals lack external ear flaps, and their rear flippers do not rotate. Harbor seals are commonly a blue-gray color on their back with a speckling of both light and darker colors; however, their coloration may vary. Their concave, dog-like snout and their "banana-like" position while hauled-out aids in their identification (NOAA Fisheries, 2022d). Harbor seals are protected under the MMPA, but they are not listed under the ESA.

4.4.2 Distribution

Harbor seals occur in all nearshore waters of the North Atlantic and North Pacific Oceans and adjoining seas above approximately 30°N (Burns, 2009). They are year-round residents in the coastal waters of eastern Canada and Maine, occurring seasonally from southern New England to New Jersey from September through late May. Harbor seals northern movement occurs prior to pupping season that takes place beginning in May through June along the Maine coast. In autumn to early winter, harbor seals move southward from the Bay of Fundy to southern New England (Hayes et al., 2022). Overall, there are five recognized subspecies of harbor seal, two of which occur in the Atlantic Ocean. The western Atlantic harbor seal (*Phoca vitulina vitulina*) is the subspecies likely to occur in the proposed project area. There is some uncertainly about the overall population stock structure of harbor seals in the western North Atlantic Ocean. However, it is theorized that harbor seals along the eastern U.S. and Canada are all from a single population (Temte et al., 1991).

4.4.3 Site-Specific Occurrence

Harbor seals are the most commonly observed marine mammals in the Thames River. Harbor seals are known to occur in Connecticut waters and travel into the Thames River and up to SUBASE New London. Monthly observations over a 3-year marine mammal survey yielded a total of 16 seal sightings, and all the identified seals were either harbor or gray seals (Tetra Tech, 2019). Harbor seals were the most common, with 12 individuals identified during the 3-year survey. No other marine mammals were observed during the nearshore marine mammal survey. Nine of the 16 seal sightings were in the inner portion of the river, north of the I-95 bridge. No seals were observed hauled-out onshore (Tetra Tech, 2019), and there are no known haul-out sites within the Thames River (Navy, 2018). During marine mammal monitoring for Pier 32 construction activities that occurred from May 2022 through December 2022, only 1 harbor seal was recorded (Navy, 2023).

Harbor seal populations have increased in Connecticut since the 1980s and are common in Long Island Sound from September through June (Medic, 2005). Aerial surveys of haul-out sites around Long Island in November of 2018 recorded more than 900 harbor and gray seals (Atlantic Marine Conservation Society, 2018). The closest haul-out site is 10 miles south of Pier 31 at Fishers Island in Long Island Sound.

4.5 Gray Seal

4.5.1 Status and Management

Gray seals, which are also members of the true seal family Phocidae, are a coastal species that generally remains within the continental shelf region. However, they do venture into deeper water, as they have been known to dive up to 1,560 feet to capture prey during feeding. Gray seals primarily feed on fish, squid, various crustacean species, and octopus. Adult gray seals are sexually dimorphic, with males generally being larger than females. Adult males can reach up to 10 feet in length and weigh up to 880 pounds. Adult females can reach up to 7.5 feet in length and can weigh up to 550 pounds. As a true seal, this species lacks external ear flaps, and its rear flippers do not rotate. Depending on its geographic location and sex, gray seal appearance and coloration varies. Adult males have a silver-gray coat with darker spots scattered over their body and a prominent long-arched nose. Females generally have similar color patterns, but they do not have a prominent, long-arched nose (NOAA Fisheries, 2022e).

Gray seals can be found on both sides of the North Atlantic. Within this area, gray seals are split into three primary populations: (1) Northeast Atlantic, (2) Northwest Atlantic, and (3) the Baltic Sea (Haug et al., 2007). Gray seals are protected under the MMPA, but they are not listed under the ESA.

4.5.2 Distribution

Gray seals within U.S. waters are considered the western North Atlantic stock (from the Northwest Atlantic population), and they range from New Jersey to Labrador. Surveys conducted on Muskeget Island and adjacent sites in Nantucket Sound, and on Green and Seal Islands off the coast of Maine determined through genetic analysis that they are a new U.S population recolonized by Canadian gray seals (Wood et al., 2011). Year-round breeding has been documented on areas of outer Cape Cod and Muskeget Island in Massachusetts (Hayes et al., 2022). In U.S. waters, Muskeget Island is the largest pupping colony and the third largest of all colonies across the U.S. and Canada (den Heyer et al., 2020). In general, this species can be found year-round in the coastal waters of the Gulf of Maine (Hayes et al., 2022).

4.5.3 Site-Specific Occurrence

As previously discussed for harbor seals, gray seals were documented during the marine mammal surveys within the nearshore waters of the Thames River, although less frequently (Tetra Tech, 2019). Only three gray seals were observed in the Thames River during the three-year survey. During marine mammal monitoring for Pier 32 construction activities that occurred from May 2022 through December 2022, no gray seals were observed (Navy, 2023).

Gray seal populations have increased in Connecticut since the 1980s and are common in Long Island Sound from September through June (Medic, 2005). Aerial surveys of haul-out sites around Long Island in November 2018 recorded more than 900 harbor and gray seals (Atlantic Marine Conservation Society, 2018). The closest haul-out site is 10 miles south of Pier 31 at Fishers Island in Long Island Sound. With the increase in populations, gray seals are likely to co-occur in the Thames River with, and would not always be distinguishable from, harbor seals (Laws, 2016).

4.6 Harp Seal

4.6.1 Status and Management

Harp seals are also members of the true seal family. Unlike the gray seal and harbor seal, harp seals exhibit little sexual dimorphism. Males are generally only slightly larger than females, reaching up to 6 feet in length and weighing approximately 300 pounds. Females generally reach up to 5 feet in length and weigh up to 290 pounds. Adult harp seals are a light-gray color with black faces and a horseshoe-shaped black saddle on their back. They also have a distinctive block-shaped head. As with other true seal species, harp seals lack external ear flaps, and their rear flippers do not rotate (NOAA Fisheries, 2022f).

Harp seals are classified into three stocks, which coincide with specific pupping sites on pack ice. These pupping sites are as follows: (1) Eastern Canada, including the areas off the coast of Newfoundland and Labrador and the area near the Magdalen Islands in the Gulf of St. Lawrence, (2) the West Ice off eastern Greenland, and (3) the ice in the White Sea off the coast of Russia (Hayes et al., 2022). Harp seals are protected under the MMPA, but they are not listed under the ESA.

4.6.2 Distribution

The harp seal is a highly migratory species, and its range can extend from the Canadian Arctic to New Jersey. In U.S. waters, the species has an increasing presence in the coastal waters between Maine and New Jersey, and harp seals are considered members of the western North Atlantic stock with general presence from January through May (Hayes et al., 2022).

4.6.3 Site-Specific Occurrence

Harp seals are not known to regularly occur in the Thames River as previous surveys have not recorded their presence (Tetra Tech, 2019). However, two harp seals were identified in March and one harp seal in April 2019 by Mystic Aquarium staff. On both occasions they were observed hauled-out on the finger piers of the marina at SUBASE New London (Navy, 2019a). Harp seals are expected to occur within Long Island Sound from January through May (Hayes et al., 2022).

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5 INCIDENTAL TAKE AUTHORIZATION REQUESTED

The type of incidental taking authorization that is being requested (i.e., takes by harassment only, takes by harassment, injury and/or death), and the method of incidental taking.

5.1 Incidental Take Authorization Request

Under the MMPA (16 U.S. Code Section 1371 (a)(5)(D)), the Navy requests an IHA for the incidental take of seals by Level A and Level B and of cetaceans by Level B only as Level A zones would be confined to the Thames River where cetaceans do not occur. Incidental take is anticipated to occur as described within this application during proposed construction of the Pier 31 extension and demolition of Pier 17 Stub at SUBASE New London. As described in detail in Chapter 6, the Navy requests an IHA for the incidental take of marine mammals listed in **Table 5-1** for a period of 1 year for work proposed to occur between approximately December 2024 and November 2025.

Table 5-1 Total Underwater Incidental Take Estimates by Species

Species	*Level A (PTS onset)*			*Level B (Behavior)*		
	Individual Activities	*Concurrent Activities*	*Total Level A*	*Individual Activities*	*Concurrent Activities*	*Total Level B*
Atlantic white-sided dolphin	0	0	**0**	12[c]	0	**12**
Common dolphin	0	0	**0**	30[c]	0	**30**
Harbor porpoise	0	0	**0**	9	0	**9**
Harbor seal	8[a]	0	**8**	40	4	**44**
Gray seal	8[a]	0	**8**	40	4	**44**
Harp seal[b]	0	0	**0**	12	0	**12**
Total	16	0	**16**	143	8	**151**

Legend: PTS = permanent threshold shift
Notes: [a] 1 Level A take each of harbor and gray seals per day of impact pile driving of 36-inch steel piles = 8 takes, as requested by NMFS 12/21/23.
[b] Harp seal incidental takes are calculated for Long Island Sound. For the Thames River, harp seals are not usually present, but to guard against unauthorized incidental take, one Level B (behavioral) incidental take is added per month of construction when this species may occur (January through May).
[c] Take increased to average group size per AAMAPS data provided by NMFS.

Except with respect to certain activities not pertinent here, 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]" (50 CFR, Part 216, Subpart A, Section 216.3-Definitions).*

5.2 Method of Incidental Taking

This authorization request considers noise from impact and vibratory pile installation/extraction and auger (rotary) drilling as outlined in Chapters 1 and 2 that have the potential to disturb or displace marine mammals or produce a temporary shift in their hearing ability (temporary threshold shift [TTS]) resulting in Level B (Behavioral) harassment as defined above. Impact pile drivers have the potential to produce a permanent threshold shift (PTS) in the ability of seals to hear, resulting in Level A harassment. Level A (PTS onset) harassment would be minimized to the extent practicable given the methods of installation and measures designed to minimize the possibility of injury to marine mammals that are presented below.

- Piles would primarily be installed with a vibratory pile driver. Vibratory pile drivers have relatively low sound levels (<180 dB re 1 μPa at 10 meters) and are not expected to cause injury to marine mammals.
- Auger drilling (i.e., rotary drilling with spiral shaft through loose rock or soft sediment) would be used to remove sediment from the inside of the pipe pile casing after the casing has been driven to its required depth via vibratory and/or impact driving. The auger is progressed through the casing and the sediment is lifted out of the casing. No rock drilling is anticipated. Auger drills have lower sound levels than vibratory pile drivers (154 dB re 1 μPa). All pile driving/extracting and drilling would either not start or be halted if marine mammals approach the "shutdown zone" for the activity being performed. The shutdown zone corresponds to the Level A (PTS onset) harassment zone.
- An incidental take (take) would be recorded if a marine mammal enters the "disturbance zone" defined by the Level B (behavioral) harassment zone. Work would be allowed to proceed without cessation while marine mammals are in the disturbance zone, and marine mammal behavior within the disturbance zone would be monitored and documented. The largest Level B (Behavioral) harassment zone and the Level A (PTS onset) harassment zone would be monitored for each construction activity to be protective of marine mammals regardless of what activity is occurring.
- Impact pile driving activities would utilize a "soft start" to allow sensitive species to move away from the noise source before the commencement of pile driving.
- All in-water construction activities capable of producing noise harmful to marine mammals would occur during daylight hours.

Pier construction is not anticipated to affect the prey base or significantly affect other habitat features of marine mammals that would meet the definition of take. See Chapter 11 for more details on the impact reduction and mitigation measures proposed.

Based on estimates of sound source levels and underwater acoustic transmission loss, the Navy has identified the areas surrounding sound producing activities within which sound levels would result in Level A (PTS onset) harassment and Level B (Behavioral) harassment (refer to Chapter 6). The Navy proposes to monitor these areas during activities that produce sound levels that could result in marine mammal harassment. If a marine mammal enters the Level B (Behavioral) harassment zone (i.e., ensonified area), it would be noted as a take authorized in the IHA. Sound-producing activities would cease when a marine mammal enters the shutdown zone to prevent a prolonged exposure to sound that could reach the threshold for the onset of PTS. While the Navy believes this procedure would minimize the likelihood of Level A (PTS onset) acoustic exposures, it is possible that an animal could be present undetected within the Level A (PTS onset) harassment zone, particularly during impact installation of 36-inch steel pipe piles. Therefore, the Navy requests authorization for potential Level A (PTS onset) takes associated with these activities. A standard shutdown zone of 10 meters (33 feet) would also be applied to prevent non-acoustic injury to marine mammals from all potentially hazardous in-water activities occurring in the project area.

For most vibratory pile driving and auger drilling activities, the potential for Level A harassment by acoustic injury for seals extends less than 10 meters from the source, and for these activities, the shutdown zone automatically mitigates/minimizes Level A (PTS onset) acoustic harassment. **Table 5-2** summarizes the shutdown zone distances for each proposed activity under each potential construction scenario for seals.

Table 5-2 Level A (PTS Onset) Shutdown Zone Distances for Seals and Cetaceans by Activity

Pile type, Size, and Driving method, Location	***Level A (PTS Onset) Shutdown Distance (Seals)***	***Level A (PTS Onset) Shutdown Distance (Cetaceans)*** [a]
Vibratory Install/Extract 14-inch steel H-piles	10 meters	10 meters
Impact Install 14-inch steel H-piles	55 meters	120 meters
Vibratory Install 36-inch steel pipe piles	10 meters	10 meters
Auger drill 36-inch steel pipe piles	10 meters	10 meters
Impact Install 36-inch steel pipe piles	200[b] meters	200[b] meters
Vibratory Install 16-inch fiberglass reinforced, plastic fender piles	10 meters	10 meters
Impact Install 16-inch fiberglass reinforced, plastic fender piles	20 meters	41 meters
Vibratory extract 14-inch concrete encased steel H-piles	10 meters	20 meters
Vibratory extract of 16-inch fiberglass reinforced, plastic fender piles	10 meters	10 meters
Vibratory install and auger drilling of 36-inch steel pipe piles concurrent with vibratory install of 16-inch fiberglass reinforced, plastic fender piles	20 meters	46 meters
Vibratory install of 16-inch fiberglass reinforced, plastic piles concurrent with vibratory extraction of 14-inch concrete encased steel H-piles	15 meters	35 meters
Vibratory install of 14-inch steel H-piles concurrent with vibratory extraction of 14-inch concrete-encased steel H-piles and vibratory extraction of 16-inch fiberglass reinforced plastic fender piles.	15 meters	30 meters
Vibratory install of 14-inch steel H-piles concurrent with vibratory extraction of 16-inch fiberglass reinforces plastic fender piles	10 meters	20 meters

Note: [a]Although cetaceans are not anticipated to be in the river, because of a rare but recent observation of a dolphin in 2022, monitoring of the level A shutdown zones for cetaceans is included to guard against unauthorized incidental take of dolphin.
[b]Based on practicable shutdown zone distance implemented for other similar projects in the region (NMFS, 2022).

The presence of mid- and high-frequency cetaceans (dolphin and porpoise) in the proposed activity area is unlikely as they do not occur within the Thames River where Level A (PTS onset) would be contained. However, because of the 2022 occurrence of a dolphin in the Thames River (refer to Sections 4.1.3 and 4.2.3), monitoring of the Level A (PTS onset) shutdown zone for cetaceans is included in **Table 5-2**.

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6 NUMBERS AND SPECIES EXPOSED

By age, sex, and reproductive condition (if possible), the number of marine mammals (by species) that may be taken by each type of taking identified in Section 5, and the number of times such takings by each type of taking are likely to occur.

6.1 Introduction

In-water pile installation activities would temporarily increase the local underwater noise environment in the vicinity of the project.

Research suggests that increased noise may impact marine mammals in several ways and that these impacts depend on many factors. Noise impacts are discussed in more detail in Chapter 7. Assessing whether a sound may disturb or injure a marine mammal involves understanding the characteristics of the acoustic source and the potential effects that sound may have on the physiology and behavior of that marine mammal. Although it is known that sound is important for marine mammal communication, navigation, and foraging (National Research Council 2003, 2005), understanding the auditory effects from anthropogenic sound on marine mammals has continued to be researched and developed (Southall et al., 2019, 2021). Furthermore, many other factors in addition to the received level of sound may affect an animal's reaction, such as the animal's physical condition, prior experience with the sound, and proximity to the source of the sound.

Vibratory pile driving/extracting and auger drilling as described in Chapter 1 of this application is not expected to result in Level A exposure of marine mammals as defined under the MMPA. However, the noise-related impacts discussed in this application may result in Level B harassment. Impact pile driving could result in Level A (PTS onset) and Level B (Behavioral) exposure of marine mammals as defined under the MMPA. The methods for estimating the number and types of exposure are summarized below.

Exposure of each species was determined by:

- Estimating the area of impact where noise levels exceed acoustic thresholds for marine mammals (Sections 6.7 and 6.8);
- Evaluating potential presence of each species in the Thames River and in Long Island Sound based on site-specific surveys as outlined in Chapters 3 and 4; and
- Estimating potential harassment exposures by multiplying the density or site-specific abundance, as applicable, of each marine mammal species calculated in the area of impact by their probable duration during construction (Section 6.12).

Each of the three items above is discussed in the following sections.

6.2 Description of Noise Sources

Ambient sound is a composite of sounds from multiple sources, including environmental events, biological sources, and anthropogenic activities. Physical noise sources include waves at the surface, precipitation, earthquakes, ice, and atmospheric noise, among other events. Biological sources include marine mammals, fish, and invertebrates. Anthropogenic sounds are produced by vessels (small and large), dredging, aircraft overflights, and construction activities. Known noise levels and frequency ranges associated with anthropogenic sources similar to those that would be used for this project are summarized in **Table 6-1**. Details of each of the sources are described in the following text.

Table 6-1 Representative Levels of Underwater Anthropogenic Noise Sources

Noise Source	*Frequency Range (Hz)*	*Source Level*	*Reference*
Small vessels	860–8,000	141–175 dB RMS re 1 µPa at 1 m	Galli et al., 2003; Matzner and Jones, 2011; Sebastianutto et al., 2011
Large ship	20-1,000	176–186 dB re 1 μPa^2sec SEL at 1 m	McKenna, 2011
Tug docking gravel barge	200–1,000	149 dB RMS at 100 m	Blackwell and Greene, 2002

Legend: dB = decibel; Hz = hertz; m = meter; re 1 µPa = referenced at 1 micropascal; RMS = root mean square; SEL = sound exposure level; sec = second.

In-water construction activities associated with the proposed project include impact and vibratory pile driving/extracting, and auger drilling. The sounds produced by these activities fall into two sound types: impulsive and non-impulsive (defined below). Impact pile driving produces impulsive sounds, while vibratory pile driving/extracting and auger drilling produces non-impulsive sounds. The distinction between these two general sound types is important because they have differing potential to cause physical effects, particularly with regard to hearing (Ward, 1997).

Impulsive sounds (e.g., explosions, seismic airgun pulses, and impact pile driving), which are referred to as pulsed sounds in Southall et al. (2007, 2019, 2021), are brief, broadband, atonal transients and occur either as isolated events or repeated in some succession (Southall et al., 2007, 2019, 2021). Impulsive sounds are characterized by a relatively rapid rise from ambient pressure to a maximal pressure value followed by a decay period that may include a period of diminishing, oscillating maximal and minimal pressures (Southall et al., 2007). Impulsive sounds generally have a greater capacity to induce physical injury compared with sounds that lack these features (Southall et al., 2007, 2019, 2021).

Non-impulsive sounds (referred to as non-pulsed in Southall et al., 2007, 2019, 2021) can be tonal, broadband, or both. They lack the rapid rise time associated with pulsed sounds and can have longer durations than impulsive sounds. Non-impulsive sounds can be either intermittent or continuous. Examples of non-impulsive sounds include vessels, aircraft, and machinery operations such as drilling, dredging, and vibratory pile driving (Southall et al., 2007, 2019, 2021). In some environments, the duration of both impulsive and non-impulsive sounds can be extended due to reverberations.

6.3 Vocalizations and Hearing of Marine Mammals

All marine mammals that have been studied can produce sounds and use sounds to forage, orient, detect, respond to predators, and facilitate social interactions (Richardson et al., 1995). Measurements of marine mammal sound production and hearing capabilities provide some basis for assessing whether exposure to a particular sound source may affect a marine mammal behaviorally or physiologically. Marine mammal hearing abilities are quantified using live animals either via behavioral audiometry or electrophysiology (see Schusterman, 1981; Au, 1993; Wartzok and Ketten, 1999; Nachtigall et al., 2007). Behavioral audiograms, which are plots of animals' exhibiting hearing threshold versus frequency, are obtained from captive, trained live animals using standard testing procedures with appropriate controls and are considered to be a more accurate representation of a subject's hearing abilities. Behavioral audiograms of marine mammals are difficult to obtain because many species are too large, too rare, and too difficult to acquire and maintain for experiments in captivity. Consequently, our understanding of a species' hearing ability may be based on the behavioral audiogram of a single individual or small group of animals. In addition, captive animals may be exposed to local ambient sounds and other environmental factors that may impact their hearing abilities and may not accurately reflect the hearing abilities of free-swimming animals.

For animals not available in captive or stranded settings (including large whales and rare species), estimates of hearing capabilities are based on anatomical and physiological structures, the frequency range of the species' vocalizations, and extrapolations from related species.

Electrophysiological audiometry measures small electrical voltages produced by neural activity when the auditory system is stimulated by sound. The technique is relatively fast, does not require a conscious response, and is routinely used to assess the hearing of newborn humans. It has been adapted for use on non-humans, including marine mammals (Dolphin, 2000; Nachitall et al., 2007; Mulsow et al., 2021). For both methods of evaluating hearing ability, hearing response in relation to frequency is a generalized U-shaped curve or audiogram showing the frequency range of best sensitivity (lowest hearing threshold) and frequencies above and below with higher threshold values.

The NMFS reviewed studies of hearing sensitivity of marine mammals and developed thresholds for use as guidance when assessing the effects of anthropogenic sound on marine mammals based on measured or estimated hearing ranges (NMFS, 2018a). The guidance places marine mammals into the following functional hearing groups based on their generalized hearing sensitivities: high-frequency cetaceans, mid-frequency cetaceans, low-frequency cetaceans (mysticetes), otariid pinnipeds (sea lions and fur seals), and phocid pinnipeds (true seals). Research is underway to subdivide these hearing groups in the future (Southall et al., 2019, 2021). **Table 6-2** provides sound production and hearing capabilities for marine mammal species that are assessed in this application. There are no low-frequency species or otariid pinnipeds included in this application (refer to Chapter 3).

Table 6-2 Hearing and Vocalization Ranges for Marine Mammal Functional Hearing Groups and Species in the Thames River and/or Long Island Sound

Functional Hearing Group	*Species*	*Functional Hearing Range*[(a)]
Mid-frequency cetaceans	Atlantic white-sided dolphin, short-beaked common dolphin	150 Hz to 160 kHz
High-frequency cetaceans	Harbor porpoise	275 Hz to 160 kHz
Phocidae	Harbor seal, gray seal, harp seal	In-water: 50 Hz to 86 kHz In-air: 75 Hz to 30 kHz

Legend: Hz = Hertz; kHz = kilohertz
Note: [a]In-water hearing data from NMFS, 2018a; in-air data from Schusterman, 1981; Hemilä et al., 2006; Southall et al., 2007, 2019, 2021.

Animals are not equally sensitive to all frequencies and so auditory weighting functions (mathematical functions) are used to emphasize frequencies where animals are more susceptible to noise exposure and de-emphasize frequencies where animals are less susceptible (Finneran, 2016). In order to set acoustic threshold levels for each group, a frequency-dependent weighting function and numeric thresholds for the onset of TTS and PTS were derived from available data compiled for hearing abilities and effects of noise on marine mammals (Finneran, 2016). These thresholds are presented in Section 6.4 for hearing groups evaluated under this IHA.

6.4 Sound Exposure Criteria and Thresholds

The NMFS uses underwater sound exposure thresholds to determine when an activity could result in impacts to a marine mammal defined as Level A (PTS onset) (NMFS, 2018a) or Level B (Behavioral) harassment (NMFS, 2005) (**Table 6-3**). The NMFS (2018) has recently developed acoustic threshold levels for determining the onset of PTS in marine mammals in response to underwater impulsive and non-impulsive sound sources. The criteria use a cumulative sound exposure level (SEL_{cum}) in units of dB referenced at 1 micropascal squared second (re 1 μPa^2sec) and peak sound pressure level (SPL) in dB (dB peak) referenced at 1 micropascal (re 1 µPa). The NMFS equates the onset of PTS, which is a form of auditory injury, with Level A harassment under the MMPA. Level B (Behavioral) harassment occurs when marine mammals are exposed to impulsive/intermittent underwater sounds above 160 dB RMS re 1 µPa, such as from impact pile driving, and to non-impulsive/continuous underwater sounds above 120 dB RMS re 1 µPa, such as from vibratory pile driving (NMFS, 2005). The onset of TTS is a form of Level B (Behavioral) harassment under the MMPA. All forms of harassment, either auditory or behavioral, constitute incidental take under these statutes.

Table 6-3 Injury and Disturbance Threshold Criteria for Underwater and Airborne Noise

Marine Mammals	***Airborne Noise (impact and vibratory pile driving)[(a)]***	***Underwater Vibratory Pile Driving Noise (non-impulsive sounds)***		***Underwater Impact Pile Driving Noise (impulsive sounds)***	
	Disturbance Guideline (haul-out)[(b)]	***PTS Onset (Level A) Threshold***	***Level B Disturbance Threshold***	***PTS Onset (Level A) Threshold[(c)]***	***Level B Disturbance Threshold***
Mid-Frequency Cetaceans	Not applicable	198 dB SEL_{CUM}[(d)]	120 dB RMS	230 dB Peak[(e)] 185 dB SEL_{CUM}[(d)]	160 dB RMS
High-Frequency Cetaceans	Not applicable	173 dB SEL_{CUM}[(d)]	120 dB RMS	202 dB Peak[(e)] 155 dB SEL_{CUM}[(d)]	160 dB RMS
Phocidae (true seals)	90 dB RMS (harbor seals) 100 dB RMS (gray seals, harp seals) (unweighted)	201 dB SEL_{CUM}[(d)]	120 dB RMS	218 dB Peak[(e)] 185 dB SEL_{CUM}[(d)]	160 dB RMS

Legend: µPa = micropascal; dB = decibel; dB Peak = peak sound level in dB; PTS = permanent threshold shift; RMS = root mean square; SEL = sound exposure level SEL_{CUM} = cumulative SEL.

Notes: [a]Airborne disturbance thresholds not specific to pile driver type.
[b]Sound level at which pinniped haul-out disturbance has been documented. This is not considered an official threshold but is used as a guideline.
[c]Dual metric acoustic thresholds for impulsive sounds. Whichever results in the largest isopleth for calculating PTS onset is used in the analysis.
[d]Cumulative SEL over 24 hours.
[e]Flat weighted or unweighted peak sound pressure within the generalized hearing range.

For airborne noise, NMFS uses generic sound exposure thresholds to determine when an activity that produces airborne sound might result in impacts to a marine mammal (NMFS, 2005). Construction-generated airborne noise would have little impact to cetaceans because noise from airborne sources would not transmit as well underwater (Richardson et al., 1995); thus, noise would primarily affect hauled-out pinnipeds near the project location. NMFS has identified behavioral harassment threshold criteria for airborne noise generated by pile driving for pinnipeds regulated under the MMPA. Level A (PTS onset) threshold criteria for airborne noise have not been established. The Level B (Behavioral) harassment threshold for harbor seals is 90 dB RMS referenced to 20 micro pascals (re 20 µPa) (unweighted) and for other pinnipeds except harbor seals is 100 dB RMS re 20 µPa (unweighted).

6.5 Limitations of Existing Noise Criteria

The application of the 120 dB RMS re 1 µPa behavioral threshold can sometimes be problematic because this threshold level can be either at or below the ambient noise level of certain locations. The 120 dB RMS re 1 µPa threshold level for non-impulsive noise originated from research conducted by Malme et al. (1984, 1988) for California gray whale response to continuous industrial sounds such as drilling operations.

There is little research or data supporting a response by pinnipeds or odontocetes to non-impulsive sounds from vibratory pile driving as low as the 120 dB threshold. The threshold is based on indirect evidence from studies of gray whale responses to playbacks of industrial noise conducted in the 1980s (NMFS, 2018a). In general, pinnipeds appear to be more tolerant of, or at least habituate more quickly to, potentially disturbing underwater sound than do cetaceans, and generally appear to be less responsive to industrial sound than most cetaceans (Southall et. al., 2017, 2021; Gomez et al., 2016). Southall et al. (2007) reviewed studies conducted to document behavioral responses of harbor seals and northern elephant seals to non-impulsive sounds under various conditions and concluded that those limited studies suggest that exposures between 90 dB and 140 dB RMS re 1 µPa generally do not appear to induce strong behavioral responses.

A more recent observational study found evidence of weak but statistically significant avoidance behavior of bottlenose dolphins (*Tursiops truncatus*) and harbor porpoises in response to estimated received levels of 99–132 dB re 1$\mu Pa^2 s$ during vibratory pile driving (Graham et al., 2017). Branstetter et al. (2018) tested for the effects of vibratory pile driver noise on bottlenose dolphin echolocation by exposing penned dolphins to play back recordings at source levels of 110, 120, 130, and 140 dB re 1µPa, respectively. They found evidence of altered behavior (an almost complete cessation of echolocation clicks) only at the highest source level, for which the received level was roughly estimated as 128 dB re 1µPa. The effect on behavior diminished significantly, indicating acclimation, as the animals resumed echolocation during subsequent replications.

6.6 Auditory Masking

Natural and artificial sounds can disrupt behavior through auditory masking or interference with a marine mammal's ability to detect and interpret other relevant sounds, such as communication and echolocation signals (Wartzok et al., 2004). Masking occurs when both the signal and masking sound have similar frequencies and either overlap or occur very close to each other in time. A signal is very likely to be masked if the noise is within a certain "critical bandwidth" around the signal's frequency and its energy level is similar or higher (Holt, 2008). Noise within the critical band of a marine mammal signal would show increased interference with detection of the signal as the level of the noise increases (Wartzok et al., 2004). For example, in delphinid subjects, relevant signals needed to be 17 to 20 dB louder than masking noise at frequencies below 1 kilohertz (kHz) to be detected and 40 dB greater at approximately 100 kHz (Richardson et al., 1995). Noise at frequencies outside of a signal's critical bandwidth will have little to no effect on the detection of that signal (Wartzok et al., 2004).

Additional factors influencing masking are the temporal structure of the noise and the behavioral and environmental context in which the signal is produced. Continuous noise is more likely to mask signals than is intermittent noise of the same amplitude; quiet "gaps" in the intermittent noise allow detection of signals that would not be heard during continuous noise (Brumm and Slabbekoorn, 2005). The behavioral function of a vocalization (e.g., contact call, group cohesion vocalization, echolocation click, etc.) and the acoustic environment at the time of signaling may both influence call source level (Holt et al., 2011), which directly affects the chances that a signal will be masked (Nemeth and Brumm, 2010). Miksis-Olds and Tyack (2009) showed that during increased noise, manatees modified vocalizations differently depending on whether or not a calf was present.

Masking noise from anthropogenic sources could cause behavioral changes if it disrupts communication, echolocation, or other hearing-dependent behaviors. As noted above, noise frequency and amplitude both contribute to the potential for vocalization masking; noise from pile driving typically covers a frequency range of 10 hertz (Hz) to 2.5 kHz (Dahl et al., 2015), which is likely to overlap the frequencies of vocalizations produced by species that may occur in the proposed project area. Amplitude of noise from both impact and vibratory pile driving methods is variable and may exceed that of marine mammal vocalizations within an unknown range of each incident pile. Depending on the animal's location and vocalization source level, this range may vary over time.

Although SPLs from impulsive sources (impact pile driving) are greater, the zone of potential masking effects from non-impulsive continuous sources (vibratory pile driving/extracting and rotary drilling) may be as large or larger due to the duration and continuous nature of the sound. The potential for masking differs between species, depending on the overlap between noise sources and the animals' hearing and vocalization frequencies. In this respect, harbor porpoises, which use high-frequency sound, and dolphins (Atlantic white-sided and common dolphin) which use mid-frequency sound, are probably less vulnerable to masking from pile driving than are seals. In addition, harbor porpoise or dolphin species that may be subject to masking are transitory, passing by the mouth of the Thames River, along Long Island Sound. The animals most likely to be at risk for vocalization masking are resident pinnipeds (harbor seals and gray seals, and the occasional presence of harp seal). Possible behavioral reactions to vocalization masking include changes to vocal behavior (including cessation of calling), habitat abandonment (long- or short-term), and modifications to the acoustic structure of vocalizations (i.e., amplitude, frequency, duration, or repetition rate) which may help signalers compensate for masking (Brumm and Slabbekoorn, 2005; Brumm and Zollinger, 2011). The extent to which the animals' behaviors would mitigate the potential for masking is uncertain, and, accordingly, the Navy has estimated that masking as well as compensatory behavioral responses are likely within the Level B (Behavioral) harassment zones estimated for in-water construction noise.

6.7 Modeling Potential Noise Impacts from Pile Driving

6.7.1 Underwater Sound Propagation

In-water construction activities would generate underwater noise that potentially could result in harassment to marine mammals swimming by the proposed project area. Transmission loss (TL) underwater is the decrease in acoustic intensity as an acoustic pressure wave propagates out from a source until the pressure wave becomes indistinguishable from ambient sound. TL parameters vary with frequency, temperature, sea conditions, current, source and receiver depth, water depth, water chemistry, and bottom composition and topography. A "practical spreading" value of 15 (referred to as "practical spreading loss") is widely used for intermediate or spatially varying conditions when actual values for transmission loss are unknown (NMFS, 2005). This value was used to model the estimated range from in-water construction activities to various expected SPLs at potential project structures. This model follows a geometric propagation loss based on the distance from the noise-generating activity, resulting in an approximate 4.5 dB reduction in level for each doubling of distance from the source. In this model, the SPL at some distance away from the source (e.g., driven pile) is governed by a measured source level, minus the TL of the energy as it dissipates with distance. The TL equation is:

$$TL = 15\log_{10}\left(\frac{R_1}{R_2}\right)$$

Where:

TL is the transmission loss in dB,

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

R_2 is the distance (usually 10 m) from the driven pile of the initial measurement.

The TL model described above was used to calculate the expected noise propagation from vibratory pile driving/extracting, impact pile driving, and auger drilling using representative source levels to estimate the harassment zones or area exceeding the noise criteria. The extent of representative harassment zones for Level A (PTS onset) and Level B (Behavioral) takes for the Pier 31 extension, work trestle, and Pier 17 Stub demolition are based on notional source pile locations at the end of the proposed work areas, furthest from the shore, illustrating the maximum harassment zone that would be produced during a specific in-water construction/demolition activity. This TL model simplifies the estimation of harassment zones, but it should be recognized that noise propagation away from the source will be influenced by a variety of factors, especially bathymetry and the presence or absence of reflective or absorptive conditions, including the sea surface and sediment type.

6.7.2 Underwater Noise from Pile Driving

The intensity of pile driving sound is greatly influenced by factors such as the type of pile, the type of driver, and the physical environment in which the activity takes place. To determine reasonable SPLs from pile driving, studies with similar properties to the proposed project were evaluated. **Table 6-4** presents received SPL at a distance of 10 meters from the pile.

Table 6-4 Summary of Recommended Underwater Proxy Source Levels for Individual Pile Driving/Extracting/Drilling Activities

Pile Type	*Installation/Extraction Method*	*Pile Diameter*	*Peak (dB re 1 μPa)*	*RMS (dB re 1 μPa)*	*SEL (dB re 1 μPa² sec)*
Steel pipe	Vibratory	14-inch steel H[(a)]	NA	158	158
	Impact	14-inch steel H[(a)]	194	177	162
	Vibratory	36-inch[(b)]	NA	168	168
	Impact	36-inch[(a)]	209	198	183
	Auger Drilling (rotary)	All sizes[(c)]	NA	154	NA
Concrete encased Steel H-piles	Vibratory	14-inch[(d)]	185	162	157

Table 6-4 Summary of Recommended Underwater Proxy Source Levels for Individual Pile Driving/Extracting/Drilling Activities

Fiberglass, Reinforced plastic	Vibratory	16-inch[e]	NA	158	NA
	Impact	16-inch[f]	177	165	157

Notes: All sound pressure levels (SPLs) are unattenuated; dB=decibels; SEL = sound exposure level; single strike SEL are the proxy source levels presented for impact pile driving and were used to calculate distances to PTS; dB re 1 µPa = dB referenced to a pressure of 1 microPascal, measures underwater SPL. dB re 1 µPa^2-sec = dB referenced to a pressure of 1 microPascal squared per second. NA = Not applicable.

Sources: [a]Navy,2019a, Table 6-4; [b]168 dB is used from NMFS, 2018b, Final Rule, which is supported by the Navy 2022 Pier 32 Monitoring Report, Table 3, versus the higher source level from Navy, 2019b, Table 6-4 Portsmouth Naval Shipyard.
[b]Navy, 2019b, Table 6-4.
[c]Dazey et al., 2012.
[d]Data on vibratory extraction of concrete piles is not available. See 84 *Federal Register* 28474 p. 28479 suggesting proxy source sound levels for timber piles be used as they are expected to have similar sound levels to concrete.
[e]Illingworth and Rodkin, 2017.
[f]California Department of Transportation, 2015.

For the analyses that follow, the TL model described above was used to calculate the expected noise propagation from pile driving and drilling. For vibratory and impact behavioral zones and peak injury zones, a representative source level (**Table 6-3**) was used to estimate the area exceeding the noise criteria. The Technical Guidance (NMFS, 2018a) provides Level A (PTS onset) thresholds and auditory weighting functions for each marine mammal hearing group, whereas the NMFS Optional User Spreadsheet contains default weighting factor adjustments (WFAs) for different types of broadband sources (NMFS, 2020). The WFAs assign a single frequency to represent the sound spectrum of the source, approximating what the animal is exposed to. The WFA frequency, when applied to the auditory weighting function of the group, determines what adjustment is made to the source level prior to calculating the threshold distance. To calculate the maximum distances to Level A (PTS onset) thresholds associated with each particular source, the 2018 Technical Guidance was followed and the Optional User Spreadsheet (NMFS, 2020) was used. See **Appendix A** for acoustic calculations using the NMFS Optional User Spreadsheets.

6.8 Distance to Underwater Sound Thresholds

6.8.1 Individual Activities

Calculated distances to the underwater marine mammal auditory (PTS onset) SEL thresholds and behavioral thresholds for the three hearing groups used the NMFS user spreadsheet (NMFS, 2020) are provided in **Tables 6-5** and **Table 6-6** for individual (non-concurrent) in-water construction activities. Calculated distances to Level A (PTS onset) and Level B (Behavioral) thresholds are large but do not take into account attenuation from intersecting land masses or structures, which would reduce the overall area of potential impact.

Maximum distances to Level A (PTS onset) and Level B (Behavioral) thresholds, excluding areas truncated to account for attenuation by land masses or structures, are shown in **Figures 6-1** through **6-9**. Areas encompassed within the threshold (harassment zones), presented in **Figures 6-1** through **6-9**, were calculated using a Geographic Information System. Sound source locations were chosen to model the greatest possible affected areas from a representative notional pile location.

Table 6-5 Calculated Distances to Harassment Thresholds for Individual Activities: Impulsive (Impact Pile driving)

Structure	Figure	Pile Size and Type	Activity	Total Production Days	Level A (PTS Onset) Harassment			Level B (Behavioral) Harassment – All Marine Mammals
					MF Cetacean	HF Cetacean	Phocid	
					Maximum Distance to 185 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (sq km)	Maximum Distance to 155 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (sq km)	Maximum Distance to 185 dB SEL_{cum} Threshold(m)/Area of Harassment Zone (sq km)	Maximum Distance 160 dB RMS SPL (m)/ Area of Harassment Zone (sq km)
Work Trestle Installation (December 2024)	6-1	14-inch steel H-pile	Impact Install	15	3.6/0.000041	119.3/0.044565	53.6/0.009004	136/0.056637
Pier 31 Extension Pier Support Pile Installation (February-March 2025)	6-2	36-inch steel pipe	Impact Install	8	65.4/0.01341	2,191.1/1.588304	984.4/0.868723	3,415/2.620145
Pier 31 and Pier 17 Stub Quaywall Fender Pile Installation (October – November 2025)	6-3	16-inch fiberglass reinforced plastic pile	Impact Install	36	1.2/0.000005	40.5/0.005136	18.2/0.001035	22/0.001513

Legend: MF = mid frequency; HF = high frequency; dB RMS SPL = decibel root mean square sound pressure level; dB SEL_{cum} = cumulative sound exposure level; m = meter; PTS = Permanent Threshold Shift; sq km = square kilometer.

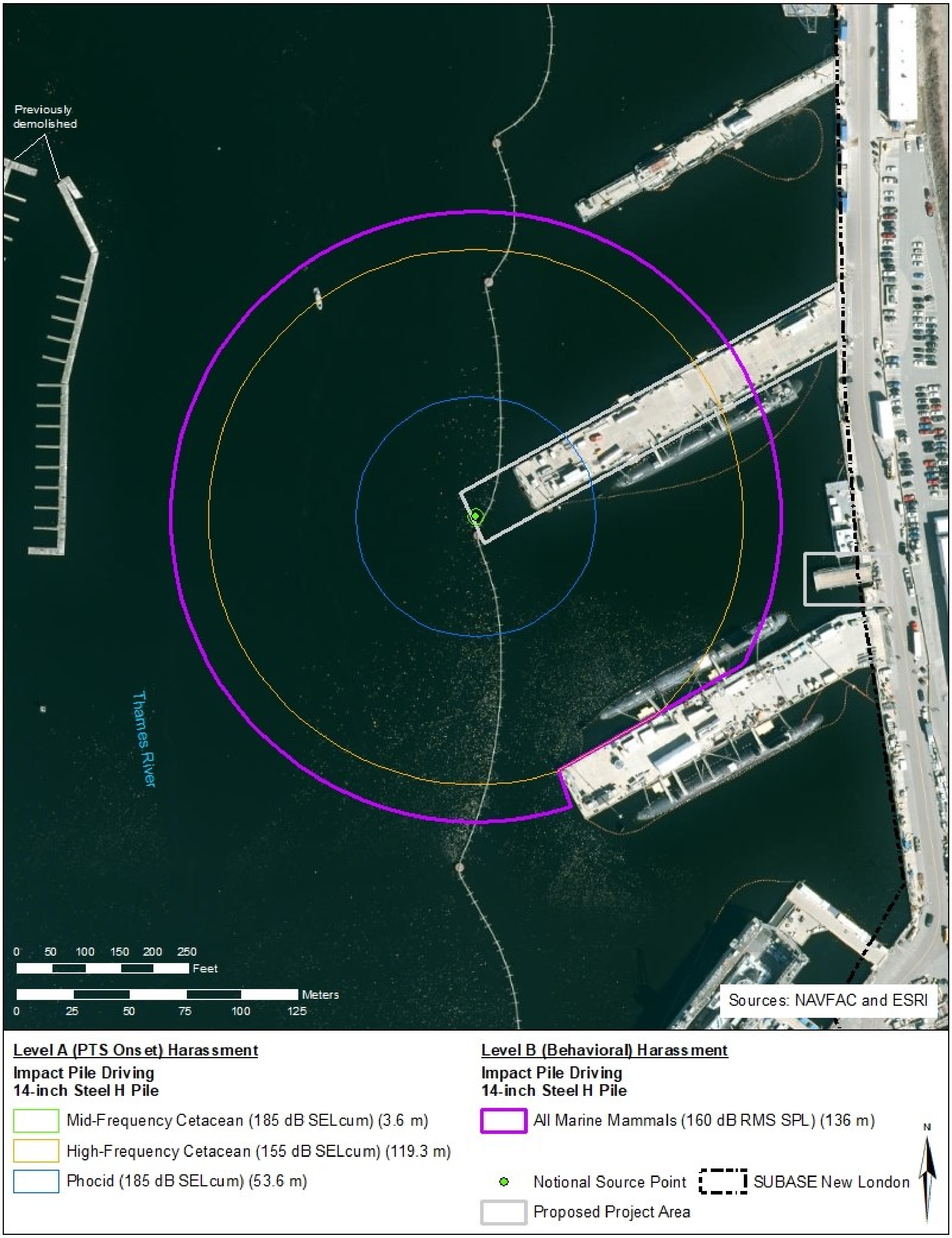

Figure 6-1 Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Impact Pile Driving to Install Temporary Work Trestle – 14-inch Steel-H Piles

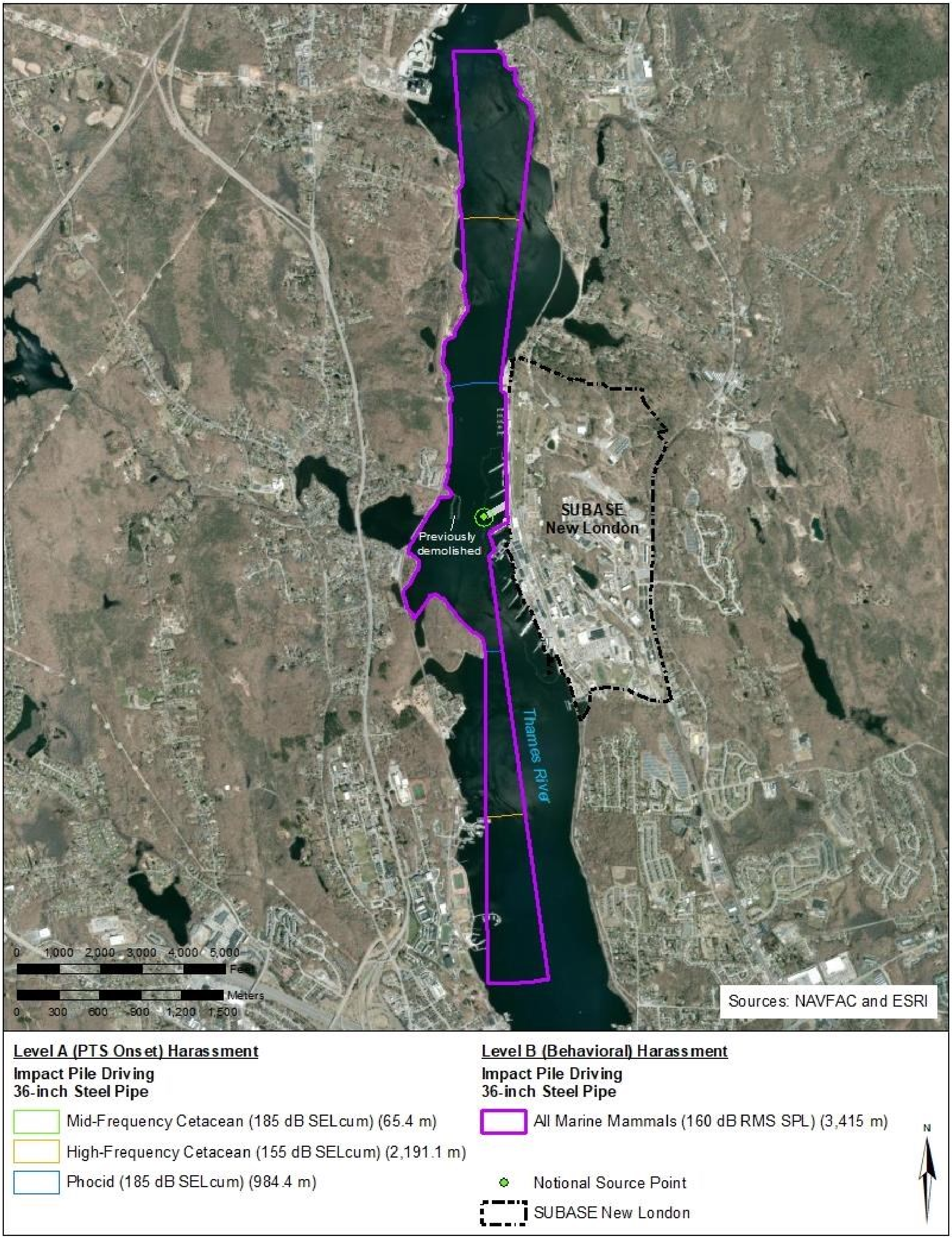

Figure 6-2 Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Impact Pile Driving Pier 31 Extension Support Piles – 36-inch Steel Pipe

Figure 6-3 Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Impact Pile Driving – 16-inch Fiberglass Fender Piles at Pier 31 and Pier 17 Stub Quaywall

Table 6-6 Calculated Distances to Harassment Thresholds for Individual Activities: Non-Impulsive Continuous (Vibratory Installation/Extraction and Auger [Rotary] Drilling)

Structure	*Figure*	*Pile Size and Type*	*Activity*	*Total Production Days*	*Level A (PTS Onset) Harassment*			*Level B (Behavioral) Harassment – All Marine Mammals*
					MF Cetacean	*HF Cetacean*	*Phocid*	
					Maximum Distance to 198 dB SEL_{cum} Threshold (m)/ Area of Harassment Zone (sq km)	*Maximum Distance to 173 dB SEL_{cum} Threshold(m)/Area of Harassment Zone (sq km)*	*Maximum Distance to 201 dB SEL_{cum} Threshold(m)/ Area of Harassment Zone (sq km)*	*Maximum Distance 120 dB RMS SPL Threshold (m)/ Area of Harassment Zone (sq km)*
Work Trestle Installation (December 2024)	6-4	14-inch steel H-pile	Vibratory Install	12	0.5/0.000001	9.0/0.000253	3.7/0.000043	3,415/2.620145
Pier 31 Extension Pier Support Pile Installation (February-March 2025)	6-5	36-inch steel pipe	Auger (Rotary) Drilling	20	0.1/0	0.8/0.000002	0.5/0.000001	1,848/1.359058
	6-6	36-inch steel pipe	Vibratory Install	120	0.4/0.000001	7.2/0.000162	2.9/0.000026	15,849/3.435273
Pier 31 and Pier 17 Stub Quaywall Fender Pile Installation (October – November 2025)	6-7	16-inch fiberglass reinforced plastic fender piles	Vibratory Install	30	0.3/0	4.9/0.000075	2.0/0.000013	3,415/2.620145
Pier 17 Stub Demolition (December 2024)	6-8	14-inch concrete encased steel H-piles	Vibratory Extract	4	1.0/0.000003	16.5/0.000851	6.8/0.000145	6,310/0.205166
Partial Demolition Pier 31 Removal of Existing	6-9	16-inch fiberglass reinforced	Vibratory Extract	14	0.3/0	4.9/0.000075	2.0/0.000013	3,415/2.47916

Table 6-6 Calculated Distances to Harassment Thresholds for Individual Activities: Non-Impulsive Continuous (Vibratory Installation/Extraction and Auger [Rotary] Drilling)

Structure	*Figure*	*Pile Size and Type*	*Activity*	*Total Production Days*	*Level A (PTS Onset) Harassment*			*Level B (Behavioral) Harassment – All Marine Mammals*
					MF Cetacean	*HF Cetacean*	*Phocid*	
					Maximum Distance to 198 dB SEL_{cum} Threshold (m)/ Area of Harassment Zone (sq km)	*Maximum Distance to 173 dB SEL_{cum} Threshold(m)/Area of Harassment Zone (sq km)*	*Maximum Distance to 201 dB SEL_{cum} Threshold(m)/ Area of Harassment Zone (sq km)*	*Maximum Distance 120 dB RMS SPL Threshold (m)/ Area of Harassment Zone (sq km)*
Fender Piles (December 2024)		plastic fender piles						
Work Trestle Removal (November 2025)	6-4	14-inch steel H-pile	Vibratory Extract	12	0.5/0.000001	9.0/0.000253	3.7/0.000043	3,415/2.620145

Legend: MF = mid frequency; HF = high frequency; dB RMS SPL = decibel root mean square sound pressure level; dB SEL_{cum} = cumulative sound exposure level; m = meter; PTS = Permanent Threshold Shift; sq km = square kilometer.

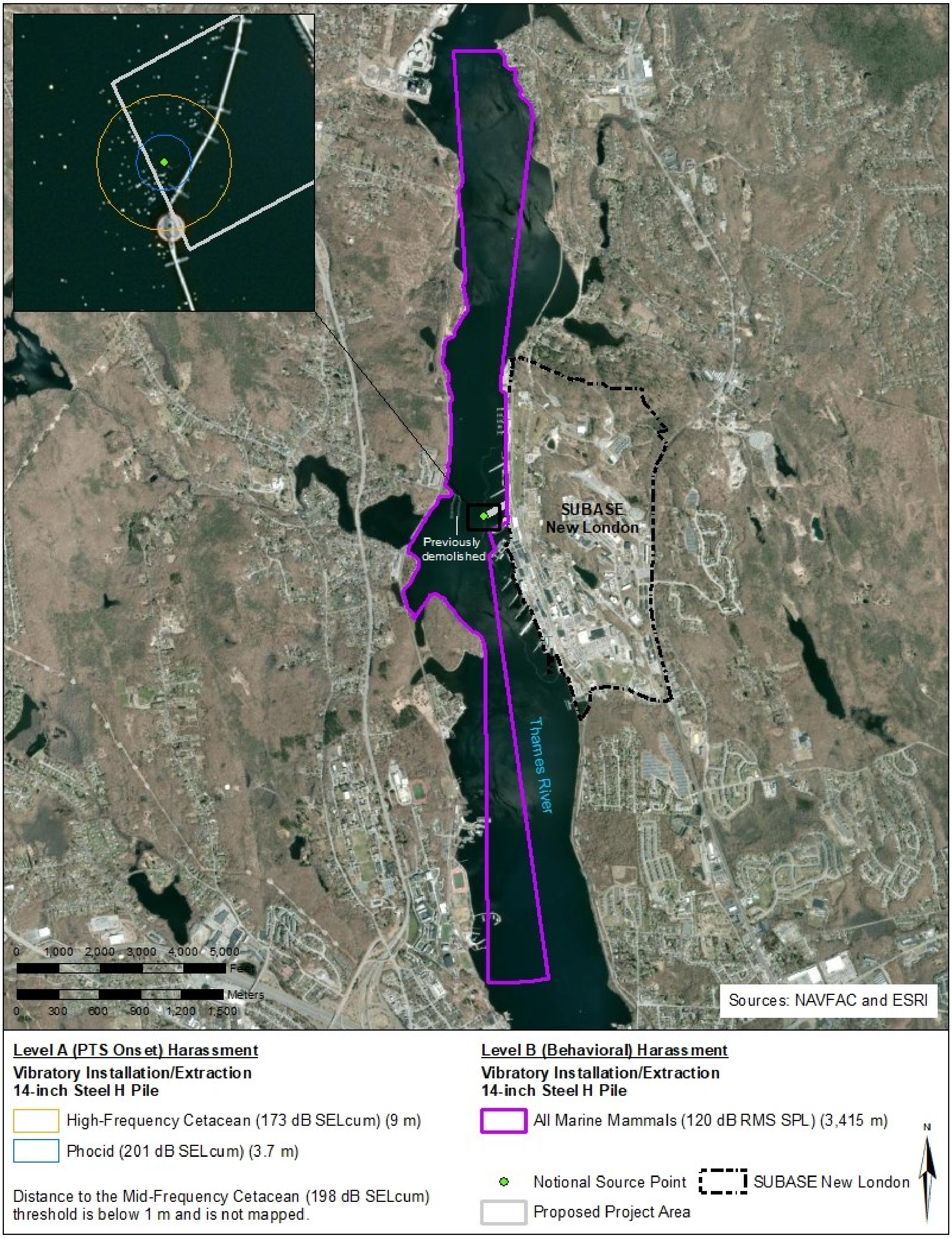

Figure 6-4 Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Vibratory Install/Extraction of Temporary Work Trestle – 14-inch Steel H-Pile

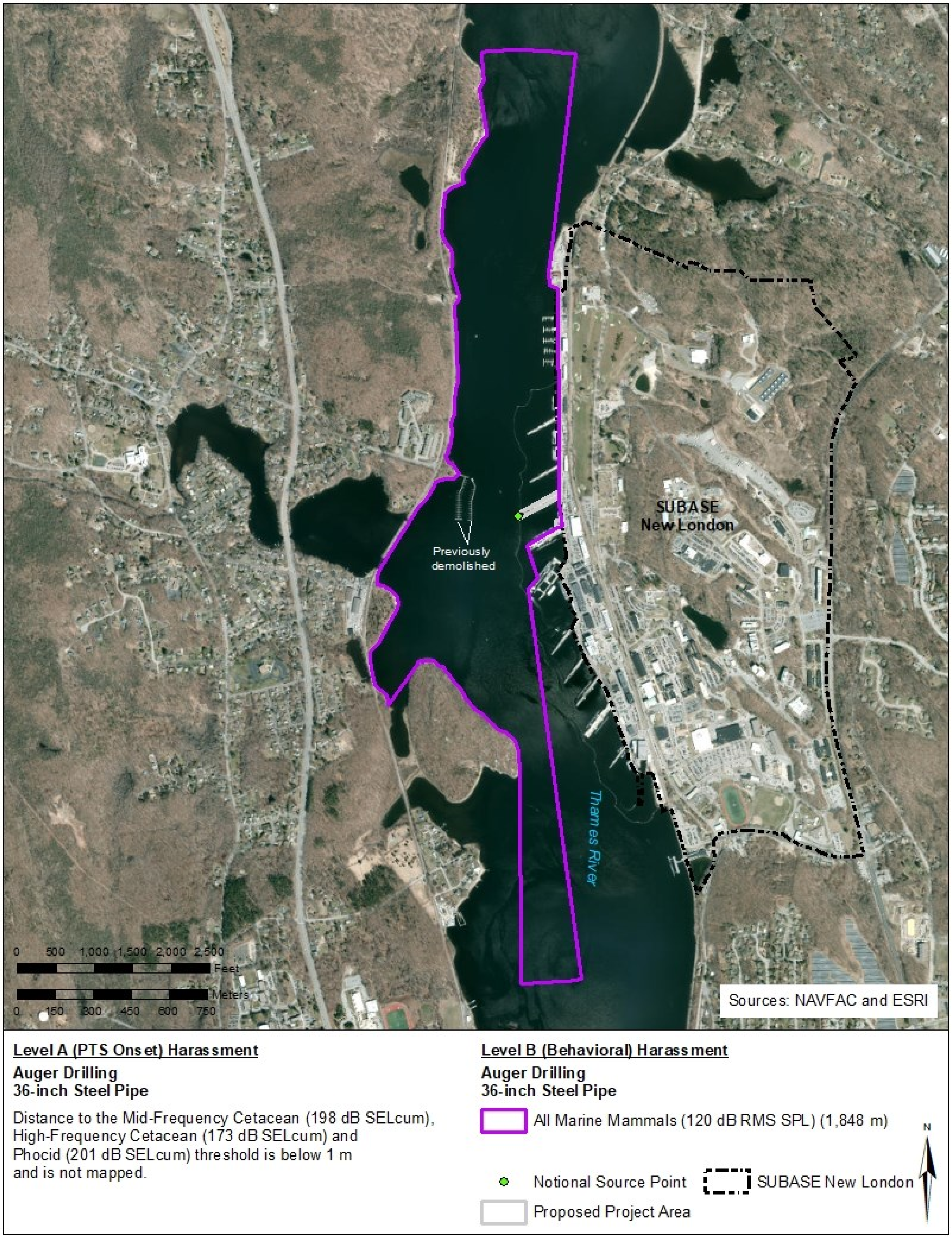

Figure 6-5 Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Auger Drilling - 36-inch Steel Pipe

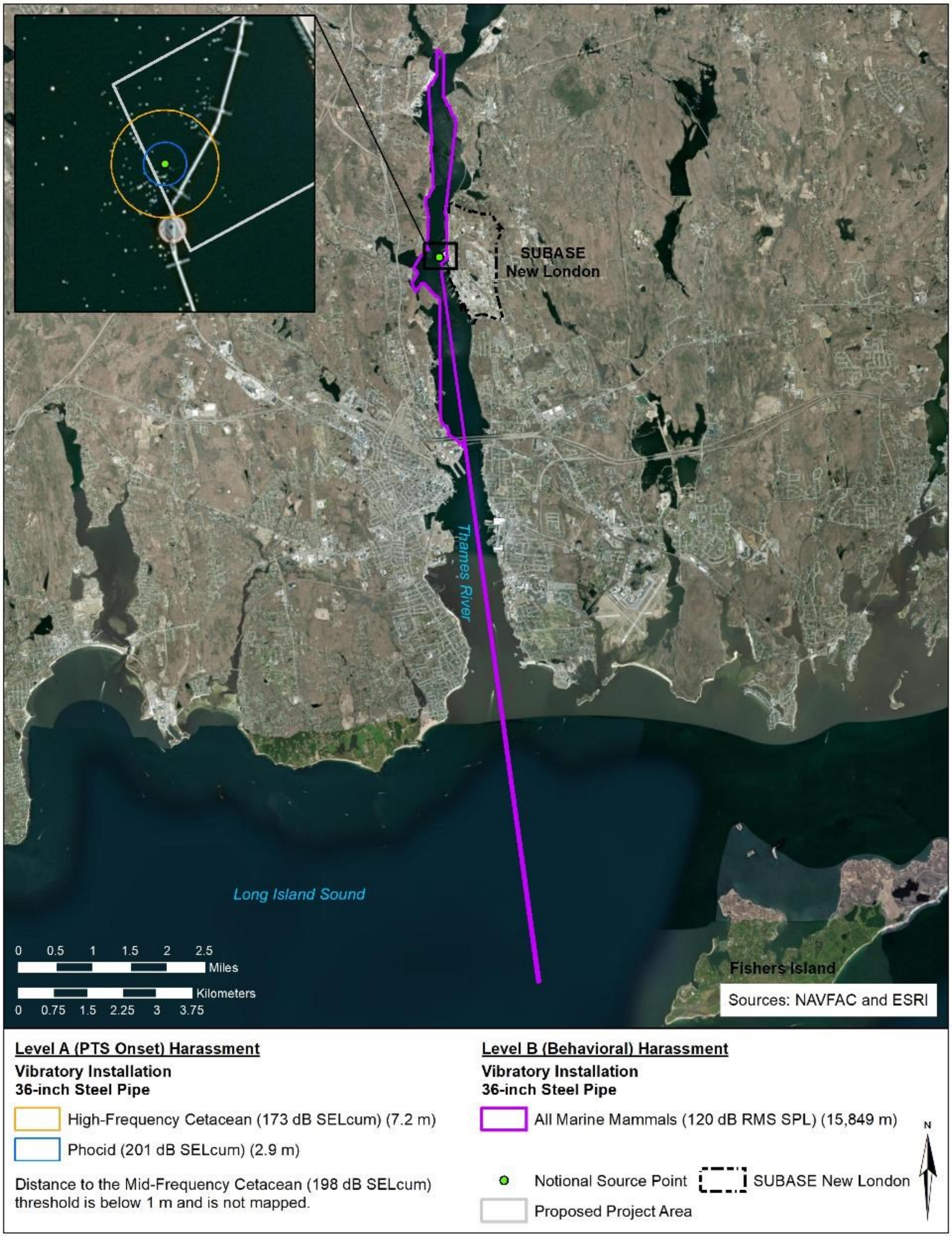

Figure 6-6 Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Vibratory Install – 36-inch Steel Pipe

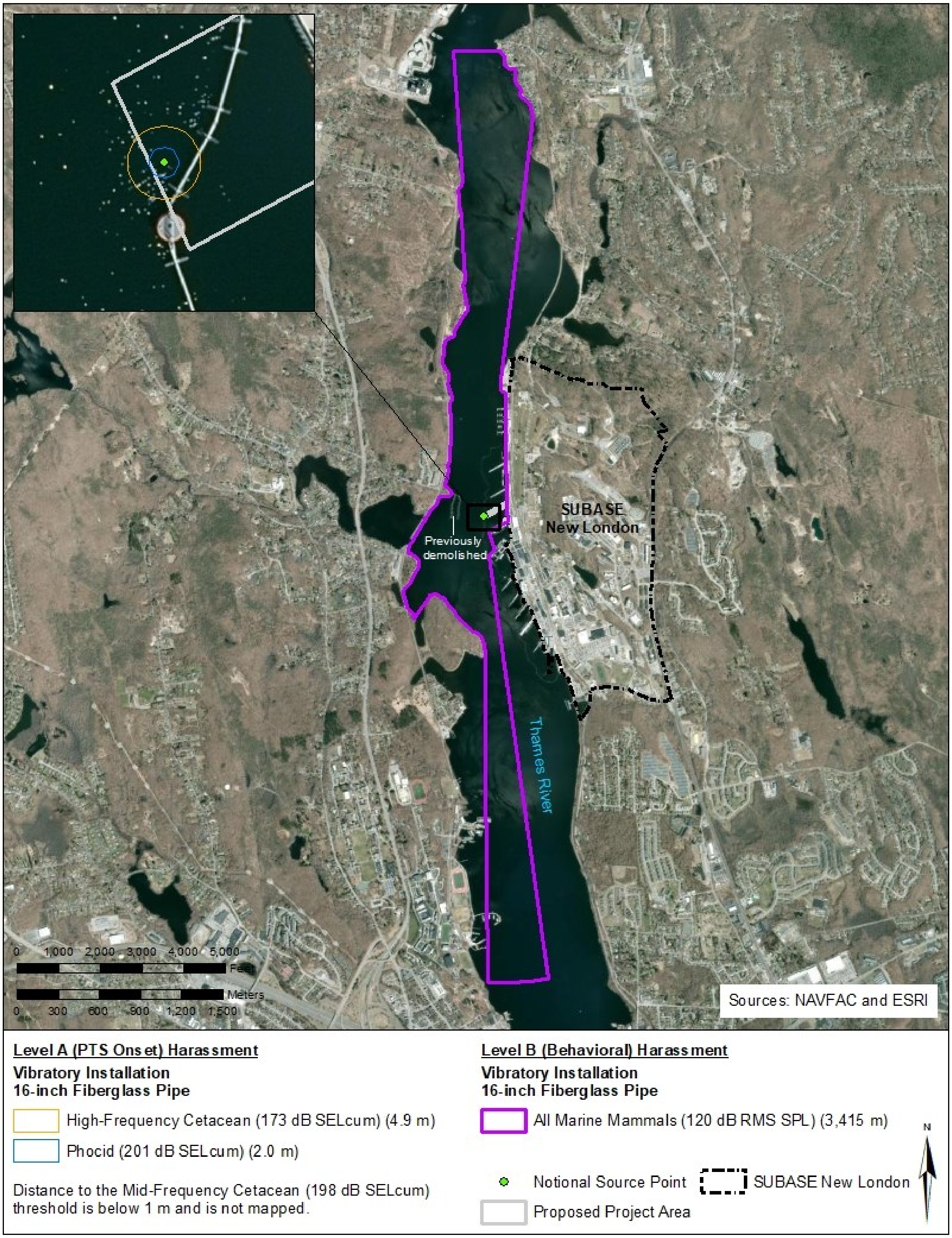

Figure 6-7 Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Vibratory Install – 16-inch Fiberglass Fender Piles at Pier 31 and Pier 17 Stub Quaywall

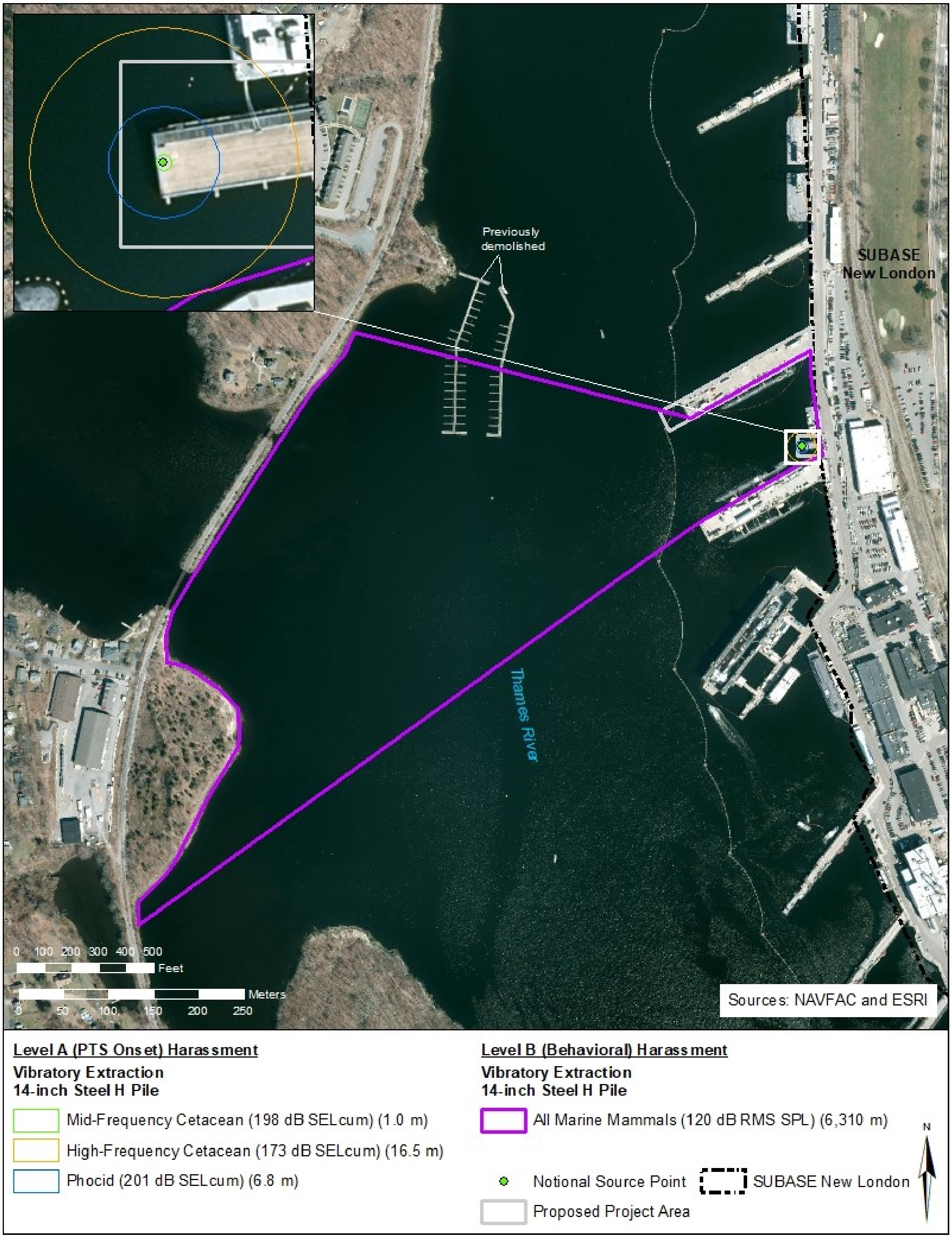

Figure 6-8 Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Vibratory Extraction – 14-inch Concrete Encased Steel H-Pile Pier 17 Stub

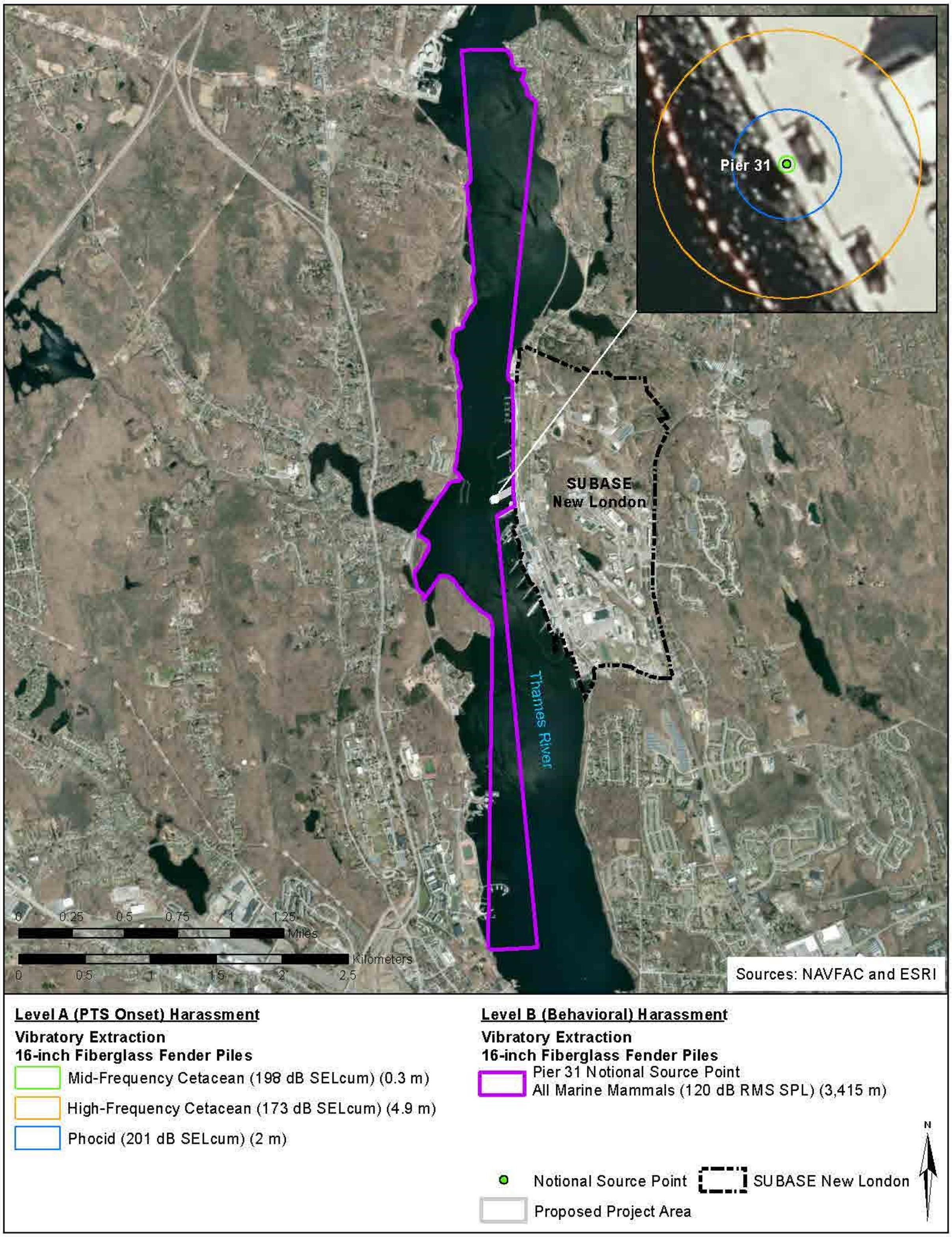

Figure 6-9 Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Vibratory Extraction – 16-inch Fiberglass Reinforced Plastic Fender Piles, Pier 31 Partial Demolition

The maximum distance to Level A (PTS onset) would be during the impact driving of 36-inch steel pipe piles at Pier 31 (see **Table 6-5**; **Figure 6-2**) and would be approximately 2,191 meters for harbor porpoise, 65 meters for Atlantic white-sided and common dolphins, and 984 meters for seals. However, this distance would be truncated due to the presence of intersecting land masses.

The farthest extent to Level B (Behavioral) harassment threshold would be a distance of 15,849 meters resulting from the vibratory installation of 36-inch pipe piles (see **Table 6-6**; **Figure 6-6**). As explained above, this harassment zone would be truncated due to the presence of intersecting land masses and would encompass a maximum area of 3.43 sq km. The number and species of marine mammals anticipated to be "taken" by in-water construction activities is presented in Section 6.13.

6.8.2 Concurrent Activities

Simultaneous use of impact pile drivers, vibratory pile drivers/extractors, and auger (rotary) drills could result in increased SPLs and harassment zone sizes given the proximity of the structure sites and the rules of decibel addition.

According to recent guidance provided by NMFS, when two noise sources have overlapping sound fields, there is potential for higher sound levels than for non-overlapping sources because the isopleth of one sound source encompasses the sound source of another isopleth. In such instances, the sources are considered additive and combined using the rules of decibel addition (**Table 6-7**). For addition of two simultaneous sources, the difference between the two sound source levels is calculated, and if that difference is between 0 and 1 dB, 3 dB are added to the higher sound source levels; if the difference is between 2 or 3 dB, 2 dB are added to the highest sound source levels; if the difference is between 4 to 9 dB, 1 dB is added to the highest sound source levels; and with differences of 10 or more decibels, there is no addition (NMFS, 2021 unpublished).

Table 6-7 Rules for Combining Sound Levels

Difference in Sound Source Level (dB)	*Rule*
0 or 1 dB	Add 3 dB to the higher source level
2 or 3 dB	Add 2 dB to the higher source level
4 to 9 dB	Add 1 dB to the higher source level
10 dB or more	Add 0 dB to the higher source level

Notes: Daily production rates combined and recalculated for the predetermined overlapping activities.
Legend: dB = decibel.
Source: NMFS, 2021 unpublished.

For simultaneous usage of three or more continuous sound sources, the three overlapping sources with the highest sound source levels are identified. Of the three highest sound source levels, 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 sound source levels 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 sound source levels (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 sound source levels 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, 2021 unpublished).

As shown in **Table 2-1**, there is one anticipated scenario when an impact hammer and vibratory hammer and extractor are occurring simultaneously. In the situation where an impact and vibratory hammer are used concurrently, the largest zone generated by either the vibratory hammer or impact hammer would be used (refer to **Table 6-5** and **Table 6-6**).

By using the rules of decibel addition method (**Table 6-7**), a revised proxy source for Level A and Level B analysis was determined for the use of the concurrent non-impulsive activity scenarios. The revised proxy values are presented in **Table 6-8** and the resulting harassment zones are shown in **Table 6-9** and depicted in **Figures 6-10** through **6-12**.

Table 6-8 Calculated Underwater Proxy Sources Levels for Concurrent Pile Driving/Extracting Activities

Structure	*Activity and Proxy*	*New Proxy for Non-Impulsive*
Work Trestle Pile Installation and Pier 17 Stub Demo	Vibratory Install of 14-inch Steel H-piles – 158 dB RMS Impact Install of 14-inch steel H-piles – 162 dB SEL Vibratory Extract of 14-inch concrete encased piles – 162 dB RMS	163 dB RMS
Work Trestle Pile Installation, Pier 17 Stub Demo, and Pier 31 Partial Demo (4 days)	Vibratory Install of 14-inch Steel H-piles – 158 dB RMS Impact Install of 14-inch Steel H-Piles – 162 dB SEL Vibratory Extract of 14-inch concrete encased steel H-piles – 162 dB RMS Vibratory Extract of 16-inch fiberglass reinforced plastic fender piles – 158 dB RMS	165 dB RMS
Work Trestle Installation and Pier 31 Demo (12 days)	Vibratory Install of 14-inch steel H-piles – 158 dB RMS Vibratory Extract of 16-inch fiberglass reinforced plastic fender piles – 158 dB RMS	161 dB RMS

Note: Per the rules of combining sound levels generated during impact pile installation, each impact proxy per pile type is modeled. When impact and vibratory are occurring concurrently, the larger zone is modeled (NMFS 2021, Unpublished Guidance).

Legend: dB RMS = decibel root mean square; dB SEL = decibel sound exposure level.

Table 6-9 Calculated Distances to Harassment Thresholds for Concurrent Activities: Non-Impulsive Continuous (Vibratory Installation/Extraction)

Structure	Figure	Pile Size and Type	Activity	Total Production Days	Level A (PTS Onset) Harassment – MF Cetacean: Maximum Distance to 198 dB SEL_{cum} Threshold (m)/ Area of Harassment Zone (sq km)	Level A (PTS Onset) Harassment – HF Cetacean: Maximum Distance to 173 dB SEL_{cum} Threshold(m)/Area of Harassment Zone (sq km)	Level A (PTS Onset) Harassment – Phocid: Maximum Distance to 201 dB SEL_{cum} Threshold(m)/Area of Harassment Zone (sq km)	Level B (Behavioral) Harassment – All Marine Mammals: Maximum Distance 120 dB RMS SPL Threshold (m)/ Area of Harassment Zone (sq km)
Concurrent Pile Driving (4 days) of 14-inch steel H-pile for temporary work trestle and vibratory extraction of 14-inch concrete encased steel H-piles from Pier 17 Stub	6-10	14-inch steel H-piles and 14-inch concrete encased steel H-piles	Vibratory Install and Extract	4	1.2/0.000005 [a] 1.2/0.000005 [b]	19.3/0.001164 [a] 19.3/0.001134 [b]	7.9/0.000195 [a] 7.9/0.000195 [b]	7,356/3.121835 [a] 7,356/0.205166 [b]
Concurrent Pile Driving (4 days) of 14-inch steel H-pile for temporary work trestle, vibratory extraction of 14-inch concrete encased steel H-piles from Pier 17 Stub, and vibratory extraction of 16-inch diameter fiberglass reinforced plastic fender piles from Pier 31.	6-11	14-inch steel H-piles, 14-inch concrete encased steel H-piles, and 16-inch fiberglass fender piles	Vibratory Install and Extract	4	1.6/0.000008 [a] 1.6/0.000008 [b] 1.6/0.000008 [c]	26.2/0.002146 [a] 26.2/0.001807 [b] 26.2/0.002146 [c]	10.8/0.000365 [a] 10.8/0.000365 [b] 10.8/0.000365 [c]	10,000/3.197942 [a] 10,000/0.205166 [b] 10,000/2.822399 [c]

Table 6-9 Calculated Distances to Harassment Thresholds for Concurrent Activities: Non-Impulsive Continuous (Vibratory Installation/Extraction)

Structure	*Figure*	*Pile Size and Type*	*Activity*	*Total Production Days*	*Level A (PTS Onset) Harassment*			*Level B (Behavioral) Harassment – All Marine Mammals*
					MF Cetacean	*HF Cetacean*	*Phocid*	
					Maximum Distance to 198 dB SEL_{cum} Threshold (m)/ Area of Harassment Zone (sq km)	*Maximum Distance to 173 dB SEL_{cum} Threshold(m)/Area of Harassment Zone (sq km)*	*Maximum Distance to 201 dB SEL_{cum} Threshold(m)/Area of Harassment Zone (sq km)*	*Maximum Distance 120 dB RMS SPL Threshold (m)/ Area of Harassment Zone (sq km)*
Concurrent Pile Driving (12 days) of 14-inch steel H-piles for temporary work trestle and vibratory extraction of 16-inch fiberglass reinforced plastic fender piles from Pier 31	6-12	14-inch steel H-piles and 16-inch fiberglass fender piles	Vibratory Install and Extract	12	1.1/0.000004 [(a)] 1.1/0.000004 [(c)]	17.8/0.00099 [(a)] 17.8/0.00099 [(c)]	7.3/0.000167 [(a)] 7.3/0.000167 [(c)]	5,412/3.078261 [(a)] 5,412/2.822399 [(c)]

Legend: MF = mid frequency; HF = high frequency; dB RMS SPL = decibel root mean square sound pressure level; dB SEL_{cum} = cumulative sound exposure level; m = meter; PTS = Permanent Threshold Shift; sq km = square kilometer.

Notes: [a]*Harassment zones mapped from Pier 31.*
[b]*Harassment zones mapped from Pier 17.*
[c]*Harassment zones from existing Pier 31 for fender pile extraction*

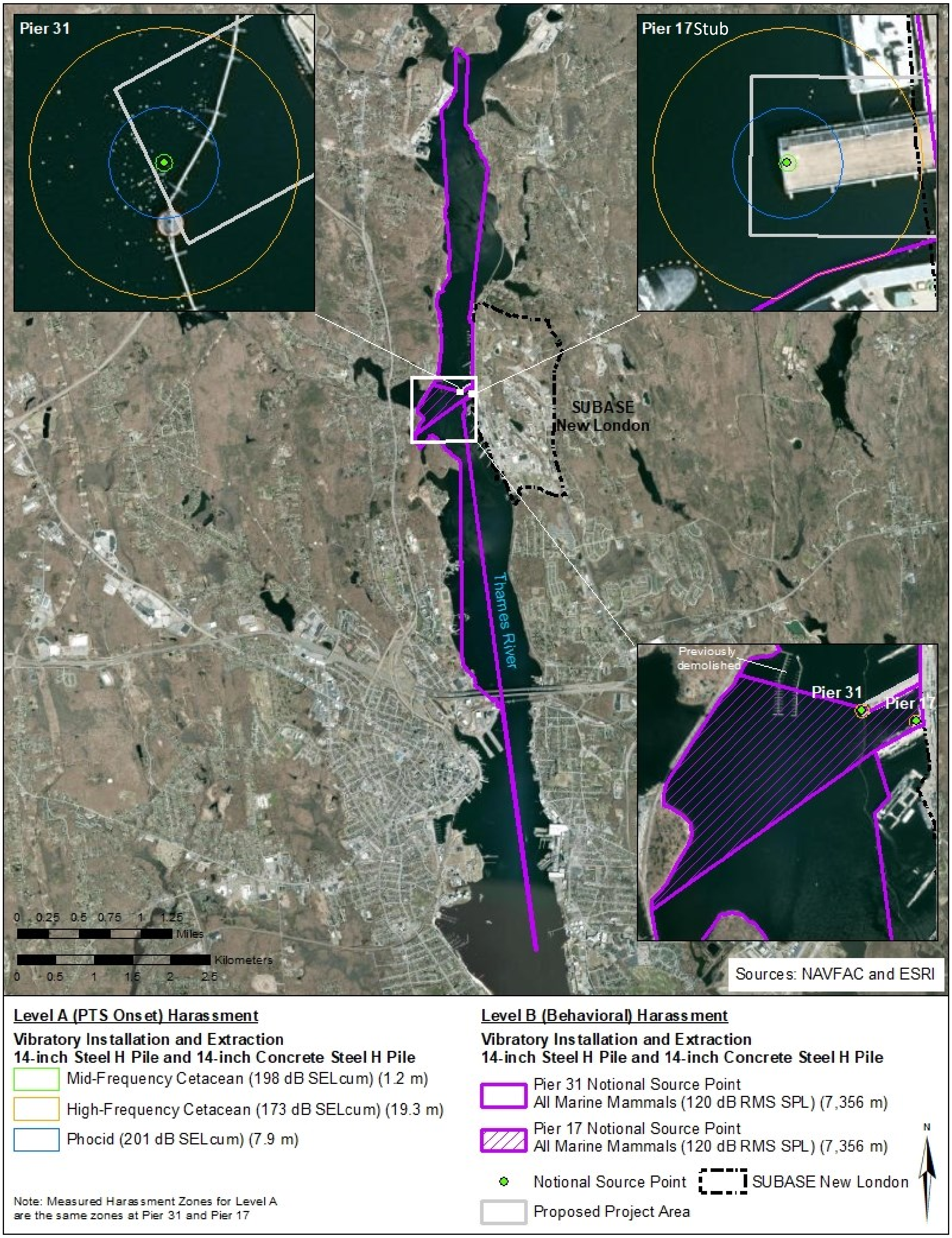

Figure 6-10 Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Concurrent Vibratory Installation of 14-inch Steel H-piles for the Work Trestle and Vibratory Extraction of 14-inch Concrete-encased Steel H-piles from Demo of Pier 17 Stub

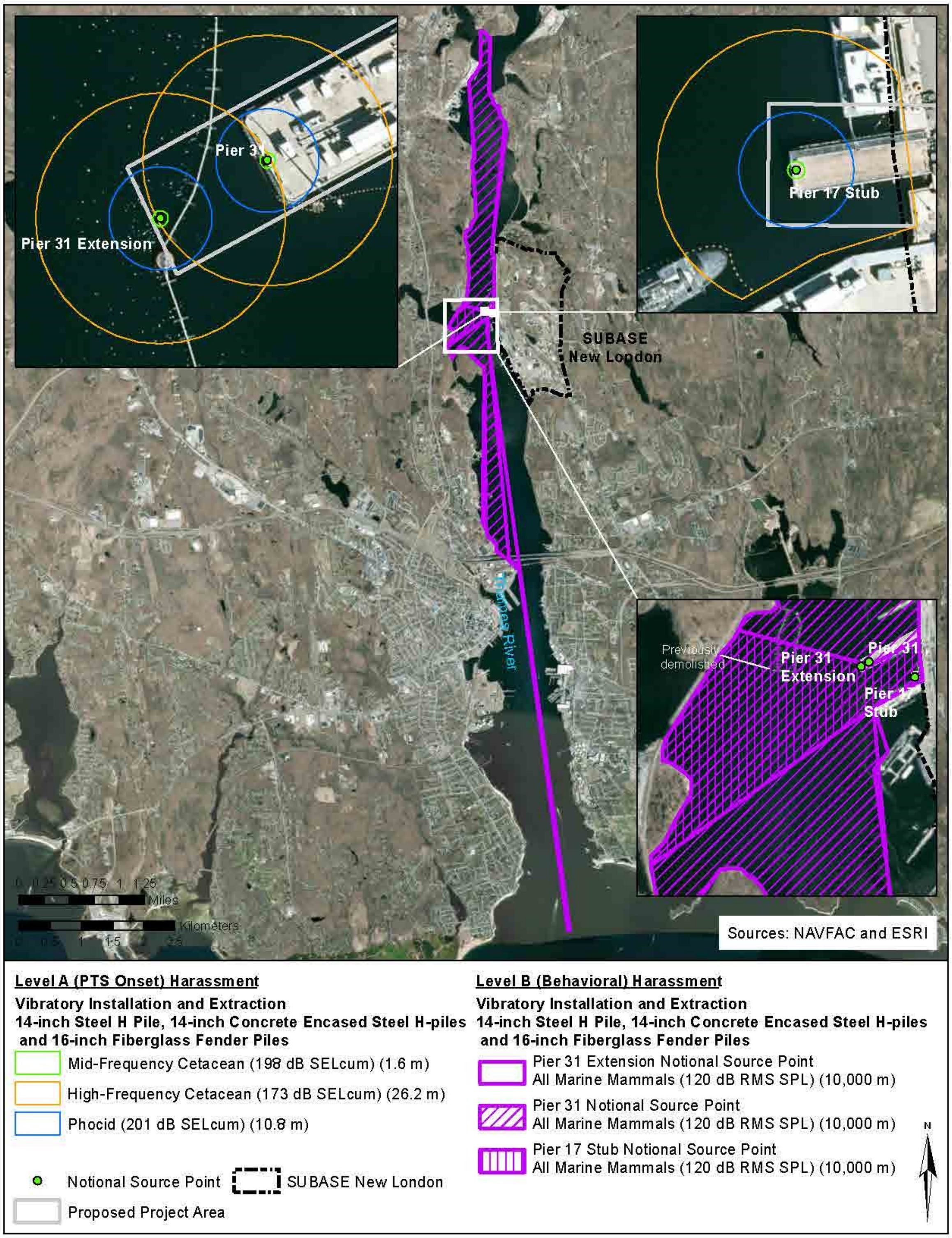

Figure 6-11 Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Concurrent Vibratory Installation of 14-inch Steel H-piles for Temporary Work Trestle, Vibratory Extraction of 14-inch Concrete-encased Steel H-piles from Pier 17 Stub, and Vibratory Extraction of 16-inch Fiberglass Reinforced Plastic Fender Piles.

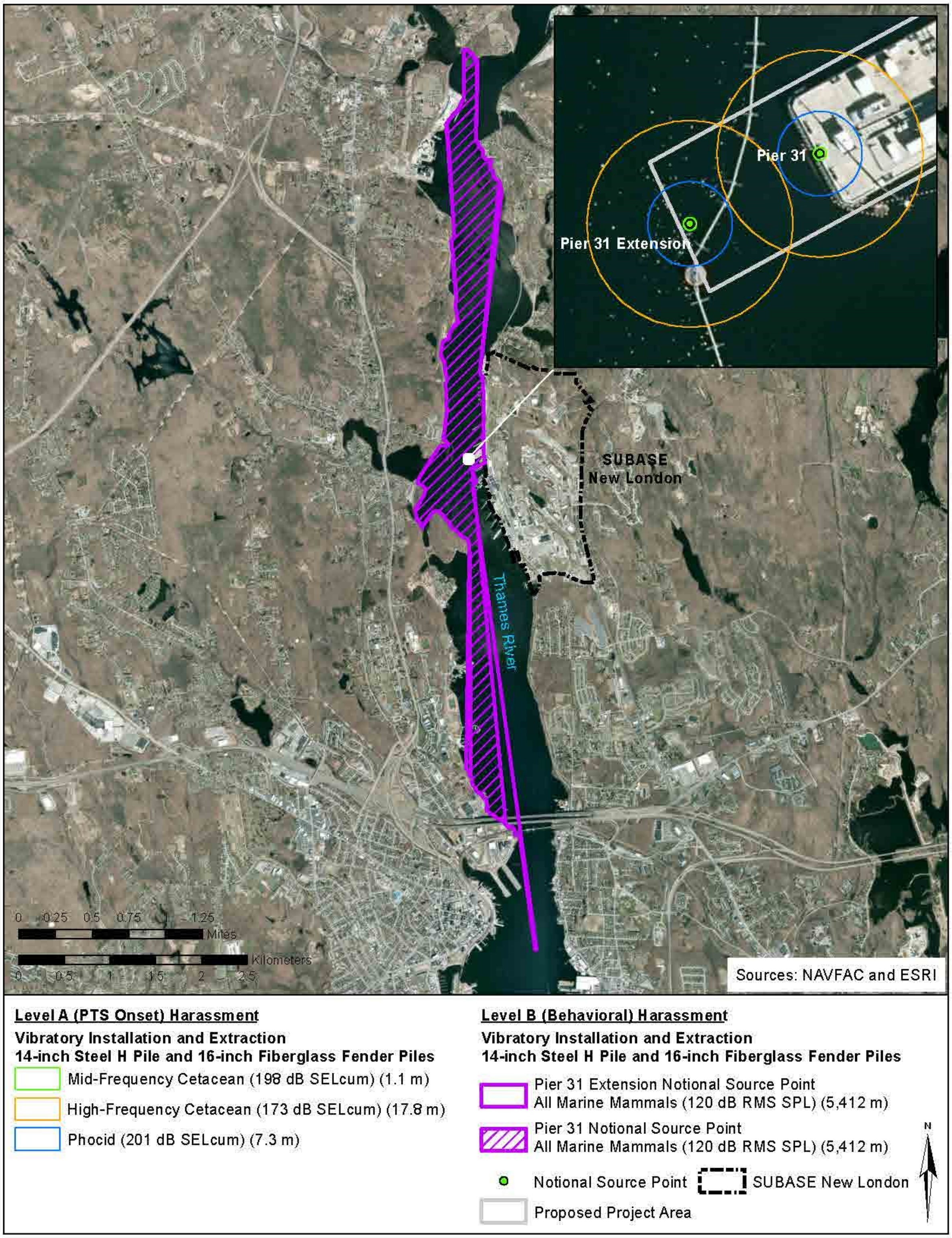

Figure 6-12 Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Concurrent Vibratory Installation of 14-inch steel H-piles for Temporary Work Trestle and Vibratory Extraction of 16-inch Fiberglass Reinforced Plastic Fender Piles from Partial Demolition of Pier 31

6.9 Distance to Airborne Sound Threshold

Pile driving can generate airborne noise that could potentially result in disturbance to marine mammals (pinnipeds) that are hauled-out. As a result, the Navy analyzed the potential for pinnipeds hauled-out to be exposed to airborne SPLs that could result in Level B behavioral harassment. The airborne noise threshold for behavioral harassment for all pinnipeds, except harbor seals, is 100 dB RMS re 20 µPa (unweighted) and for harbor seals is 90 dB RMS re 20 µPa (unweighted) (see **Table 6-3**). Construction noise behaves as point-source and, thus, propagates in a spherical manner with a 6 dB decrease in SPL over water ("hard site" condition) per doubling of distance. The water surface is considered a hard site and acts as a reflective surface where it does not provide any attenuation (Washington Department of Transportation [WSDOT], 2022). A spherical spreading loss model, assuming average atmospheric conditions, was used to estimate the distance to the 100 dB and 90 dB RMS re 20 µPa (unweighted) airborne thresholds. The TL equation is:

$$TL = 20\log_{10}\left(\frac{R_1}{R_2}\right)$$

Where:

TL is the transmission loss in dB,

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

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

The intensity of pile driving sound is greatly influenced by factors such as the type of piles, hammers, and the physical environment in which the activity takes place. To determine reasonable airborne source SPLs, proxy source levels were chosen based on a review of available pile driving in-situ recordings (WSDOT, 2022). These proxy source levels are presented in **Table 6-10**.

Table 6-10 Summary of Recommended Airborne Proxy Source Levels

Pile Size (diameter in inches)	*Impact*	*Vibratory*
	Root Mean Square (RMS) L_{max} (Unweighted)	*RMS L_{eq} (Unweighted)*
36-inch steel pipe[(a)]	116[(a)]	95[(b)]
14-inch steel H-pile[(c)]	110	88
16-inch fiberglass fender pile	108[(a)]	94[(b)]
Auger drilling	NA	69[(d)]

Notes: All values relatives to dB re 20 µPa = dB referenced to a pressure of 20 microPascals at 15 meters (50-feet); $L_{eq=}$ Equivalent continuous SPLs; L_{max}= RMS maximum level of a noise; NA = not applicable.

Source: WSDOT, 2022 ([a]Table 7-4; [b]Table 7-5; [d]Table 7-6).
Proxy source level for 18-inch concrete used for 16-inch fiberglass as fiberglass proxies were not available. [c]Navy, 2015 (proxy source for airborne sound level from 14-inch steel H-pile was not available. Proxy for a 16-inch steel pipe was used).

The distance to the pinniped airborne noise thresholds during pile installation and drilling are shown in **Table 6-11**. Because these areas are smaller than the underwater behavioral threshold zones, and animals swimming within the airborne zones would already have been exposed within a Level B underwater zone, a separate analysis of Level B take was not conducted for the airborne zones. There are no known haul-outs within the distances to the airborne noise thresholds; therefore, no additional takes due to exposure to airborne noise are requested. Due to the absence of haul-outs, the potential for acoustic harassment by airborne sound is considered negligible and is not analyzed further.

Table 6-11 Calculated and Measured Distances to Pinniped Behavioral Airborne Noise Thresholds

Activity	*Harbor Seal Threshold = 90 dB RMS*	*Gray and Harp Seal Threshold = 100 dB RMS*
Vibratory installation 36-inch steel pipe	27 meters	8.4 meters
Impact installation of 36-inch steel pipe	299 meters	94.6 meters
Vibratory installation/ extraction of 14-inch steel H-pile	12 meters	3.8 meters
Impact installation of 14-inch steel H-pile	150 meters	47.4 meters
Vibratory installation/ extraction of 16-inch fiberglass reinforced plastic fender piles	24 meters	7.5 meters
Impact installation of 16-inch fiberglass reinforced plastic fender piles	189 meters	37.7 meters
Auger (rotary) drilling	2.1 meters	6.7 meters

Notes: dB = decibel; m = meter; RMS = root mean square.

6.10 Estimated Duration of Pile Driving

Vibratory and impact pile driving or extracting and auger drilling for Pier 31 extension and Pier 17 Stub demolition would take approximately 242 days over a period of 12 consecutive months. Refer to **Table 2-1** for a summary of pile driving activity by pile size.

6.11 Basis for Estimating Take by Harassment

The Navy is seeking authorization for the potential taking of small numbers of Atlantic white-sided dolphins, common dolphins, harbor porpoises, harbor seals, gray seals, and harp seals. Takes of the dolphin species, harbor porpoise, and harp seal would be primarily from the mouth of the Thames River and extending south into Long Island Sound where the behavioral harassment zone from vibratory pile driving extends. The cetacean species are not expected within the Thames River and thus Level A and Level B impacts from impulsive noise (impact pile driving) would be localized to the Thames River and for the most part, surrounding the driven pile (Level A harassment zones). Harp seals are considered rare in the Thames River, but due to observations of two harp seals at SUBASE (Navy, 2019a), one Level B take of harp seal in the river is requested per month between January through May to avoid unauthorized take. The takes requested are expected to have a less than significant effect on individual animals and no effect on the populations of these species. Effects experienced by individual marine mammals are expected to be primarily limited to short-term disturbance of normal behavior or temporary displacement of animals near the source of the noise.

6.12 Estimating Potential Exposures to Pile Driving Noise

Cetaceans spend their entire lives in the water and spend most of their time (greater than 90 percent for most species) entirely submerged below the surface. When at the surface, cetacean bodies are almost entirely below the water's surface, with only the blowhole exposed to allow breathing. This makes cetaceans difficult to locate visually and exposes them to underwater noise, both natural and anthropogenic, essentially 100 percent of the time because their ears are nearly always below the water's surface.

Pinnipeds (seals and sea lions) spend significant amounts of time out of the water during breeding, molting, and hauling-out periods. In the water, pinnipeds spend varying amounts of time underwater. When not actively diving, pinnipeds at the surface often orient their bodies vertically in the water column and hold their heads above the water surface. Consequently, pinnipeds may not be exposed to underwater sounds to the same extent as cetaceans.

For the purpose of assessing impacts from underwater sound, the Navy assumed that all cetacean and pinniped species spend 100 percent of their time in the water. This approach is conservative because seals spend a portion of their time hauled-out and, therefore, are expected to be exposed to less sound than is estimated by this approach.

To quantitatively assess exposure of marine mammals to noise levels from pile driving activities over the NMFS threshold guidance, marine mammal density estimates used in the analysis came from the NMSDD Phase III for the Atlantic Fleet Training and Testing Area (Navy, 2017) and from Northeast Ocean Data (2023). Cetacean densities were derived from Northeast Ocean Data to determine Level B takes as cetaceans do not occur in the Thames River, and Level A exposure for those species would not occur as Level A noise would be localized to the river. The harassment zone used to calculate takes for cetaceans was from the mouth of the Thames River extending south into Long Island Sound and out to the furthest extent that underwater sound travels (during individual and concurrent vibratory pile driving activities). Densities for seals were derived from the NMSDD (Navy, 2017). The NMSDD uses a combined density for harbor seal and gray seal for which the densities for each species were 0.049 per sq km in the Thames River and 0.070 per sq km in Long Island Sound. Harp seals are typically very rare in the Thames River but regularly occur in Long Island Sound. A density of 0.287 per sq km for harp seals was used for Long Island Sound (Navy, 2017). In order to guard against unauthorized take of harp seals in the Thames River, it was assumed that one harp seal may be present during pile installation activities that occur from January through May (Navy, 2019a).

To determine the number of animals potentially exposed within the harassment zone, the following equation was used:

$$\text{Exposure estimate} = (N \times \text{Harassment Zone}) \times \text{maximum days of pile driving}$$

Where:

N = density estimate used for each species

Harassment Zone = the area where noise exceeds the noise threshold value

The following assumptions were used to calculate potential exposures to impact and vibratory pile driving noise for each threshold:

- Each animal can be "taken" via Level B harassment once every 24 hours.
- All piles would have an underwater noise disturbance distance equal to the pile that causes the greatest noise disturbance (i.e., the pile farthest from shore) installed with the method that has the largest harassment zone. If vibratory pile driving/extracting would occur, the largest harassment zone for Level B harassment would be produced by vibratory driving/extracting. In

this case, the harassment zone for an impact hammer would be encompassed by the larger harassment zone from the vibratory driver/extractor.

- The entire harassment zone for vibratory pile driving (inclusive of the Thames River and Long Island Sound) was used to estimate exposure of seals to noise impacts. Because cetaceans do not occur in the Thames River, exposures of cetaceans were estimated using only the Long Island Sound harassment zone portion (see **Figure 6-4**).
- Days of construction and demolition were conservatively based on a relatively slow daily production rate, but actual daily production rates may be higher, resulting in fewer actual pile driving/extracting and drilling days. The production days are used solely to assess the number of days during which pile driving/extracting and drilling could occur if production were delayed due to equipment maintenance, safety, etc. In a real construction situation, production rates would be maximized when possible.

6.13 Exposure Estimates

Exposure estimates for each species are discussed in the following sections. Exposure estimates for individual activities are presented in **Table 6-12**. Exposure estimates for concurrent activities are discussed under each species. Annual reporting requirements (see Chapter 13) will provide details of how many actual and extrapolated animals of each species are exposed to noise levels considered potential Level A or Level B harassment.

Exposure estimates generally do not differentiate age, sex, or reproductive condition. However, some inferences can be made based on what is known about the life stages of the animals that visit or inhabit the Thames River and/or Long Island Sound. When possible and with the available data, this is discussed by species in the sections that follow.

6.13.1 Atlantic White-Sided Dolphin

Monthly surveys conducted in the Thames River from 2017 through 2019 did not record presence of Atlantic white-sided dolphin (Tetra Tech, 2019). An assumed juvenile dolphin (species was not determined) was observed swimming in the Thames River (specifically near Norwich Marina) in July 2022. Other surveys, observations, and reports have been specific to areas adjacent to but not including the Thames River (Hayes et al., 2022; Kenney and Vigness-Raposa, 2010; Jefferson et al., 2009). Dolphins occur occasionally in Long Island Sound. Historic sightings of pods of dolphins in Long Island Sound date back to pre-World War II but have become increasingly rare (Durham, 2009). Therefore, Atlantic white-sided dolphins are more likely to occur from the mouth of the Thames River south into Long Island Sound. They are most common between southern Georges Bank and Gulf of Maine from October to December (Hayes et al., 2022), and this is the timeframe they would be most likely to occur in Long Island Sound.

The average density for Atlantic white-sided dolphin in Long Island Sound (0.022 per sq km) was used for the sake of being conservative. This density was used to determine abundance of animals that could be present in the area for exposure, using the equation abundance = n * harassment zone. On average, Atlantic white-sided dolphins occur in groups of 12 (NMFS, 2023). Only vibratory pile driving activities would generate a harassment zone that extends into Long Island Sound. To calculate takes, the harassment zone portion from the mouth of the Thames River to the furthest extent into Long Island Sound that the noise threshold reaches was for the Atlantic white-sided dolphin.

Table 6-12 Total Underwater Exposure Estimates by Species by Individual Activity

Marine Mammals	*Underwater Vibratory Pile driving/Extracting and Auger (Rotary) Drilling Criteria (e.g., non-impulsive/continuous sounds)*				*Underwater Impact Pile driving Criteria (e.g., impulsive sounds)*			
	Level A[a] (PTS onset) Threshold 173 dB SEL[b] Porpoise	*Level A[a] (PTS onset) Threshold 198 dB SEL[b] Dolphins*	*Level A[a] (PTS onset) Threshold 201 dB SEL[b] Seals*	*Level B (Behavior) Harassment Threshold 120 dB RMS[c]*	*Level A[a] (PTS onset) Threshold 155 dB SEL[b] Porpoise*	*Level A[a] (PTS onset) Threshold 185 dB SEL[b] Dolphins*	*Level A[a] (PTS onset) 185 dB SEL[b] Seals*	*Level B (Behavior) Harassment Threshold 160 dB RMS[c]*
Atlantic white-sided dolphin	NA	0	NA	12[e]	NA	0	NA	0
Common dolphin	NA	0	NA	30[e]	NA	0	NA	0
Harbor porpoise	0	NA	NA	9	0	NA	NA	0
Harbor seal	NA	NA	0	40	NA	NA	8[f]	0
Gray seal	NA	NA	0	40	NA	NA	8[f]	0
Harp seal[d]	NA	NA	0	12	NA	NA	0	0
Total All Species	**0**	**0**	**0**	**143**	**0**	**0**	**16**	**0**

Notes: There would be no non-auditory takes (see Chapter 5.2). See Chapter 5.1, Table 5-1 for total estimated takes for individual and concurrent activities.
NA = threshold is not applicable to the species.
[a]Level A (PTS onset) takes would likely be multiple exposures of the same individual, rather than single exposures of unique individuals.
[b]dB re 1 µPa^2-s
[c]dB re 1µPa RMS
[d]To guard against unauthorized take, the Navy is requesting one Level B (behavioral) take of harp seal in the Thames River per month of construction/demolition when this species may occur (January through May). This number has been added to the total takes calculated for harp seals in Long Island Sound.
[e]Take increased to average group size (NMFS, 2023).
[f]1 take per day of impact pile driving = 8 takes, as requested by NMFS 12/21/23.

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No Level A takes of Atlantic white-sided dolphin are anticipated. Potential Level B takes could occur if Atlantic white-sided dolphins are present near the mouth of the Thames River and south into Long Island Sound during the time of vibratory pile driving. It is anticipated that should a pod of Atlantic white-sided dolphin be present, there could be up to 12 Level B takes during vibratory pile driving. Because this species' regular occurrence is in much deeper waters than the extent of the harassment zone (Hayes et al., 2022), takes of this species are extremely low. Should an Atlantic white-sided dolphin be exposed to sound from vibratory pile driving, potential behavioral reactions such as increased swimming speeds, increased surfacing time, or decreased foraging could result. Most likely, Atlantic white-sided dolphins would move away from the sound source with very little disruption of normal behavior. Therefore, potential takes by disturbance would have a negligible short-term effect on individual Atlantic white-sided dolphins and would not result in population-level impacts. No Level A or Level B takes are anticipated during proposed concurrent pile driving activities.

6.13.2 Common Dolphin

Monthly surveys conducted in the Thames River from 2017 through 2019 did not record presence of common dolphin (Tetra Tech, 2019). As mentioned for Atlantic white-sided dolphin, an assumed juvenile dolphin (species was not determined) was observed swimming in the Thames River (specifically near Norwich Marina) in July 2022. Other surveys, observations, and reports have been specific to areas adjacent to but not including the Thames River (Hayes et al., 2022; Kenney and Vigness-Raposa, 2010; Jefferson et al., 2009). Dolphins occur occasionally in Long Island Sound. Historic sightings of pods of dolphins in Long Island Sound date back to pre-World War II but have become increasingly rare (Durham, 2009). Therefore, common dolphins are more likely to occur from the mouth of the Thames River south into Long Island Sound. They are most common in the Gulf of Maine from July to October (Hayes et al., 2022), and this is the timeframe they are likely to occur in Long Island Sound.

The average density for common dolphin in Long Island Sound (0.15 per sq km) was used for the sake of being conservative. This density was used to determine abundance of animals that could be present in the area for exposure, using the equation abundance = n * harassment zone. The average group size for common dolphin is 30 (NMFS, 2023). Only vibratory pile driving activities would generate a harassment zone that extends into Long Island Sound. To calculate takes, the harassment zone portion from the mouth of the Thames River to the furthest extent into Long Island Sound that the noise threshold reaches was used to calculate take of common dolphin.

No Level A takes of common dolphin are anticipated. Potential Level B takes could occur if short-beaked common dolphins are present near the mouth of the Thames River and south into Long Island Sound in general during the time of vibratory pile driving. It is anticipated that should a pod of common dolphins be present, there could be up to 30 Level B takes during vibratory pile driving activities. Because this species' regular occurrence is in much deeper waters than the extent of the harassment zone (Hayes et al., 2022), takes of this species are extremely low. Should a common dolphin be exposed to sound from vibratory pile driving, potential behavioral reactions such as increased swimming speeds, increased surfacing time, or decreased foraging could result. Most likely, common dolphins would move away from the sound source with very little disruption to normal behavior. Therefore, potential takes by disturbance would have a negligible short-term effect on individual short-beaked common dolphins and would not result in population-level impacts. No Level A or Level B takes are anticipated during proposed concurrent pile driving activities.

6.13.3 Harbor Porpoise

Monthly surveys conducted in the Thames River from 2017 through 2019 did not record presence of harbor porpoise (Tetra Tech, 2019). As discussed above for dolphins, other surveys, reports, and studies have been specific to areas adjacent to but not including the Thames River (Hayes et al., 2022; Kenney and Vigness-Raposa, 2010; Jefferson et al., 2009), and thus data for potential occurrence of harbor porpoise in the Thames River is limited. Porpoise occur occasionally in Long Island Sound. Historic sightings of pods of porpoises in Long Island Sound date back to pre-World War II but have become increasingly rare (Durham, 2009). Therefore, harbor porpoises are more likely to occur from the mouth of the Thames River into Long Island Sound. Peak abundance of harbor porpoise in Long Island Sound is expected to be in December (Northeast Ocean Data, 2023).

The average density for harbor porpoise in Long Island Sound (0.32 per sq km) was used for the sake of being conservative. This density was used to determine abundance of animals that could be present in the area for exposure, using the equation abundance = n * harassment zone. Only vibratory pile driving activities would generate a harassment zone that extends into Long Island Sound. To calculate take for the harbor porpoise, the area of the behavioral harassment zone that extends from the mouth of the Thames River to the furthest extent into Long Island Sound that the noise threshold reaches was used.

No Level A takes of harbor porpoise are anticipated. Potential Level B takes could occur if harbor porpoises are present near the mouth of the Thames River and south into Long Island Sound in general during the time of vibratory pile driving. It is anticipated that should harbor porpoise be present, there could be up to nine takes during vibratory pile driving activities. Should a harbor porpoise be exposed to sound from vibratory pile driving, potential behavioral reactions such as increased swimming speeds, increased surfacing time, or decreased foraging could result. Most likely, harbor porpoises may move away from the sound source with very little disruption to normal behavior. Therefore, potential takes by disturbance would have a negligible short-term effect on individual harbor porpoises and would not result in population-level impacts. No Level A or Level B takes are anticipated during proposed concurrent pile driving activities.

6.13.4 Harbor Seal

Harbor seals may be present September to late May in the project vicinity and in the Thames River in general. As discussed in Section 4.4, a total of 12 individual sightings of harbor seals were recorded during monthly surveys over a 3-year period (Tetra Tech, 2019). No seals were observed on shore (Tetra Tech, 2019), and there are no haul-out areas within the Thames River (Navy, 2018). During marine mammal monitoring for Pier 32 construction activities that occurred from May 2022 through December 2022, only 1 harbor seal was recorded (Navy, 2023). Harbor seals also occur within Long Island Sound (Hayes et al., 2022).

Two different densities were used to calculate takes of harbor seals. A density of 0.049 per sq km was used in the Thames River and a density of 0.070 per sq km was used in Long Island Sound (Navy, 2017). These densities were used to determine abundance of animals that could be present in the area of exposure, using the equation abundance = n * harassment zone. It was determined that up to one Level A take of harbor seal could occur within the Thames River during each of eight days of impact pile driving of 36-inch steel pipe piles resulting in a total of eight Level A takes.

A total of up to 40 Level B takes would occur within the behavioral disturbance harassment zone for phocids, which includes the Thames River and Long Island Sound (see **Figure 6-4**).

For concurrent scenarios, estimated takes of harbor seal are provided in **Table 6-13**. During four days of proposed concurrent pile driving activity to vibratory install piles at the work trestle and extract piles from Pier 17 stub, no Level A takes are anticipated for harbor seal, but up to 1 Level B take may occur (see **Table 6-13**; **Figure 6-10**). During four days of proposed concurrent pile driving activity to vibratory install piles at the work trestle, vibratory extract piles from Pier 17 stub, and vibratory extract piles during partial demolition of Pier 31, no Level A takes are anticipated for harbor seal, but up to 1 Level B take may occur (See **Figure 6-11**). During 12 days of proposed concurrent pile driving activity to vibratory install piles at the work trestle and vibratory extract piles during partial demolition of Pier 31, no Level A takes are anticipated for harbor seal, but up to 2 Level B takes may occur (See **Figure 6-12**). Should a harbor seal be exposed to sound from vibratory pile driving/extracting, potential behavioral reactions such as increased swimming speeds, increased surfacing time, or decreased foraging could result. Most likely, harbor seals may move away from the sound source and be temporarily displaced from waters near the construction areas (Aarts et al., 2018). However, potential takes by disturbance would have a negligible short-term effect on individual harbor seals and would not result in population-level impacts.

Table 6-13 Harbor Seal Exposure Estimates for Concurrent Activities

Structure	*Concurrent Equipment Use Scenario*	*Level A Takes*	*Level B Takes*
Temporary Work Trestle Install and Pier 17 Stub Demolition	Impact install/vibratory install of 14-inch steel H-piles and extracting 14-inch concrete-encased steel H-piles	0	1
Temporary Work Trestle Install, Pier 17 Stub Demolition, and Pier 31 Partial Demolition	Impact install/vibratory install of 14-inch steel H-piles, vibratory extracting 14-inch concrete encased steel H-piles, and vibratory extracting 16-inch fiberglass fender piles	0	1
Temporary Work Trestle Install and Pier 31 Partial Demolition	Impact install/vibratory install of 14-inch steel H-pile and extracting 16-inch fiberglass fender piles	0	2
Total Concurrent Takes		**0**	**4**

6.13.5 Gray Seal

Gray seals may be present March through June in the project vicinity and the Thames River in general, although at lower abundance than harbor seals (Tetra Tech, 2019). Gray seals also occur within Long Island Sound (Hayes et al., 2022).

Densities used to calculate takes for gray seal are the same as described above for harbor seal per the NMSDD (Navy, 2017). These densities were used to determine abundance of animals that could be present in the area of exposure, using the equation abundance = n * harassment zone. It was determined that up to one Level A take of gray seal could occur within the Thames River during each of eight days impact pile driving of 36-inch steel pipe piles resulting in a total of eight Level A takes.

A total of up to 40 Level B takes of gray seal could occur within the behavioral harassment zone for phocids, which includes the Thames River and Long Island Sound (see **Figure 6-4**).

For concurrent scenarios, estimated takes of gray seal are provided in **Table 6-14**. During four days of proposed concurrent pile driving activity to vibratory install piles at the work trestle and extract piles from Pier 17 stub, no Level A takes are anticipated for gray seal but up to 1 Level B take may occur (see **Table 6-14** and **Figure 6-10**). During four days of proposed concurrent pile driving activity to vibratory install piles at the work trestle, vibratory extract piles from Pier 17 stub, and vibratory extract piles during partial demolition of Pier 31, no Level A takes are anticipated for gray seal, but up to 1 Level B take may occur (See **Figure 6-11**). During 12 days of proposed concurrent pile driving activity to vibratory install piles at the work trestle and vibratory extract piles during partial demolition of Pier 31, no Level A takes are anticipated for gray seal, but up to 2 Level B takes may occur (See **Figure 6-12**). Should a gray seal be exposed to sound from vibratory pile driving/extracting, potential behavioral reactions such as increased swimming speeds, increased surfacing time, or decreased foraging could result. Most likely, gray seals may move away from the sound source and be temporarily displaced from waters near the construction areas (Aarts et al., 2018). However, potential takes by disturbance would have a negligible short-term effect on individual gray seals and would not result in population-level impacts.

Table 6-14 Gray Seal Exposure Estimates for Concurrent Activities

Structure	*Concurrent Equipment Use Scenario*	*Level A Takes*	*Level B Takes*
Temporary Work Trestle Install and Pier 17 Stub Demolition	Impact install/vibratory install of 14-inch steel H-piles and extracting 14-inch concrete-encased steel H-piles	0	1
Temporary Work Trestle Install, Pier 17 Stub Demolition, and Pier 31 Partial Demolition	Impact install/vibratory install of 14-inch steel H-piles, vibratory extracting 14-inch concrete encased steel H-piles, and vibratory extracting 16-inch fiberglass fender piles	0	1
Temporary Work Trestle Install and Pier 31 Partial Demolition	Impact install/vibratory install of 14-inch steel H-pile and extracting 16-inch fiberglass fender piles	0	2
Total Concurrent Takes		**0**	**4**

6.13.6 Harp Seal

Harp seals may be present in the project vicinity January through May. In general, harp seals are much rarer than the harbor seal and gray seal in the Thames River and were not observed during previous years surveys (Tetra Tech, 2019). However, two harp seals were identified in March and one harp seal in April 2019 by Mystic Aquarium staff. On both occasions they were hauled-out on the finger piers of the marina at SUBASE (Navy, 2019a).

The density used for calculating takes of harp seal in the harassment zone that extends from the mouth of the Thames River south into Long Island Sound is 0.287 per sq km (Navy, 2017). This density was used to determine abundance of animals that could be present in the area for exposure, using the equation abundance = n * harassment zone. It was determined that no Level A takes to harp seals are anticipated and up to 12 Level B takes would occur. This total includes 1 take per month of harp seal, from January to May, when it is assumed they could be present in the Thames River (Navy, 2019a). Should a harp seal be exposed to sound from vibratory pile driving, potential behavioral reactions such as increased swimming speeds, increased surfacing time, or decreased foraging could result. Most likely, harp seals would move away from the sound source resulting in temporary displacement from waters near the construction areas (Aarts et al., 2018). However, potential takes by disturbance would have a negligible short-term effect on individual harp seals and would not result in population-level impacts. No Level A or Level B takes are anticipated during proposed concurrent pile driving activities.

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7 IMPACTS TO MARINE MAMMAL SPECIES OR STOCKS

The anticipated impact of the activity upon the species or stock of marine mammals.

7.1 Potential Underwater Noise Effects of Pile Driving on Marine Mammals

The effects of pile driving on marine mammals are dependent on several factors, including the species, size, and depth of the animal; the depth, intensity, and duration of the pile driving sound; the depth of the water column; the substrate of the habitat; the distance between the pile and the animal; and the sound propagation properties of the environment. Impacts on 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 received level and duration of the sound exposure, which are in turn influenced by the distance between the animal and the source. The farther 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. Shallow environments are typically more structurally complex, which leads to rapid sound attenuation. In addition, substrates that are soft (e.g., sand) will absorb or attenuate the sound more readily than hard substrates (e.g., rock), which may reflect the acoustic wave. Soft porous substrates will also likely require less time to drive the pile, and possibly less forceful equipment, which will ultimately decrease the intensity of the acoustic source (Dahl et al., 2015).

Potential impacts on marine species are expected to be the result of physiological responses to both the type and strength of the acoustic signature (Viada et al., 2008). Behavioral impacts may also occur, though the type and severity of these effects are more difficult to define due to limited studies addressing the behavioral effects of impulsive as well as non-impulsive sounds on marine mammals. Potential effects can range from brief acoustic effects such as behavioral disturbance, tactile perception, physical discomfort, slight injury of the internal organs, and temporary to permanent impairment of the auditory system to death of the animal (Yelverton et al., 1973; O’Keefe and Young, 1984; Ketten, 1995; Dahl et al., 2015; Finneran, 2015; Kastelein et al., 2016, 2018).

With implementation of impact mitigation measures and monitoring discussed in Chapter 11, physiological impacts by way of auditory and non-auditory injury would be avoided, thus only the potential for behavioral impacts may occur and are discussed below.

7.1.1 Physiological Responses

Direct tissue responses to impact/impulsive sound stimulation may range from mechanical vibration or compression with no resulting injury to tissue trauma (injury). Because the ears are the most sensitive organ to pressure, they are the organs most sensitive to injury (Ketten, 2000). Sound-related trauma can be lethal or sub-lethal. Lethal impacts are those that result in immediate death or serious debilitation in or near an intense source (Ketten, 1995). Sub-lethal damage to the ear from a pressure wave can rupture the tympanum, fracture the ossicles, damage the cochlea, cause hemorrhage, and leak cerebrospinal fluid into the middle ear (Ketten, 2004). Sub-lethal impacts also include hearing loss, which is caused by exposure to perceptible sounds. Moderate injury implies partial hearing loss. Permanent hearing loss (also called PTS) can occur when the hair cells of the ear are damaged by a very loud event, as well as prolonged exposure to noise.

Instances of TTS and/or auditory fatigue are well documented in marine mammal literature as being one of the primary avenues of acoustic impact. TTS has been documented in controlled settings using captive marine mammals exposed to strong SELs at various frequencies (Ridgway et al., 1997; Kastak et al., 1999; Finneran et al., 2005; Finneran, 2015). While injuries to other sensitive organs are possible, they are less likely since pile driving impacts are almost entirely acoustically mediated. Based on the site-specific occurrence information presented in Chapter 4, harbor seals and gray seals are likely to be present as they are common in the area. Harbor porpoise, dolphins, and harp seal are less likely to occur within the Thames River but may be present at the mouth of the river and within Long Island Sound. Auditory effects could be experienced by individual seals in the project area but are not expected to cause population-level impacts or affect the continued survival of the species.

7.1.2 Behavioral Responses

Behavioral responses to sound are highly variable and context specific. For each potential behavioral change, the magnitude of the change ultimately determines the severity of the response. A number of factors may influence an animal's response to noise, including its previous experience, its auditory sensitivity, its biological and social status (including age and sex), and its behavioral state and activity at the time of exposure. Habituation occurs when an animal's response to a stimulus wanes with repeated exposure, usually in the absence of unpleasant associated events (Wartzok et al., 2004). Animals are most likely to habituate to sounds that are predictable and unvarying. 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. Behavioral state or differences in individual tolerance levels may affect the type of response as well. For example, animals that are resting may show greater behavioral change in response to disturbing noise levels than animals that are highly motivated to remain in an area for feeding (Richardson et al., 1995; National Research Council, 2003; Wartzok et al., 2004). Indicators of disturbance may include sudden changes in the animal's behavior or avoidance of the affected area. A marine mammal may show signs that it is startled by the noise and/or it may swim away from the sound source and avoid the area. Increased swimming speed, increased surfacing time, and cessation of foraging in the affected area would indicate disturbance or discomfort. Pinnipeds may increase their haul-out time, possibly to avoid in-water disturbance.

- Controlled experiments with captive marine mammals showed pronounced behavioral reactions, including avoidance of loud sound sources (Ridgway et al., 1997; Finneran et al., 2003) and an increase in the respiration rate of harbor porpoises (Kastelein et al., 2013). Observed responses of wild marine mammals to loud pulsed sound sources (typically seismic guns or acoustic harassment devices, and also including pile driving) have been varied but often consist of avoidance behavior or other behavioral changes suggesting discomfort (Morton and Symonds, 2002; also see reviews in Gordon et al., 2004; Wartzok et al., 2004; and Nowacek et al., 2007). Some studies of acoustic harassment and acoustic deterrence devices have found habituation in resident populations of seals and harbor porpoises (see review in Southall et al., 2007). Blackwell et al. (2004) found that ringed seals exposed to underwater pile driving sounds in the 153 to 160 dB RMS range tolerated this noise level and did not seem unwilling to dive and did not react strongly to pile driving activities. Responses of two pinniped species to impact pile driving at the San Francisco-Oakland Bay Bridge East Span Seismic Safety Project were mixed (California Department of Transportation, 2001; Thorson and Reyff, 2006; Thorson, 2010). Harbor seals were observed in the water at distances of approximately 400 to 500 meters (1,300 to 1,650 feet) from the pile driving activity and exhibited no alarm responses, although several

> showed alert reactions, and none of the seals appeared to remain in the area. One of these harbor seals was even seen to swim to within 150 meters (492 feet) of the pile driving barge during pile driving.

Studies of marine mammal responses to continuous noise, such as vibratory pile installation, are limited and are generally evaluated along with impacts from impulsive noise (impact pile driving) or with other general non-impulsive continuous noise (i.e., drilling and vessel noise) (Ridgeway et al., 1997; National Research Council, 2003; McKenna, 2011; Cianbro, 2018a,b). Marine mammal monitoring at the Port of Anchorage marine terminal redevelopment project found no response by marine mammals swimming within the threshold distances to noise impacts from construction activities, including pile driving (both impact hammer and vibratory driving) (Integrated Concepts & Research Corporation, 2009). Most marine mammals observed during the two lengthy construction periods (i.e., beluga whales, harbor seals, harbor porpoises, and Steller sea lions) were observed in smaller numbers. Background noise levels at this port are typically at 125 dB.

A comprehensive review of acoustic and behavioral responses to noise exposure by Nowacek et al. (2007) concluded that one of the most common behavioral responses is displacement. To assess the significance of displacement, it is necessary to know the areas to which the animals relocate, the quality of that habitat, and the duration of the displacement in the event that they return to the pre-disturbance area. Short-term displacement may not be of great concern unless the disturbance happens repeatedly. Similarly, long-term displacement may not be of concern if adequate replacement habitat is available.

Marine mammals encountering noise-producing activities during the in-water construction period would likely avoid affected areas where they experience noise-related discomfort, limiting their ability to forage or rest there. As described in the section above, individual responses to noise are expected to be variable: some individuals may occupy the project area during noise-generating activities without apparent discomfort, but others may be displaced with undetermined long-term effects. For example, harbor seals have been observed to temporarily avoid areas within 15 miles of active pile driving starting from predicted received levels of between 166 and 178 dB re 1 µPa (Russell et al., 2016). During marine mammal monitoring for Pier 32 construction at SUBASE in May through December 2022, only 1 harbor seal was recorded (Navy, 2023). Avoidance of the affected area during in-water construction would reduce the likelihood of injury impacts, and seals have not been observed foraging in and around the project area. Noise-related disturbance may also inhibit some marine mammals from transiting the area. Installation of the largest pile type would create the maximum distance to PTS during impact pile driving (8 days of pile driving) and maximum distance to Behavioral Harassment during vibratory installation (120 days). There would likely be displacement of marine mammals from the affected area due to these behavioral disturbances during pile driving activities, but it would be expected to be minor and temporary. In addition, these activities would only occur during daylight hours, and marine mammals transiting the proposed project area or foraging or resting in the proposed project area at night would not be affected. Effects of pile driving activities would be experienced by individual marine mammals but would not cause population-level impacts or affect the continued survival of the species.

7.2 Conclusions Regarding Impacts on Species or Stocks

Individual marine mammals may be exposed to increased sound during pile driving operations, which may result in Level B behavioral harassment. Any marine mammals that are exposed (harassed) may change their normal behavior patterns (e.g., swimming speed, foraging habits, etc.) or be temporarily displaced from the area of construction. Any exposures to Level B harassment would likely have only a minor effect on individuals and no effect on the population. One Level A take each for harbor seal and gray seal is requested, and a shutdown zone would be implemented to ensure avoidance of physical injury (see **Table 5-2**). In-water construction activities would stop if marine mammals approach the shutdown zones. The take numbers requested in this application do not take mitigation measures into account and are, therefore, a conservative estimate. Mitigation is expected to avoid most potential adverse underwater impacts to marine mammals from impulsive noise sources. Nevertheless, some exposure would be unavoidable. The expected level of unavoidable and unmitigated exposure (defined as acoustic harassment) is presented in Chapter 6. This level of effect is not anticipated to have any adverse impact to population recruitment, survival, or recovery.

8 IMPACTS TO SUBSISTENCE USE

The anticipated impact of the activity on the availability of the species or stock of marine mammals for subsistence uses.

This chapter is not applicable. The project region of influence is the Thames River and Long Island Sound. No traditional subsistence hunting areas are within the region.

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9 IMPACTS TO THE MARINE MAMMAL HABITAT AND THE LIKELIHOOD OF RESTORATION

The anticipated impact of the activity upon the habitat of the marine mammal populations, and the likelihood of restoration of the affected habitat.

Impacts to habitat would be temporary and include increased human activity and noise levels and localized, minor impacts to water quality near the individual project site. Impacts would not result in permanent impacts to habitats used directly by marine mammals.

9.1 Effects from Human Activity and Noise

Existing human activity and underwater noise levels, primarily due to industrial activity and vessel traffic, could increase above baseline temporarily during in-water construction.

Marine mammals in proposed project and surrounding areas encounter vessel traffic associated with both Navy and non-Navy activities. Behavioral changes in response to vessel presence include avoidance reactions, alarm/startle responses, temporary abandonment of haul-outs by pinnipeds, and other behavioral and stress-related changes (such as altered swimming speed, direction of travel, resting behavior, vocalizations, diving activity, and respiration rate) (Watkins, 1986; Würsig et al., 1998; Terhune and Verboom, 1999; Ng and Leung, 2003; Foote et al., 2004; Mocklin, 2005; Bejder et al., 2006; Nowacek et al., 2007). Some dolphin species approach vessels and are observed bow riding or jumping in the wake of vessels (Norris and Prescott, 1961; Shane et al., 1986; Würsig et al., 1998; Ritter, 2002). In other cases, neutral behavior (i.e., no obvious avoidance or attraction) has been reported (review in Nowacek et al., 2007). Little is known about the biological importance of changes in marine mammal behavior under prolonged or repeated exposure to high levels of vessel traffic, such as increased energetic expenditure or chronic stress, which can produce adverse hormonal or nervous system effects (Reeder and Kramer, 2005).

During proposed construction activities, additional vessels may operate in the proposed project area, but they would operate at low speeds within the relatively limited construction zone and access route during the in-water construction period. The presence of vessels would be temporary and occur at current Navy facilities that have some existing level of vessel traffic. Therefore, effects are expected to be limited to short-term behavioral changes and are not expected to rise to the level of take or harassment as defined under the MMPA.

Additional noise could be generated by barge-mounted equipment, such as cranes and generators, but this noise would typically not exceed existing underwater noise levels resulting from existing routine waterfront operations. While the increase may change the quality of the habitat, it is not expected to exceed the Level A or B harassment thresholds, and impacts to marine mammals from these noise sources is expected to be negligible.

9.2 Impacts to Water Quality

Temporary and localized reduction in water quality would occur as a result of bottom sediment disturbance during dredging and other in-water construction activities. Some of the sediment in the dredge areas may also contain contaminants that may be resuspended during construction. Effects to water quality are expected to be localized, and turbidity would return to normal levels within minutes to hours after pile installation or removal. Through the implementation of BMPs to manage turbidity and sedimentation, these impacts are not anticipated to be significant for marine mammals or their forage base. During pile installation and removal activities, suspension of anoxic sediment compounds could result in temporary, minor, localized reduced dissolved oxygen in the water column. However, if decreases occur, they would be minimal and localized and are not anticipated to result in levels that are significant for marine mammals or their forage base.

9.3 Underwater Noise Impacts on Fish

9.3.1 Underwater Noise Impacts on Fish

The greatest potential impact to fish during construction would occur during impact pile driving when pile driving noise would exceed the established underwater noise injury and TTS thresholds for fish. However, the duration of impact pile driving would be limited to the final stage of installation after the pile has been driven as close as practicable to the design depth with a vibratory driver and/or auger drill.

Fish are vulnerable to tissue damage and hearing loss from impact pile driving activities, but studies evaluating how fish detect particle motion components of sound indicate that exposure levels associated with vibratory or continuous sound do not produce tissue damage (Hastings, 2014; Hawkins and Popper 2018a, b). Results of studies on various stress parameters and behavioral responses in fish are highly variable. All studies, including those for long- and short-term exposure, were conducted on captive fish in enclosed areas where fish could not avoid the sounds. It is possible that it was not necessarily the sound itself that resulted in the stress response, but rather the inability for the fish to move away from the disturbing sound.

Research has shown that stress from noise is greater as a result of intermittent sounds than for vibratory and continuous sounds (Popper et al., 2019). Vibratory pile driving and drilling would possibly elicit behavioral reactions from fish such as temporary avoidance of the area but are unlikely to cause injuries to fish or have persistent effects on local fish populations. In addition, the project area is located in and adjacent to the federal navigation channel in the Thames River, which is subject to high levels of marine traffic from recreational boaters, commercial shipping, and ferry transit, and thus fish are consistently exposed to continuous noise sources from vessel noise and other anthropogenic noise from adjacent industrial facilities (see Section 2.2.4, Ambient Sound). In general, impacts on marine mammal prey species are expected to be minor and temporary. Therefore, adverse effects to the marine mammal prey base would be insignificant and would not rise to the level of MMPA take.

9.4 Summary of Impacts on Marine Mammal Habitat

Marine mammal species potentially using habitat near the proposed project area would be seals (specifically harbor and gray seals and possibly harp seals) and would primarily transit the area; no known foraging or haul-out areas are located within proposed project area. The most likely impacts on marine mammal habitat for the project are from underwater noise, turbidity, and potential effects on the food supply. However, it is not expected that any of these impacts would be significant. Therefore, impacts of the project are not likely to have adverse effects on marine mammal foraging habitat in the proposed project area.

10 IMPACTS TO MARINE MAMMALS FROM LOSS OR MODIFICATION OF HABITAT

The anticipated impact of the loss or modification of the habitat on the marine mammal populations involved.

The proposed activities are not expected to have any habitat-related effects that could cause significant or long-term consequences for individual marine mammal species or the population. As previously discussed, harbor seals, gray seals, and to an even lesser extent, harp seals, and cetaceans, do not occur in large numbers, nor are they expected to use the project area as frequent foraging habitat. Based on the discussions in Chapter 9, there would be no impacts to marine mammals addressed in the application resulting from loss or modification of marine mammal habitat.

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11 MEANS OF EFFECTING THE LEAST PRACTICABLE ADVERSE IMPACTS

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, their habitat, and on their availability for subsistence uses, paying particular attention to rookeries, mating grounds, and areas of similar significance.

The Navy would employ the minimization measures listed in this chapter to avoid and minimize impacts on marine mammals, their habitats, and forage species. Best management practices and minimization measures are included in the construction contract plans and must be agreed upon by the contractor prior to any construction activities.

11.1 General Construction Best Management Practices

The construction contractor would be responsible for preparation of an environmental protection plan. The plan would be submitted and implemented prior to the commencement of any construction activities and is a binding component of the overall contract. The plan shall identify construction elements and recognize spill sources at the site. The plan shall outline best management practices, responsive actions in the event of a spill or release, and notification and reporting procedures. The plan shall also outline contractor management elements such as personnel responsibilities, project site security, site inspections, and training.

- No petroleum products, chemicals, or other toxic or harmful materials shall be allowed to enter surface waters.
- Wash water resulting from washdown of equipment or work areas shall be contained for proper disposal and shall not be discharged unless authorized.
- Equipment that enters surface waters shall be maintained to prevent any visible sheen from petroleum products.
- No oil, fuels, or chemicals shall be discharged to surface waters or onto land where there is a potential for re-entry into surface waters to occur. Fuel hoses, oil drums, oil or fuel transfer valves, fittings, etc. shall be checked regularly for leaks. Materials would be maintained and stored properly to prevent spills.
- No cleaning solvents or chemicals used for tools or equipment cleaning shall be discharged to ground or surface waters.
- Any floating debris generated during installation would be retrieved. Any debris in a containment boom would be removed by the end of the workday or when the boom is removed, whichever occurs first. Retrieved debris would be disposed of at an upland disposal site.

11.2 Minimization Measures for Marine Mammals

The following minimization measures would be implemented during in-water construction to reduce exposure to Level A (PTS onset) harassment and Level B (Behavioral) harassment and avoid non-auditory injury.

11.2.1 Coordination

The Navy shall conduct briefings between construction supervisors and crews, the marine mammal monitoring team, and Navy staff prior to the start of all pile driving/extracting/drilling activity and when new personnel join the work, to explain responsibilities, communication procedures, marine mammal monitoring protocol, and operational procedures.

11.2.2 Acoustic Minimization Measures

Vibratory installation would be used to the extent possible to drive steel piles to minimize high SPLs associated with impact pile driving.

11.2.3 Soft Start

The objective of a soft start is to provide a warning and/or give animals in proximity to impact pile driving a chance to leave the area prior to an impact driver operating at full capacity, thereby exposing fewer animals to loud underwater and airborne sounds.

- A soft-start procedure would be used for impact pile driving at the beginning of each day's in-water pile driving or any time impact pile driving has ceased for more than 30 minutes.
- The contractor would provide an initial set of strikes from the impact hammer at reduced energy, followed by a 30-second waiting period, then two subsequent sets. (The reduced energy of an individual hammer cannot be quantified because it varies by individual drivers. Also, the number of strikes would vary at reduced energy because raising the hammer at less than full power and then releasing it results in the hammer "bouncing" as it strikes the pile, resulting in multiple "strikes.")

11.2.4 Visual Monitoring and Shutdown Procedures

A Marine Mammal Monitoring Plan would be submitted to NMFS for approval prior to commencement of project activities. The plan would incorporate all monitoring and mitigation measures and reporting requirements of the application and subsequent authorization. The purpose of the plan is for the contractor to prepare a comprehensive document containing all requirements and ensures they understand all requirements. At a minimum, the plan would include the following:

- For all in-water construction activities, Level A (PTS onset) and Level B (Behavioral) harassment zones would be visually monitored (**Table 11-1**) with implementation of shutdown zones to avoid injury (**Table 5-2**).
- To prevent injury from physical interaction with construction equipment, a shutdown zone of 33 feet or 10 meters would be implemented during all in-water construction activities having the potential to affect marine mammals to ensure marine mammals are not present within this zone and to protect marine mammals from collisions with project vessels during pile driving/extracting and other construction activities. These activities could include but are not limited to barge positioning, drilling, or pile driving. For some sound-generating activities, the potential for Level A (PTS onset) harassment by acoustic injury extends less than 10 meters from the source (see **Table 6-6**), and for these activities, the shutdown zone automatically mitigates/minimizes Level A (PTS onset) harassment (**Table 11-1**).

Table 11-1 Marine Mammal Level A (PTS Onset) and Level B (Behavioral) Harassment Zones for Monitoring

Pile type, Size, and Driving method, Location	*Level A (PTS Onset) Monitoring Zone for Seals*	*Level A (PTS Onset) Monitoring Zone for Cetaceans*	*Level B (Behavioral) Monitoring Zone for Marine Mammals*
Vibratory Install/Extract 14-inch steel H-piles	10 meters	10 meters	3,415 meters
Impact Install 14-inch steel H-piles	55 meters	120 meters	136 meters
Vibratory Install 36-inch steel pipe piles	10 meters	10 meters	Maximum harassment zone[(a)]
Auger drill 36-inch steel pipe piles	10 meters	10 meters	1,848 meters
Impact Install 36-inch steel pipe piles	200 meters[b]	200 meters[b]	3,415 meters
Vibratory Install 16-inch fiberglass reinforced, plastic piles	10 meters	10 meters	3,415 meters
Impact Install 16-inch fiberglass reinforced, plastic piles	20 meters	41 meters	22 meters
Vibratory extract 14-inch concrete encased steel H-piles	15 meters	26 meters	6,310 meters
Vibratory extract of 16-inch fiberglass reinforced, plastic fender piles	10 meters	10 meters	3,415 meters
Vibratory install and auger drilling of 36-inch steel pipe piles concurrent with vibratory install of 16-inch fiberglass reinforced, plastic piles	20 meters	46 meters	Maximum harassment zone[(a)]
Vibratory install of 16-inch fiberglass reinforced, plastic piles concurrent with vibratory extraction of 14-inch concrete encased steel H-piles	15 meters	35 meters	7,356 meters
Vibratory install of 14-inch steel H-piles concurrent with vibratory extraction of 14-inch concrete-encased steel H-piles and vibratory extraction of 16-inch fiberglass reinforced plastic fender piles.	15 meters	30 meters	Maximum harassment zone[(a)]
Vibratory install of 14-inch steel H-piles concurrent with vibratory extraction of 16-inch fiberglass reinforces plastic fender piles	10 meters	20 meters	5,412 meters

Note: [a]Harassment zone would be truncated due to the presence of intersecting land masses and would encompass a maximum area of 3.43 sq km.

- The behavioral disturbance zone would include all areas where the underwater SPLs are anticipated to equal or exceed the Level B (disturbance) criteria for marine mammals during impact and vibratory pile driving (**Table 11-1)**. Therefore, impact pile driving would generate a 3,415-meter behavioral disturbance harassment zone within the Thames River. Level B disturbance during vibratory pile driving would extend in a narrow band into Long Island Sound, as shown in **Figure 6-4**.
- The shutdown zone (**Table 5-2**) would be visually monitored for all pile driving days, and the full extent of the disturbance zone would be visually monitored.

- Visual monitoring would be conducted by experienced biologists with training in marine mammal detection and the ability to describe relevant behaviors that may occur in proximity to in-water construction activities (hereafter "Protected Species Observers [PSOs]"). PSOs must be approved by NMFS.
- If a marine mammal species for which incidental take has not been authorized is seen approaching or entering the shutdown zone or the disturbance zone during impact or vibratory pile driving, pile driving would cease. If such circumstances recur, the Navy would consult with NMFS concerning the potential need for an additional take authorization.
- Pile driving would cease if any marine mammal is detected in the shutdown zone. If a marine mammal is observed in the disturbance zone, but not approaching or entering the shutdown zone, a Level B take would be recorded, and the work would be allowed to proceed without cessation provided the number of authorized takes, as specified in the NMFS-issued IHA, would not be exceeded. All species that enter the Level A or Level B zones would be monitored and documented, with the PSO estimating the amount of time the animal spends within the zone while pile driving is underway. One level A take each of harbor seal and gray seal is requested to protect against unauthorized take.
- In the event of a shutdown, pile driving would be halted and delayed until either the animal has voluntarily left and been visually confirmed beyond the shutdown zone or 15 minutes have elapsed without re-detection of the animal.
- Visual monitoring would take place from 30 minutes prior to initiation through 30 minutes post-completion of pile driving. Prior to the start of pile driving, the shutdown zone and disturbance zone would be monitored for 30 minutes to ensure that the zones are clear of marine mammals. Pile driving would only commence once PSOs have declared the shutdown zone clear of pinnipeds.
- Visual monitoring would be conducted by up to five PSOs depending on the pile activity. One PSO would be stationed on land-based features (such as Pier 17 or 32) or a construction barge, and four PSOs would monitor from two boats for the larger monitoring zones. Given the configuration of the Behavioral Disturbance (Level B) harassment zone (relatively narrow and linear as shown in **Figures 6-6 and 6-9**), it is assumed that four PSOs would be sufficient to monitor the harassment zone via boat. Trained PSOs would be placed at the best vantage point(s) practicable depending on which type of pile driving/extracting and/or drilling activity is occurring so as to efficiently monitor for marine mammals and implement shutdown/delay procedures when applicable. PSOs implement shutdown/delay procedures by calling for the shutdown to the pile driver operator. Potential PSO stations may include the following but are subject to change and would be finalized in the Marine Mammal Monitoring Plan:
    - Pile installation/extraction barge;
    - Shore-based locations (such as Pier 17 or 32);
    - Small boats; and
    - Mouth of Thames River, looking out into Long Island Sound.
- The marine mammal observers shall have no other construction-related tasks assigned to them while conducting monitoring.
- If the Level A (PTS onset) shutdown zone is obscured by fog or poor lighting conditions, pile driving would not be initiated until the entire Level A (PTS onset) shutdown zone is visible.

11.2.5 Acoustic Measurements

During in-water construction activities, acoustic measurements would be obtained and would be used to empirically adjust the Level A (PTS onset) shutdown and Level B (Behavioral) disturbance zones, subject to review from NMFS. For further detail regarding acoustic monitoring, see Section 13.2.

11.2.6 Mitigation Effectiveness

As identified in Section 11.2.4, all PSOs utilized for mitigation activities would be NMFS-approved biologists with training in marine mammal detection and behavior. Due to their specialized training, the Navy expects that visual mitigation would be highly effective. Trained PSOs have specific knowledge of marine mammal physiology, behavior, and life history that may improve their ability to detect individuals or help determine whether observed animals are exhibiting behavioral reactions to construction activities.

Visual detection conditions in the proposed project area are generally excellent. Located in Thames River, the area is sheltered from large swells and infrequently experiences strong winds. PSOs would be positioned in locations that provide the best vantage point(s) for monitoring, such as on nearby piers or on a small boat, and the shutdown zone covers a small and accessible area of the Thames River. The behavioral zone is much larger but monitoring from vessels positioned at the mouth of the Thames River would ensure coverage of the zone. As such, proposed mitigation measures are likely to be very effective.

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12 ARCTIC PLAN OF COOPERATION

Where the proposed activity would take place in or near a traditional Arctic subsistence hunting area and/or may affect the availability of a species or stock of marine mammal for Arctic subsistence uses, the applicant must submit either a plan of cooperation or information that identifies what measures have been taken and/or will be taken to minimize any adverse effects on the availability of marine mammals for subsistence uses. A plan must include the following:

(i) A statement that the applicant has notified and provided the affected subsistence community with a draft plan of cooperation;

(ii) A schedule for meeting with the affected subsistence communities to discuss proposed activities and to resolve potential conflicts regarding any aspects of either the operation or the plan of cooperation;

(iii) A description of what measures the applicant has taken an/or will take to ensure that proposed activities will not interfere with subsistence whaling or sealing; and

(iv) What plans the applicant has to continue to meet with the affected communities, both prior to and while conducting activity, to resolve conflicts and to notify the communities of any changes in the operation.

This chapter is not applicable. There is no subsistence use of marine mammal species or stocks in the proposed project area.

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13 MONITORING AND REPORTING MEASURES

The suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species, the level of taking or impacts on populations of marine mammals that are expected to be present while conducting activities and suggested means of minimizing burdens by coordinating such reporting requirements with other schemes already applicable to persons conducting such activity. Monitoring plans should include a description of the survey techniques that will be used to determine the movement and activity of marine mammals near the activity site(s) including migration and other habitat uses, such as feeding.

The Navy intends to complete marine mammal and hydroacoustic monitoring of the proposed project area in order to provide a more robust assessment of sound levels from pile driving and marine mammal responses, and to refine avoidance and minimization measures as warranted by the results. A Marine Mammal Monitoring Plan and Hydroacoustic Monitoring Plan would be developed further and submitted to NMFS for approval in advance of the start of construction of the IHA period.

The following monitoring measures would be implemented along with the mitigation measures (Chapter 11) to reduce impacts to marine mammals to the lowest extent practicable during the period of this IHA.

13.1 Marine Mammal Monitoring Plan

A Marine Mammal Monitoring Plan would be prepared and submitted to NMFS for approval well in advance of the start of construction of the IHA period. Visual monitoring of the Level A (PTS onset) shutdown and Level B (Behavioral) disturbance zone would occur for 100 percent of pile driving. If a marine mammal is observed entering the Level B (Behavioral) disturbance zone, an exposure would be recorded and behaviors documented.

13.1.1 Methods of Monitoring

The Navy would monitor the shutdown zone and disturbance zone before, during, and after pile driving activities. Based on NMFS requirements, the Marine Mammal Monitoring Plan would include the following procedures:

- NMFS-approved PSOs would be located on land, land-based features such docks, piers, or bridges, or small craft vessels in order to properly observe the entire monitoring and shutdown zones.
- Monitoring would be conducted by up to five PSOs depending on the pile activity. At least one PSO must have prior experience performing the duties of a PSO during construction activities. One PSO would be stationed on land-based features and four PSOs would monitor from two boats for the larger monitoring zones.
- PSOs would be located at the best vantage point(s) to observe the zone associated with behavioral impact thresholds based on what impact/vibratory/drilling activity is occurring.
- During all observation periods, PSOs would use binoculars and the naked eye to search continuously for marine mammals.
- Monitoring distances would be measured with range finders.
- Distances to animals would be based on the best estimate of the PSO, relative to known distances to objects in the vicinity of the PSO.

- Bearing to animals would be determined using a compass.
- In-water activities would be curtailed under conditions of fog or poor visibility that might obscure the presence of a marine mammal within the shutdown zone.
- Pre-Activity Monitoring:
  - The shutdown, Level A (PTS onset), and Level B (Behavioral) disturbance zones would be monitored for 30 minutes prior to in-water construction/demolition activities. If a marine mammal is present within the shutdown or Level A (PTS onset) zone, the activity would be delayed until the animal(s) leave the shutdown or Level A (PTS onset) zone. Activity would resume only after the PSO has determined that, through sighting or by waiting approximately 30 minutes, the animal has moved outside the shutdown or Level A (PTS onset) zone. If a marine mammal is observed approaching the shutdown or Level A (PTS onset) zone, the PSO who sighted that animal would notify the shutdown and Level A (PTS onset) zone PSO(s) of its presence.
- During Activity Monitoring:
  - If a marine mammal is observed entering the Level A (PTS onset) and Level B (Behavioral) disturbance zone, that activity would be completed without cessation, unless the animal enters or approaches the shutdown zone, at which point all activities would be halted. If an animal is observed within the shutdown zone during in-water construction, the activity would be stopped as soon as it is safe to do so. In-water construction can only resume once the animal has left the shutdown zone of its own volition or has not been re-sighted for a period of 15 minutes.
- Post-Activity Monitoring:
  - Monitoring of the shutdown, Level A (PTS onset), and Level B (Behavioral) disturbance zones would continue for 30 minutes following the completion of the activity.

13.1.2 Data Collection

PSOs must use previously approved sighting forms included in **Appendix B**. The marine mammal report must contain the informational elements described in the Marine Mammal Monitoring Plan, including but not limited to:

- Dates and times (begin and end) of all marine mammal monitoring.
- Construction activities occurring during each daily observation period, including how many and what types of piles were driven and by what method (i.e., impact/vibratory/drilling).
- Weather parameters and water conditions during each monitoring period (e.g., wind speed, percent cover, visibility, sea state).
- Total duration of driving time for each pile (vibratory driving and drilling) and number of strikes for each pile (impact driving).
- Species (genus/species, lowest possible taxonomic level, or unidentified), PSO confidence in identification, numbers, group composition (if there is a mix of species), and, if possible, sex and age class of marine mammals.
- Time of sighting, PSO location during monitoring and at time of sighting (if different), and construction activity at time of sighting.
- Distance and location of each observed marine mammal relative to the in-water construction activities for each sighting and activity occurring at time of sighting.
- Estimated number of animals (minimum/maximum/best estimate).

- Estimated number of animals by cohort (adults/juveniles).
- Animal's closest point of approach and estimated time spent within the harassment zones.
- Description of any marine mammal behavioral observations (e.g., observed behaviors such as feeding or traveling), including an assessment of behavioral responses thought to have resulted from the activity (e.g., no response or changes in behavioral state such as ceasing feeding, changing direction, flushing, or breaching).
- Distances and bearings of each marine mammal observed to the in-water construction activity for each sighting (if activities were occurring at time of sighting).
- Estimated time span from when a marine mammal is observed approaching the Level A (PTS onset) zone and when construction activity is shutdown, as well as the estimated amount of time the marine mammal spends in the Level A (PTS onset) zone during shutdown and estimated amount of time that a marine mammal spends within the Level B (Behavioral) harassment zones while construction activities are underway (see Section 11.2.4).
- Number of individuals of each species (differentiated by month as appropriate) detected within the harassment zone and estimates of number of marine mammals taken by species (a correction factor may be applied to total take numbers, as appropriate). The number of takes shall not exceed the authorized number specified in the NMFS-issued IHA.
- 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 ability to track groups or individuals.
- Submittal of all PSO datasheets and/or raw sighting data (in a separate file from the final report referenced above).

13.2 Hydroacoustic Monitoring Plan

The Navy would implement in situ acoustic monitoring efforts to measure SPLs from in-water activities. The Navy would collect and evaluate acoustic sound recording levels during construction and demolition activities. Hydrophones would be placed at locations 10 meters (33 feet) from the noise source and, where the potential for Level A (PTS onset) harassment exists, at a second representative monitoring location at an intermediate distance between the cetacean and phocid shutdown and Level A (PTS onset) zones. For the pile driving/extraction and auger drilling events acoustically measured, 100 percent of the data would be analyzed.

At a minimum, the methodology includes:

- For underwater recordings, a stationary hydrophone system with the ability to measure SPLs would be placed in accordance with NMFS most recent guidance for the collection of source levels.
- Hydroacoustic monitoring would be successfully conducted for at least 10 percent and up to 10 of each different type of pile and each method of installation (**Table 13-1**). Monitoring would occur at 33 feet (10 meters) from the noise; at a location intermediate of the pinniped and cetacean Level A (PTS onset) zones; and occasionally near the predicted harassment zones for Level B (Behavioral) harassment. The resulting data set would be analyzed to examine and confirm SPLs and rates of transmission loss for each separate in-water construction activity. With NMFS concurrence, these metrics would be used to recalculate the limits of the shutdown,

Level A (PTS onset), and Level B (Behavioral) disturbance zones, and to make corresponding adjustments in marine mammal monitoring of these zones. Hydrophones would be placed using a static line deployed from a stationary (temporarily moored) vessel. Locations of hydroacoustic recordings would be collected via global positioning system. A depth sounder and/or weighted tape measure would be used to determine the depth of the water. The hydrophone would be attached to a weighted nylon cord or chain to maintain a constant depth and distance from the pile area. The nylon cord or chain would be attached to a float or tied to a static line.

Table 13-1 Hydroacoustic Monitoring Summary

Pile type	*Count*	*Method of Install/Extract*	*Number Monitored*
14-inch steel H-pile	60	Impact	10
14-inch steel H-pile	60	Vibratory	10
36-inch steel pipe	20	Impact	10
36-inch steel pipe	20	Vibratory	10
16-inch fiberglass reinforced plastic fender piles	60	Impact	10
16-inch fiberglass reinforced plastic fender piles	60	Vibratory	10
14-inch concrete encased steel H-piles	20	Vibratory	10
36-inch steel pipe	20	Auger (rotary) drill	10

- Each hydrophone (underwater) would be calibrated at the start of each action and would be checked frequently to the applicable standards of the hydrophone manufacturer.
- Environmental data would be collected, including but not limited to, the following: wind speed and direction, air temperature, humidity, surface water temperature, water depth, wave height, weather conditions, and other factors that could contribute to influencing the airborne and underwater sound levels (e.g., aircraft, boats, etc.).
- The chief inspector would supply the acoustics specialist with the substrate composition, hammer or drill model and size, hammer or drill energy settings and any changes to those settings during the piles being monitored, depth of the pile being driven or shaft excavated, and blows per foot for the piles monitored.
- For acoustically monitored piles, data from the monitoring locations would be post-processed to obtain the following sound measures:
  - Maximum peak pressure level recorded for all the strikes associated with each pile, expressed in dB re 1 µPa.
    - Mean, median, minimum, and maximum RMS pressure level in [dB re 1 µPa].
    - Mean duration of a pile strike (based on the 90 percent energy criterion).
    - Number of hammer strikes.
    - Mean, median, minimum, and maximum single strike SEL in [dB re μPa^2 s].
  - Cumulative SEL as defined by the mean single strike SEL + $10*\log_{10}$ (number of hammer strikes) in [dB re μPa^2 s].

- Median integration time used to calculate SPL RMS.
- A frequency spectrum (pressure spectral density) in dB re µPa^2 per Hz based on the average of up to eight successive strikes with similar sound. Spectral resolution would be 1 Hz, and the spectrum would cover nominal range from 7 Hz to 20 kHz.
- Finally, the cumulative SEL would be computed from all the strikes associated with each pile occurring during all phases, i.e., soft start, Level 1 to Level 4. This measure is defined as the sum of all single strike SEL values. The sum is taken of the antilog, with $\log_{10}$ taken of result to express in [dB re µPa^2 s].

- For vibratory driving/extraction/drilling: duration and frequency spectrum of vibratory driving per pile; mean, median, and maximum sound levels (dB re: 1 µPa): root mean square sound pressure level (SPLrms), SELcum (and timeframe over which the sound is averaged).

13.3 Reporting

13.3.1 Marine Mammal Monitoring Report

A draft monitoring report would be submitted to NMFS within 90 days of the end of pile driving activities. The report would synthesize the data recorded during hydroacoustic and marine mammal monitoring and estimate the number of marine mammals that may have been harassed through the entire project. The results would be summarized in graphical form and include summary statistics and time histories of sound values based upon the data from the activities monitored for this IHA period. NMFS would provide comments within 30 days after receiving this report, and the Navy would address the comments and submit revisions within 30 days of receipt. If no comment is received from NMFS within 30 days, the report would be considered final.

13.3.2 Report Requirements

Marine Mammals

The marine mammal monitoring report would contain the information described in the monitoring plan and at a minimum, the report shall include:

- General data:
  - Date and time of activities.
  - Water conditions (e.g., sea state, tidal state).
  - Weather conditions (e.g., percent cover, visibility).
- Pre-activity observational survey-specific data:
  - Dates and time survey is initiated and terminated.
  - Description of any observable marine mammal behavior in the immediate area during monitoring.
  - Actions performed to minimize impacts to marine mammals.
- During activity observational survey-specific data:
  - Description of any observable marine mammal behavior within monitoring zones (shutdown and disturbance) or in the immediate area surrounding monitoring zones (shutdown and disturbance).
  - Actions performed to minimize impacts to marine mammals.
  - Times when pile driving is stopped due to presence of marine mammals within the shutdown zones and time when pile driving resumes.

- Post-activity observational survey-specific data:
  - Results, which include the detections of marine mammals; species and numbers observed; sighting rates and distances; and behavioral reactions within and outside of monitoring zones.
  - A refined take estimate based on the number of marine mammals observed during the course of construction.

Hydroacoustic

The hydroacoustic monitoring report would contain the informational elements described in the Hydroacoustic Monitoring Plan and, at minimum, would include:

- Hydrophone equipment and methods: recording device; sampling rate; distance (meter) from the pile where recordings were made; depth of water and recording device(s).
- Type and size of pile being driven, substrate type, method of driving during recordings (e.g., hammer model and energy), and total pile driving duration.
- Whether a sound attenuation device is used and, if so, a detailed description of the device used and the duration of its use per pile.
- For impact pile driving: number of strikes and strike rate; depth of substrate to penetrate; pulse duration and mean, median, and maximum sound levels (dB re: 1 µPa); SPLrms; SELcum; peak sound pressure level (SPLpeak); and single-strike sound exposure level (SELs-s).
- For vibratory driving/extraction/drilling: duration and frequency spectrum of vibratory driving per pile; mean, median, and maximum sound levels (dB re: 1 µPa): SPLrms, SELcum (and timeframe over which the sound is averaged).
- One-third octave band spectrum and power spectral density plot.
- General Daily Site Conditions
  - Date and time of activities.
  - Water conditions (e.g., sea state, tidal state).
  - Weather conditions (e.g., percent cover, visibility).

14 RESEARCH EFFORTS

Suggested means of learning of, encouraging, and coordinating research opportunities, plans, and activities relating to reducing such incidental taking and evaluating its effects.

The U.S. Navy is one of the world's leading organizations in assessing the effects of human activities in the marine environment, including marine mammals. From 2004 through 2013, the Navy funded over $240M specifically for marine mammal research. Navy scientists work cooperatively with other government researchers and scientists, universities, industry, and non-governmental conservation organizations in collecting, evaluating, and modeling information on marine resources. They also develop approaches to ensure that these resources are minimally impacted by existing and future Navy operations. It is imperative that the Navy's research and development (R&D) efforts related to marine mammals are conducted in an open, transparent manner with validated study needs and requirements. The goal of the Navy's R&D program is to enable collection and publication of scientifically valid research, as well as development of techniques and tools for Navy, academic, and commercial use. Historically, R&D programs are funded and developed by the Navy's Chief of Naval Operations Energy and Environmental Readiness and Office of Naval Research, Code 322 Marine Mammals and Biological Oceanography Program. Primary focus of these programs since the 1990s has been on understanding the effects of sound on marine mammals, including physiological, behavioral, and ecological effects.

The Office of Naval Research's current Marine Mammals and Biology Program trusts include, but are not limited to: (1) monitoring and detection research; (2) integrated ecosystem research, including sensor and tag development; (3) effects of sound on marine life (such as hearing, behavioral response studies, physiology [diving and stress], and Population Consequences of Acoustic Disturbance); and (4) models and databases for environmental compliance.

To manage some of the Navy's marine mammal research programmatic elements, the Navy developed the Living Marine Resources (LMR) R&D Program (http://www.lmr.navy.mil/) in 2011. The goal of the LMR R&D Program is to identify and fill knowledge gaps and to demonstrate, validate, and integrate new processes and technologies to minimize potential effects to marine mammals and other marine resources. Key elements of the LMR program include the following:

- Providing science-based information to support Navy environmental effects assessments for research, development, acquisition, testing, and evaluation as well as Fleet at-sea training, exercises, maintenance, and support activities.
- Improving knowledge of the status and trends of marine species of concern and the ecosystems of which they are a part.
- Developing the scientific basis for the criteria and thresholds to measure the effects of Navy-generated sound.
- Improving understanding of underwater sound and sound field characterization unique to assessing the biological consequences resulting from underwater sound (as opposed to tactical applications of underwater sound or propagation loss modeling for military communications or tactical applications).
- Developing technologies and methods to monitor and, where possible, mitigate biologically significant consequences to LMR resulting from naval activities, emphasizing those consequences that are most likely to be biologically significant.

Overall, the Navy will continue to research and contribute to university/external research to improve the state of the science regarding marine species biology and acoustic effects. These efforts include monitoring programs, data sharing with the NMFS from R&D efforts, and current research as previously described.

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Appendix A

Acoustic Model Spreadsheets

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E.1: IMPACT PILE DRIVING (STATIONARY SOURCE: Impulsive, Intermittent

VERSION 2.2: 2020

KEY

(green)	**Action Proponent Provided Information**
(pink)	**NMFS Provided Information (Technical Guidance)**
(blue)	**Resultant Isopleth**

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Pier 31 Extension - Subase New London
PROJECT/SOURCE INFORMATION	Temporary Work Trestle Install (Total of 60 piles for 15 days) (June 2024)

Please include any assumptions

PROJECT CONTACT	

STEP 2: WEIGHTING FACTOR ADJUSTMENT

		Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value
Weighting Factor Adjustment (kHz)¥	2	

¥ Broadband: 95% frequency contour percentile (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 73), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: METHOD E.1-1 is PREFERRED method when SEL-based source levels are available (because pulse duration is not required). Only use method E.1-2 if SEL-based source levels are not available.

E.1-1: METHOD TO CALCULATE PK AND SEL_{cum} (SINGLE STRIKE EQUIVALENT) **PREFERRED METHOD (pulse duration not needed)**

Unweighted $SEL_{cum\ (at\ measured\ distance)}$ = SEL_{ss} + 10 Log (# strikes)	**198.0**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	162
Number of strikes per pile	1000
Number of piles per day	4
Transmission loss coefficient	15
Distance of single strike SEL_{ss} ($L_{E,p,\ single\ strike}$) measurement (meters)	10

PK

$L_{p,0\text{-}pk}$ specified at "x" meters (Cell G29)	194
Distance of $L_{p,0\text{-}pk}$ measurement (meters)*	10
$L_{p,0\text{-}pk}$ Source level	209.0

RESULTANT ISOPLETHS*

*Impulsive sounds have dual metric thresholds (SELcum & PK). Metric producing largest isopleth should be used.

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	183	185	155	185	203
PTS Isopleth to threshold (meters)	**100.2**	**3.6**	**119.3**	**53.6**	**3.9**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**NA**	**NA**	**2.9**	**NA**	**NA**

"NA": PK source level is ≤ to the threshold for that marine mammal hearing group.

E.1-2: METHOD TO CALCULATE PK AND SEL_{cum} (USING RMS SPL SOURCE LEVEL)

SEL_{cum}

Sound Pressure Level (L_{rms}), specified at "x" meters (Cell B53)	
Number of piles per day	
Strike (pulse) Duration^ (seconds)	
Number of strikes per pile	
Duration of Sound Production (seconds)	0
10 Log (duration of sound production)	#NUM!
Transmission loss coefficient	
Distance of sound pressure level (L_{rms}) measurement (meters)	

^Window that makes up 90% of total cumulative energy (5%-95%) based on Madsen 2005

PK

$L_{p,0\text{-}pk}$ specified at "x" meters (Cell G47)	
Distance of $L_{p,0\text{-}pk}$ measurement (meters)*	
$L_{p,0\text{-}pk}$ Source level	#NUM!

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS*

*Impulsive sounds have dual metric thresholds (SELcum & PK). Metric producing largest isopleth should be used.

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	183	185	155	185	203
PTS Isopleth to threshold (meters)	**#NUM!**	**#NUM!**	**#NUM!**	**#NUM!**	**#NUM!**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**#NUM!**	**#NUM!**	**#NUM!**	**#NUM!**	**#NUM!**

"NA": PK source level is ≤ to the threshold for that marine mammal hearing group.

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (-dB)†	**-0.01**	**-19.74**	**-26.87**	**-2.08**	**-1.15**

NOTE: If user decided to override these Adjustment values, they need to make sure to download another copy to ensure the built-in calculations function properly.

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

E.1: IMPACT PILE DRIVING (STATIONARY SOURCE: Impulsive, Intermittent

VERSION 2.2: 2020

KEY

(green)	**Action Proponent Provided Information**
(pink)	**NMFS Provided Information (Technical Guidance)**
(blue)	**Resultant Isopleth**

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Pier 31 Extension - Subase New London
PROJECT/SOURCE INFORMATION	Pier 31 Extension Support Pile Installation 36-inch steel (concrete filled) pipe (Total of 20 piles for 8 days) (January - February 2025)

Please include any assumptions

PROJECT CONTACT	

STEP 2: WEIGHTING FACTOR ADJUSTMENT

		Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value
Weighting Factor Adjustment (kHz)¥	2	

¥ Broadband: 95% frequency contour percentile (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 73), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: METHOD E.1-1 is PREFERRED method when SEL-based source levels are available (because pulse duration is not required). Only use method E.1-2 if SEL-based source levels are not available.

E.1-1: METHOD TO CALCULATE PK AND SEL_{cum} (SINGLE STRIKE EQUIVALENT) **PREFERRED METHOD (pulse duration not needed)**

Unweighted $SEL_{cum\ (at\ measured\ distance)}$ = SEL_{ss} + 10 Log (# strikes)	**217.0**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	183
Number of strikes per pile	1000
Number of piles per day	2.5
Transmission loss coefficient	15
Distance of single strike SEL_{ss} ($L_{E,p,\ single\ strike}$) measurement (meters)	10

PK

$L_{p,0\text{-}pk}$ specified at "x" meters (Cell G29)	209
Distance of $L_{p,0\text{-}pk}$ measurement (meters)*	10
$L_{p,0\text{-}pk}$ Source level	224.0

RESULTANT ISOPLETHS*

*Impulsive sounds have dual metric thresholds (SELcum & PK). Metric producing largest isopleth should be used.

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	183	185	155	185	203
PTS Isopleth to threshold (meters)	**1,839.5**	**65.4**	**2,191.1**	**984.4**	**71.7**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**2.2**	**NA**	**29.3**	**2.5**	**NA**

"NA": PK source level is ≤ to the threshold for that marine mammal hearing group.

E.1-2: METHOD TO CALCULATE PK AND SEL_{cum} (USING RMS SPL SOURCE LEVEL)

SEL_{cum}

Sound Pressure Level (L_{rms}), specified at "x" meters (Cell B53)	
Number of piles per day	
Strike (pulse) Duration^ (seconds)	
Number of strikes per pile	
Duration of Sound Production (seconds)	0
10 Log (duration of sound production)	#NUM!
Transmission loss coefficient	
Distance of sound pressure level (L_{rms}) measurement (meters)	

^Window that makes up 90% of total cumulative energy (5%-95%) based on Madsen 2005

PK

$L_{p,0\text{-}pk}$ specified at "x" meters (Cell G47)	
Distance of $L_{p,0\text{-}pk}$ measurement (meters)*	
$L_{p,0\text{-}pk}$ Source level	#NUM!

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring

requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS*

*Impulsive sounds have dual metric thresholds (SELcum & PK). Metric producing largest isopleth should be used.

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	183	185	155	185	203
PTS Isopleth to threshold (meters)	**#NUM!**	**#NUM!**	**#NUM!**	**#NUM!**	**#NUM!**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**#NUM!**	**#NUM!**	**#NUM!**	**#NUM!**	**#NUM!**

"NA": PK source level is ≤ to the threshold for that marine mammal hearing group.

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (-dB)†	**-0.01**	**-19.74**	**-26.87**	**-2.08**	**-1.15**

NOTE: If user decided to override these Adjustment values, they need to make sure to download another copy to ensure the built-in calculations function properly.

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

E.1: IMPACT PILE DRIVING (STATIONARY SOURCE: Impulsive, Intermittent

VERSION 2.2: 2020

KEY

(green)	**Action Proponent Provided Information**
(pink)	**NMFS Provided Information (Technical Guidance)**
(blue)	**Resultant Isopleth**

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Pier 31 Extension - Subase New London
PROJECT/SOURCE INFORMATION	Pier 31 Fender Pile Installation 16-inch fiberglass (Total of 60 piles for 24 days) (March - April 2025)

Please include any assumptions

PROJECT CONTACT	

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value

Weighting Factor Adjustment (kHz)[¥]	2	

[¥] Broadband: 95% frequency contour percentile (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 73), and enter the new value directly. However, they must provide additional support and documentation supporting this modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

NOTE: METHOD E.1-1 is PREFERRED method when SEL-based source levels are available (because pulse duration is not required). Only use method E.1-2 if SEL-based source levels are not available.

E.1-1: METHOD TO CALCULATE PK AND SEL_{cum} (SINGLE STRIKE EQUIVALENT) **PREFERRED METHOD (pulse duration not needed)**

Unweighted $SEL_{cum\ (at\ measured\ distance)}$ = SEL_{ss} + 10 Log (# strikes)	**191.0**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	157
Number of strikes per pile	1000
Number of piles per day	2.5
Transmission loss coefficient	15
Distance of single strike SEL_{ss} ($L_{E,p,\ single\ strike}$) measurement (meters)	10

PK

$L_{p,0\text{-}pk}$ specified at "x" meters (Cell G29)	177
Distance of $L_{p,0\text{-}pk}$ measurement (meters)*	10
$L_{p,0\text{-}pk}$ Source level	192.0

RESULTANT ISOPLETHS*

*Impulsive sounds have dual metric thresholds (SELcum & PK). Metric producing largest isopleth should be used.

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	183	185	155	185	203
PTS Isopleth to threshold (meters)	**34.0**	**1.2**	**40.5**	**18.2**	**1.3**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**NA**	**NA**	**NA**	**NA**	**NA**

"NA": PK source level is ≤ to the threshold for that marine mammal hearing group.

E.1-2: METHOD TO CALCULATE PK AND SEL_{cum} (USING RMS SPL SOURCE LEVEL)

SEL_{cum}

Sound Pressure Level (L_{rms}), specified at "x" meters (Cell B53)	
Number of piles per day	
Strike (pulse) Duration[^] (seconds)	
Number of strikes per pile	
Duration of Sound Production (seconds)	0
10 Log (duration of sound production)	#NUM!
Transmission loss coefficient	
Distance of sound pressure level (L_{rms}) measurement (meters)	

[^]Window that makes up 90% of total cumulative energy (5%-95%) based on Madsen 2005

PK

$L_{p,0\text{-}pk}$ specified at "x" meters (Cell G47)	
Distance of $L_{p,0\text{-}pk}$ measurement (meters)*	
$L_{p,0\text{-}pk}$ Source level	#NUM!

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring

requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS*

*Impulsive sounds have dual metric thresholds (SELcum & PK). Metric producing largest isopleth should be used.

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	183	185	155	185	203
PTS Isopleth to threshold (meters)	**#NUM!**	**#NUM!**	**#NUM!**	**#NUM!**	**#NUM!**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**#NUM!**	**#NUM!**	**#NUM!**	**#NUM!**	**#NUM!**

"NA": PK source level is ≤ to the threshold for that marine mammal hearing group.

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (-dB)†	**-0.01**	**-19.74**	**-26.87**	**-2.08**	**-1.15**

NOTE: If user decided to override these Adjustment values, they need to make sure to download another copy to ensure the built-in calculations function properly.

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

A: STATIONARY SOURCE: Non-Impulsive, Continuous

VERSION 2.2: 2020

KEY

(green)	**Action Proponent Provided Information**
(pink)	**NMFS Provided Information (Technical Guidance)**
(blue)	**Resultant Isopleth**

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Pier 31 Extension Subase New London
PROJECT/SOURCE INFORMATION	Pier 31 Support Pile Installation 36-inch steel (concrete filled) pipe - Auger drill for 20 days (January - February 2025)
Please include any assumptions	
PROJECT CONTACT	

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value.

Weighting Factor Adjustment (kHz)¥	2	

¥ Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 47), and enter the new value directly. However, they must provide additional support and documentation supporting this modificatio

STEP 3: SOURCE-SPECIFIC INFORMATION

Source Level (L_{rms})	154
Duration of Sound Production (hours) within 24-h period	8
Duration of Sound Production (seconds)	28800
10 Log (duration of sound production)	44.59
Propagation loss coefficient	15

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	**0.9**	**0.1**	**0.8**	**0.5**	**0.0**

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (-dB)†	**-0.01**	**-19.74**	**-26.87**	**-2.08**	**-1.15**

NOTE: If user decided to override these Adjustment values, they need to make sure to download another copy to ensure the built-in calculations function properly.

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

A.1: Vibratory Pile Driving (STATIONARY SOURCE: Non-Impulsive, Continuous)

VERSION 2.2: 2020

KEY

(green)	**Action Proponent Provided Information**
(pink)	**NMFS Provided Information (Technical Guidance)**
(blue)	**Resultant Isopleth**

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Pier 31 Extension
PROJECT/SOURCE INFORMATION	Pier 31 Extension Pier Support Pile Installation (Total of 20 Piles for 120 days) (January - February 2025)

Please include any assumptions

PROJECT CONTACT	

STEP 2: WEIGHTING FACTOR ADJUSTMENT

		Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value
Weighting Factor Adjustment (kHz)¥	2.5	

¥ Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 48), and enter the new value directl However, they must provide additional support and documentation supporting this modificatio

STEP 3: SOURCE-SPECIFIC INFORMATION

Sound Pressure Level (L_{rms}), specified at "x" meters (Cell B30)	168
Number of piles within 24-h period	0.17
Duration to drive a single pile (minutes)	42
Duration of Sound Production within 24-h period (seconds	428.4
10 Log (duration of sound production)	26.32
Transmission loss coefficient	15
Distance of sound pressure leve (L_{rms}) measurement (meters)	10

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	**4.8**	**0.4**	**7.2**	**2.9**	**0.2**

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (-dB)†	**-0.05**	**-16.83**	**-23.50**	**-1.29**	**-0.60**

NOTE: If user decided to override these Adjustment values, they need to make sure to download another copy to ensure the built-in calculations function properly.

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

A.1: Vibratory Pile Driving (STATIONARY SOURCE: Non-Impulsive, Continuous)

VERSION 2.2: 2020

KEY

(green)	**Action Proponent Provided Information**
(pink)	**NMFS Provided Information (Technical Guidance)**
(blue)	**Resultant Isopleth**

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Pier 31 Extension
PROJECT/SOURCE INFORMATION	Removal of Temporary Work Trestle (Total of 60 Piles for 12 days) (May 2025)

Please include any assumptions

PROJECT CONTACT	

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value

Weighting Factor Adjustment (kHz)[¥]	2.5	

[¥] Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 48), and enter the new value directl However, they must provide additional support and documentation supporting this modificatio

STEP 3: SOURCE-SPECIFIC INFORMATION

Sound Pressure Level (L_{rms}), specified at "x" meters (Cell B30)	158
Number of piles within 24-h period	5
Duration to drive a single pile (minutes)	20
Duration of Sound Production within 24-h period (seconds	6000
10 Log (duration of sound production)	37.78
Transmission loss coefficient	15
Distance of sound pressure leve (L_{rms}) measurement (meters)	10

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	**6.1**	**0.5**	**9.0**	**3.7**	**0.3**

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (-dB)†	**-0.05**	**-16.83**	**-23.50**	**-1.29**	**-0.60**

NOTE: If user decided to override these Adjustment values, they need to make sure to download another copy to ensure the built-in calculations function properly.

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

A.1: Vibratory Pile Driving (STATIONARY SOURCE: Non-Impulsive, Continuous)

VERSION 2.2: 2020

KEY

(green)	**Action Proponent Provided Information**
(pink)	**NMFS Provided Information (Technical Guidance)**
(blue)	**Resultant Isopleth**

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Pier 31 Extension Subase New London
PROJECT/SOURCE INFORMATION	Pier 31 Fender Piles 16-inch Fiberglass (Total of 60 piles for 30 days) (March - April 2025)

Please include any assumptions

PROJECT CONTACT	

STEP 2: WEIGHTING FACTOR ADJUSTMENT

		Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using
Weighting Factor Adjustment (kHz)[¥]	2.5	

[¥] Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 48), and enter the new value directly. However, they must provide additional support and documentation supporting this modification

STEP 3: SOURCE-SPECIFIC INFORMATION

Sound Pressure Level (L_{rms}), specified at "x" meters (Cell B30)	158
Number of piles within 24-h period	2
Duration to drive a single pile (minutes)	20
Duration of Sound Production within 24-h period (seconds)	2400
10 Log (duration of sound production)	33.80
Transmission loss coefficient	15
Distance of sound pressure level (L_{rms}) measurement (meters)	10

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	**3.3**	**0.3**	**4.9**	**2.0**	**0.1**

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (-dB)†	**-0.05**	**-16.83**	**-23.50**	**-1.29**	**-0.60**

NOTE: If user decided to override these Adjustment values, they need to make sure to download another copy to ensure the built-in calculations function properly.

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

A.1: Vibratory Pile Driving (STATIONARY SOURCE: Non-Impulsive, Continuous)

VERSION 2.2: 2020

KEY

(green)	**Action Proponent Provided Information**
(pink)	**NMFS Provided Information (Technical Guidance)**
(blue)	**Resultant Isopleth**

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Pier 31 Extension Subase New London
PROJECT/SOURCE INFORMATION	Pier 31 Vibratory Extraction 16-inch Fiberglass reinforced plastic fender piles (Total of 28 piles for 14 days)

Please include any assumptions

PROJECT CONTACT	

STEP 2: WEIGHTING FACTOR ADJUSTMENT

		Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using
Weighting Factor Adjustment (kHz)[¥]	2.5	

[¥] Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 48), and enter the new value directly. However, they must provide additional support and documentation supporting this modification

STEP 3: SOURCE-SPECIFIC INFORMATION

Sound Pressure Level (L_{rms}), specified at "x" meters (Cell B30)	158
Number of piles within 24-h period	2
Duration to drive a single pile (minutes)	20
Duration of Sound Production within 24-h period (seconds)	2400
10 Log (duration of sound production)	33.80
Transmission loss coefficient	15
Distance of sound pressure level (L_{rms}) measurement (meters)	10

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	**3.3**	**0.3**	**4.9**	**2.0**	**0.1**

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (-dB)†	**-0.05**	**-16.83**	**-23.50**	**-1.29**	**-0.60**

NOTE: If user decided to override these Adjustment values, they need to make sure to download another copy to ensure the built-in calculations function properly.

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

A.1: Vibratory Pile Driving (STATIONARY SOURCE: Non-Impulsive, Continuous)

VERSION 2.2: 2020

KEY

(green)	**Action Proponent Provided Information**
(pink)	**NMFS Provided Information (Technical Guidance)**
(blue)	**Resultant Isopleth**

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Pier 31 Extension Subase New London
PROJECT/SOURCE INFORMATION	Pier 17 Demo-Extract 14-inch concrete encased Steel H piles (Total of 20 piles for 4 days) (June 2024)

Please include any assumptions

PROJECT CONTACT	

STEP 2: WEIGHTING FACTOR ADJUSTMENT

		Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using default value
Weighting Factor Adjustment (kHz)¥	2.5	

¥ Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 48), and enter the new value directl However, they must provide additional support and documentation supporting this modificatio

STEP 3: SOURCE-SPECIFIC INFORMATION

Sound Pressure Level (L_{rms}), specified at "x" meters (Cell B30)	162
Number of piles within 24-h period	5
Duration to drive a single pile (minutes)	20
Duration of Sound Production within 24-h period (seconds	6000
10 Log (duration of sound production)	37.78
Transmission loss coefficient	15
Distance of sound pressure leve (L_{rms}) measurement (meters)	10

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring

requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	**11.2**	**1.0**	**16.5**	**6.8**	**0.5**

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (-dB)†	**-0.05**	**-16.83**	**-23.50**	**-1.29**	**-0.60**

NOTE: If user decided to override these Adjustment values, they need to make sure to download another copy to ensure the built-in calculations function properly.

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

A.1: Vibratory Pile Driving (STATIONARY SOURCE: Non-Impulsive, Continuous)

VERSION 2.2: 2020

KEY

(green)	**Action Proponent Provided Information**
(pink)	**NMFS Provided Information (Technical Guidance)**
(blue)	**Resultant Isopleth**

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Pier 31 Extension Subase New London
PROJECT/SOURCE INFORMATION	4 Days concurrent vibratory pile driving of 14-inch steel-H pipe pile at work trestle piles and vibratory extraction of 14-inch concrete-encased steel-h at Pier 17 Stub piles.

Please include any assumptions

PROJECT CONTACT	

STEP 2: WEIGHTING FACTOR ADJUSTMENT

Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using

Weighting Factor Adjustment (kHz)[¥]	2.5	

[¥] Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 48), and enter the new value directly. However, they must provide additional support and documentation supporting this modification

STEP 3: SOURCE-SPECIFIC INFORMATION

Sound Pressure Level (L_{rms}), specified at "x" meters (Cell B30)	163
Number of piles within 24-h period	5
Duration to drive a single pile (minutes)	20
Duration of Sound Production within 24-h period (seconds)	6000
10 Log (duration of sound production)	37.78
Transmission loss coefficient	15
Distance of sound pressure level (L_{rms}) measurement (meters)	10

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	**13.1**	**1.2**	**19.3**	**7.9**	**0.6**

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (-dB)†	**-0.05**	**-16.83**	**-23.50**	**-1.29**	**-0.60**

NOTE: If user decided to override these Adjustment values, they need to make sure to download another copy to ensure the built-in calculations function properly.

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

A.1: Vibratory Pile Driving (STATIONARY SOURCE: Non-Impulsive, Continuous)

VERSION 2.2: 2020

KEY

(green)	**Action Proponent Provided Information**
(pink)	**NMFS Provided Information (Technical Guidance)**
(blue)	**Resultant Isopleth**

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Pier 31 Extension Subase New London
PROJECT/SOURCE INFORMATION	4 Days concurrent vibratory pile driving of 14-inch steel H-pipe pile at work trestle, Vibratory Extraction of 16-inch fiberglass reinforced plastic fender piles from Pier31, and vibratory extraction of 14-inch concrete-encased piles from Pier 17 Stub.

Please include any assumptions

PROJECT CONTACT	

STEP 2: WEIGHTING FACTOR ADJUSTMENT

		Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using
Weighting Factor Adjustment (kHz)[¥]	2.5	

[¥] Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 48), and enter the new value directly. However, they must provide additional support and documentation supporting this modification

STEP 3: SOURCE-SPECIFIC INFORMATION

Sound Pressure Level (L_{rms}), specified at "x" meters (Cell B30)	165
Number of piles within 24-h period	5
Duration to drive a single pile (minutes)	20
Duration of Sound Production within 24-h period (seconds)	6000
10 Log (duration of sound production)	37.78
Transmission loss coefficient	15
Distance of sound pressure level (L_{rms}) measurement (meters)	10

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	**17.7**	**1.6**	**26.2**	**10.8**	**0.8**

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (-dB)†	**-0.05**	**-16.83**	**-23.50**	**-1.29**	**-0.60**

NOTE: If user decided to override these Adjustment values, they need to make sure to download another copy to ensure the built-in calculations function properly.

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

A.1: Vibratory Pile Driving (STATIONARY SOURCE: Non-Impulsive, Continuous)

VERSION 2.2: 2020

KEY

(green)	**Action Proponent Provided Information**
(pink)	**NMFS Provided Information (Technical Guidance)**
(blue)	**Resultant Isopleth**

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Pier 31 Extension Subase New London
PROJECT/SOURCE INFORMATION	12 days concurrent vibratory pile driving of 14-inch steel h-pipe pile at work trestle and vibratory extraction of 16-inch fiberglass reinforced plastic fender piles from Pier 31. Install of 7 piles per day (5 piles per day for WT + 2 piles per day for Pier 31 Demo for 12 concurrent days).

Please include any assumptions

PROJECT CONTACT	

STEP 2: WEIGHTING FACTOR ADJUSTMENT

		Specify if relying on source-specific WFA, alternative weighting/dB adjustment, or if using
Weighting Factor Adjustment (kHz)¥	2.5	

¥ Broadband: 95% frequency contour percentile (kHz) OR Narrowband: frequency (kHz); For appropriate default WFA: See INTRODUCTION tab

† If a user relies on alternative weighting/dB adjustment rather than relying upon the WFA (source-specific or default), they may override the Adjustment (dB) (row 48), and enter the new value directly. However, they must provide additional support and documentation supporting this modification

STEP 3: SOURCE-SPECIFIC INFORMATION

Sound Pressure Level (L_{rms}), specified at "x" meters (Cell B30)	161
Number of piles within 24-h period	7
Duration to drive a single pile (minutes)	20
Duration of Sound Production within 24-h period (seconds)	8400
10 Log (duration of sound production)	39.24
Transmission loss coefficient	15
Distance of sound pressure level (L_{rms}) measurement (meters)	10

NOTE: The User Spreadsheet tool provides a means to estimates distances associated with the Technical Guidance's PTS onset thresholds. Mitigation and monitoring requirements associated with a Marine Mammal Protection Act (MMPA) authorization or an Endangered Species Act (ESA) consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance and the User Spreadsheet tool.

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	**12.0**	**1.1**	**17.8**	**7.3**	**0.5**

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
a	1	1.6	1.8	1	2
b	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94
f_2	19	110	140	30	25
C	0.13	1.2	1.36	0.75	0.64
Adjustment (-dB)†	**-0.05**	**-16.83**	**-23.50**	**-1.29**	**-0.60**

NOTE: If user decided to override these Adjustment values, they need to make sure to download another copy to ensure the built-in calculations function properly.

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

Appendix B

Marine Mammal Observation Record Form

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Project name: ______________ Lead observer: ______________ Page ______ of ______

Project location : ______________ Lead observer contact info: ______________ Date: ______________

Effort Info				Sighting Info*				
Event	Time of Event (start and end)	Observer*	Visibility Info (e.g. wind, glare, swell)	Species	Distance to Animal (from Observer)	# of Animals Group Size (min/max/best) # of Calves	Animal Movement Relative to Pile Driving Equipment/ Behavior Code	Behavior Change/ Response to Activity/ Other Comments
Start Monitoring – End Monitoring Soft Start – Vibratory – Impact Sighting – Delay – Shutdown	: :				yds	/ / ___ calves	toward or away parallel none Behavior Code: _______	
Start Monitoring – End Monitoring Soft Start – Vibratory – Impact Sighting – Delay – Shutdown	: :				yds	/ / ___ calves	toward or away parallel none Behavior Code: _______	
Start Monitoring – End Monitoring Soft Start – Vibratory – Impact Sighting – Delay – Shutdown	: :				yds	/ / ___ calves	toward or away parallel none Behavior Code: _______	
Start Monitoring – End Monitoring Soft Start – Vibratory – Impact Sighting – Delay – Shutdown	: :				yds	/ / ___ calves	toward or away parallel none Behavior Code: _______	
Start Monitoring – End Monitoring Soft Start – Vibratory – Impact Sighting – Delay – Shutdown	: :				yds	/ / ___ calves	toward or away parallel none Behavior Code: _______	
Start Monitoring – End Monitoring Soft Start – Vibratory – Impact Sighting – Delay – Shutdown	: :				yds	/ / ___ calves	toward or away parallel none Behavior Code: _______	
Start Monitoring – End Monitoring Soft Start – Vibratory – Impact Sighting – Delay – Shutdown	: :				yds	/ / ___ calves	toward or away parallel none Behavior Code: _______	

*Note location of observer and any marine mammal sightings with date/time on project map

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