MMPA Permit Visual and Hydroacoustic Monitoring Plan
For the
Pier 3 Demolition and Reconstruction

At
Naval Station Norfolk
Norfolk, Virginia

Revised April 2023

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Acronyms and Abbreviations

Acronym	***Definition***
dBrms	Decibels Root Mean Square Referenced
ft.	Feet
IHA	Incidental Harassment Authorization
LOA	Letter of Authorization
m	Meters
MMPA	Marine Mammal Protection Act
NAVSTA	Naval Station
Navy	U.S. Department of the Navy
NMFS	National Marine Fisheries Service
NRM	Installation Natural Resources Manager
PSO	Protected Species Observers
RMS	Root-Mean-Square Sound Pressure Levels
SEL	Sound Exposure Levels
SME	Subject Matter Expert
VA	Virginia

Chapter 1. Introduction

1.1 Purpose of the Marine Mammal and Acoustic Monitoring Plan

The purpose of this Marine Mammal and Acoustic Monitoring Plan (Plan) is to detail the protocols for marine mammal and acoustic monitoring activities associated with the Pier 3 Demolition and Reconstruction at Naval Station (NAVSTA) Norfolk (Figure 1-1). In accordance with the Marine Mammal Protection Act (MMPA) of 1972, as amended, an application for Incidental Harassment Authorization (IHA) was submitted to National Marine Fisheries Service (NMFS) on July 15, 2021 and the authorization was issued to the Navy on March 15, 2022. A request for a Letter of Authorization (LOA) for remaining activities was submitted to NMFS on April 8, 2022 and is currently under review. A request to amend the IHA to allow for concurrent activities was submitted to NMFS July 29, 2022 and the amended IHA was issued to the Navy on January 9, 2023. A request to renew Year 1 activities to enable completion of work that had been delayed was submitted to NMFS on February 23, 2023 and was issued on March 31, 2023.

Incidental take of humpback whale (*Megaptera novaeangliae*), bottlenose dolphin (*Tursiops truncatus*), harbor porpoise (*Phocoena phocoena*), harbor seal (*Phoca vitulina*), and gray seal (*Halichoerus grypus*) are anticipated as a result of the proposed project.

The proposed project includes the replacement of Pier 3 at NAVSTA Norfolk, located in Norfolk, VA, as well as various upgrades and improvements to nearby bulkheads and wharves. The proposed project will occur in phases over a period of four years, from April 2022 through March 2027. Activities within the first year of construction are covered by the Incidental Harassment Authorization, with remaining construction activities covered by the forthcoming LOA, from April 2023 through March 2027. Vibratory and impact pile driving and drilling activities associated with proposed activities have the potential to affect marine mammals within marine waters adjacent to these Navy installations and could result in harassment under the MMPA.

The purpose of monitoring is:

1. To minimize the potential for Level A (PTS onset) harassment of marine mammals by implementing shutdown zones whenever a marine mammal is within a distance as specified by the application and subsequent authorizations;
2. To determine the numbers and species of marine mammals that occur within established Level A (PTS onset) and Level B (behavioral) harassment zones, and to document any differences in species, numbers, or effects relative to project-related in-water activities; and
3. To empirically measure sound source levels for different types of piles and installation/removal methods, as detailed in the application and subsequent authorizations.

The plan was submitted to NMFS on November 19, 2021 with the revised application. This updated plan incorporates changes since the originally issued IHA, including information in the amended IHA and the LOA application. This Plan is valid for take incidental to the specified activities at NAVSTA Norfolk from April 2023 through March 2027.

Figure 1-1 Project Site

1.2 Summary of Activities to be Monitored for Marine Mammals

All relevant in-water construction and demolition activities that have the potential to result in Level A and Level B harassment of marine mammals, including installation of piles via vibratory and impact pile driving, pre-drilling, and removal of piles via vibratory hammers, shall be monitored.

In-water construction and demolition activities under this Plan must comply with all mitigation and minimization measures as detailed in the issued authorization, requested renewal authorization, and Chapter 11 and Chapter 13 of the LOA application (Appendix A) and subsequent authorization:

In-water activities expected to result in incidental takes of marine mammals would occur from April 2022 through March 2027. The estimated duration of noise generating activities for the first year of construction covered under the requested IHA is provided Table 1-1. Table 1-2 lists the estimated schedule for activities under the renewal IHA; and Table 1-3 lists the schedule for activities covered under LOA request.

Table 1-1 In-Water Construction Activities Occurring During IHA Period, April 1, 2022 – March 31, 2023

Location	***Activity***	***Amount and Schedule***	***Type and Size***	***Method[1]***	***Daily Production Rate (Piles/day)***	***Total production Days***
Pier 4	Demolition of Existing Fender Piles	36 fender piles June 2022 – September 2022	14-inch timber	Vibratory Hammer	4	9 days
	Installation of Fender Piles	36 fender piles June 2022 – September 2022	24-inch precast concrete square	Pre-drilling with Impact Hammer OR	6	6 days
				Impact Hammer	12	3 days
Pier 3T	Demolition of Existing Pier 3T	286 bearing piles August 2022 – November 2022	18-inch precast concrete square	Vibratory Hammer	4	72 days
		87 fender piles August 2022 – November 2022	14-inch timber	Vibratory Hammer	4	22 days
CEP-175	Repair Fender System	9 fender piles October 2022 – November 2022	13-inch polymeric	Pre-drilling with Impact Hammer OR	7	2 days
				Impact Hammer OR	7	2 days
				Vibratory Hammer	7	2 days
CEP-102	Demolish Partial Existing Fender System	22 fender piles October 2022 – November 2022	18-inch concrete square	Vibratory Hammer	4	6 days
		9 fender piles October 2022 – November 2022	14-inch timber	Vibratory Hammer	4	3 days
		4 fender piles	13-inch polymeric	Vibratory Hammer	4	1 day
Pier 3	Begin Construction of New Pier 3	300 bearing piles October 2022 – March 2023	24-inch precast concrete square	Impact Hammer	2	150 days
CEP-176	Begin Construction of New Bulkhead	109 bearing piles December 2022 – 30 March 2023	42-inch steel pipe	Impact Hammer OR	2	55 days
				Vibratory Hammer	2	55 days

		221 sheet piles December 2022 – 30 March 2023	28-inch steel sheet	Impact Hammer OR	4	55 days
				Vibratory Hammer	4	55 days
CEP-102	Construction of a Portion of the New Bulkhead	4 bearing piles December 2022 – 30 March 2023	42-inch steel pipe	Impact Hammer OR	2	2 days
				Vibratory Hammer	2	2 days
		8 bulkhead sheet piles December 2022 – 30 March 2023	28-inch steel sheet	Impact Hammer OR	4	2 days
				Vibratory Hammer	4	2 days
		11 bearing piles December 2022 – 30 March 2023	24-inch precast concrete square	Pre-drilling with Impact Hammer OR	2	6 days
				Impact Hammer	2	6 days
Total piles installed, extracted, or drilled		1,138				
Total days pile driving/extraction/drilling						270 days[2,3]

[1]Only one method of installation is likely; however, because the exact means of installation are up to the selected construction contractor, all possibilities have been analyzed.
[2]Total number of days takes into account only the most days possible for each pile type with multiple potential installation methods (i.e. worst case).
[3]The preliminary schedule has work at Pier 4, demo of Pier 3T, start of construction at Pier 3, and work at CEP-175 could potentially occur simultaneously, thus the total days of pile driving/extraction/drilling reflects this assumption.

Table 1-2 In-Water Construction Activities During the Renewal Period from April 1, 2023 – June 30, 2023

Estimated Schedule	*Activity*	*Total Amount and Estimated Dates*	*Activity Component*	*Method*	*Daily Production Rate*	*Total Production Days*
April 1, 2023 – June 30, 2023	CEP-176 Bulkhead	Install 80 bearing piles *Apr-23 to May-23*	42-inch diameter steel pipe	Impact or Vibratory Hammer	4 piles/day	20
April 1, 2023 – June 30, 2023	CEP-176 Bulkhead	Install 160 sheet piles *Apr-23 to May-23*	28-inch wide steel sheet	Impact or Vibratory Hammer	14 piles/day	12
April 1, 2023 – June 30, 2023	CEP-175 Bulkhead	Install 18 fender piles *Apr-23 to May-23*	13-inch dia. polymeric piles	Impact or Vibratory Hammer (Note 1)	5 piles/day	4
April 1, 2023 – June 30, 2023	CEP-102 Platform	Remove 11 fender piles *Apr-23 to Jun-23*	18-inch concrete square	Vibratory Hammer	4 piles/day	3
		Remove 9 fender piles *Apr-23 to Jun-23*	14-inch timber	Vibratory Hammer	4 piles/day	3
		Remove 4 fender piles *Apr-23 to Jun-23*	13-inch polymeric	Vibratory Hammer	4 piles/day	1
April 1, 2023 – June 30, 2023	CEP-102 Platform	Install 6 bearing piles *May-23*	24-inch square precast concrete	Impact Hammer (Note 1)	2 piles/day	3
		Install 4 bearing piles *Apr-23 to Jun-23*	42-inch steel pipe	Impact or Vibratory Hammer	2 piles/day	2

		Install 8 bulkhead sheet piles *Apr-23 to Jun-23*	28-inch steel sheet	Impact or Vibratory Hammer	4 piles/day	2
		Install 11 bearing piles *Apr-23 to Jun-23*	24-inch square precast concrete	Impact Hammer (Note 1)	2 piles/day	6
April 1, 2023 – June 30, 2023	Pier 3	Install 270 bearing piles *May-23 to June-23*	24-inch square precast concrete	Impact Hammer	4 piles/day	68

Table 1-3 In-Water Construction Activities Occurring During LOA Period, April 1, 2023 – March 31, 2027

Estimated Schedule	***Activity***	***Total Amount and Estimated Dates***	***Activity Component***	***Method***	***Daily Production Rate***	***Total Production Days***
April 1, 2023 – March 31, 2024	CEP-176 Bulkhead	Install 103 bearing piles *Apr-23 to May-23*	42-inch diameter steel pipe	Impact or Vibratory Hammer	4 piles/day	26
April 1, 2023 – March 31, 2024	CEP-176 Bulkhead	Install 221 sheet piles *Apr-23 to May-23*	28-inch wide steel sheet	Impact or Vibratory Hammer	14 piles/day	16
April 1, 2023 – March 31, 2024	CEP-175 Bulkhead	Install 9 fender piles *Apr-23 to May-23*	13-inch dia. polymeric piles	Impact or Vibratory Hammer (Note 1)	5 piles/day	2
April 1, 2023 – March 31, 2024	CEP-102 Platform Phase 2 Portion 113-108	Install 11 bearing piles *May-23*	24-inch square precast concrete	Impact Hammer (Note 1)	2 piles/day	6
April 1, 2023 – March 31, 2024	Pier 3	Install 280 bearing piles *May-23 to Sep-23*	24-inch square precast concrete	Impact Hammer	4 piles/day	70
April 1, 2023 – March 31, 2024	CEP-102 Platform Phase 2 Portion 113-108	Install 6 fender piles *Jul-23*	18-inch square precast concrete	Impact Hammer (Note 1)	4 piles/day	2
April 1, 2023 – March 31, 2024	Pier 3	Install 250 bearing piles *Jul-23 to Nov-23*	24-inch square precast concrete	Impact Hammer	4 piles/day	63
April 1, 2024 – March 31, 2025	Pier 3	Install 409 fender piles *Jun-24 to Oct-24*	24-inch precast concrete square	Impact Hammer (Note 1)	6 piles/day	69
April 1, 2024 – March 31, 2025	Pier 3	Install 18 fender piles *Jun-24 to Nov-24*	18-inch diameter steel pipe	Impact Hammer	6 piles/day	3
April 1, 2024 – March 31, 2025	CEP-102 Bulkhead South Portion 188-163	Install 26 bearing piles *Dec-24 to Jan-25*	42-inch diameter steel pipe	Impact or Vibratory Hammer	2 piles/day	13
April 1, 2024 – March 31, 2025	CEP-102 Bulkhead South Portion 188-163	Install 53 sheet piles *Jan-25*	28-inch wide steel sheet	Impact or Vibratory Hammer	14 piles/day	4
April 1, 2024 – March 31, 2025	CEP-102 Bulkhead South Portion 188-163	Extract 26 fender piles *Feb-25*	18-inch square precast concrete	Vibratory Hammer	9 piles/day	3

Estimated Schedule	*Activity*	*Total Amount and Estimated Dates*	*Activity Component*	*Method*	*Daily Production Rate*	*Total Production Days*
April 1, 2025 – March 31, 2026	CEP-102 Platform South Portion 188-163	Install 40 bearing piles *Apr-25 to May-25*	24-inch square precast concrete	Impact Hammer (Note 1)	2 piles/day	20
April 1, 2025 – March 31, 2026	Existing Pier 3	Extract 624 fender piles *Aug-25 to Sep-25*	14-inch diameter timber	Vibratory Hammer	25 piles/day	25
April 1, 2025 – March 31, 2026	CEP-102 Platform South Portion 188-163	Install 25 fender piles *Sept-25*	18-inch square precast concrete	Impact Hammer (Note 1)	4 piles/day	7
April 1, 2025 – March 31, 2026	CEP-102 Bulkhead Center Portion 163-114	Install 50 bearing piles *Sep-25 to Oct-25*	42-inch diameter steel pipe	Impact or Vibratory Hammer	2 piles/day	25
April 1, 2025 – March 31, 2026	Existing Pier 3	Extract 72 fender piles *Sep-25 to Oct-25*	24-inch square precast concrete	Vibratory Hammer	12 piles/day	6
April 1, 2025 – March 31, 2026	CEP-102 Bulkhead Center Portion 163-114	Install 102 sheet piles *Oct-25*	28-inch wide steel sheet	Impact or Vibratory Hammer	14 piles/day	8
April 1, 2025 – March 31, 2026	CEP-102 Bulkhead Center Portion 163-114	Extract 36 fender piles *Nov-25*	18-inch square precast concrete	Vibratory Hammer	9 piles/day	4
April 1, 2025 – March 31, 2026	Existing Pier 3	Extract 873 bearing piles *Nov-25 to Mar-26*	16-inch and 18-inch square precast concrete	Vibratory Hammer	10 piles/day	88
April 1, 2025 – March 31, 2026	CEP-102 Platform Center Portion 163-114	Install 41 bearing piles *Feb-26 to Mar-26*	24-inch square precast concrete	Impact Hammer (Notes 1)	2 piles/day	21
April 1, 2026 – March 31, 2027	Existing Pier 3	Extract 30 bearing piles *Apr-26*	16-inch and 18-inch square precast	Vibratory Hammer	10 piles/day	3
April 1, 2026 – March 31, 2027	CEP-102 Platform Center Portion 163-114	Install 32 bearing piles *April-26*	24-inch square precast concrete	Impact Hammer (Notes 1)	2 piles/day	16
April 1, 2026 – March 31, 2027	CEP-102 Platform Center Portion 163-114	Install 50 fender piles *April-26*	18-inch square precast concrete	Impact Hammer (Note 1)	4 piles/day	13
	Total piles installed/removed	1,726/1,661				

Source: NAVFAC Midlant 2022

Notes: 1 - Pre-drilling is permitted to assist with pile installation; Estimated construction schedule as delays may occur due to equipment failure or weather.

Detailed acoustic modeling is included in Appendix A (Acoustic Transmission Loss Modeling) and estimated numbers of species takes are included in the issued amended IHA, issued IHA renewal, and LOA application (see Appendices of this Plan).

1.3 Mitigation Measures

The following mitigation measures, as specified in the submitted application and anticipated authorization, shall be implemented during in-water noise generating activities to minimize Level A and Level B harassment.

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

2. **Soft Start**: The contractor shall utilize a “soft start” procedure to provide a warning and/or give animals in proximity to pile driving the opportunity to leave the area prior to an impact driver operating at full capacity. The soft start shall be accomplished by providing an initial set of strikes from the impact hammer at reduced energy, followed by a 30-second waiting period, then two subsequent sets. The soft start procedure shall be used for impact pile driving at the beginning of each day’s in-water pile driving or any time pile driving has ceased for more than 30 minutes.

   The reduced energy of an individual hammer cannot be quantified because they vary by individual drivers. Also, the number of strikes will 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.”

3. **Visual Monitoring and Shutdown Procedures**: The Contractor shall abide by this revised Marine Mammal and Hydroacoustic Monitoring Plan, which incorporates changes resulting from the amended IHA, IHA renewal, and LOA request. At a minimum, the monitoring must include the following:

   The monitoring shall be implemented and shutdown procedures shall be put into effect if a marine mammal were to approach the shutdown zone for the activity being conducted. Impacts are expected to be insignificant and no injury would be expected, as monitors must ensure the shutdown zone is clear of mammals before the start of in-water noise generating activities. Proposed monitoring zones are provided in Table 11-1 of the submitted application (Appendix A). The minimum monitoring zone is equivalent to the general construction shutdown zone described below.

   - For humpback whales, work must stop any time the species is sighted approaching the humpback whale Level A harassment zones. This approach will prevent the need for Level A takes for this species.
   - For all impact and vibratory pile driving and drilling, shutdown zones would be as specified in Table 1-3 for individual activities under the IHA and IHA renewal; Table 1-4 for concurrent activities under the IHA and IHA renewal; Table 1-5 for individual activities under the LOA; and Table 1-6 for concurrent activities under the LOA. These shutdown zones will help to reduce injury to marine mammals. The shutdown zones will be monitored at all times and work must stop as soon as safely possible if an animal is seen approaching these zones.

- To record takes, the entire Level A (PTS onset) zones beyond the specified shutdown zones and a portion of the Level B (behavioral) harassment zones will be visually monitored. The largest Level A (PTS) onset zone is 2,123 m during the impact pile driving of 28-inch steel sheet piles (Table 6-5).
- In order to prevent injury from physical interaction with construction equipment, a general construction shutdown zone of 10 m or 33 ft. shall 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. These activities could include but are not limited to 1) barge positioning, 2) dredging, or 3) pile driving. For some sound-generating activities, the potential for Level A (PTS onset) harassment by acoustic injury extends less than 10 m from the source, and for these activities, the shutdown zone automatically mitigates/minimizes Level A (PTS onset) harassment.
- Visual monitoring shall be conducted by experienced personnel 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]). For activities that require multiple PSOs, the Contractor will identify a lead PSO. The lead PSO shall have experience working as a PSO on a project subject to a NMFS incidental take authorization.
- 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 pile driving, the noise producing activity must cease. If such circumstances recur, the Navy will consult with NMFS concerning the potential need for an additional take authorization.
- Pile driving will cease if any marine mammal is detected in or approaching the Level A shutdown zones. If a marine mammal is observed in the Level B (behavioral) harassment zone or the Level A (PTS onset) harassment zone beyond the shutdown zones, but not approaching or entering the shutdown zone, a take will be recorded, and the work will be allowed to proceed without cessation.
- All species that enter either the Level A (PTS onset) harassment or Level B (behavioral) harassment zones shall be monitored and documented, with the PSO estimating the amount of time the animal spends within the Level A or Level B zone while pile driving is underway.
- In the event of a shutdown, pile driving shall 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 must 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 shall be monitored for 30 minutes to ensure that the zones are clear of marine mammals. Pile driving will only commence once observers have declared the shutdown zone clear of marine mammals.
- Monitoring shall be conducted by, at a minimum, a two-person PSO team designated by the construction contractor. Given the configuration of the ZOIs, which vary depending on the pile type/size and the pile driver type (see harassment zone figures in the applications), it is assumed that two PSOs would be sufficient to monitor the ZOIs for

impact drivers, and three to four PSOs would be sufficient to monitor the ZOIs for vibratory drivers. However, additional monitors may be added if warranted by the level of marine mammal activity in the area. PSOs shall be placed at the best vantage point(s) practicable (Figure 1-2) to monitor for marine mammals and implement shutdown/delay procedures when applicable by calling for the shutdown by the pile driver operator.

Table 1-4 Shutdown Zone Distances for Individual Activities Under the IHA and IHA Renewal

Pile type, size, and driving method	Level A Shutdown Distance (m) for Humpback Whales[1]	Level A Shutdown Distance (m) for Harbor Porpoise	Level A Shutdown Distance (m) for all other Species
Vibratory drive 14-inch timber piles	30	30	30
Vibratory drive 13-inch polymeric piles	30	30	30
Impact drive 13-inch polymeric piles	30	30	30
Vibratory drive 16-inch and 18-inch concrete piles	30	30	30
Impact drive 16-inch and 18-inch concrete piles	45	45	45
Vibratory drive 24-inch concrete piles	10	10	10
Impact drive 24-inch concrete piles	160	500[2]	200[2]
Vibratory drive 28-inch steel sheet piles	65	65	65
Impact drive 28-inch steel sheet piles	775	500[2]	200[2]
Vibratory drive 42-inch steel pipe piles	50	120	50
Impact drive 42-inch steel pipe piles	1,005	500[2]	200[2]
Pre-Drilling	10	10	10

Notes: 1. Shutting down to the max Level A threshold for humpback whales will result in no Level A takes to the species.

2. Distances negotiated with NMFS during consultation.

Table 1-5 Shutdown Zone Distances for Concurrent Activities Under the IHA and IHA Renewal

Pile type, size, and driving method	Level A Shutdown Distance (m) for Humpback Whales[1]	Level A Shutdown Distance (m) for Harbor Porpoise	Level A Shutdown Distance (m) for all other Species
Vibratory remove two 14-inch timber piles	55	55	35
Vibratory remove 18-inch concrete and 14-inch timber piles	55	55	35

Vibratory remove 14-inch timber and 18-inch concrete piles at Pier 3T and rotary drill for 24-inch concrete piles at Pier 4	60	60	35
Vibratory remove 14-inch timber piles at Pier 3T and vibratory install 42-inch pipe at either CEP-176 or CEP-102	200	200	50
Vibratory remove 18-inch concrete at Pier 3T and vibratory install 42-inch pipe at either CEP-176 or CEP-102	200	200	50
Vibratory remove 14-inch timber piles at Pier 3T and rotary drill for 24-inch concrete piles at new Pier 3	45	45	30
Vibratory remove 14-inch timber piles at Pier 3T and rotary drill for 24-inch concrete piles at new Pier 3	45	45	30
Vibratory remove 18-inch concrete piles at Pier 3T and rotary drill for 24-inch concrete piles at new Pier 3	45	45	30

Notes: 1. Shutting down to the max Level A threshold for humpback whales will result in no Level A takes to the species.

Table 1-6 Shutdown Zone Distances for Individual Pile Driving Activities Under the LOA

Estimated LOA Year[1]	*Pile type, size, and driving method*	*Level A Shutdown Distance (m) for Humpback Whales*[2]	*Level A Shutdown Distance (m) for Harbor Porpoise*	*Level A Shutdown Distance (m) for all other Species*
Year 2	Impact Install 42-inch steel pipe piles	1,490	500[3]	200[3]
	Vibratory Install 42-inch stee pipe piles	140	200	70
	Impact Install 28-inch steel sheet piles	1,790	500[3]	200[3]
	Vibratory Install 28-inch steel sheet piles	110	150	80
	Impact Install 13-inch polymeric piles	20	30	30
	Vibratory Install 13-inch polymeric piles	20	30	30
	Impact Install 24-inch precast concrete bearing piles	260	500[3]	200[3]
	Impact Install 18-inch precast concrete fender piles	10	10	10
	Pre-drilling	10	10	10
Year 3	Impact Install 24-inch precast concrete fender piles	40	50	30
	Impact Install 18-inch steel piles	700	500[3]	200[3]
	Impact Install 42-inch steel pipe piles	1,010	500[3]	200[3]
	Vibratory Install 42-inch steel pipe piles	90	120	50
	Impact Install 28-inch steel sheet piles	1,790	500[3]	200[3]
	Vibratory Install 28-inch steel sheet piles	110	150	70
	Vibratory Extract 18-inch precast concrete fender piles	40	60	30
	Pre-drilling	10	10	10
Year 4	Impact Install 24-inch precast concrete bearing piles	120	150	70
	Vibratory Extract 14-inch timber piles	70	110	50
	Impact Install 18-inch precast concrete fender piles	10	10	10
	Impact Install 42-inch steel pipe piles	1,010	500[3]	200[3]
	Vibratory Install 42-inch steel pipe piles	90	120	50
	Vibratory Extract 24-inch concrete fender piles	50	70	30
	Impact Install 28-inch steel sheet piles	1,790	500[3]	200[3]
	Vibratory Install 28-inch steel sheet piles	120	150	70
	Vibratory Extract 18-inch precast concrete fender piles	40	60	30
	Vibratory Extract 16-18-inch precast concrete bearing piles	40	60	30
	Pre-drilling	10	10	10
Year 5	Vibratory Extract 16-18-inch precast concrete bearing piles	40	60	30
	Impact Install 24-inch precast concrete bearing piles	120	150	70
	Impact Install 18-inch precast concrete fender piles	10	10	10
	Pre-drilling	10	10	10

Notes: 1. Activities per LOA year are estimated as some activities may shift due to schedules and delays

2. Work will shut down if a humpback whale is sighted in any Level A zone, therefore, there would be no Level A takes of this species.

3. Shut down zones agreed to with NMFS during project discussions.

Key: m = meter

Table 1-7 Shutdown Zone Distances for Concurrent Pile Driving Activities Under the LOA

Estimated LOA Year[1]	*Pile type, size, and driving method*	*Level A Shutdown Distance (m) for Humpback Whales*[2]	*Level A Shutdown Distance (m) for Harbor Porpoise*	*Level A Shutdown Distance (m) for all Phocids*	*Level A Shutdown Distance (m) for*
Year 2	Install of 42-inch steel pipe and 28-inch steel sheets	550	500	100	50
Year 2	Install of two 42-inch steel pipe piles	320	475	100	30
Year 2	Install of 42-inch steel pipe and 24-inch Square precast concrete	170	250	100	15
Year 2	Install of 42-inch steel pipe piles and 13-inch polymeric piles	255	380	100	25
Year 3	Install of 24-inch Square precast concrete fender piles	10	10	10	10
Year 3	Install of 42-inch steel pipe and 28-inch steel sheets	510	500	100	50
Year 4	Extraction of 14-inch timber piles, install of 42-inch steel pipe	985	500	100	90
Year 5	Concurrent extraction of 16- and 18-inch Square	80	120	50	80

Notes: 1. Activities per LOA year are estimated as some activities may shift due to schedules and delays.

Figure 1-2 Potential Protected Species Observer Locations

Chapter 2. Monitoring Zones

2.1 Level A and Level B Harassment Monitoring Shutdown Zones

Level A and Level B harassment zones are shown in Appendix A, as well as in the individual applications. Monitoring zones are based on consultation with NMFS for this project.

2.2 Observer Monitoring Locations

To effectively monitor the Level A and Level B harassment zones, PSOs shall be positioned at the best practicable vantage points, taking into consideration security, safety, and space limitations. Potential PSO locations are shown on Figure 1-2. The actual number of PSOs may vary depending on the construction activity and the size of the Level A and Level B harassment zones for the activity.

Chapter 3. Visual Monitoring Protocols

The visual monitoring components of this Plan take into consideration the logistical, environmental, and security requirements for working in the project area. The distances to the Level A and Level B harassment boundaries are used to determine monitoring locations for the activities associated with this Plan.

3.1 Protected Species Observer Qualifications

The PSOs must meet NMFS qualifications for PSOs: either be biologists with prior training and experience to meet the qualifications in conducting marine mammal monitoring, professional PSOs with certification (i.e., Protected Species Observer), recognized membership in a professional organization (i.e., Marine Mammal Observer Association), or may substitute education (undergraduate degree in biological science or related field) or training for experience. The PSO (or lead PSO if multiple PSOs required) must have had prior experience working as a PSO on construction projects subject to a NMFS take authorization. PSOs must be approved by NMFS and resumes for each PSO must be provided showing the relevant qualifications for acting as a PSO. The construction Contractor shall attached PSO resumes as an appendix to this plan for submission to NMFS.

All PSOs shall be independent of the activity contractor (for example, employed by a subcontractor) and have no other assigned tasks during monitoring periods. PSOs must have the ability to correctly identify the marine mammal species potentially present in the action area and accurately describe the relevant species-specific behaviors that may occur in proximity to in-water construction activities.

Additional qualifications and protocols of PSOs include the following:

- Must have the ability to conduct field observations and collect data according to the assigned protocol.
- Where a team of multiple PSOs are required, one observer shall be designated as lead observer throughout the duration of the project. The lead PSO must have had prior experience working as an observer on construction projects.
- All credentials for assigned PSOs shall be submitted to the Navy for approval
- All PSOs working on this project must attend a training brief by the Installation Natural Resources Manager (NRM) that will include the following:
    - Navy's Marine Species Awareness Training video shall be shown
    - Harassment zones that must be monitored and locations where PSOs must be stationed
    - Species for takes have been authorized
    - Monitoring and data collection protocols
    - Reporting protocols to ensure take limit is not exceeded
    - Reporting protocols to NMFS in accordance with the issued authorization

- Must have experience or training in the field identification of marine mammals, including the identification of behaviors
- Must have visual acuity in both eyes (correction is permissible) sufficient for discernment of moving targets at the water's surface with ability to estimate target size and distance. Use of binoculars may be necessary to correctly identify the target.
- Must have sufficient training, orientation, or experience with the construction operation to provide for personal safety during observation periods.
- Must have writing skills sufficient to prepare a report of observations including but not limited to the number and species of marine mammals observed, dates and times when in-water construction activities were conducted, dates and times when in-water construction activities were suspended to avoid potential incidental injury from construction sound of marine mammals observed within a defined zone, and marine mammal behavior.
- Ability to communicate orally, by radio or in person, with project personnel to provide real-time information on marine mammals observed in the area as necessary.

3.2 Visual Monitoring

Based on the requirements identified in the issued IHA and IHA renewal, as well as the anticipated LOA, a minimum of two PSOs would be utilized for impact pile driving activities and 3-4 PSOs would be used for vibratory driving and drilling activities. Additional PSOs may be necessary depending on the size of the Level A and Level B harassment zones for the specific activity that is occurring. These PSOs could potentially be stationed at Pier 1, Pier 2 Pier 3, Pier 8, Pier 14, or the north jetty, depending on the size of the zones in order to best monitor each harassment zone. PSOs will be required to be stationed on elevated platform(s) with the exception of the north jetty, which does not allow access for a lift.

3.2.1 Equipment

The following equipment shall be required to conduct visual monitoring:

- Laser rangefinders used to measure distances to known objects as reference points for distances to marine mammals observed in the water
- Portable marine radios for the observers to communicated with the lead PSO, construction contractor and other observers
- Hearing protection for all personnel near the sound source. Depending on observer locations relative to the sound source, and the subsequent airborne source levels, a noise-reducing headset with capabilities to connect to a radio may be used
- Cellular phones (one per PSO location), and the contact information for the lead observer, other observers, and construction contractor
- Nautical charts
- Daily tide table for the project area
- Watch or chronometer
- Standard handheld binoculars and, if needed, high magnification binoculars
- Monitoring plan, Level A and B harassment zone figures, and/or other relevant permit requirement specifications in sealed transparent plastic cover
- Data collection sheets with plastic cover (waterproof paper recommended)
- Marine mammal identification guides (waterproof paper recommended)
- Clipboard
- Pen/Pencil (capable of writing in rain)
- Elevated platform(s)

3.3 Visual Monitoring Methods

Prior to the start of all in-water noise generating activities, briefings shall be conducted between the Navy, the construction contractor, and the PSO team. Briefings shall be conducted any time new personnel join the work. These briefings will explain responsibilities, communication procedures, visual monitoring protocols, and operational procedures. All PSOs must attend the training brief described above in Section 3.1.

The PSOs are tasked with collecting marine mammal sighting data, including behaviors noted for pre-, during-, and post-pile driving periods. All observations of marine mammals shall be logged, with locations within the Level A or Level B harassment zone or shutdown zone noted. An assessment of take must occur if an animal or group of animals enters any of the Level A or Level B harassment zones during project-related activities. The efficacy of visual detection depends on factors such as the PSOs ability to detect the animal, the environmental conditions (visibility and sea state), and monitoring platforms. Pre-, during-, and post- noise generating activity visual survey protocols are described below.

3.3.1 Visual Survey Protocols

The following survey protocols shall be implemented prior to the start of noise generating activities:

3.3.1.1 Pre-Activity Monitoring

- The Level A (PTS onset) and Level B (behavioral) harassment zones and the shutdown zones shall be monitored for 30 minutes prior to in-water construction/demolition activities. If a marine mammal is present within the shutdown zone, the activity shall be delayed until the animal(s) leave the shutdown zone. Activity will resume only after the PSO has determined that, through sighting or by waiting approximately 15 minutes, the animal has moved outside the shutdown zone. If a marine mammal is observed approaching the shutdown zone, the PSO who sighted that animal must notify the shutdown PSO of its presence.

3.3.1.2 During-Activity monitoring

- During Activity Monitoring: If a marine mammal is observed entering the Level B (behavioral) harassment zone or the Level A (PTS onset) harassment zone beyond the shutdown zones, but not approaching or entering the shutdown zone, a take will be recorded, and the work will be allowed to proceed without cessation unless the animal enters or approaches the Level A (PTS onset) shutdown zone, at which point all pile driving activities shall be halted. If an animal is observed within the shutdown zone during pile driving, then pile driving shall be stopped as soon as it is safe to do so. Pile driving can only resume once the animal has left the Level A (PTS onset) shutdown zone of its own volition or has not been re-sighted for a period of 15 minutes.

3.3.1.3 Post-Activity Monitoring

- Post-Activity Monitoring: Monitoring of the Level A (PTS onset) and Level B (behavioral) harassment zones must continue for 30 minutes following the completion of the activity.

3.4 Data Collection

PSOs must use approved sighting forms (Appendix C). At a minimum, the following information shall be collected on the sighting forms:

- Date and time that noise generating activities begin and end
- Construction activities occurring during each observation period
- Weather parameters identified in the acoustic monitoring (i.e., wind, humidity, temperature)
- Tide state and water currents
- Visibility
- Species, numbers, and, if possible, sex and age class of marine mammals
- Marine mammal behavior patterns observed, including bearing and direction of travel, and, if possible, the correlation to SPLs
- Distance from pile driving activities to marine mammals and distance from the marine mammal to the observation point
- Estimated amount of time an animal spends within the Level A or Level B harassment zones while noise generating activities are underway
- Locations of all marine mammal observations
- Other human activity in the area

To the extent practicable, PSOs must record behavioral observations that may make it possible to determine whether the same or different individuals are being taken as a result of project activities over the course of a day.

The Lead PSO shall be responsible for consistency in data collection and shall consult with the NAVFAC Construction Manager (CM) and the Installation NRM to ensure consistency and oversight on the data collection. The Contractor and/or Lead PSO must update the CM and NRM monthly to keep them abreast of the current take estimate, ensuring authorized takes are not exceeded. Should the project "take" 80% of the authorized takes for a species, the NRM shall be immediately notified. The NRM will in turn notify the Region SME in order to coordinate additional takes with NMFS.

Chapter 4. Hydroacoustic Monitoring Plan

This section comprises the hydroacoustic monitoring plan for the Pier 3 Demolition and Reconstruction. The applications and authorizations issued for this project stipulate the number and types of piles and activities for which the project must collect acoustic data. Data under the first year of construction that was not collected due to construction delays will be collected during subsequent years of construction.

4.1 Objectives

The purpose of hydroacoustic monitoring, or sound source verification (SSV), is to characterize underwater noise from pile driving activities during various types of pile driving, extraction, and drilling associated with this project. Data collected shall be reported to NMFS, as required by the issued authorization. Data collected can also be used in future environmental planning and consultation documents.

4.2 Survey Locations

Monitoring shall include two underwater positions and shall be conducted in accordance with NMFS guidance (NMFS 2012). One underwater location shall be at the standard 10 meters from the sound source, while the other positions shall be located at a distance of at least 20x water depth at the pile. **(If the Contractor determines that this distance interferes with shipping lanes or vessel traffic, or if there**

is other reasons why this criteria cannot be achieved, the Plan must offer an alternate site as close to the criteria as possible and be resubmitted to NMFS for approval).

4.3 Temporal Considerations

Measurements shall be collected as detailed in the issued authorizations for this project (Appendix A) for each pile type during the entire pile-driving/extracting/drilling event, but during data analysis, only the periods of maximum hammer energy shall be characterized. Maximum hammer energy is characterized by removing starts (ramp up of hammer energy) and stops (ramp down of hammer energy) from data being analyzed.

4.4 Monitoring Equipment Proposed for Use

The recording equipment shall be capable of recording the minimum bandwidth required per NMFS 2012 guidelines. For this project, the specific equipment that shall be used for acoustic monitoring is yet to be determined as the construction contractor has not been selected. Once they are onboard, they will provide equipment specifications for NMFS' approval.

4.5 Data Processing

Acoustic monitoring must include the measurement of peak sound pressures, root-mean-square sound pressure levels (RMS) and sound exposure levels (SEL). Different data processing is required to characterize source levels for vibratory pile driving than for impact driving. For vibratory pile driving, characterize overall dB RMS levels by taking 10 sec averages across the whole event and averaging all the 10 sec periods. Averaging 10 sec periods will likely capture the variation in sound levels over the pile-driving event. For impact pile driving, characterize overall dB RMS levels by integrating sound for each waveform across 90% of the acoustic energy in each wavy (using the 5-95 percentiles to establish the 90% criterion) and averaging across all waves in the pile-driving event.

The underwater acoustic recordings or measured data shall be analyzed to provide peak, RMS, and SEL sound pressure levels along with narrow or 1/3rd octave band frequency spectra.

Chapter 5. Interagency Notification for Injured or Dead Marine Mammals

In the unanticipated event that the specified activity clearly causes the take of a marine mammal in a manner prohibited by the issued authorization, such as a serious injury, or mortality, the contractor must immediately cease the specified activities and report the incident to the NMFS Office of Protected Resources and Greater Atlantic Region Stranding Coordinator (866-755-6622). The report must include the following information:

1. Time and date of the incident
2. Description of the incident
3. Environmental conditions (i.e., wind speed and direction, Beaufort sea state, cloud cover, and visibility)
4. Description of all marine mammal observations and active sound source use in the 24 hours preceding the incident
5. Species identification or description of the animal(s) involved
6. Fate of the animal(s)
7. Photographs or video footage of the animal(s)

Activities must not resume until NMFS is able to review the circumstances of the prohibited take. NMFS will work with the Navy to determine what measures are necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. The Navy may not resume their activities until notified by NMFS.

In the event the contractor discovers an injured or dead marine mammal, and the lead PSO determines that the cause of the injury or death is unknown and the death is relatively recent (i.e., in less than a moderate state of decomposition), the Navy must immediately report the incident to the Office of Protected Resources, NMFS, and the Greater Atlantic Coast Region Stranding Coordinator. The report must include the same information identified above. Activities may continue while NMFS reviews the circumstances of the incident. NFMS will work with the Navy to determine whether additional mitigation measures or modifications to the activities are appropriate.

In the event the contractor discovers an injured or dead marine mammal, and the lead PSO determines that the injury or death is not associated with or related to the specified activities (i.e., previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), the Navy must report the incident to the Office of Protected Resources, and the Greater Atlantic Coast Region Stranding Coordinator within 24 hours of the discovery.

All incidences of injured or dead marine mammals must be coordinated with Region SME and OPNAV N4I, in addition to the agency notifications above. The Installation NRM should reach out to the Region SME with all of the details of the report. The Region SME will coordinate with OPNAV N4I.

Chapter 6. Reporting

Monitoring reports shall be provided to NMFS as specified in and in accordance with the issued authorizations. **Reports shall be submitted to the Navy 30 days before the due date to NMFS for internal Navy review**. The reporting procedures are summarized below.

6.1 Annual Reports

A draft report for all visual and acoustic monitoring for the first year of construction was submitted to NMFS on February 2, 2023. No comments were received from NMFS, therefore the report for Year 1, from April 1, 2022 – December 31, 2023 is considered final.

Hydroacoustic monitoring that was not conducted in Year 1 in accordance with the issued authorization will be completed and included in future reports. A draft report for all visual and acoustic monitoring completed during the IHA renewal period will be submitted within 90 days of the completion of monitoring under the renewal, and will include data captured from the date of preparation of the first report, from January 1, 2023 through March 31, 2023. **This report will be due to NMFS on June 30, 2024 and therefore shall be submitted to the Navy for review no later than May 31, 2024.**

The anticipated LOA coverage was requested to begin on April 1, 2023. Under the LOA, reports must be submitted annually for all visual and acoustic monitoring within ninety calendar days after each activity year, starting in April 2024; therefore, **a report under the LOA will be due to NMFS on June 30, 2024 which shall be submitted to the Navy for review no later than May 31, 2024**. The Contractor may combine the reports for the IHA renewal and the first year of construction under the LOA into one report.

This report must contain the informational elements from the application, including, but not limited to:

1. Dates and times (begin and end) of all marine mammal monitoring
2. Construction activities occurring during each daily observation period, including how many and what type of piles were driven or removed and by what method (i.e., impact or vibratory)

3. Weather parameters and water conditions during each monitoring period (e.g., wind speed, percent cover, visibility, sea state)
4. The number of marine mammals observed, by species, relative to the pile location and if pile driving or removal was occurring at time of sighting
5. Age and sex class, if possible, of all marine mammals observed
6. PSO locations during marine mammal monitoring
7. Distances and bearings of each marine mammal observed to the plie being driven or removed for each sighting (if pile driving or removal was occurring at time of sighting).
8. Description of any marine mammal behavior patterns during observation, including direction of travel
9. Number of individuals of each species (differentiated by month as appropriate) detected within the monitoring zone, and estimates of number of marine mammals take, by species (a correction factor may be applied to total take numbers, as appropriate)
10. 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.
11. Description of attempt to distinguish between the number of individual animals taken and the number of incidences of take, such as ability to track groups or individuals

Annual reports must also include results from all acoustic monitoring conducted during the reporting period, in accordance with the details in Chapter 4 of this Plan.

NMFS will provide comments within thirty days of receipt of the annual report and the Navy will address the comments and submit revisions within thirty days after receiving NMFS comments. If no comment is received from NMFS within thirty days, the annual report is considered final/completed.

6.2 Final Report

A draft comprehensive final report summarizing all monitoring conducted under the authorizations for this project must be submitted within ninety calendar days of the completion of the project. **Assuming no subsequent authorizations will be required, this comprehensive summary report will be due to NMFS by June 1, 2027. The Contractor must submit this report to the Navy for review by May 31, 2027**. NMFS will have 30 days to comment on this final comprehensive report and the Navy shall prepare a final report within thirty days following resolution of comments on the draft report from NMFS. This report must contain the informational elements from the application, including, but not limited to:

1. Dates and times (begin and end) of all marine mammal monitoring
2. Construction activities occurring during each daily observation period, including how many and what type of piles were driven or removed and by what method (i.e., impact or vibratory)
3. Weather parameters and water conditions during each monitoring period (e.g., wind speed, percent cover, visibility, sea state)
4. The number of marine mammals observed, by species, relative to the pile location and if pile driving or removal was occurring at time of sighting
5. Age and sex class, if possible, of all marine mammals observed
6. PSO locations during marine mammal monitoring
7. Distances and bearings of each marine mammal observed to the plie being driven or removed for each sighting (if pile driving or removal was occurring at time of sighting).
8. Description of any marine mammal behavior patterns during observation, including direction of travel

9. Number of individuals of each species (differentiated by month as appropriate) detected within the monitoring zone, and estimates of number of marine mammals take, by species (a correction factor may be applied to total take numbers, as appropriate)
10. 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.
11. Description of attempt to distinguish between the number of individual animals taken and the number of incidences of take, such as ability to track groups or individuals.

Literature Cited

NMFS 2012. Guidance Document: Data Collection Methods to Characterize Impact and Vibratory Pile Driving Source Levels Relevant to Marine Mammals. Memo from NMFS Northwest Region and Northwest Fisheries Science Center to Interested Parties. January 31, 2012.

Appendix A: Acoustic Transmission Loss Modeling

UNDERWATER ACOUSTIC TRANSMISSION LOSS MODELING & TAKE ANALYSIS WORK PLAN

TO

REPLACE SUBMARINE PIER 3

AT THE

NAVAL STATION NORFOLK

NORFOLK, VIRGINIA

NAVAL FACILITIES ENGINEERING SYSTEMS COMMAND

MID-ATLANTIC, NORFOLK, VIRGINIA

OCTOBER 2021

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UNDERWATER ACOUSTIC TRANSMISSION LOSS MODELING, & TAKE ANALYSIS WORK PLAN TO REPLACE SUBMARINE PIER 3

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ACRONYMS & ABBREVIATIONS

ANSI ------------------------ American National Standards Institute;

dB --------------------------- Decibel(s);

$dB_{re1\mu Pa}$ --------------------- dB Referenced To A Pressure Of 1 microPascal (Measures Underwater Sound Pressure Levels);

$dB_{re1\mu Pa2\text{-}sec}$ ---------------- dB Referenced To A Pressure Of 1 microPascal Squared Per Second (Measures Underwater Sound Level Exposure);

dB_{pk} ------------------------ Peak Pressure;

dB SEL_{cum} ------------------ Cumulative Sound Exposure Level;

DPS ------------------------ Distinct Population Segment;

ESA ------------------------ Endangered Species Act;

GIS -------------------------- Geographical Information Systems;

dB_{peak} ----------------------- Instantaneous Peak Sound Pressure Level In Decibels (Can Apply To Either Airborne Or Underwater Sound);

kHz -------------------------- Kilohertz;

MMPA --------------------- Marine Mammal Protection Act;

NAVSTA -------------------- Naval Station;

Navy ------------------------ Department of the Navy;

NMFS --------------------- National Marine Fisheries Service;

PTS -------------------------- Permanent Threshold Shifts;

RMS ------------------------ Root Mean Square;

SEL -------------------------- Sound Exposure Level;

SPL -------------------------- Sound Pressure Level;

PTS -------------------------- Permanent Threshold Shift;

TTS -------------------------- Temporary Threshold Shift;

µPa ------------------------ MicroPascal(s);

WFA ------------------------ Weighting Factor Adjustment;

ZOI -------------------------- Zone Of Influence

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1.0 OVERVIEW:

The United States Department of the Navy (Navy) proposes to replace Pier 3 at Naval Station (NAVSTA) Norfolk in Norfolk, Virginia (**Figure 1)**. The proposed replacement of Pier 3 would require the removal of the existing Piers 3 and 3T, construction of new bulkhead and wharf, construction of new bulkhead with relieving platform, temporary outfitting of Pier 4 for submarine berthing, new dredging, and Antiterrorism Force Protection requirements.

Figures 2 and 3 identify the pier structure footprints to be demolished, constructed, and what will remain. The acoustic model will analyze pile driving associated with the construction of the new fuel pier. All existing structural and fender piles at pier 3 and pier 3T would be completely extracted, and existing fender piles at Pier 4 would be removed in 6 places. Vibratory extraction would be utilized for pile removal.

The Pier 3 replacement is needed because the existing Pier 3 is deficient and does not meet current or future submarine berthing requirements. Constructed in 1944 to support Convoy Escort Ships used during WWII, Pier 3 cannot meet the requirements to support multiple Virginia Class submarines. Pier 3 was not intended to berth modern nuclear submarines and is currently operating over 30 years beyond its original expected life. Without the recapitalization of Pier 3, the Navy's mission would be compromised.

The goal of this task is to develop a rigorous, defensible model of underwater transmission loss from project activities for the purpose of mapping zones of influence (ZOIs) within which "takes" of marine mammals, as defined under the Marine Mammal Protection Act (MMPA), can be anticipated. The Acoustic Transmission Loss Modeling effort will also support the analysis of project effects on Endangered Species Act (ESA)-listed fish and sea turtle species and Essential Fish Habitat.

The key components of this analysis include (1) the definition of acoustic source levels; (2) mathematical models and assumptions for acoustic transmission loss from the source; (3) the application of thresholds for different levels of effect on marine mammals and other species to determine the distances within which those thresholds are exceeded; (4) mapping the resulting model of acoustic transmission loss onto the project area using geographical information systems (GIS) to quantify the areas of ZOIs; and (5) use of appropriate density data to calculate the number of takes that may occur within the ZOIs.

This submittal presents Cardno's proposed Work Plan as well as preliminary results (See Appendix A). The proposed approach is consistent with that used in recent Navy applications for Incidental Harassment Authorization and Letter of Authorization for similar construction activities at Navy installations on the Atlantic and Pacific coasts. A glossary of acoustical terms is provided in Section 7 at the end of the plan.

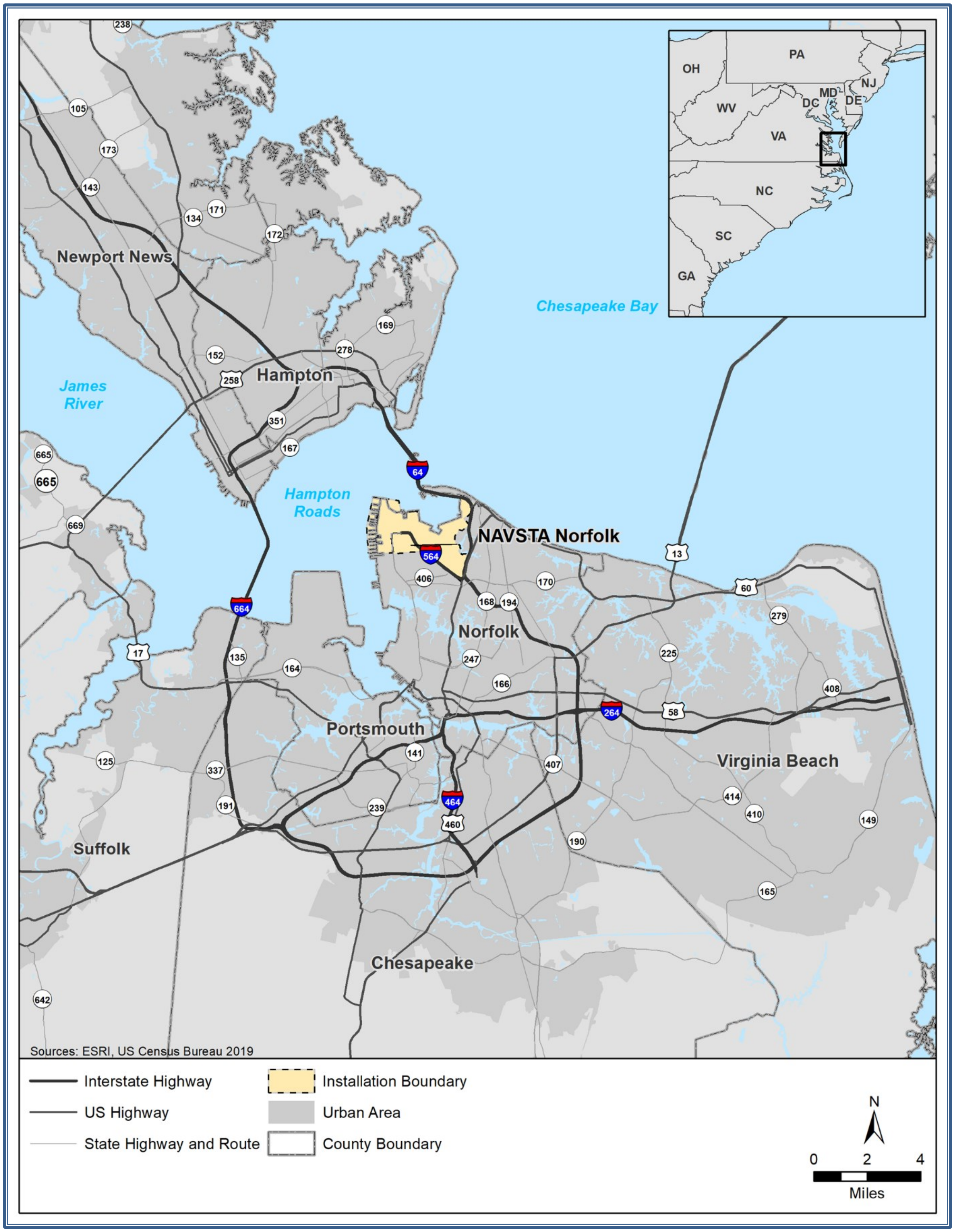

Figure 1: Project Location Map

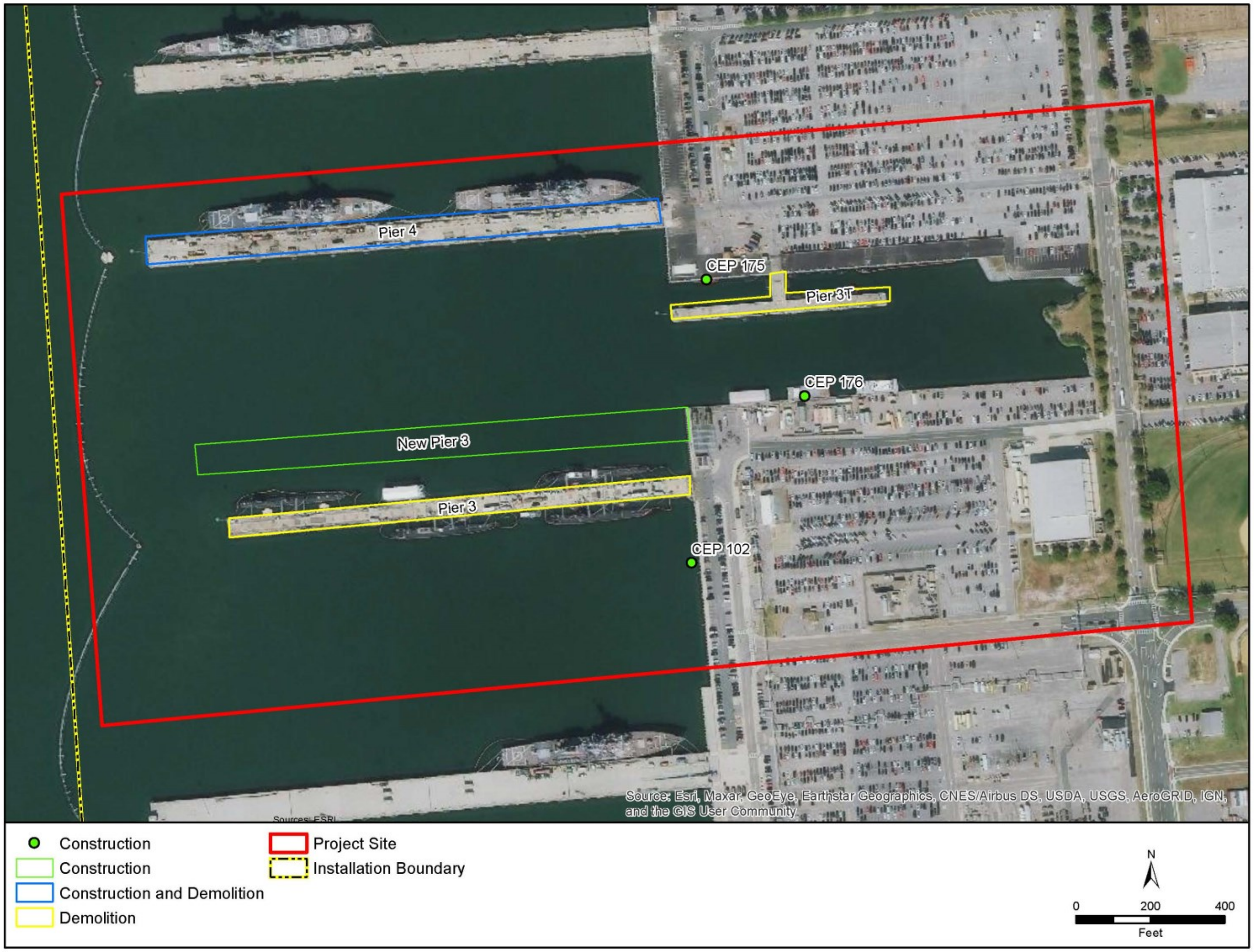

Figure 2: Proposed Construction & Demolition

2.0 Species To Be Assessed:

Species proposed to be assessed for impacts from acoustic sources are listed in **Table 1**. The list includes all ESA-listed or otherwise protected marine mammal, sea turtle, and fish species determined to have a reasonable possibility of presence within the project's acoustic ZOI where exposure to underwater sound could result in a "take" by harassment under the MMPA or ESA. The list includes all species that have the potential to occur within the water bodies of or vicinity of the project area (Elizabeth River and Hampton Roads). Potential presence of species is based on Marine Mammal Stock Assessment Reports in the Atlantic (Waring et al. 2016) and the Request for Letter of Authorization (LOA) for Incidental Harassment of Marine Mammals for NAVSTA Norfolk Marine Structure Maintenance, Pile Replacement, and Select Waterfront Improvements (Navy 2020). The Navy's Marine Species Density Database (Navy 2017) was also reviewed. Further analysis will determine which of these species can be screened out based on extremely low density and discountable likelihood of take.

Table 1: Species To Be Assessed For Impacts From Acoustic Sources

Common Name	Scientific Name	Regulatory Authority
Marine Mammals		
Humpback whale	*Megaptera novaeangliae*	MMPA
Common bottlenose dolphin	*Tursiops truncatus*	MMPA
Harbor porpoise	*Harbor porpoise*	MMPA
Harbor seal	*Phoca vitulina*	MMPA
Gray seal	*Halichoerus grypus*	MMPA
Sea Turtles		
Leatherback (E)	*Dermochelys coriacea*	ESA
Loggerhead (Northwest Atlantic Ocean DPS) (T)	*Caretta caretta*	ESA
Green (North Atlantic DPS) (T)	*Chelonia mydas*	ESA
Kemp's ridley (E)	*Lepidochelys kempii*	ESA
Fishes		
Atlantic sturgeon (E)	*Acipenser oxyrinchus*	ESA
Shortnose sturgeon (E)	*Acipenser brevirostrum*	ESA

Legend: T = Threatened, E = Endangered, MMPA = Marine Mammal Protection Act, ESA = Endangered Species Act; DPS = Distinct Population Segment.

3.0 Acoustic Source Levels:

Replacing Pier 3 will require demolition and construction activities. Demolition activities will involve removal of piles and the pier structure of Piers 3 and 3T. Both demolition and construction would occur at Pier 4. New construction would occur at the new Pier 3, CEP102, CEP175, and CEP176. The types and numbers of piles to be removed and constructed under the Proposed Action are shown in **Table 2**. To be conservative, the total number of piles were assumed to be installed and removed during high tide. In order to estimate sound source levels for pile driving activities proposed for this project, available documentation for projects that are most similar to the Proposed Action in terms of the type and size of pile, method of installation, and substrate conditions, were reviewed to identify the most relevant proxy sound source levels (**Table 3).** The most appropriate proxies are provided based on consistency with other NAVFAC MIDLANT pile driving projects.

Table 2: Replacement Of Pier 3 Pile Installation & Removal Activity

Facility	Method of Pile Driving / Extraction	Pile Type	Pile Size	Number of Sheets (pairs) / Piles	Impact Pile Driving (Pile Strikes per Pile[5])	Vibratory Pile Driving / Extracting or Drilling (Minutes to drive a single pile[5])	Maximum number of piles installed each day	Pile embedment below mudline
Construction Of 674 LF Relieving Platform (CEP102)	Impact Hammer Or Vibratory Hammer[1]	ASTM A252, Gr 3 Pipe	42-Inch Diameter Steel Pipe	79 Bearing Piles (Bulkhead)	2000	3 To 4 Hours	2	110 feet
	Impact Hammer Or Vibratory Hammer[1]	ASTM A572 Gr.60	Steel Sheet Piles[1]	158 Sheet Piles (Bulkhead)	270	1 Hour	4	27 feet
	Impact Hammer[2]	Precast Concrete Piles	24-Inch Square	124 Bearing Piles	2700	3 Hours	2	75 feet
	Predrilling And Continue With Impact Hammer[2]				2000	3 Hours	2	Drilling=20 feet Driving=55 feet
	Impact Hammer[3]	Precast Concrete Piles	18-Inch Square	81 Fender Piles	450	30 Minutes	12	30 feet
	Predrilling And Continue With Impact Hammer[3]				120	1 Hour	6	Drilling=28 feet Driving=2 feet
Construction Of 1324 LF Of Pier (Pier 3)	Impact Hammer[2]	Precast Concrete Piles	24-Inch Square	530 Bearing Piles	3200	3 To 4 Hours	2	83 feet
	Impact Hammer[3]	Precast Concrete Piles	24-Inch Square	392 Fender Piles	1000	1 Hour	4	42 feet
	Predrilling And Continue With Impact Hammer[3]				120	2 Hours	3	Drilling=48 feet Driving=2 feet
	Impact Hammer Or Vibratory Hammer[4]	Steel Pipe	18-Inch Diameter	18 Fender Piles	450	30 Minutes	5	25 feet
Construction Of 216 LF Fenders (Pier 4)	Impact Hammer[3]	Precast Concrete Piles	24-Inch Square	36 Fender Piles	450	30 Minutes	12	31 feet
	Predrilling And Continue With Impact Hammer[3]				120	1 Hour	6	Drilling=29 feet Driving=2 feet

Table 2: Replacement Of Pier 3 Pile Installation & Removal Activity

Facility	Method of Pile Driving / Extraction	Pile Type	Pile Size	Number of Sheets (pairs) / Piles	Impact Pile Driving (Pile Strikes per Pile[5])	Vibratory Pile Driving / Extracting or Drilling (Minutes to drive a single pile[5])	Maximum number of piles installed each day	Pile embedment below mudline
Construction Of 34 LF Fenders (CEP175)	Impact Hammer Or Vibratory Hammer[4]	Polymeric Piles[4]	13-Inch Diameter	9 Fender Piles	450	30 Minutes	7	27 feet
	Predrilling And Continue With Impact Hammer[4]				100	1 Hour	7	Drilling=22 feet Driving=5 feet
Construction Of 806 LF Bulkhead (CEP176 wharf)	Impact Hammer Or Vibratory Hammer[1]	ASTM A252, Gr 3 Pipe	42-Inch Diameter Steel Pipe	109 Bearing Piles	1800	3 To 4 Hours	2	90 feet
	Impact Hammer Or Vibratory Hammer[1]	ASTM A572 Gr.60	Steel Sheet Piles[1]	221 Sheet Piles	270	1 Hour	4	25 feet
Demolition Of Existing Fender System At CEP102	Vibratory Extraction	Timber Piles	14-Inch Diameter	9 Fender Piles	Na	1 Hour	4	NA
		Precast Concrete Piles	18-Inch Square	79 Fender Piles				
		Polymeric Piles	13-Inch Diameter	4 Fender Piles				
Demolition Of Existing Pier 3	Vibratory Extraction	Precast Concrete Piles	16- And 18-Inch	740 Bearing Piles	Na	1 Hour	4	NA
	Vibratory Extraction	Precast Concrete Piles	24-Inch Square	72 Fender Piles	Na	1 Hour	4	NA
	Vibratory Extraction	Timber Piles	14-Inch Diameter	624 Fender Piles	Na	1 Hour	4	NA
Demolition Of Existing Fenders At Pier 4	Vibratory Extraction	Timber Piles	14-Inch Diameter	36 Fender Piles	Na	1 Hour	4	NA

Table 2: Replacement Of Pier 3 Pile Installation & Removal Activity

Facility	Method of Pile Driving / Extraction	Pile Type	Pile Size	Number of Sheets (pairs) / Piles	Impact Pile Driving (Pile Strikes per Pile[5])	Vibratory Pile Driving / Extracting or Drilling (Minutes to drive a single pile[5])	Maximum number of piles installed each day	Pile embedment below mudline
Demolition Of Existing Pier 3T	Vibratory Extraction	Precast Concrete Piles	18-Inch Square	286 Bearing Piles	Na	1 Hour	4	NA
	Vibratory Extraction	Timber Piles	14-Inch Diameter	87 Fender Piles	Na	1 Hour	4	NA

Notes: [1] Steel piles shall be installed using steam, air, or diesel drop, single-acting, double-acting, differential-acting, or hydraulic type, or using vibratory hammers. Jetting and predrilling will not be permitted to aid the installation of piling. If necessary, internal jetting may be used aid the pulling of piles. Steel sheet pile NZ26 is 27.56" wide and 17.32" deep.

[2] Precast Prestressed Concrete Bearing piles shall be installed using steam, air, or diesel drop, single-acting, double-acting, differential-acting, or hydraulic type. On CEP-102 bulkhead jetting and predrilling are permitted for marine prestressed concrete bearing piles. Jetting and predrilling are not permitted at other prestressed concrete bearing pile locations.

[3] Precast Prestressed Concrete Fender piles shall be installed using steam, air, or diesel drop, single-acting, double-acting, differential-acting, or hydraulic type. Jetting and predrilling are permitted to install the fender piles.

[4] Polymeric Fender piles shall be installed using steam, air, or diesel drop, single-acting, double-acting, differential-acting, or hydraulic type. Polymeric piles may be installed using vibratory hammers. Jetting will not be permitted to aid the installation of piling. Predrilling is permitted to install the fender piles. Polymeric piles are a generic name for HDPE or plastic piles.

[5] Pile installation hours and number of strikes per pile are based on previous experience. The actual driving time/strikes depend on the actual method of installation. Method of installation and hammer size will be the responsibility of the installation contractor.

Pile extraction hours are based on previous experience. The actual extraction time and the actual method of pile extraction depends on the contractor and condition of piles.

[6] MLLW EL. -1.64' Mudline elevation is -39.64' at Pier 3 and Pier 4. Mudline elevation is approx. -25' at Pier 3T, CEP175, and CEP176.

Legend: LF = linear feet; MLLW = Mean Lower Low Water; NA = not applicable

Table 3: Underwater Sound Pressure Levels From Similar Construction Activities & Recommended Proxy Source Levels

Pile Size, Type	Installation Method	Sound Pressure Levels (SPL) or Sound Exposure Level (SEL) at 10 meters distance			Source
		Average Peak SPL, dB re 1 µPa	Average Root Mean Square SPL, dB re 1 µPa	Average SEL, dB re 1 µPa²-sec	
42-Inch Diameter Steel Pipe	Impact	213	190	177	Navy 2015
	Vibratory[1]	NA	168	NA	Sitka 2017
28-Inch Steel Sheet	Impact[2]	211	196	181	NAVFAC SW 2020
	Vibratory	NA	167	167	Navy 2015
24-Inch Diameter Concrete Pile	Impact	189	176	163	Illingworth & Rodkin 2017
Pre-Drilling Concrete Pile	Drilling	NA	154	NA	Dazey et al. 2012
18-Inch Diameter Square Concrete Pile	Impact[3]	185	166	154	Caltrans 2020
18-Inch Diameter Steel Pile	Impact[4]	208	187	176	Caltrans 2020
	Vibratory	196	158	158	Caltrans 2020
13-Inch Plastic	Impact	177	153	-	Denes et al. 2016
	Vibratory[5]	185	162	157	Caltrans 2020
13-Inch Plastic	Vibratory[5] Extraction	185	162	157	Caltrans 2020
16-Inch Diameter Concrete	Vibratory Extraction	185	162	157	Caltrans 2020
18-Inch Concrete Piles	Vibratory Extraction	185	162	157	Caltrans 2020
24-Inch Concrete Piles	Vibratory Extraction	185	162	157	Caltrans 2020
14-Inch Diameter Timber	Vibratory Install / Extract	185	162	157	Caltrans 2020

Notes: [1]-Proxy data for 48-inch steel piles. No data available for 42-inch; [2]-proxy for 30-inch steel pile used as proxy for 28-inch sheet piles due to unavailable data.[3]-proxy data for 18-inch Octagonal piles; [4]-Impact proxy for 18-inch steel pipe unavailable. Used proxy for 20-inch steel pipe; [5]-Vibratory install/extraction proxy for plastic piles unavailable. Assume SPL to be consistent with timber.

Legend: dB=decibels; RMS = root mean square, SEL = sound exposure level; dB re 1 µPa = dB referenced to a pressure of 1 microPascal, measures underwater SPL. dB re 1 µPa²-sec = dB referenced to a pressure of 1 microPascal squared per second. Single strike SEL are the proxy source levels presented for impact pile driving and are used to calculate distances to permanent threshold shift (PTS). NA = Not applicable

4.0 Acoustic Transmission Loss Models:

4.1 Model For Level A (PTS) Harassment Of Marine Mammals:

Acoustic transmission loss modeling for cumulative sound exposure that may result in Level A harassment to marine mammals will be conducted using National Marine Fisheries Service (NMFS) marine mammal acoustic technical guidance (*Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing—Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts, April 2018*) (NMFS 2018a). This guidance provides acoustic thresholds for the onset of permanent threshold shift (PTS), which would be considered Level A harassment under the MMPA. PTS from pile driving activities will be calculated for marine mammals in the project area using the *Optional User Spreadsheet* (herein referred to as NMFS spreadsheet) provided on the NMFS website (NMFS 2020a).

For impact pile driving, the single strike SEL / pulse equivalent will be used, and for vibratory pile driving the root mean square (RMS) SPL source level will be used. An intermediate “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. It is generally accepted by NMFS for use in pile driving applications and has been used in most Navy projects that involve pile driving. Per the NMFS spreadsheet, a default Weighting Factor Adjustment (WFA) of 2.0 kHz will be used for calculating PTS for impact pile driving, drilling, and DTH pile driving and 2.5 kHz will be used for vibratory pile driving. These WFAs are acknowledged by NMFS as conservative.

The NMFS spreadsheet generates threshold distances to PTS for the situation in which an animal remains stationary for the entire 24-hour duration of activity. Although PTS is unlikely to occur due to likely animal avoidance during pile driver operations (Russell et al. 2016), some animals could habituate to the noise source and continue to occupy the area. The NMFS spreadsheet therefore provides a boundary condition for the maximum distance at which PTS could occur. In order to properly calculate the distances to PTS, number of pile strikes per pile and duration (in minutes) of vibratory pile driving in a day is required for the analysis. See **Tables 2 and 3** for pile installation activity that will be used in the NMFS spreadsheet.

4.2 Model For Level B (Behavioral) Harassment Of Marine Mammals:

Cardno proposes to use a general formula for underwater acoustic transmission loss in decibels (dB) as a function of distance from the source as follows:

$$TL = B * log10\left(\frac{R1}{R2}\right) + C * (R1 - R2)$$

The B term has a value of 10 for cylindrical spreading, which is most applicable in shallow / confined waters where sound is reflected, and 20 for spherical spreading, which is most applicable in deep / unconfined waters where sound can propagate in all three dimensions. An intermediate “practical spreading” value of 15 is applicable where the environment contains elements of both (see Section 4.1). The amount of linear loss (C) is proportional to the frequency of sound. Due to the low frequencies of sound generated by impact pile driving, this factor would be conservatively assumed to equal zero for all calculations and transmission loss will be calculated using only logarithmic spreading. For this project we recommend the assumption of practical spreading loss, which with the conservative assumption that C = 0, simplifies to:

$$TL = 15\, log10\left(\frac{R1}{R2}\right)$$

Where:

TL is the transmission loss in dB,

R1 is the distance of the modeled SPL from the driven pile, and

R2 is the distance (usually 10 meters) from the driven pile of the initial measurement.

This formula would be used to estimate the distances to critical threshold levels that bound the ZOIs for MMPA Level B (Behavioral) Harassment due to impulsive underwater sound.

In modeling transmission loss from the proposed project area, the conventional assumption would be made that acoustic propagation from the source is impeded by natural and relatively dense manmade features that extend into the water, resulting in acoustic shadows behind such features.

4.3 Model For Fish:

Cardno proposes to use the transmission loss (TL) formula below for determining distance to thresholds for ESA-listed sturgeon:

$$Transmission\ Loss\ (TL) = 15 * Log10[radius]$$

To calculate distance to thresholds (see Chapter 5), number of pile strikes per pile are required for the project. **Table 2** provides pile installation activity for the project.

4.4 Model For Sea Turtles:

The hearing capabilities of sea turtles are poorly known and there is very little available information on the effects of noise on sea turtles, especially to determine impacts from natural and anthropogenic, sound sources (i.e., pile driving noise; Popper et al. 2014). Methods for analyzing acoustic impacts to sea turtles will be consistent with the Navy's Criteria and Thresholds for U.S. Navy Acoustic and Explosives Effects Analysis (Phase III) (Navy 2017).

Cardno proposed to use the same transmission loss formula that used for fish (above) in determining distance to thresholds for ESA-listed sea turtles. To calculate distance to thresholds (see Chapter 5), number of pile strikes per pile are required for the project. **Table 2** provides pile installation activity for the project.

5.0 Sound Exposure Criteria & Thresholds:

5.1 Marine Mammals:

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 Code of Federal Regulations, Part 216, Subpart A, Section 216.3-Definitions). Level A is the more severe form of harassment because it may result in injury, whereas Level B only results in behavioral disturbance without the potential for injury.

As introduced in Chapter 4, NMFS finalized the acoustic threshold levels for determining the onset of PTS in marine mammals in response to underwater impulsive and non-impulsive / continuous sound sources (NMFS 2018b). The criteria use cumulative SEL metrics (dB SEL_{cum}) and peak pressure (dB pk) rather than the dB RMS metric. NMFS equates the onset of PTS, which is a form of auditory injury, with Level A harassment under the MMPA and "harm" under the ESA. Level B harassment is considered to occur when marine mammals are exposed to impulsive underwater sounds > 160 decibels referenced to a pressure of 1 microPascal (dB RMS re 1 µPa) from impact pile driving and to non-impulsive underwater sounds > 120 dB RMS re 1 µPa (**Table 4**). The application of the 120 dB RMS threshold is considered precautionary (NMFS 2009, 74 Federal Register 41684) as it can sometimes be problematic because this threshold level can be either at or below the ambient noise level of certain locations. Behavioral harassment may or may not result in a stress response.

Acoustic disturbance levels from vibratory or impact pile driving have the potential to exceed the harassment levels defined in **Table 4** for both non-impulsive / continuous and impulsive sound levels. This table incorporates PTS thresholds in combination with prior existing thresholds for Level B exposure.

Table 4: PTS & Behavioral Disturbance Threshold Criteria For Underwater Noise

Marine Mammals	Vibratory Pile Driving Noise (Non-Impulsive Sounds) (re 1 µPa)		Impact Pile Driving Noise (Impulsive Sounds) (re 1 µPa)	
	PTS Onset (Level A) Threshold	Level B Disturbance Threshold	PTS Onset (Level A) Threshold(1)	Level B Disturbance Threshold
Low-Frequency Cetaceans	199 dB SEL_{CUM}(2)	120 dB RMS	219 dB Peak(3) 183 dB SEL_{CUM}(2)	160 dB RMS
Mid-Frequency Cetaceans	198 dB SEL_{CUM}(2)	120 dB RMS	230 dB Peak(3) 185 dB SEL_{CUM}(2)	160 dB RMS
High-Frequency Cetaceans	173 dB SEL_{CUM}(2)	120 dB RMS	202 dB Peak(3) 155 dB SEL_{CUM}(2)	160 dB RMS
Phocidae (True Seals)	201 dB SEL_{CUM}(2)	120 dB RMS	218 dB Peak(3) 185 dB SEL_{CUM}(2)	160 dB RMS

Notes:
(1) Dual metric acoustic thresholds for impulsive sounds. Whichever results in the largest isopleth for calculating PTS onset is used in the analysis.
(2) Cumulative SEL over 24 hours.
(3) Flat weighted or unweighted peak sound pressure within the generalized hearing range.

Legend: µPa = micropascal; dB = decibel; PTS = permanent threshold shift; RMS = root mean square; SEL = sound exposure level.

5.2 FISH:

Criteria and thresholds to estimate impacts from sound produced by impact pile driving activities are presented below in **Table 5**. Consistent with Popper et al. 2014, dual metric sound exposure criteria are utilized. It is assumed that a specified effect would occur when either metric (cumulative SEL or peak

SPLs) is met or exceeded. Guidelines were developed for mortality and the lowest level where injury was found (recoverable injury). In addition, Popper et al. (2014) developed guidance for the onset of TTS. **Table 5** lists the impact pile driving guidance for the lowest level where injury was found and the onset of TTS.

In addition, if the received SEL from an individual pile strike is below a certain level, then the accumulated energy from multiple strikes would not contribute to injury, regardless of how many pile strikes occur. This SEL is referred to as "effective quiet", and is assumed to be 150 dB (referenced to a pressure of 1 microPascal squared per second [re: 1 µPa2-sec]). Effective quiet establishes a limit on the maximum distance from the pile where injury to fishes is expected – the distance at which the single strike SEL attenuates to 150 dB. Beyond this distance, no physical injury is expected, regardless of the number of pile strikes. Underwater sound would likely cause behavioral changes to fish, which can vary from impaired startle response, freeze response, and increased swimming speed to avoidance (Lafrate et al. 2016)

In summary, based on the best available information for other fish species, underwater noise at or above the levels presented in **Table 5** have the potential to cause injury or behavioral modification to fish. See Appendix A for calculated distances to thresholds during pile driving activities.

Table 5: Fish Impact Pile Driving Injury Guidance

Fish Hearing Group	Onset Of Mortality		Onset Of Injury		Temporary Threshold Shift
	SEL_{cum}	SPL_{peak}[2]	SEL_{cum}	SPL_{peak}[2]	
No Swim Bladder (Particle Motion Detection)	> 219 dB	> 213 dB	> 216 dB	> 213 dB	NC
Swim Bladder Not Involved In Hearing (Particle Motion Detection)	210 dB	> 207 dB	203 dB	> 207 dB	> 186 dB cumulative SEL[3]
Swim Bladder Involved In Hearing (Primarily Pressure Detection)	207 dB	> 207 dB	203 dB	> 207 dB	186 dB cumulative SEL[3]
Eggs & Larvae	> 210 dB	> 207 dB	Not quantified	Not quantified	Not quantified

Source: Popper, et al. 2014

Notes: [1] No vibratory criteria have been established

[2] Peak levels are relative to 1 micropascal (µPa) and cumulative SEL levels are relative to 1 micropascal squared (µPa2) per second.

[3] Cumulative SEL over 24 hours.

Legend: > = greater than; NC = effects from exposure to sound produced by impact pile driving is considered to be unlikely, therefore no criteria are reported; dB = decibel; SEL = sound exposure level; TTS = temporary threshold shift.

5.3 Sea Turtles:

Unweighted peak pressure thresholds for TTS and PTS were developed for sea turtles based on auditory sensitivity in marine mammals (Navy 2017, 2018) (**Table 6**). Popper et al. (2014) recommended applying SEL-based impact thresholds developed for fishes without a swim bladder to sea turtles, which was adjusted based on an 11 dB difference found between the SEL-based non-impulsive TTS threshold and the SEL-based impulsive TTS thresholds for marine mammals. Sea turtles are expected to avoid exposure to underwater RMS SPL of 175 dB re 1 µPa or greater (Navy 2017). This threshold is considered the behavioral threshold. The adjusted weighted SELs and behavioral threshold for sea turtles from pile driving noise are shown in **Table 6.** See Appendix A for calculated distances to thresholds during pile driving activities.

Table 6: PTS, TTS, & Behavior Thresholds For Sea Turtles Exposed To Impulsive & Non-Impulsive Sounds

Non-Impulsive		Impulsive				Behavioral (weighted re µPa2-s)
TTS (weighted SPL Threshold re µPa2-s)	PTS (weighted SPL Threshold re µPa2-s)	TTS (weighted SPL Threshold re µPa2-s)	TTS Peak SPL (unweighted SPL Threshold re 1 µPa)	PTS (weighted SPL Threshold re µPa2-s	PTS (unweighted SPL Threshold re µPa)	
200 dB SEL	220 dB SEL	189 dB SEL	226 dB Peak	204 dB SEL	232 dB Peak	175 dB RMS

Legend: PTS = permanent threshold shift, TTS = temporary threshold shift, SEL = sound exposure level, SPL = sound pressure level, SEL_{cum} = cumulative SEL over 24 hours, NA = Not Applicable.

5.4 GIS Mapping Of ZOIs:

To create a GIS map of the modeled ZOIs, the following are proposed: 1) Use of a high-resolution ArcGIS aerial image of the project area so that the shoreline boundaries of ZOIs can be accurately drawn; 2) Define a modeled sound source location that provides a reasonable approximation for project activities with the greatest potential for effects; 3) The application of rules for sound propagation and acoustic shadowing along bearing angles that intersect shoreline obstructions; and 4) The translation of the TL Model into a graphical depiction of diminishing sound pressure isopleths as a function of the sound source level and TL over distance.

The calculations are made in a MicroSoft Excel workbook, which is used to create a multi-ring buffer of isopleths (i.e., sound contours) diminishing in 1 dB increments from the sound source location. The sound contours are created in GIS and clipped to the boundary of the respective ZOI and then displayed on a map. The graphical outputs will be modified based on different source levels.

5.5 Description Of Take Calculation:

Consistent with other Navy projects, take estimates associated with pile installation activity are typically calculated using the following general formula:

$$Take\ estimate\ =\ species\ density\ *\ area\ of\ ZOI\ for\ the\ activity\ *\ days\ of\ activity$$

For species where density estimates are not available for the area, the methods used in the Year 1 application will be applied to the LOA for remaining construction.

6.0 MODELED ZONES OF INFLUENCE FOR MARINE MAMMALS:

Calculated distances to the underwater marine mammal auditory (PTS onset) SEL thresholds and behavioral disturbance thresholds for the four hearing groups are provided below for vibratory, impact, and pre-drilling activities associated with proposed construction and vibratory extraction activities associated with proposed demolition of in-water structures (Tables 7 and 8). Figures depicting the ZOIs are contained in Appendix A.

Modeled areas of noise depicted in the figures are an overestimate and are therefore considered conservative. Sound is expected to be truncated from encountered land masses, anthropogenic structures (i.e., piers, piles, human-made structures), and depth. Adjusted maximum distances are provided for the behavioral disturbance thresholds where the extent of noise reaches land prior to reaching the calculated radial distances to the threshold. Areas encompassed within the threshold ZOI were calculated using the location of a representative pile. Sound source locations were chosen to model the greatest possible affected areas.

Table 7: Injury & Disturbance Zones For Underwater Marine Mammals – Impact Pile Driving Noise

Structure	Pile Size & Type	Level A (PTS Onset) Harassment					Level B (Behavioral) Harassment All Species	
		Total Pile Driving Days	LF Cetacean	MF Cetacean	HF Cetacean	Phocid		
			Maximum Distance To 183 dB SELcum Threshold (m) / Area of ZO1 (sq km)	Maximum Distance To 185 dB SELcum Threshold (m) / Area of ZOI (sq km)	Maximum Distance To 155 dB SELcum Threshold (m) / Area of ZOI (sq km)	Maximum Distance To 185 dB SELcum Threshold (m) / Area of ZO1 (sq km)	Maximum Distance To 160 dB RMS SPL Threshold (m)	Area Of ZOI Within 160 dB RMS SPL Threshold (sq km)
674 LF Relieving Platform (CEP102)	42-Inch Steel Pipe	40	1,001.8 / 1.38	35.6 / 0.002	1,193.3 / 1.90	536.1 / 0.45	1,000	1.37
	ASTM A572 Gr. 60 Steel Sheet	40	773.3 / 0.87	27.5 / 0.001	921.1 / 1.18	413.8 / 0.27	2,512	7.96
	24-Inch Square Concrete	72	142.7 / 0.03	5.1 / 0.000081	169.9 / 0.05	76.4 / 0.01	117	0.02
	18-Inch Square Concrete	14	35.8 / 0.002	1.3 / 0.00000528	42.7 / 0.003	19.2 / 0.0008	25	0.001
Construction Of 1324 LF Of Pier (Pier 3)	24-Inch Square Concrete	265	159.8 / 0.08	5.7 / 0.0001	190.3 / 0.11	85.5 / 0.02	117	0.04
	24-Inch Square Concrete	98	116.8 / 0.04	4.2 / 0.00005	139.1 / 0.06	62.5 / 0.01	117	0.04
	18-Inch Steel Pipe Piles	4	585.5 / 0.99	20.8 / 0.001	697.4 / 1.33	313.3 / 0.31	631	1.12
Construction Of 216 LF Fenders (Pier 4)	24-Inch Square Concrete	3	142.7 / 0.06	5.1 / 0.000081	169.9 / 0.09	76.4 / 0.02	117	0.04

Table 7: Injury & Disturbance Zones For Underwater Marine Mammals – Impact Pile Driving Noise

Structure	Pile Size & Type	Level A (PTS Onset) Harassment					Level B (Behavioral) Harassment All Species	
		Total Pile Driving Days	LF Cetacean	MF Cetacean	HF Cetacean	Phocid		
			Maximum Distance To 183 dB SELcum Threshold (m) / Area of ZO1 (sq km)	Maximum Distance To 185 dB SELcum Threshold (m) / Area of ZOI (sq km)	Maximum Distance To 155 dB SELcum Threshold (m) / Area of ZOI (sq km)	Maximum Distance To 185 dB SELcum Threshold (m) / Area of ZO1 (sq km)	Maximum Distance To 160 dB RMS SPL Threshold (m)	Area Of ZOI Within 160 dB RMS SPL Threshold (sq km)
Construction Of 34 LF Fenders (CEP175)	13-Inch Polymeric Piles	2	21.5 / 0.0007	0.8 / 0.000001	25.6 / 0.001	11.5 / 0.0002	3	0.000014
Construction Of 806 LF Bulkhead (CEP176 Wharf)	42-Inch Diameter Steel Pipe	55	933.8 / 0.36	33.2 / 0.002	1,112.3 / 0.50	499.7 / 0.12	1,000	0.41
	ASTM A572 Gr. 60 Steel Sheet	56	773.3 / 0.26	27.5 / 0.001	921.1 / 0.35	413.8 / 0.09	2,512	2.43

Notes: [1]Distance to behavioral disturbance thresholds calculated using practical spreading loss model.
Legend: PTS= permanent threshold shift; dB RMS= decibel root mean square; m = meters; sq m = square meters.

Table 8: Injury & Disturbance Zones for Underwater Marine Mammals – Vibratory Pile Driving / Extraction or Drilling Noise

Structure	Pile Size	Total Pile Driving Days	Level A (PTS Onset) Harassment				Level B (Behavioral) Harassment All Species	
			LF Cetacean	MF Cetacean	HF Cetacean	Phocid		
			Maximum Distance To 199 dB SELcum Threshold (m) / Area of ZO1 (sq km)	Maximum Distance To 198 dB SELcum Threshold (m) / Area Of ZOI (sq km)	Maximum Distance To 173 dB SELcum Threshold (m) / Area Of ZOI (sq km)	Maximum Distance To 201 dB SELcum Threshold (m) / Area Of ZO1 (sq km)	Maximum Distance To 120 dB RMS SPL Threshold (m)	Area Of ZOI Within 120 dB RMS SPL Threshold (sq km)
674 LF Relieving Platform (CEP102)	42-Inch Steel Pipe	40	80 / 0.011112	7.1 / 0.000156	118.3 / 0.023413	48.6 / 0.00435	15,849	98.91
	Steel Sheet	40	43.2 / 0.0035	3.8 / 0.000045	63.9 / 0.007	26.3 / 0.001	13,594	90.6
	24-Inch Square Concrete[2]	72	0.8 / 0.000002	0.04/ < 0.000001	0.7 / 0.000002	0.4 / 0.000001	1,848	4.38
	18-Inch Square Concrete[2]	14	0.8 / 0.000002	0.04 / < 0.000001	0.7 / 0.000002	0.4 / 0.000001	1,848	4.38
Construction Of 1324 LF Of Pier (Pier 3)	24-Inch Square Concrete[2]	265	0.9 / 0.000003	0.1 / < 0.000001	0.8 / 0.000002	0.5 / 0.000001	1,848	6.53
	24-Inch Square Concrete[2]	98	0.9 / 0.000003	0.1 / < 0.000001	0.8 / 0.000002	0.5 / 0.000001	12,023	94.4
	18-Inch Steel Pipe	4	7.9 / 0.00019	0.7 / 0.000002	11.7 / 0.0004	4.8 / 0.0000072	3,415	19.3
Construction Of 216 LF Fenders (Pier 4)	24-Inch Square Concrete[2]	3	0.8 / 0.000002	0.04 / < 0.000001	0.7 / 0.000002	0.4 / 0.000001	1,848	6.78
Construction Of 34 LF Fenders (CEP175)	13-Inch Polymeric	2	18.4 / 0.0005	1.6 / 0.000004	27.1 / 0.001	11.2 / 0.0002	6,310	11.1

Table 8: Injury & Disturbance Zones for Underwater Marine Mammals – Vibratory Pile Driving / Extraction or Drilling Noise

Structure	Pile Size	Total Pile Driving Days	Level A (PTS Onset) Harassment				Level B (Behavioral) Harassment All Species	
			LF Cetacean	MF Cetacean	HF Cetacean	Phocid		
			Maximum Distance To 199 dB SELcum Threshold (m) / Area of ZO1 (sq km)	Maximum Distance To 198 dB SELcum Threshold (m) / Area Of ZOI (sq km)	Maximum Distance To 173 dB SELcum Threshold (m) / Area Of ZOI (sq km)	Maximum Distance To 201 dB SELcum Threshold (m) / Area Of ZO1 (sq km)	Maximum Distance To 120 dB RMS SPL Threshold (m)	Area Of ZOI Within 120 dB RMS SPL Threshold (sq km)
Construction Of 806 LF Bulkhead (CEP176 Wharf)	42-Inch Steel Pipe	55	80 / 0.01	7.1 / 0.00008	118.3 / 0.02068	48.6 / 0.00373	15,849	45.97
	Steel Sheet	56	43.2 / 0.003	3.8 / 0.000025	63.9 / 0.006	26.3 / 0.001	13,594	39.9
Demolition Of Existing Fender System At CEP102	14-Inch Timber	10	20.1 / 0.0009	1.8 / 0.00001	29.7 / 0.0018	12.2 / 0.0004	6,310	49.9
	18-Inch Concrete	20	20.1 / 0.0009	1.8 / 0.00001	29.7 / 0.0018	12.2 / 0.0004	6,310	49.9
	13-Inch Polymeric	1	20.1 / 0.0009	1.8 / 0.00001	29.7 / 0.0018	12.2 / 0.0004	6,310	49.9
Demolition Of Existing Pier 3	16-Inch And 18-Inch Concrete Piles	185	20.1 / 0.001	1.8 / 0.00001	29.7 / 0.003	12.2 / 0.0004	6,310	49.9
	24-Inch Square Concrete	18	20.1 / 0.001	1.8 / 0.00001	29.7 / 0.003	12.2 / 0.0004	6,310	49.9
	14-Inch Timber	156	20.1 / 0.001	1.8 / 0.00001	29.7 / 0.003	12.2 / 0.0004	6,310	49.9
Demolition Of Existing Fenders At Pier 4	14-Inch Timber	9	20.1 / 0.001	1.8 / 0.00001	29.7 / 0.003	12.2 / 0.0004	6,310	49.9

Table 8: Injury & Disturbance Zones for Underwater Marine Mammals – Vibratory Pile Driving / Extraction or Drilling Noise								
Structure	Pile Size	Total Pile Driving Days	Level A (PTS Onset) Harassment				Level B (Behavioral) Harassment All Species	
			LF Cetacean	MF Cetacean	HF Cetacean	Phocid		
			Maximum Distance To 199 dB SELcum Threshold (m) / Area of ZO1 (sq km)	Maximum Distance To 198 dB SELcum Threshold (m) / Area Of ZOI (sq km)	Maximum Distance To 173 dB SELcum Threshold (m) / Area Of ZOI (sq km)	Maximum Distance To 201 dB SELcum Threshold (m) / Area Of ZO1 (sq km)	Maximum Distance To 120 dB RMS SPL Threshold (m)	Area Of ZOI Within 120 dB RMS SPL Threshold (sq km)
Demolition of Existing Pier 3T	18-inch Square Concrete	72	20.1/0.001	1.8/0.00001	29.7/0.003	12.2/0.0004	6,310	49.9
	14-inch Timber	22	20.1/0.001	1.8/0.00001	29.7/0.003	12.2/0.0004	6,310	49.9

Notes: [1]Distance to behavioral disturbance thresholds calculated using practical spreading loss model; [2]Pre-drilling.
Legend*:* PTS= permanent threshold shift; dB RMS= decibel root mean square; m = meters; sq m = square meters.

7.0 GLOSSARY:

Table 9: Glossary Of Acoustical Terms	
Term	**Definition**
Decibel (dB)	A unit describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure. The reference pressure for water is 1 microPascal (µPa) and for air is 20 µPa (approximate threshold of human audibility).
Sound Pressure Level (SPL)	Sound pressure is the force per unit area, usually expressed in microPascals where 1 Pascal equals 1 Newton exerted over an area of 1 square meter. The SPL is expressed in decibels as 20 times the logarithm to the base 10 of the ratio between the pressure exerted by the sound to a reference sound pressure. SPL is the quantity that is directly measured by a sound level meter.
Frequency, Hertz (Hz)	Frequency is expressed in terms of oscillations, or cycles, per second. Cycles per second are commonly referred to as hertz (Hz). Typical human hearing ranges from 20 Hz to 20 kHz.
Peak Sound Pressure, dB re 1 microPascal (µPa)	Peak sound pressure is based on the largest absolute value of the instantaneous sound pressure over the frequency range from 20 Hz to 20 kHz. This pressure is expressed in this application as dB re 1 µPa.
Root Mean Square (RMS), dB re 1µPa	The RMS level is the square root of the mean of the squared pressure level(s) as measured over a specified time period. For pulses, the rms has been defined as the average of the squared pressures over the time that comprise that portion of waveform containing 90 % of the sound energy for one impact pile driving impulse.
Sound Exposure Level (SEL), dB re 1 µPa^2 sec	Sound exposure level is a measure of energy. Specifically, it is the dB level of the time integral of the squared-instantaneous sound pressure, normalized to a 1-second period. It can be an extremely useful metric for assessing cumulative exposure because it enables sounds of differing duration, to be compared in terms of total energy.
Frequency Spectrum, dB Over Frequency Range	The amplitude of sound at various frequencies, usually shown as a graphical plot of the mean square pressure per unit frequency (µPa^2/Hz) over a frequency range (e.g., 10 Hz to 10 kHz in this application).
Ambient Noise Level	The background sound level, which is a composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.

8.0 References:

California Department of Transportation (Caltrans). (2015). Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish. Available online at: http://www.dot.ca.gov/hq/env/bio/fisheries_bioacoustics.htm. November 2015.

Dazey, E. McIntosh, B., Brown, S., and Dudzinski, K.M. (2012). Assessment of Underwater Anthropogenic Noise Associated with Construction Activities in Bechers Bay, Santa Rosa Island, California. Journal of Environmental Protection, 2012,3,1286-1294. http://dx.doi.org/10.4236/jep.2012.310146.

Finneran, J. J. (2016). Auditory Weighting Functions and TTS/PTS Exposure Functions for Marine Mammals Exposed to Underwater Noise. SSC Pacific. Technical Report 3026.

Lafrate J.D., Watwood S.L., Reyier E.A., Scheidt D.M., Dossot G.A., and Crocker S.E. (2016). Effects of Pile Driving on the Residency and Movement of Tagged Reef Fish. PLoS ONE 11(11): e0163638. doi:10.1371/journal.pone.0163638.

NMFS. (2018a). 2018 Revision to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts. NOAA Technical Memorandum NMFS-OPR-59. April.

NMFS. (2018b). Biological Opinion on the Navy Hawaii-Southern California Training and Testing Activities. FPR-2018-9275. December 10, 2018.

NMFS. (2020). 2018 Revision to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing: Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts (Version 2.0). Optional User Spreadsheet. Version 2.1. July.

NMFS. (2021a). 2018 Revision to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing: Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts (Version 2.0). Optional User Spreadsheet. Version 2.1. July. Updated by Amy Scholik, NOAA's National Marine Fisheries Services, to include Sirenian thresholds for impulsive (impact) in place of Otariid pinnipeds. February 24.

NMFS. (2021a). 2018 Revision to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing: Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts (Version 2.0). Optional User Spreadsheet. Version 2.2. Dec. Updated by Amy Scholik, NOAA's National Marine Fisheries Services, to include Sirenian thresholds for non-impulsive/continuous (vibratory) in place of Otariid pinnipeds. February 24.

NAVFAC SW. (2020). Compendium of Underwater and Airborne Sound Data from Pile Driving and In-Water Demolition Activities in San Diego Bay. October.

Navy. (2017). U.S. Navy Marine Species Density Database Phase III for the Atlantic Fleet Training and Testing Study Area. Naval Facilities Engineering Command Atlantic Final Technical Report. Naval Facilities Engineering Command Atlantic, Norfolk, VA. 281 pp.

Navy. (2018). Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing. Naval Undersea Warfare Center Division, Newport, Rhode Island. NUWC-NPT Technical Report. August 2018.

Popper, A. N., Hawkins, A. D., Fay, R. R., Mann, D. A., Bartol, S., Carlson, T. J., Halvorsen, M. B. (2014). ASA S3/SC1. 4 TR-2014 Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report Prepared by ANSI-Accredited Standards Committee S3/SC1 and Registered with ANSI: Springer.

Russell, D.J.F., G.D. Hastie, D. Thompson, V.M. Janik, P.S. Hammond, L.A.S. Scott-Hayward, J. Matthiopoulos, E.L. Jones, and B.J. McConnell. (2016). Avoidance of wind farms by harbour seals is limited to pile driving activities. *Journal of Applied Ecology*, doi: 10.1111/1365-2664.12678.

Southall, B. L., James J. Finneran, Colleen Reichmuth, Paul E. Nachtigall, Darlene R. Ketten, Ann E. Bowles, William T. Ellison, Douglas P. Nowacek, and Peter L. Tyack. (2019). Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects. *Aquatic Mammals* 2019, *45*(2), 125-232, DOI 10.1578/AM.45.2.2019.125.

City of Borough of Sitka Department of Public Works. (2017). Request for an Incidental Harassment Authorization City and Borough of Sitka Gary Paxton Industrial Park Multipurpose Dock Project Sawmill Cove, Sitka, Alaska. Prepared by: Solstice Alaska Consulting, Inc., Anchorage, Alaska for City and Borough of Sitka Department of Public Works Sitka, Alaska.

Waring, Gordon T., Elizabeth Josephson, Katherine Maze-Foley, and Patricia E. Rosel, Editors. (2016). US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2015. NOAA Technical Memorandum NMFS-NE-238.

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Appendix A
ZOI TABLES & FIGURES

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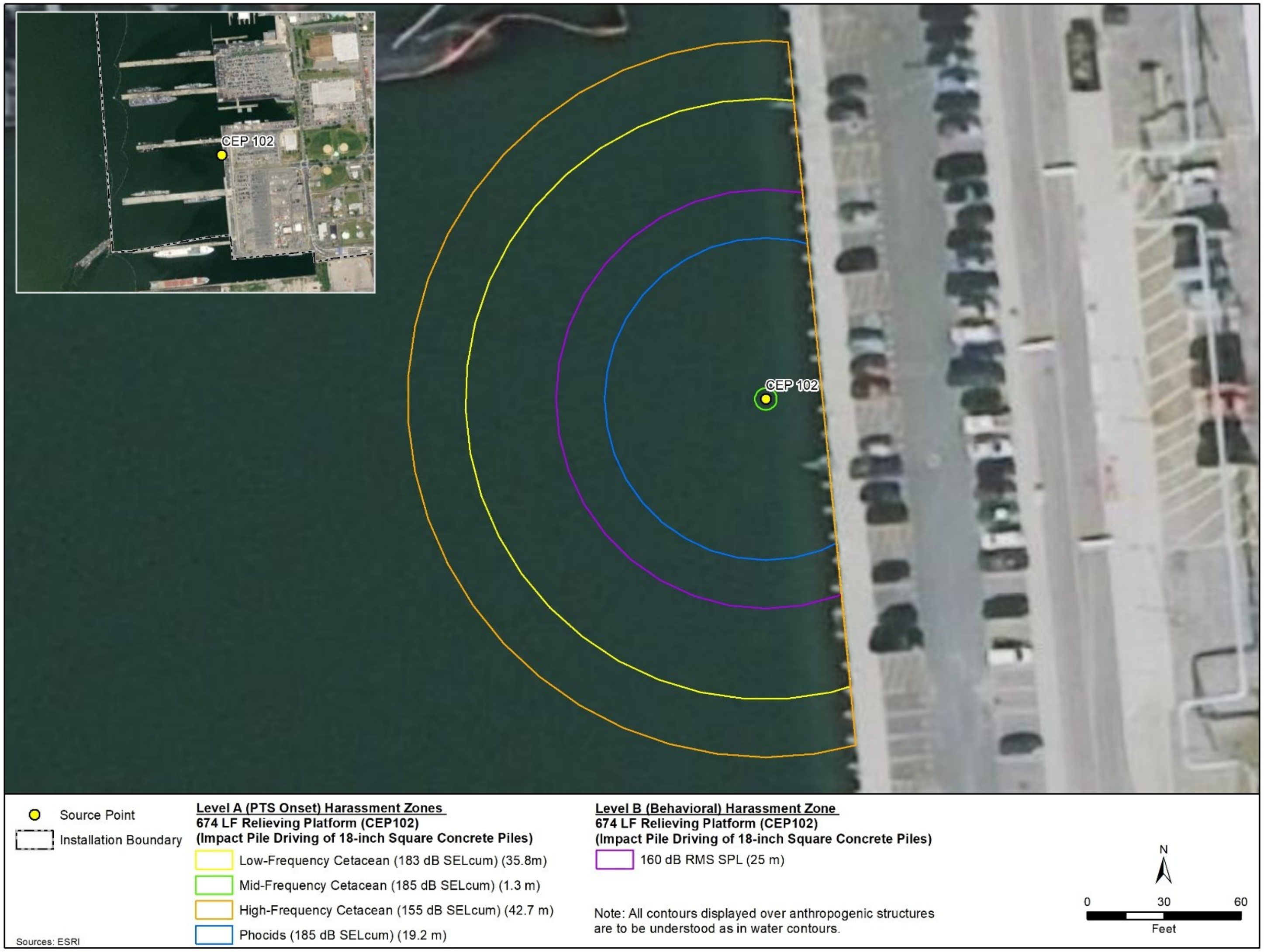

Figure A-1: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Impact Pile Driving At CEP102 – 18-Inch Square Concrete

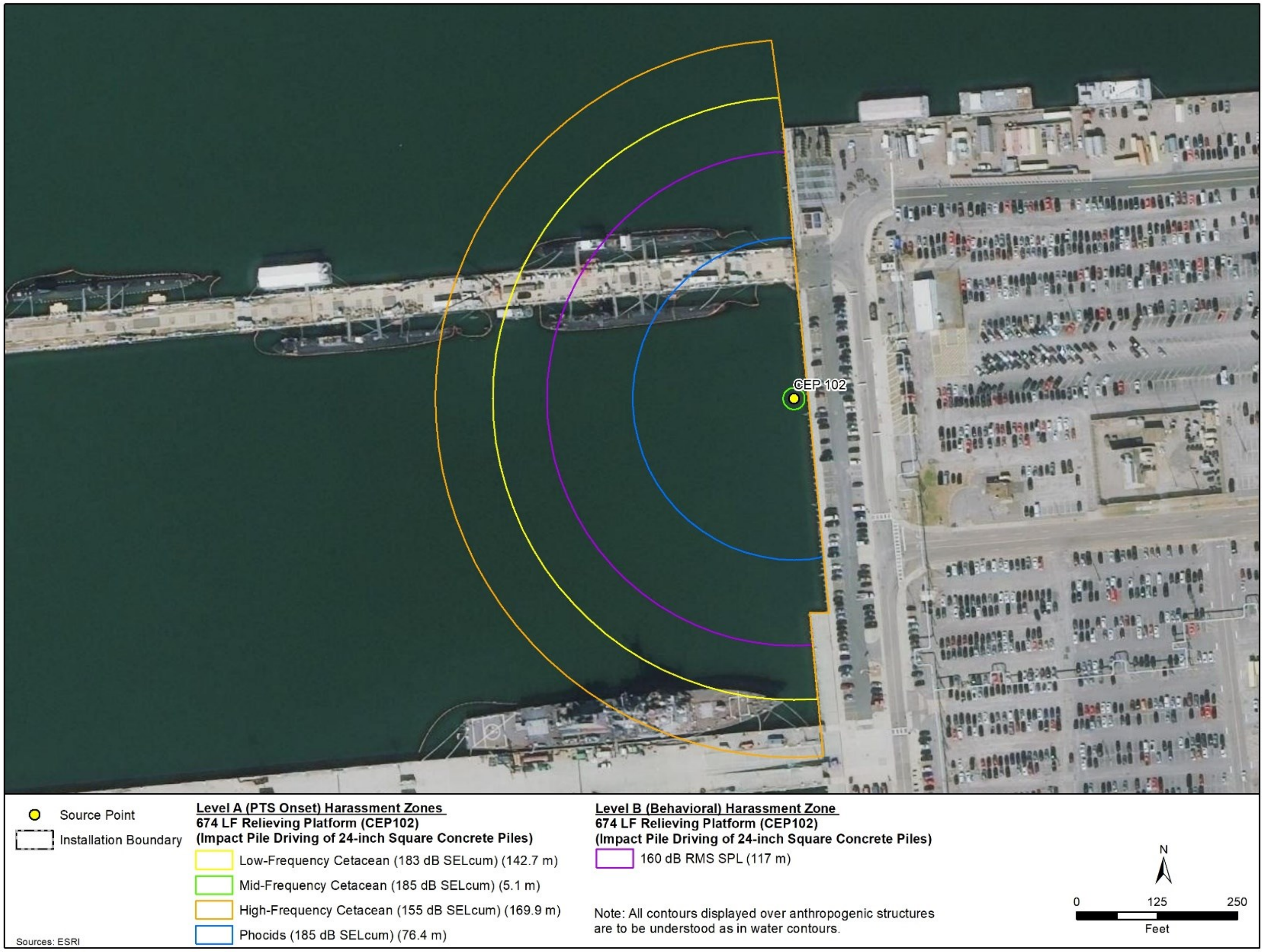

Figure A-2: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Impact Pile Driving At CEP 102 – 24-Inch Square Concrete

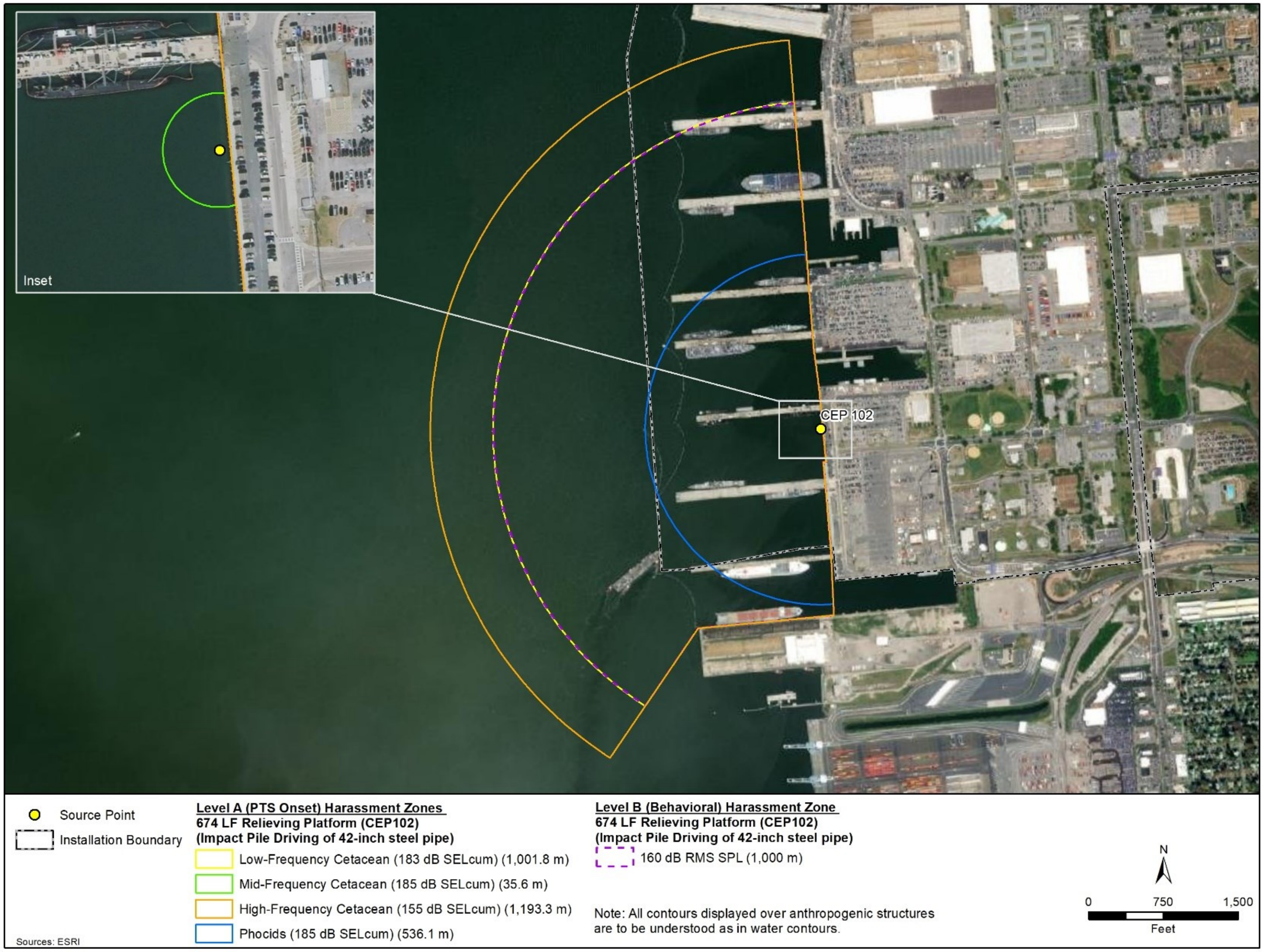

Figure A-3: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Impact Pile Driving At CEP 102 – 42-Inch Steel Pipe

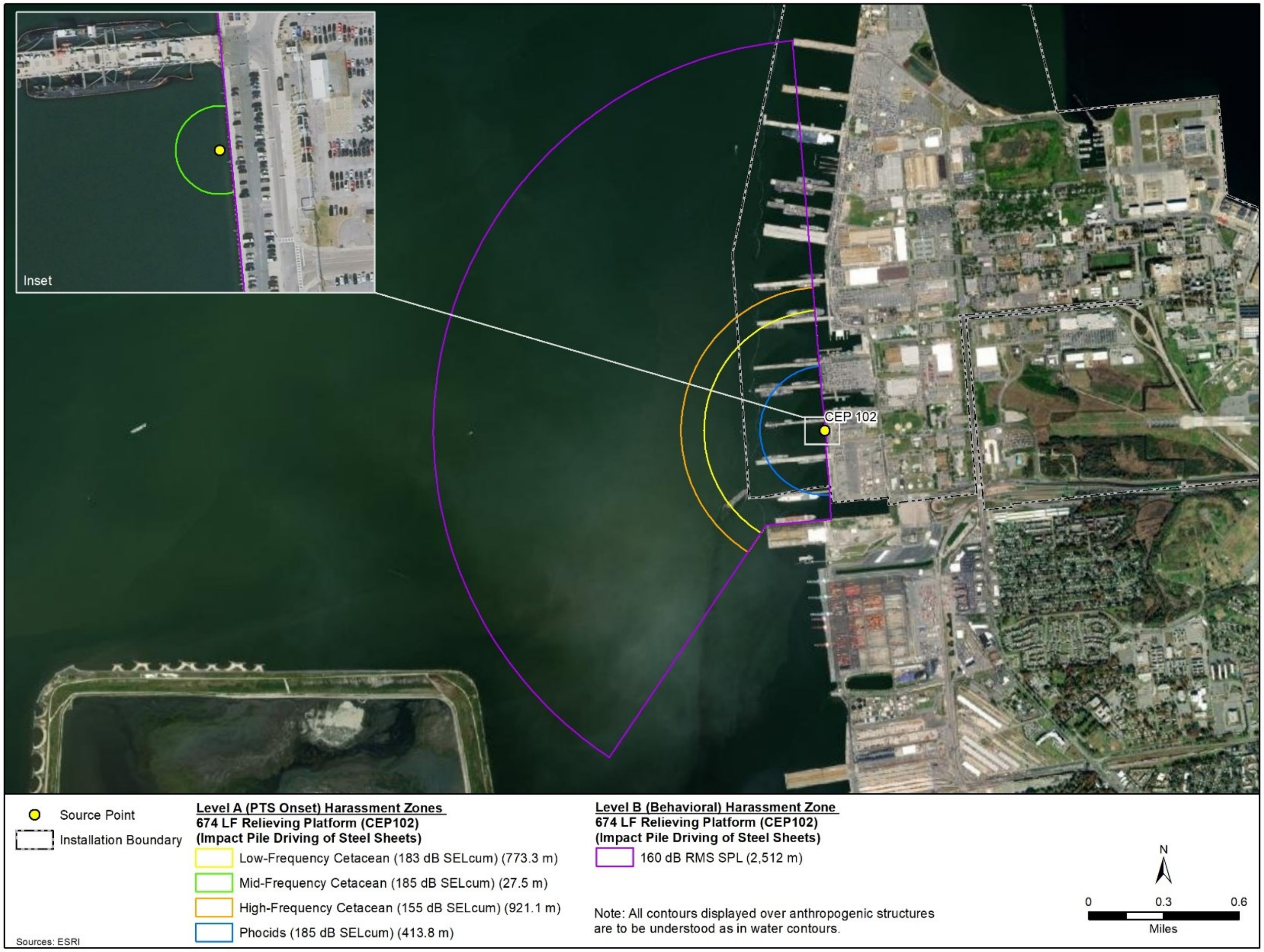

Figure A-4: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Impact Pile Driving At CEP 102 - Steel Sheet

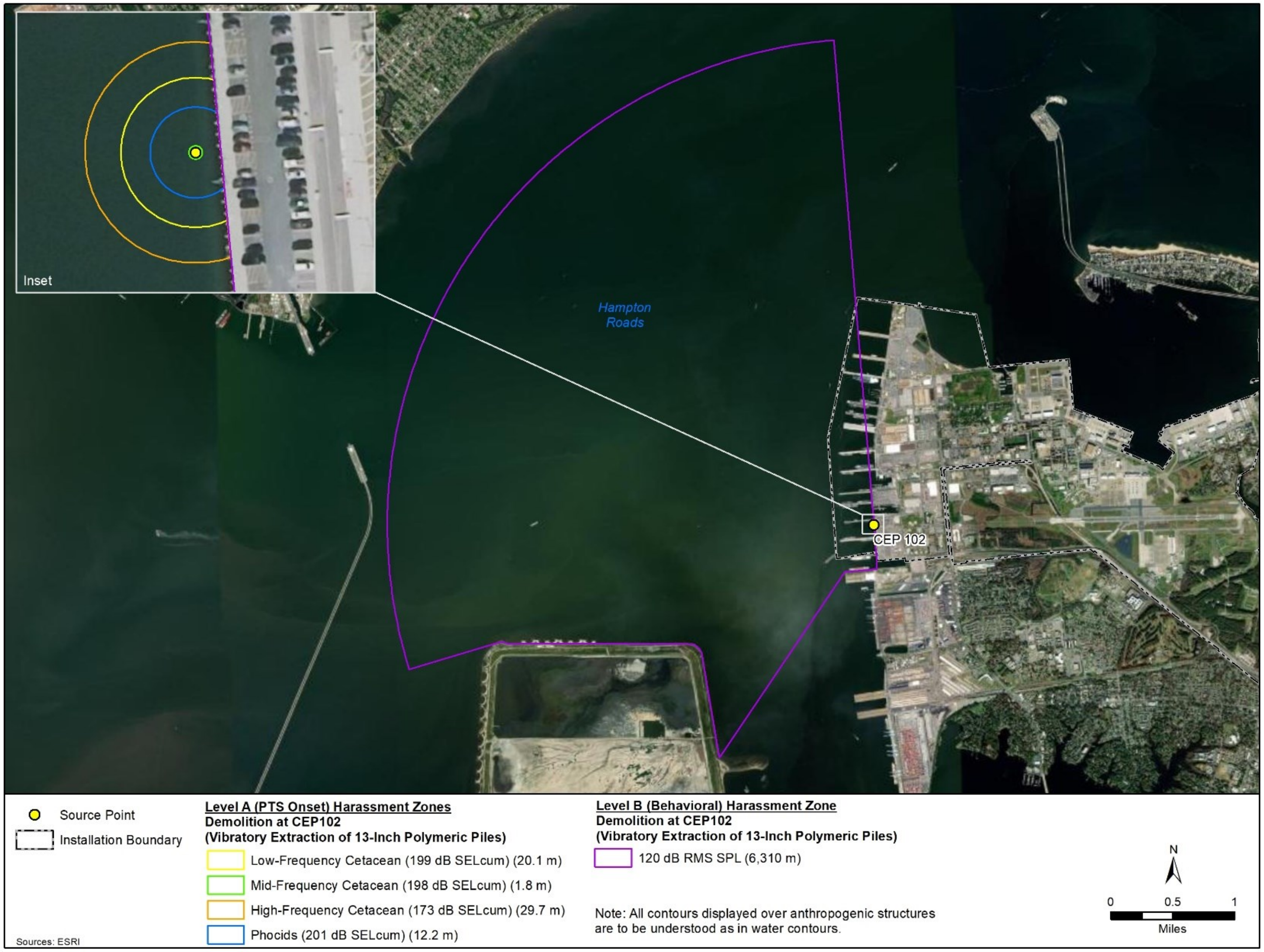

Figure A-5: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Vibratory Pile Driving At CEP 102 – 13-Inch Polymeric

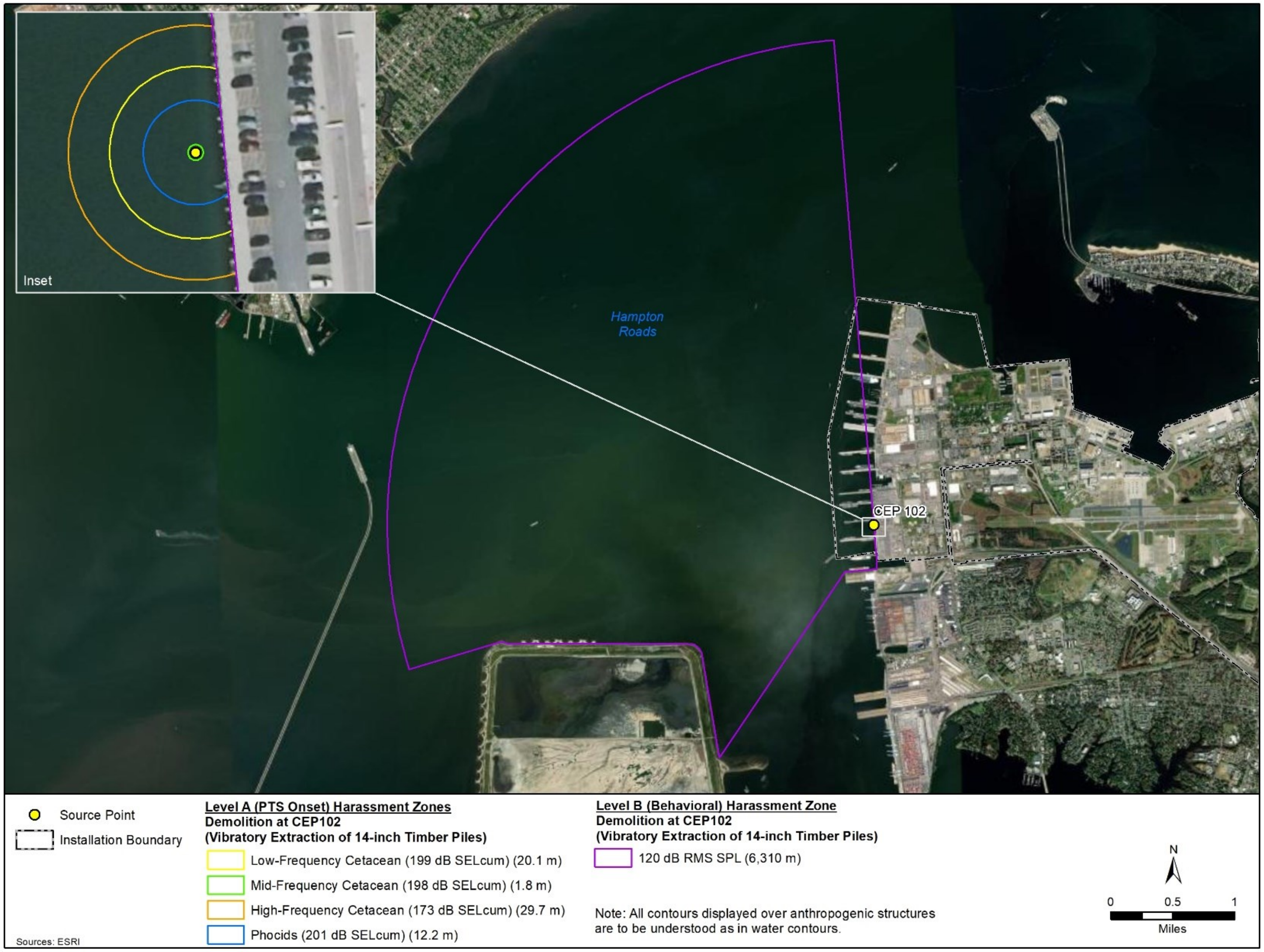

Figure A-6: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Vibratory Pile Driving At CEP 102 – 14-Inch Timber

Figure A-7: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Vibratory Pile Driving At CEP 102 – 18-Inch Concrete

Figure A-8: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Vibratory Pile Driving At CEP 102 – 18-Inch Square Concrete

Figure A-9: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Vibratory Pile Driving At CEP 102 – 24-Inch Square Concrete

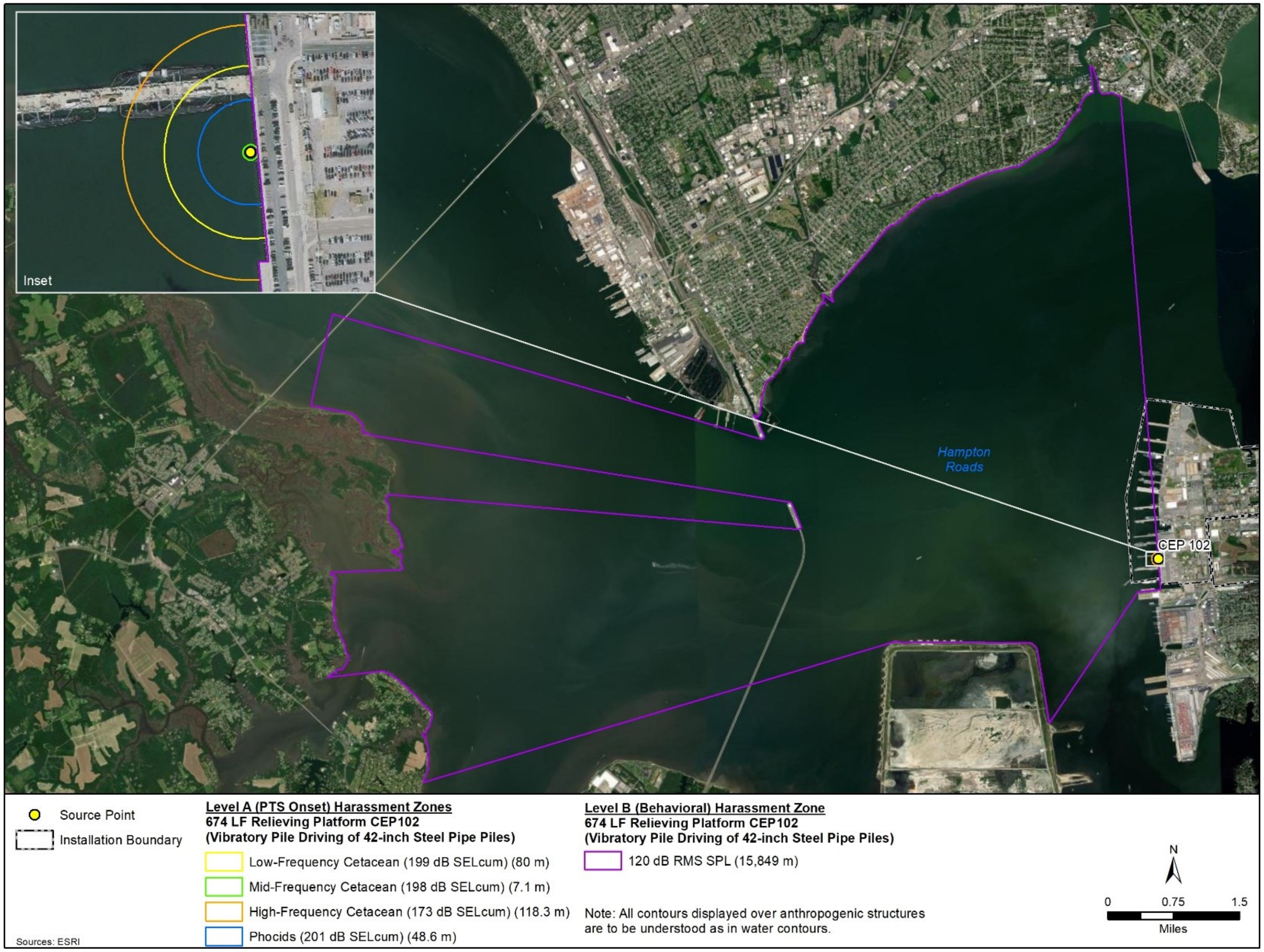

Figure A-10: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Vibratory Pile Driving At CEP 102 – 42-Inch Steel Pipe

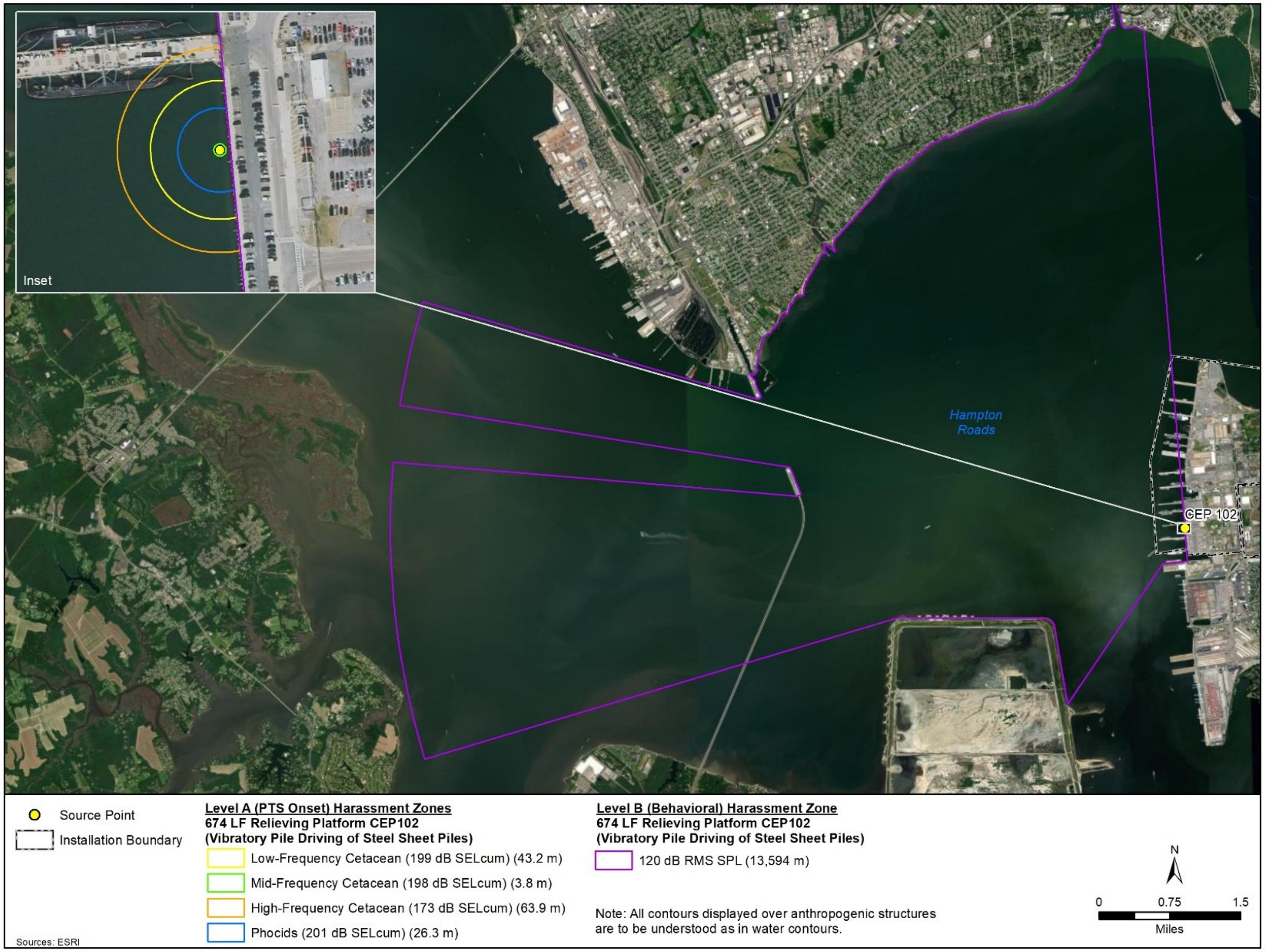

Figure A-11: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Vibratory Pile Driving At CEP 102 – Steel Sheet

Figure A-12: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Impact Pile Driving At CEP 175 – 13-Inch Polymeric

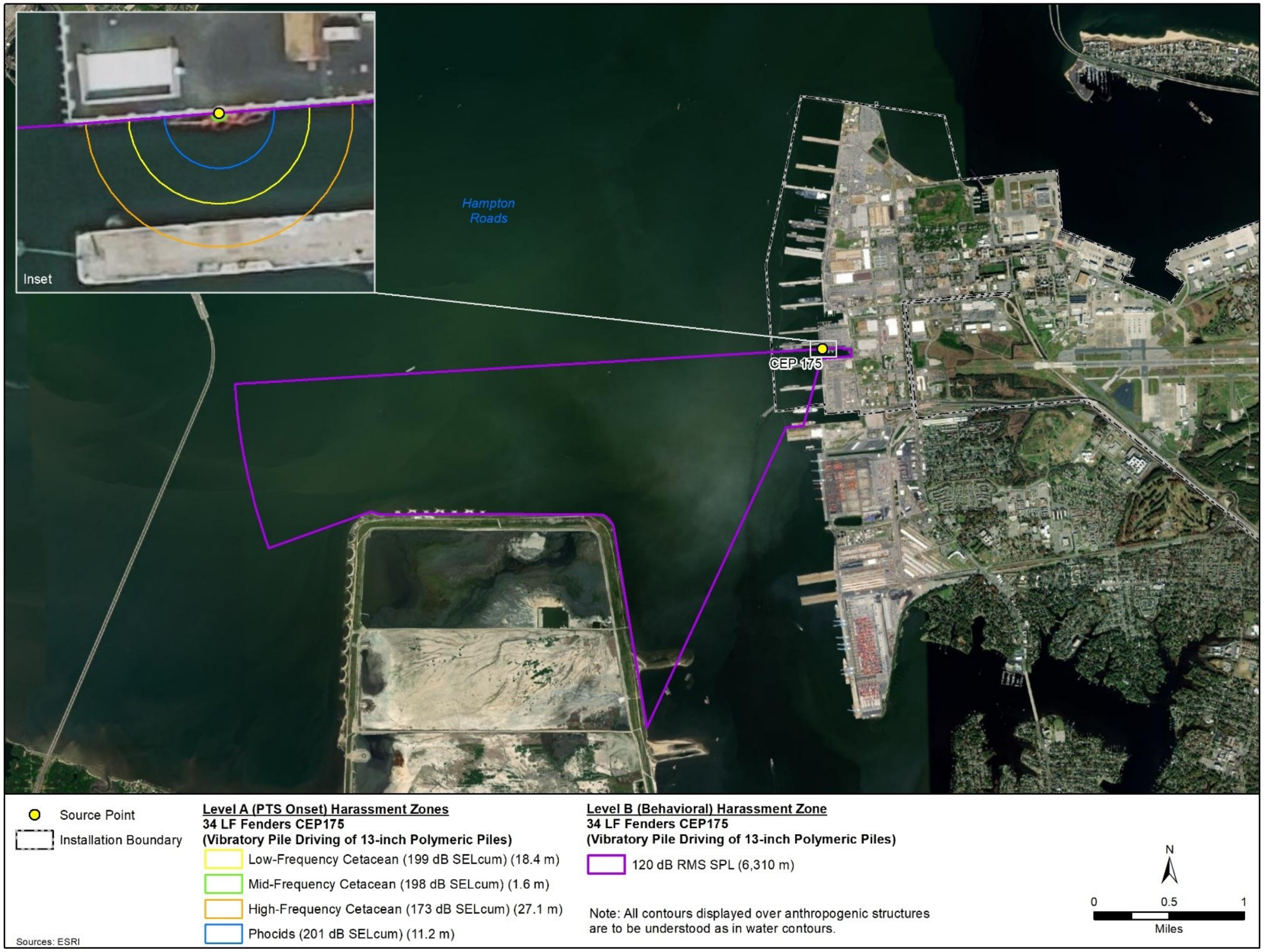

Figure A-13: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Vibratory Pile Driving At CEP 175 – 13-Inch Polymeric

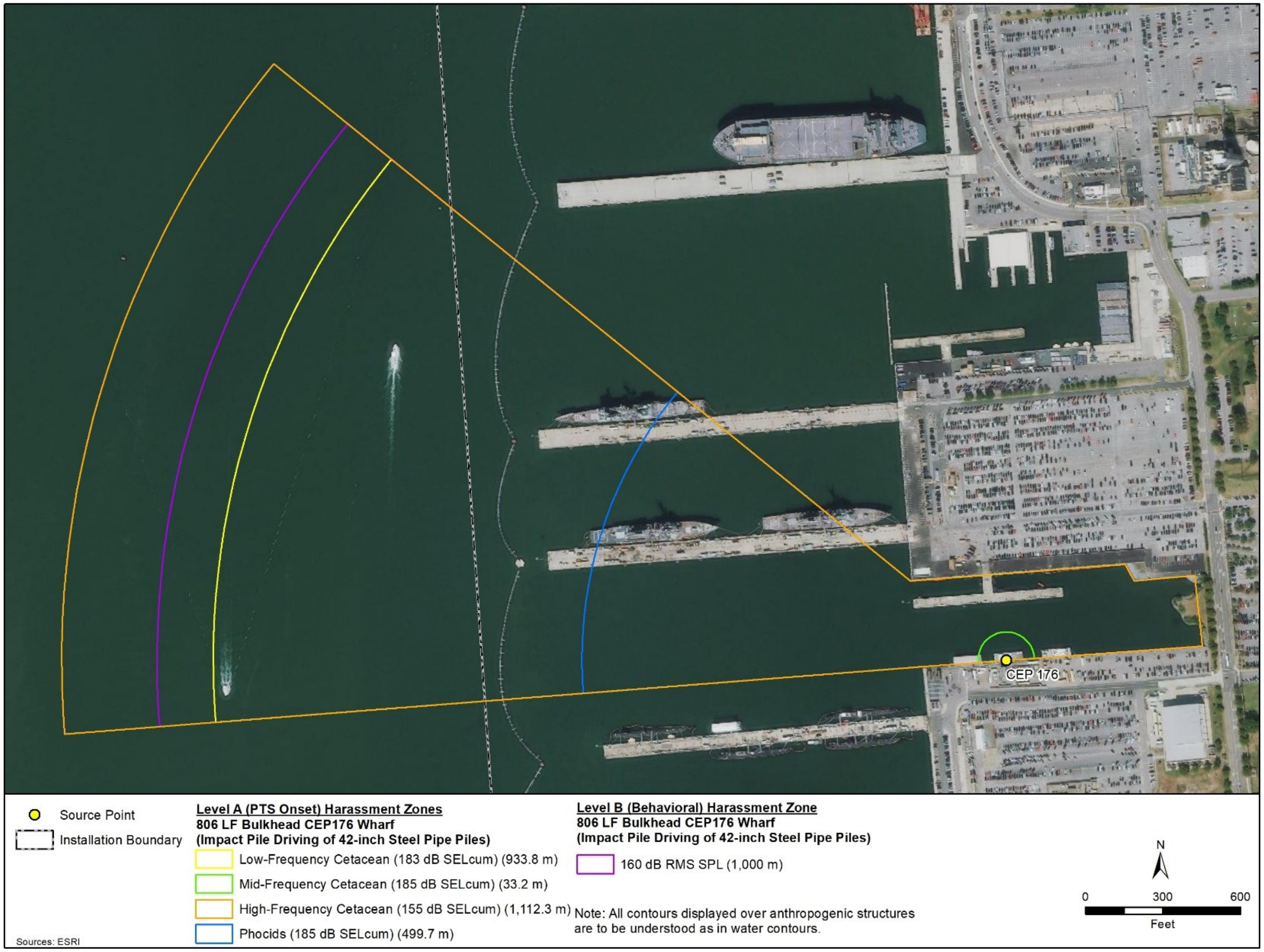

Figure A-14: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Impact Pile Driving At CEP 176 – 42-Inch Steel Pipe

Figure A-15: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Impact Pile Driving At CEP 176 – Steel Sheet

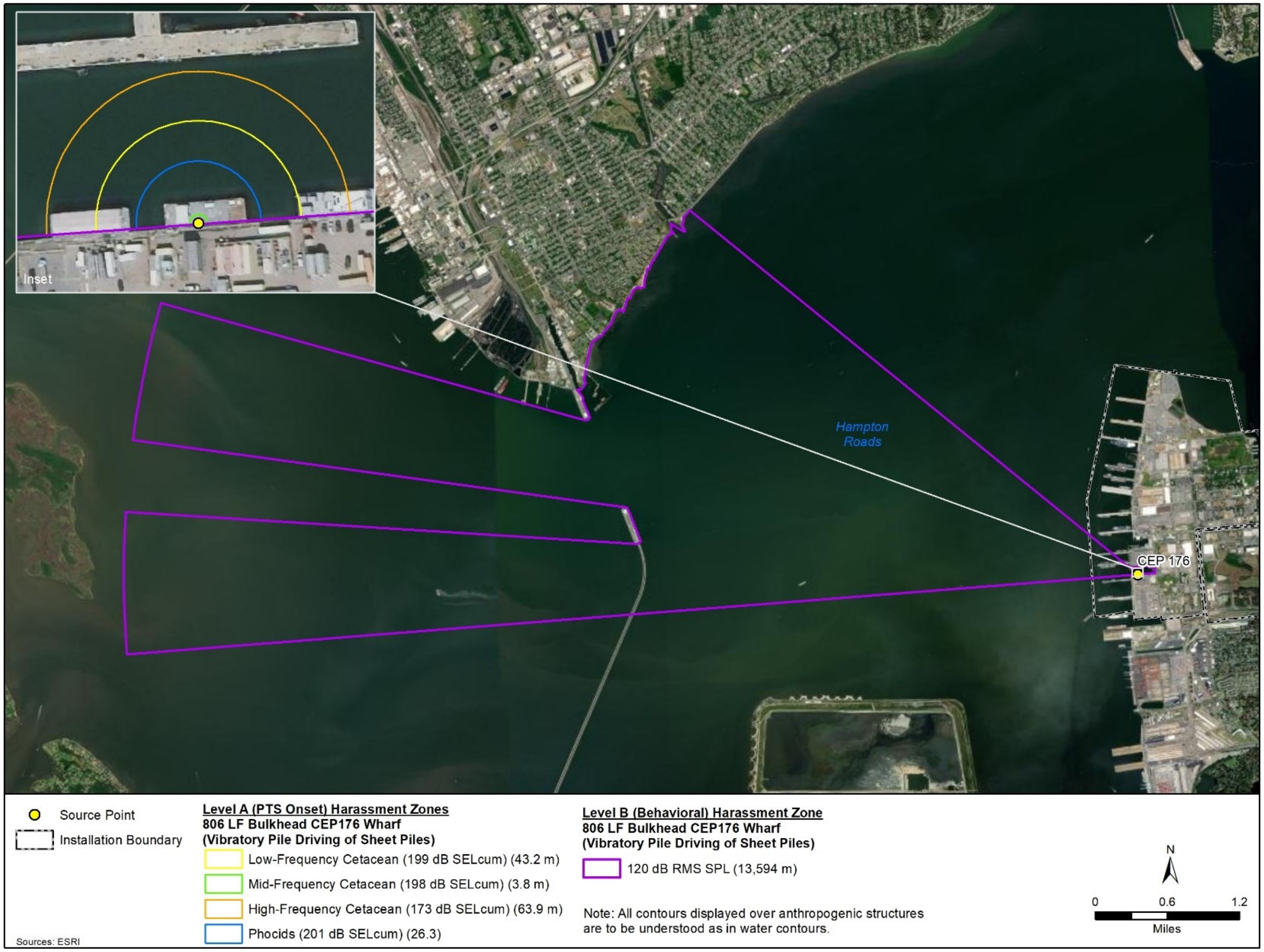

Figure A-16: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Vibratory Pile Driving At CEP 176 – Steel Sheet

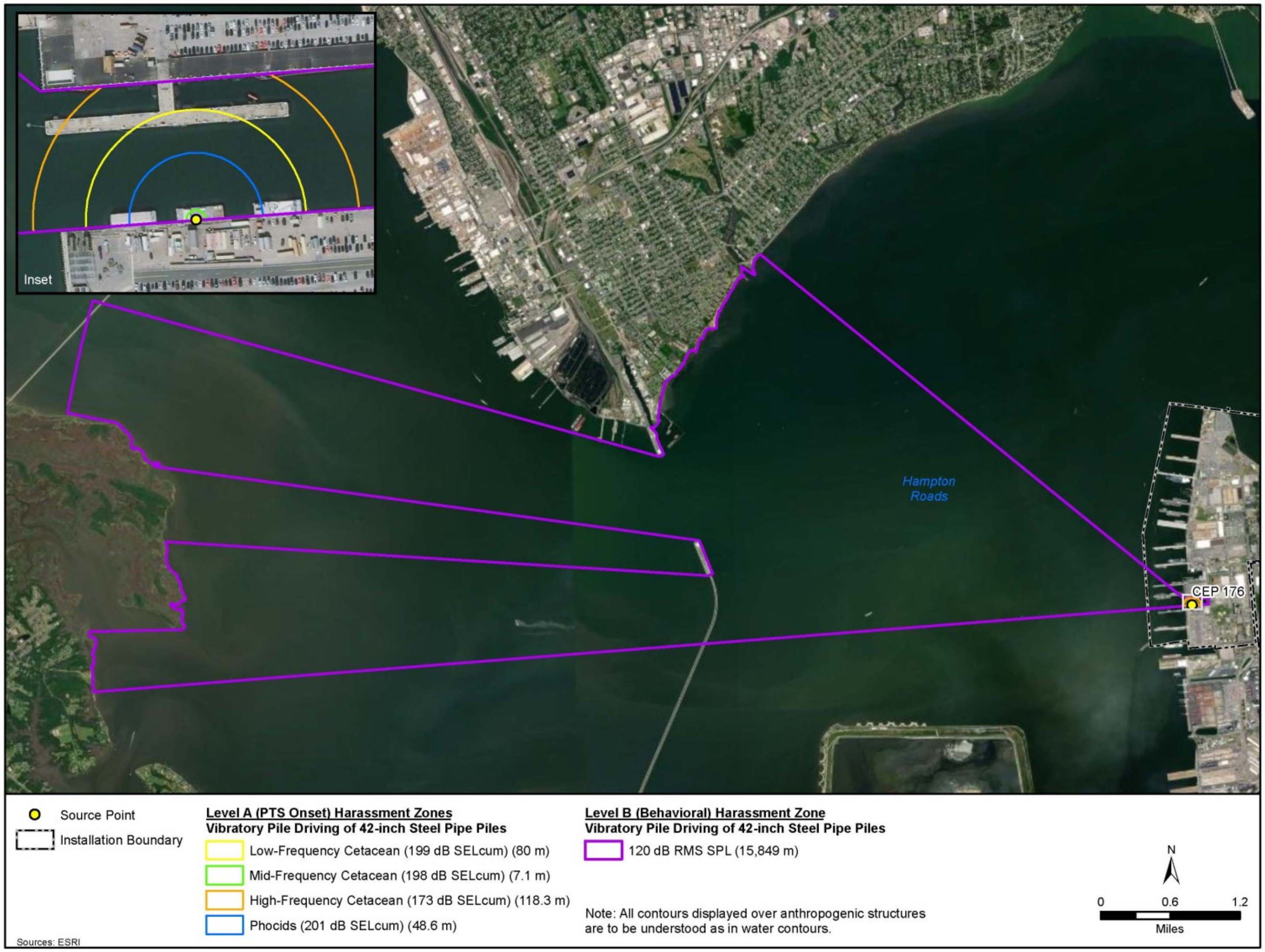

Figure A-17: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Vibratory Pile Driving At CEP 176 – 42-Inch Steel Pipe

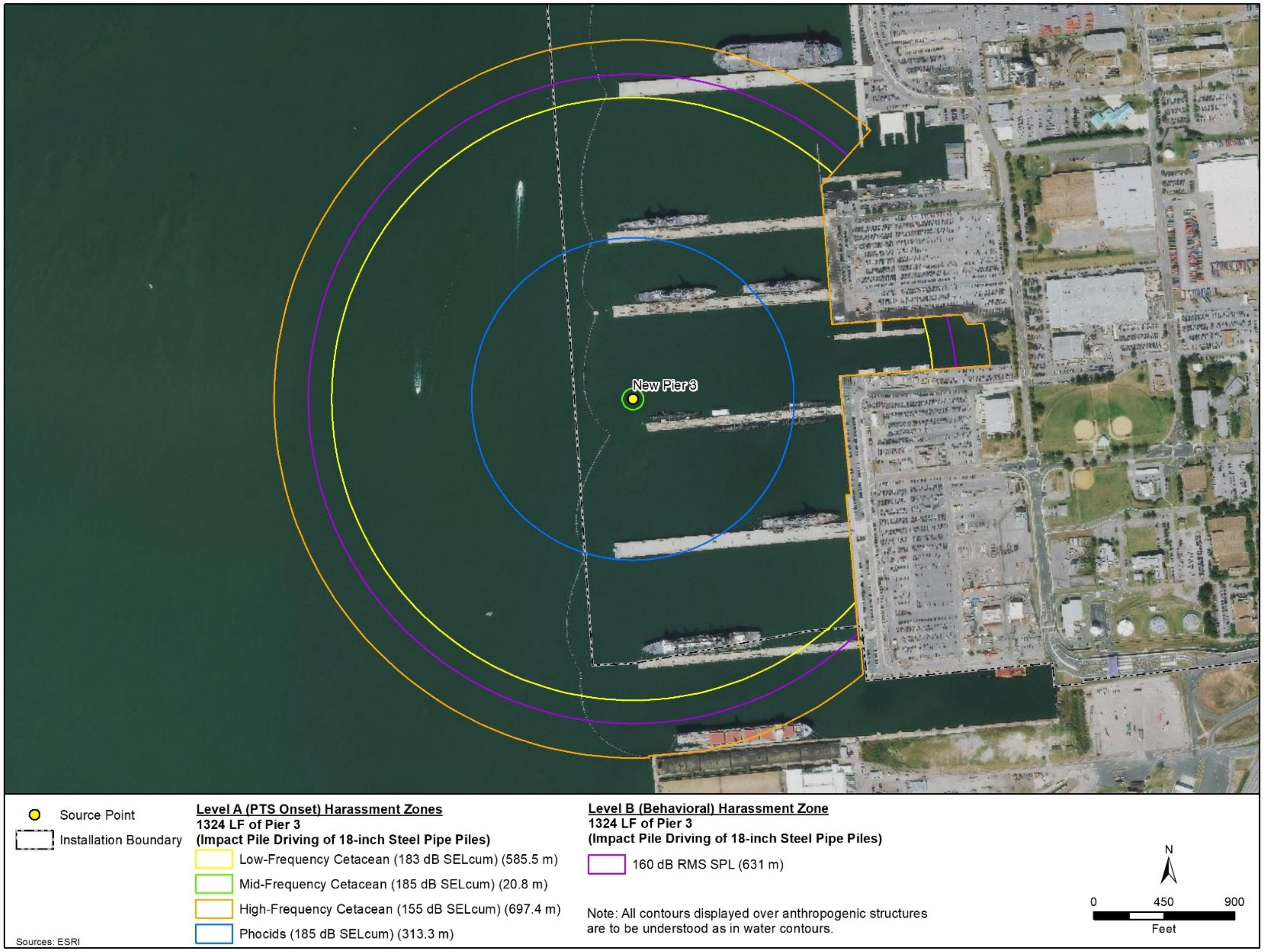

Figure A-18: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Impact Pile Driving At New Pier 3 – 18-Inch Steel Pipe

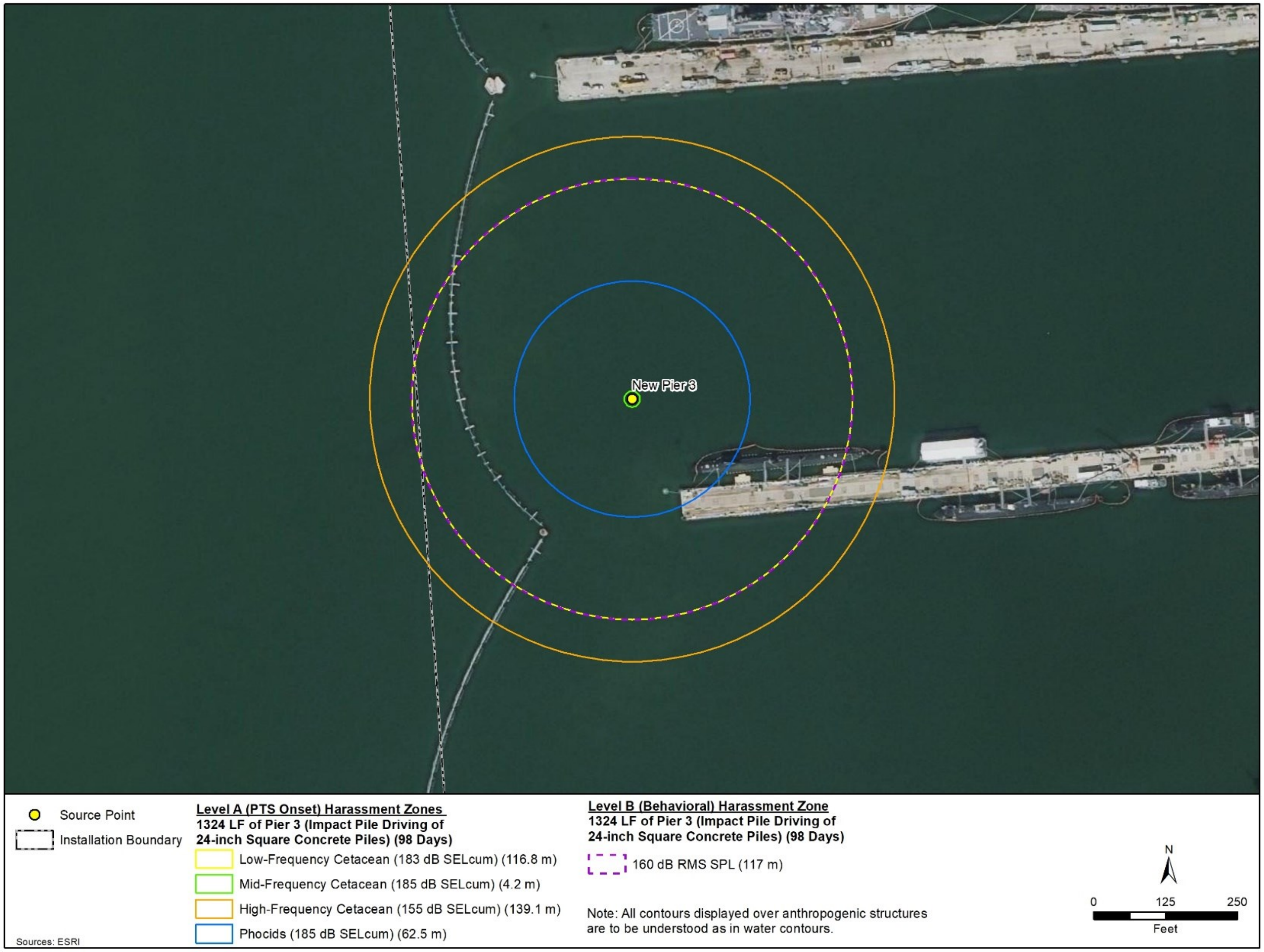

Figure A-19: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Impact Pile Driving At New Pier 3 – 24-Inch Square Concrete 98 Days

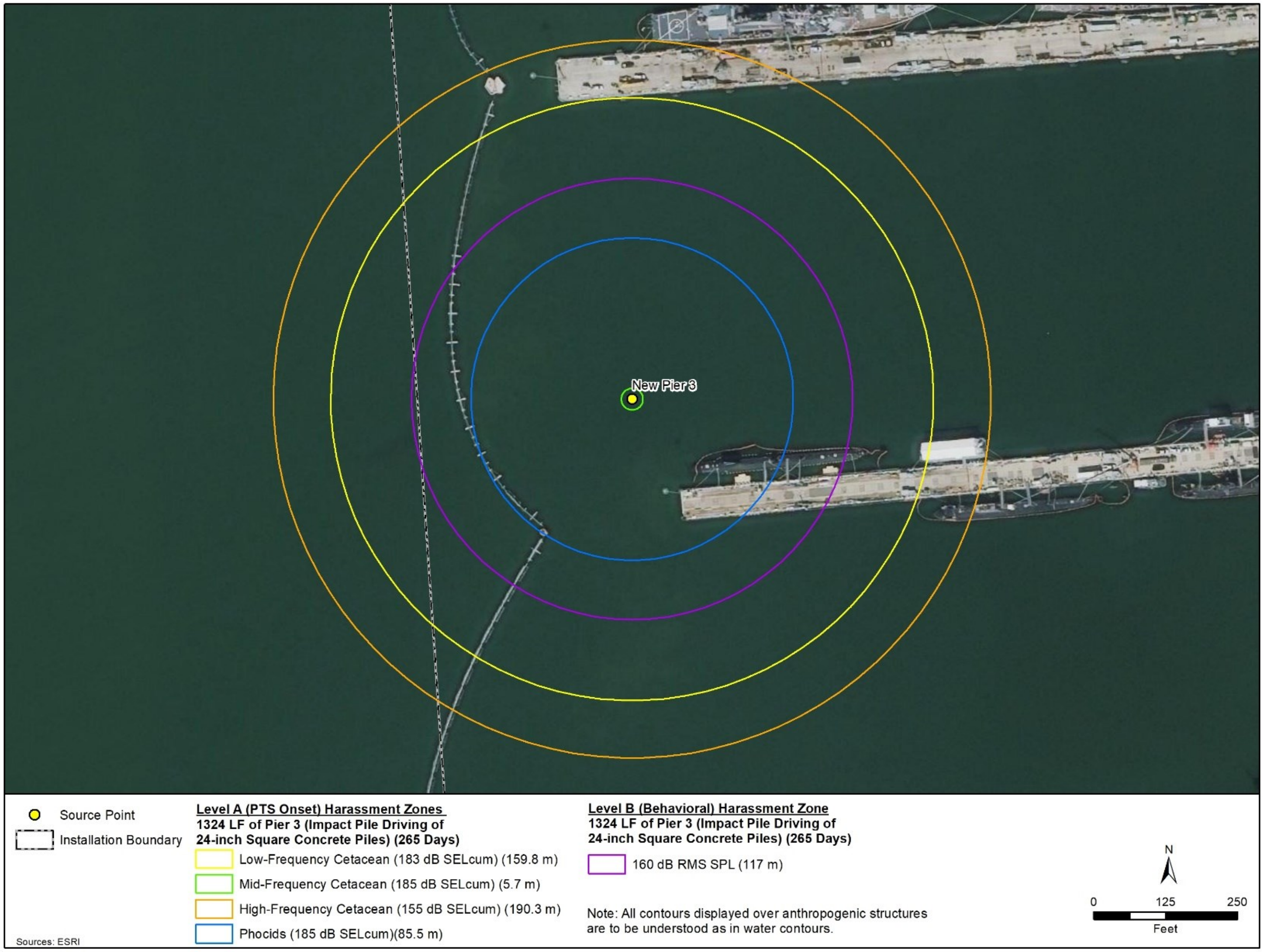

Figure A-20: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Impact Pile Driving At New Pier 3 – 24-Inch Square Concrete 265 Days

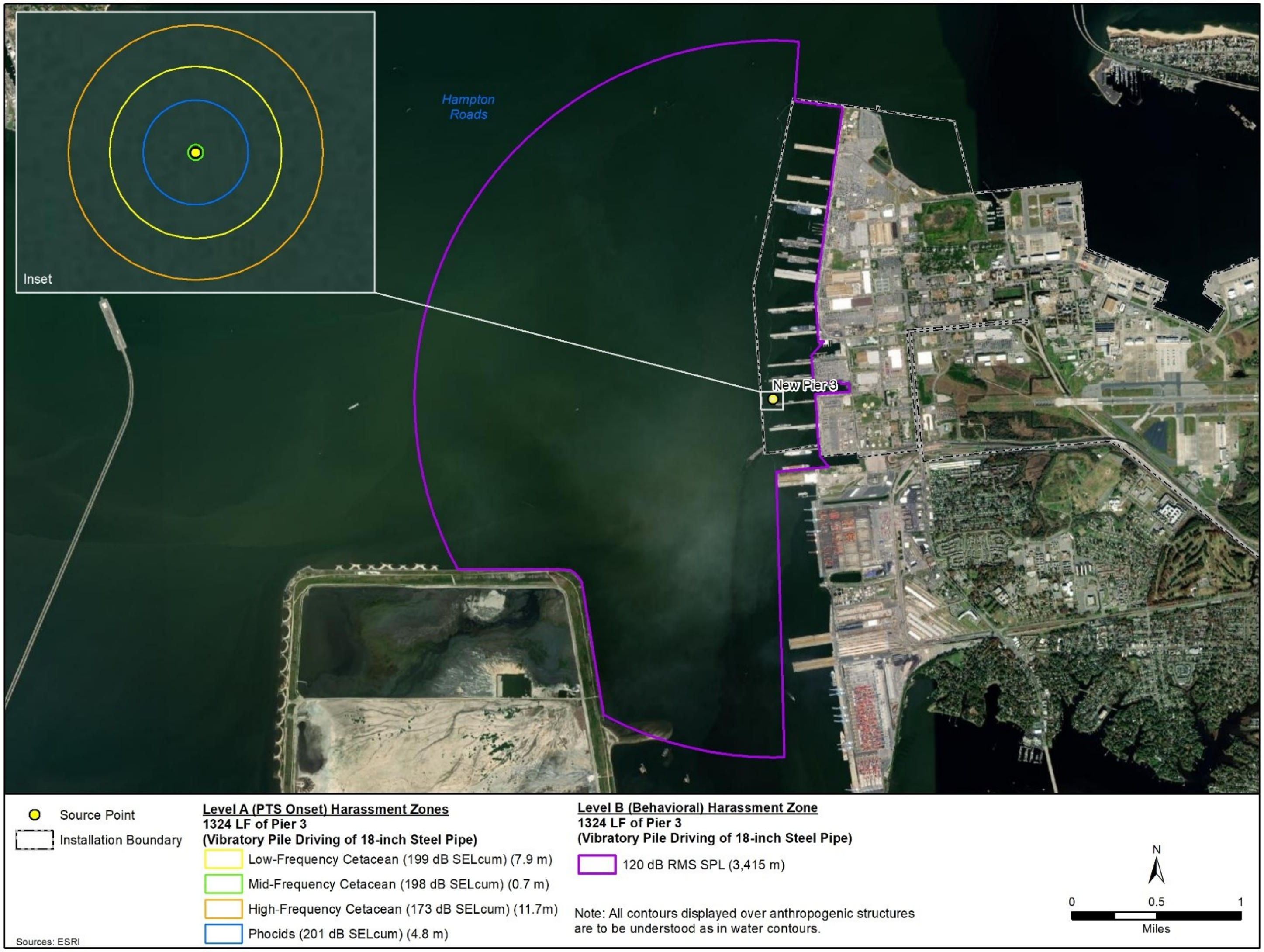

Figure A-21: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Vibratory Pile Driving At New Pier 3 – 18-Inch Steel Pipe

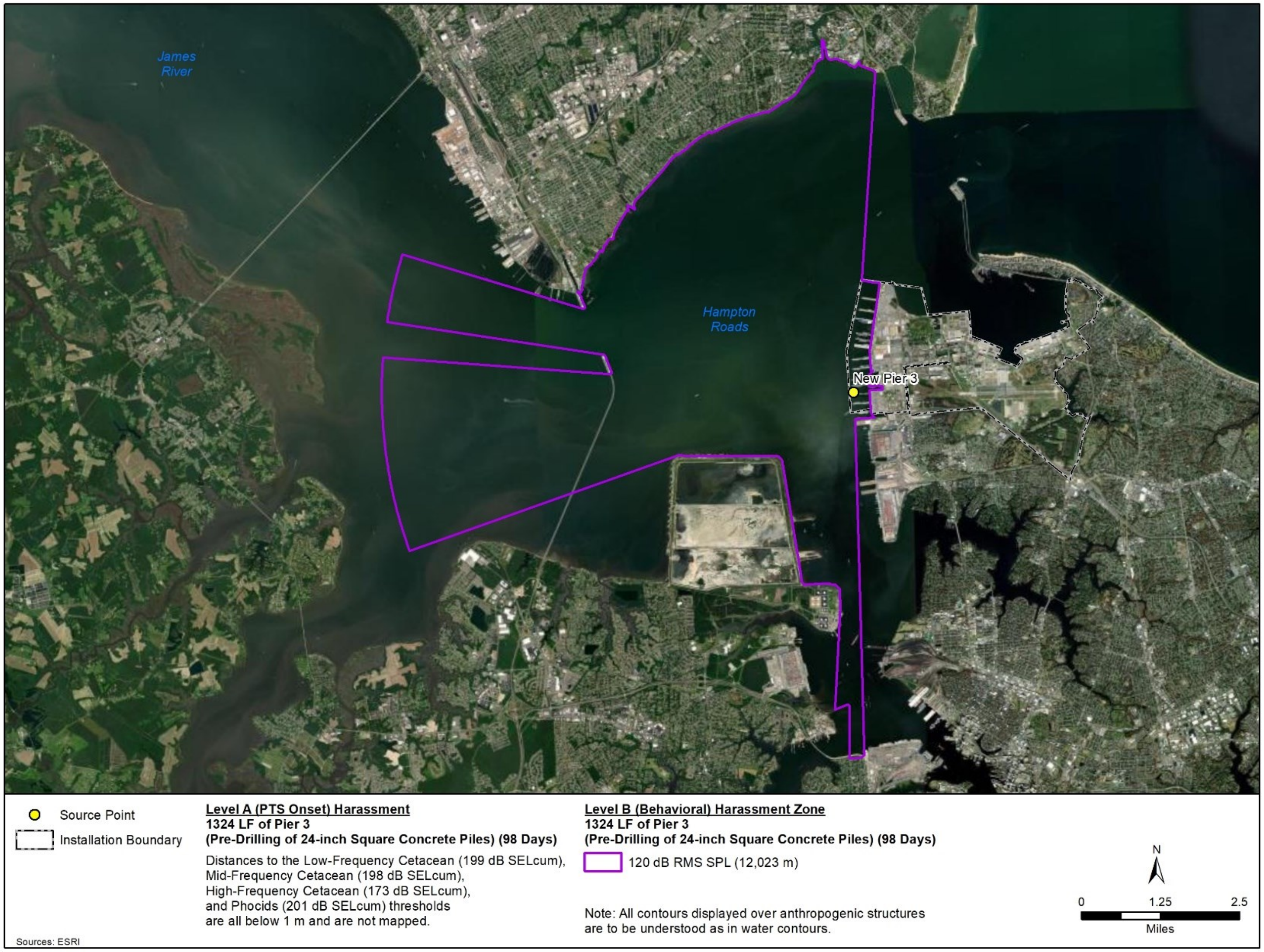

Figure A-22: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Vibratory Pile Driving At New Pier 3 – 24-Inch Square Concrete 98 Days

Figure A-23: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Vibratory Pile Driving At New Pier 3 – 24-Inch Square Concrete 265 Days

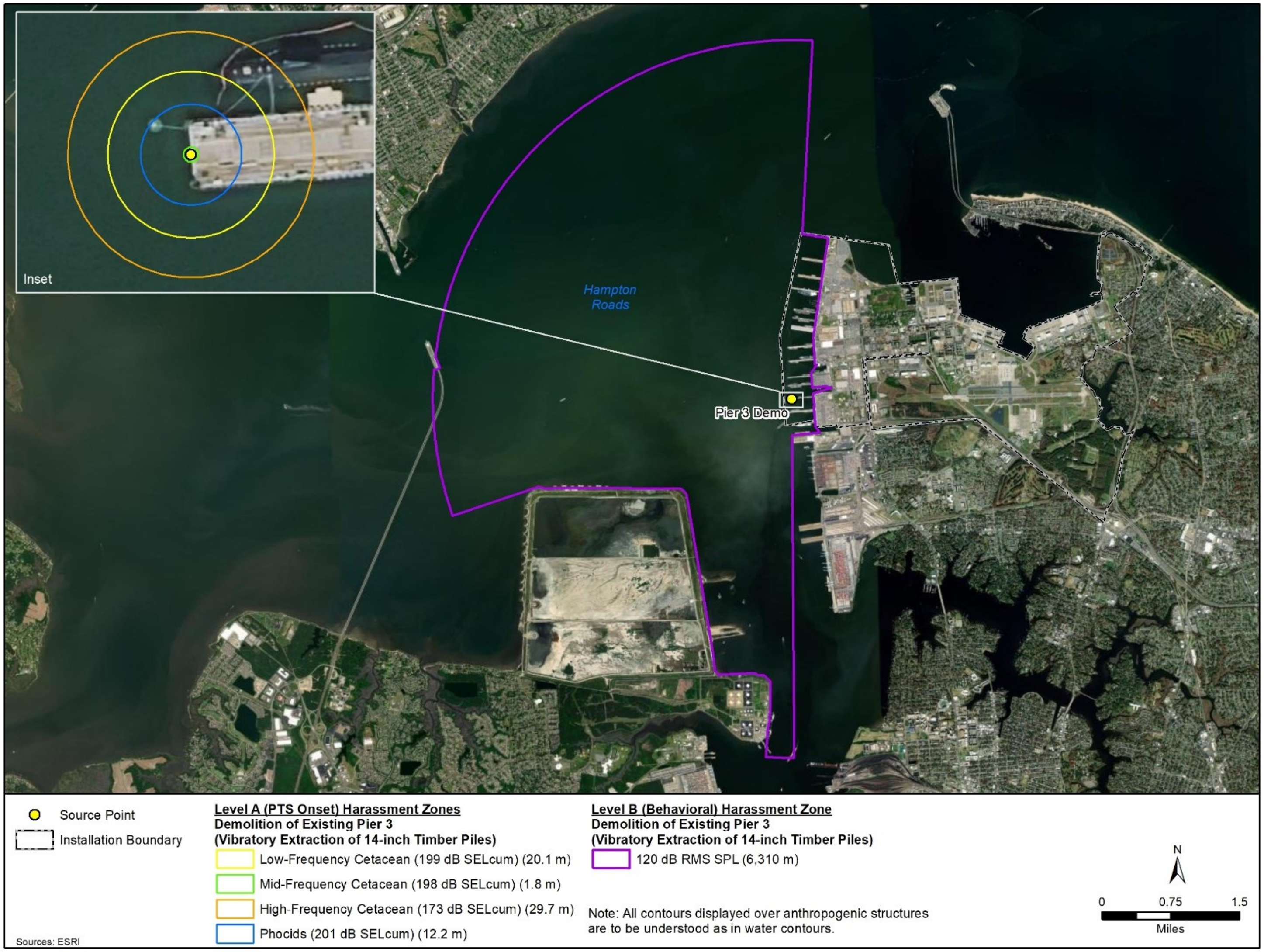

Figure A-24: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Vibratory Extraction At Existing Pier 3 – 14-Inch Timber

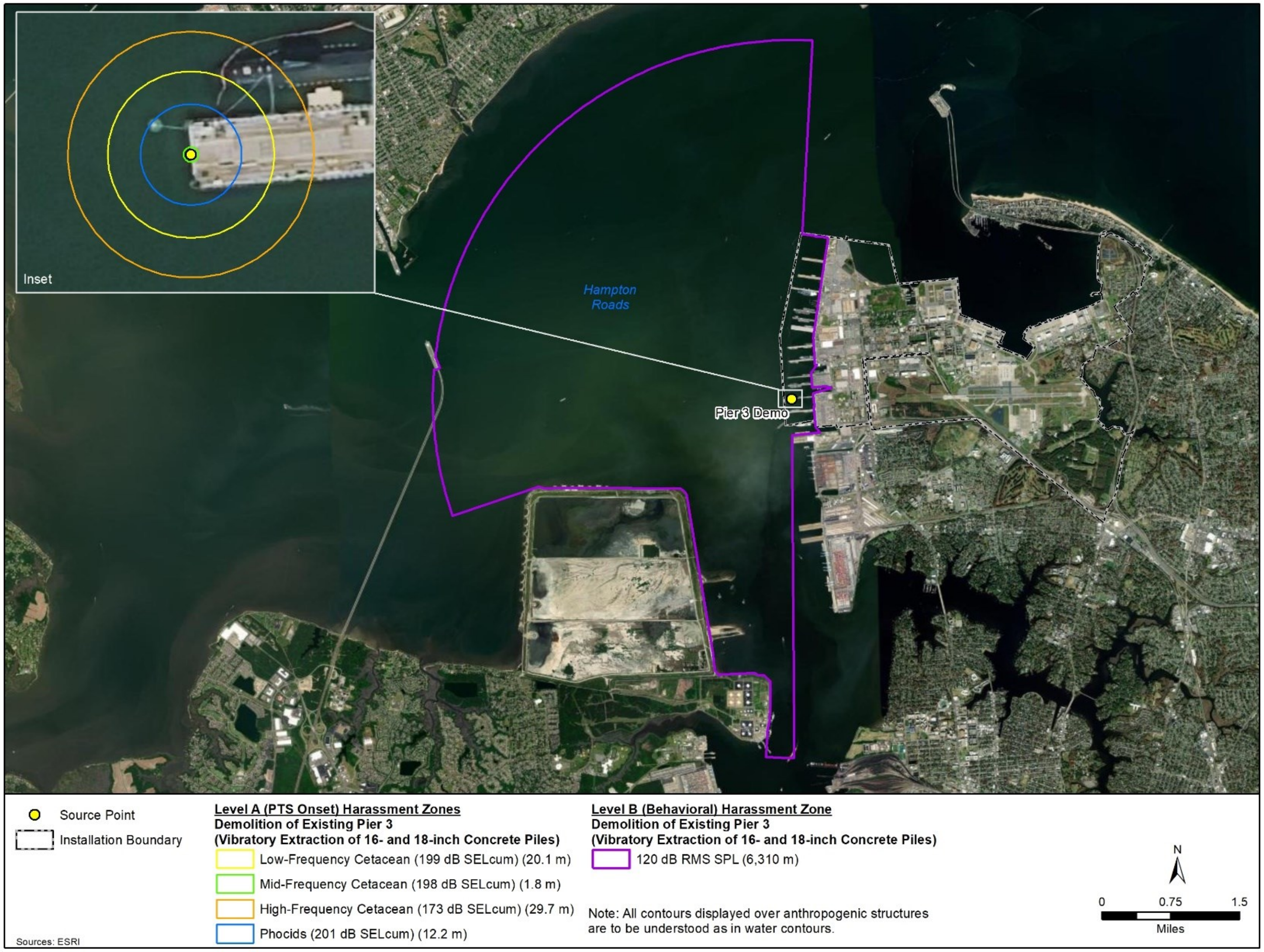

Figure A-25: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Vibratory Extraction At Existing Pier 3 – 16- & 18-Inch Concrete

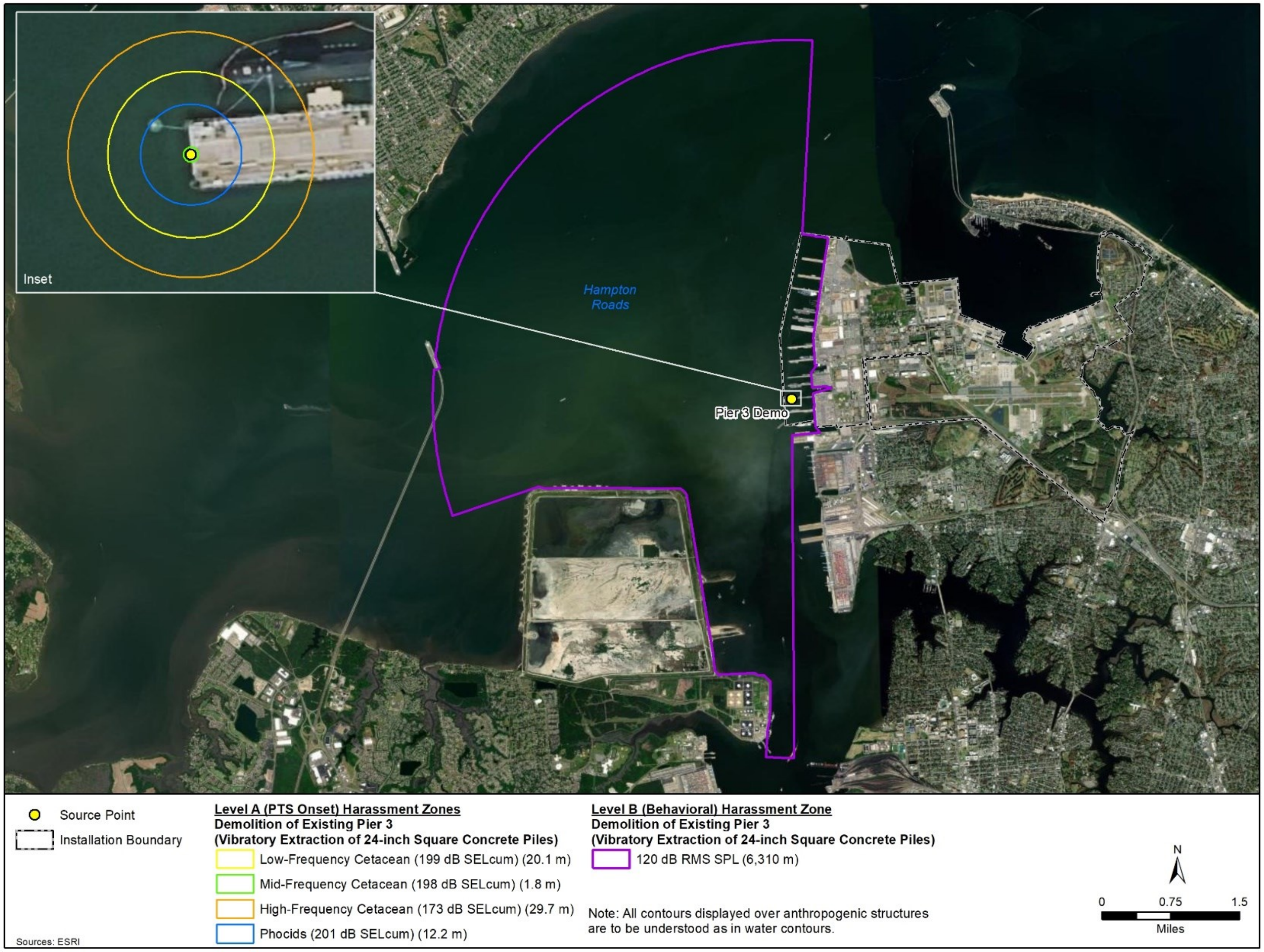

Figure A-26: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Vibratory Extraction At Existing Pier 3 – 24-Inch Square Concrete

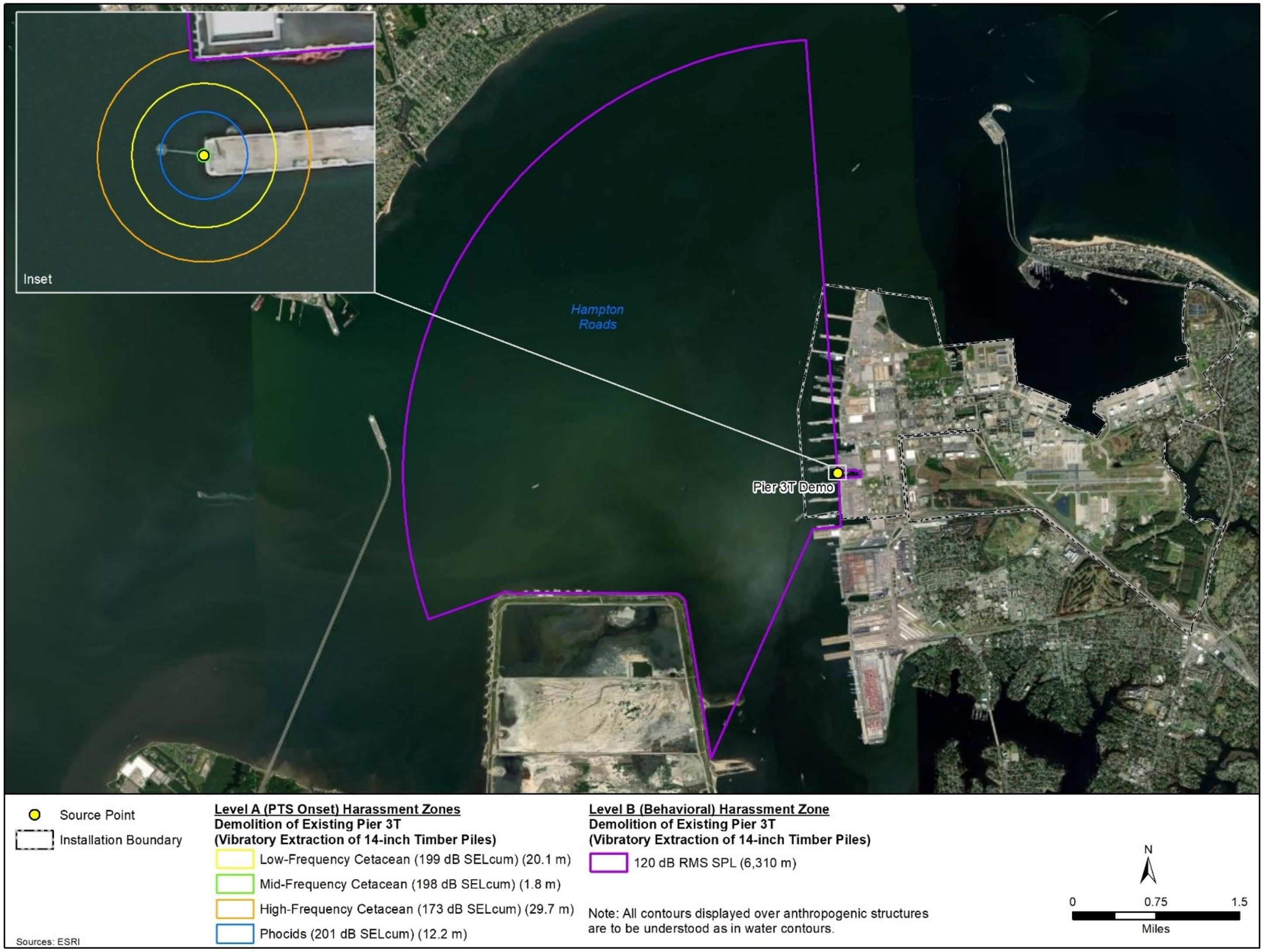

Figure A-27: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Vibratory Extraction At Pier 3T – 14-Inch Timber

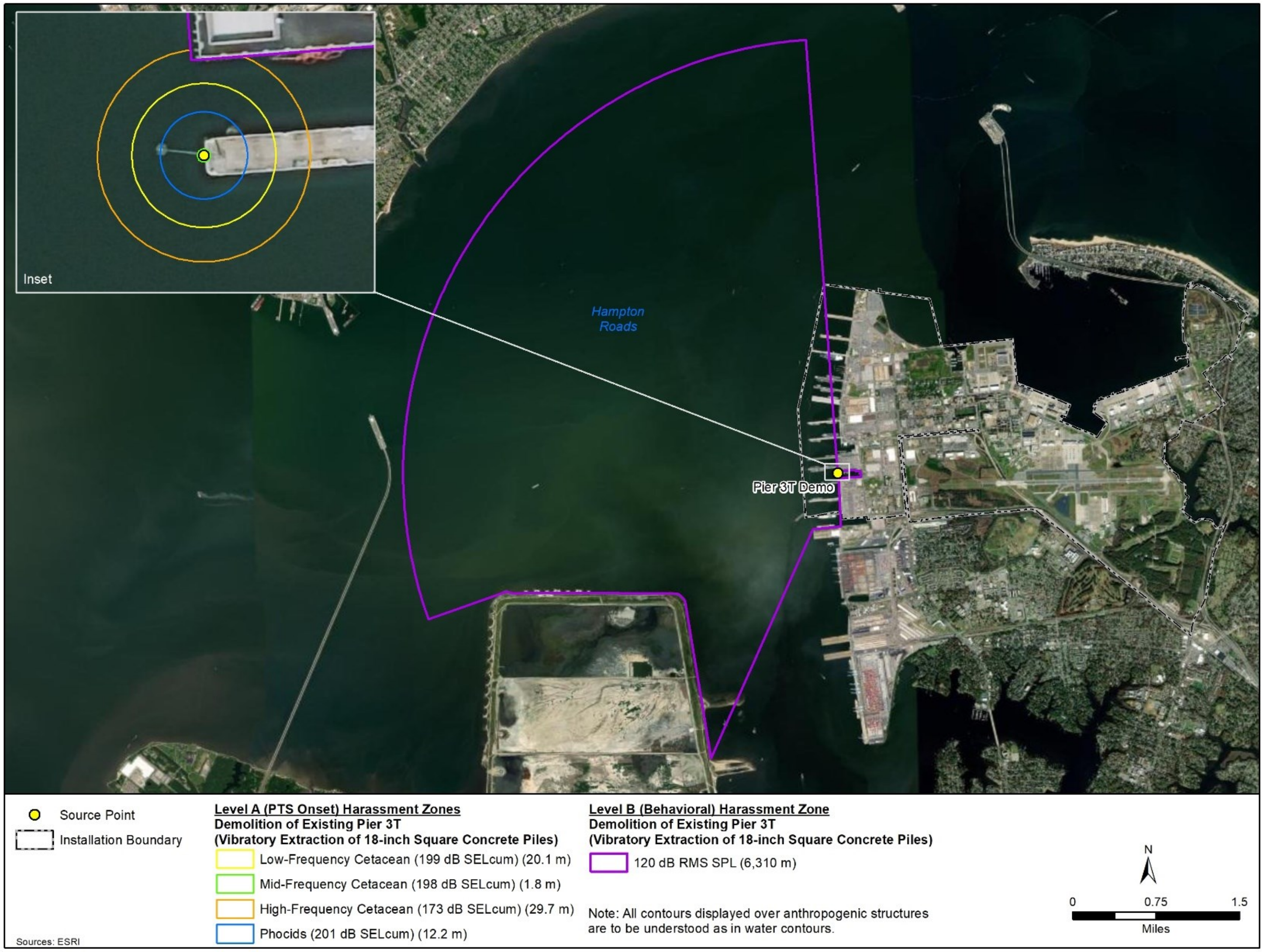

Figure A-28: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Vibratory Extraction At Pier 3T – 18-Inch Square Concrete

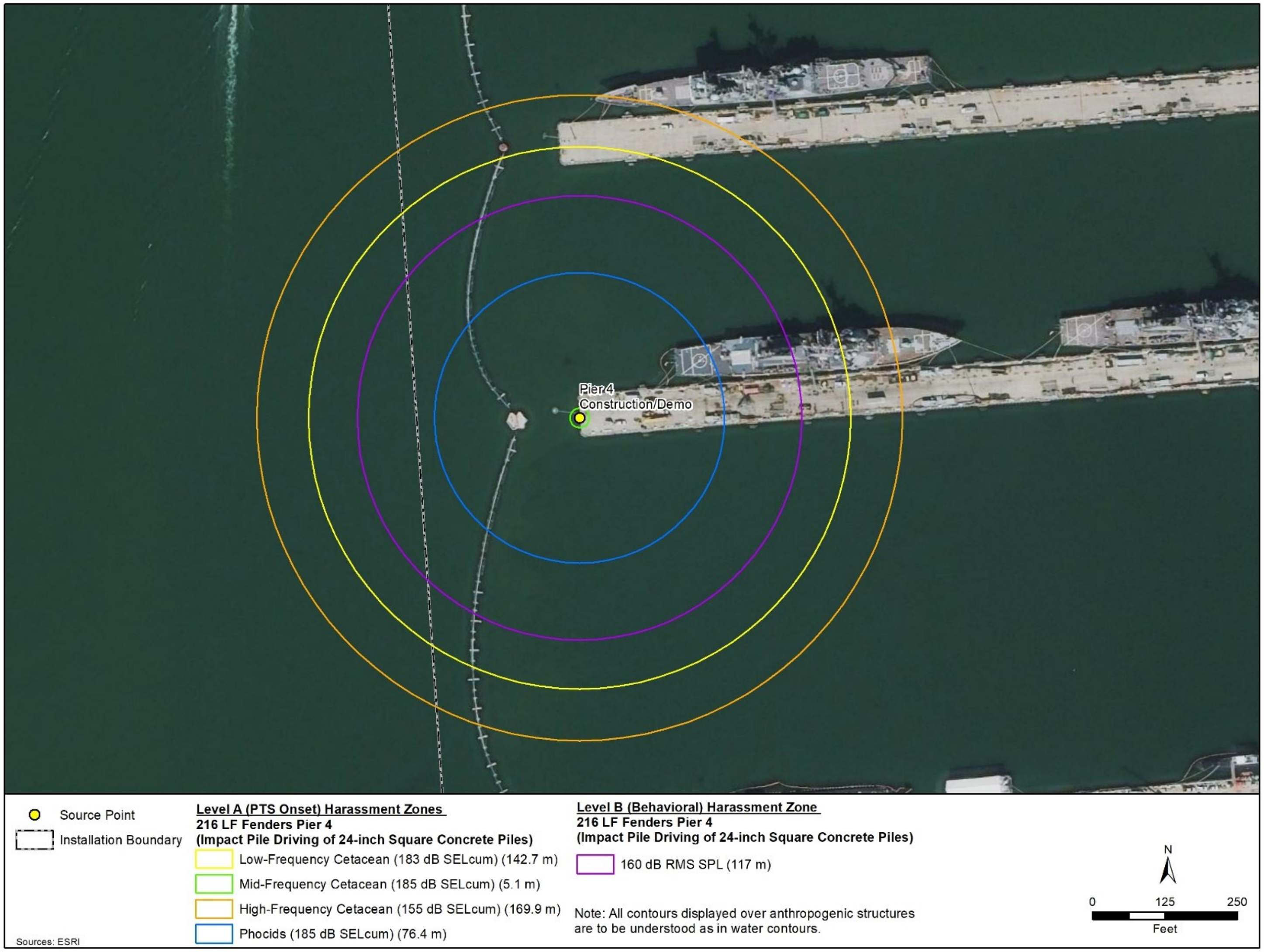

Figure A-29: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Impact Pile Driving At Pier 4 – 24-Inch Square Concrete

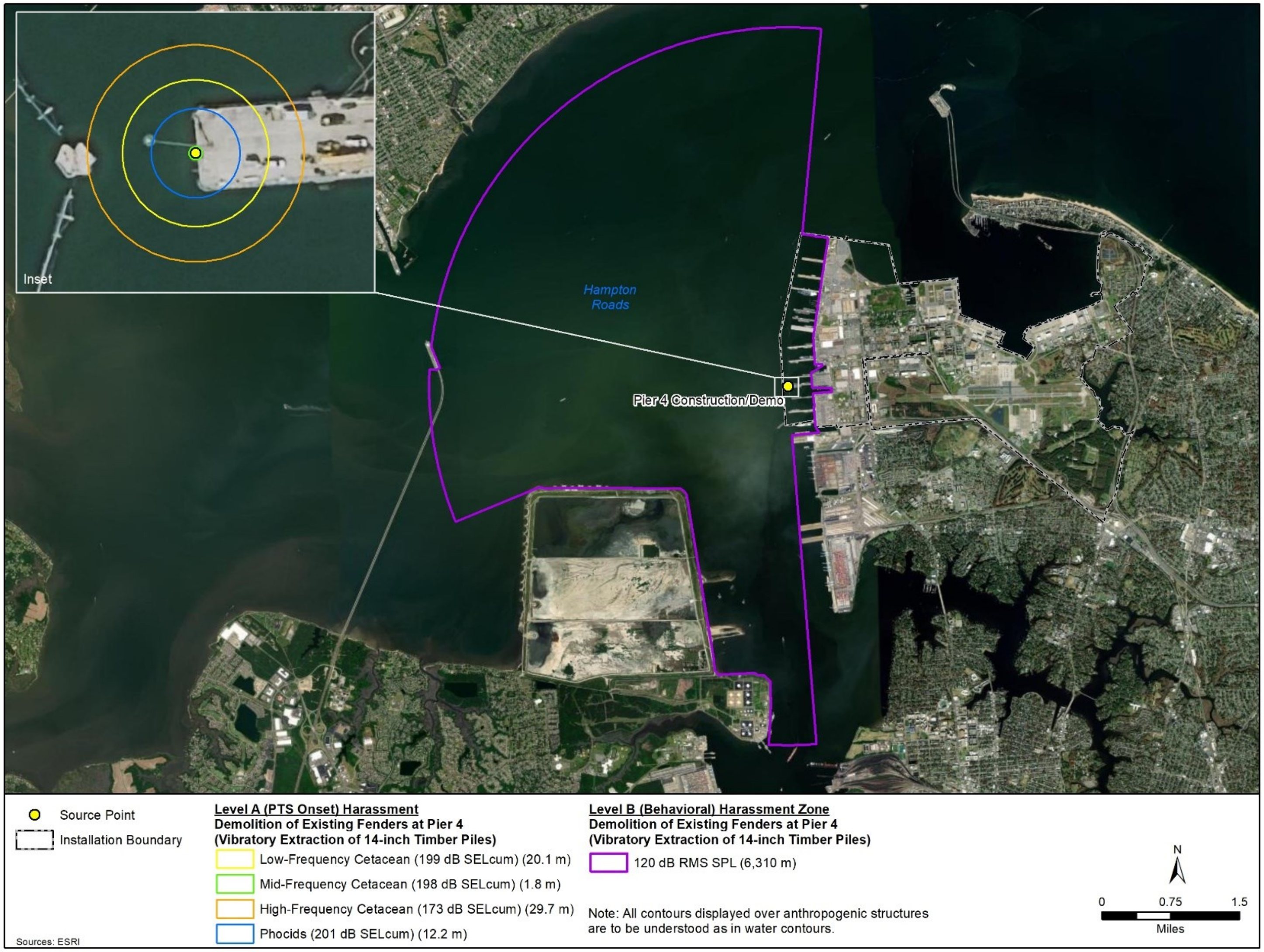

Figure A-30: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Vibratory Extraction At Pier 4 - 14-Inch Timber

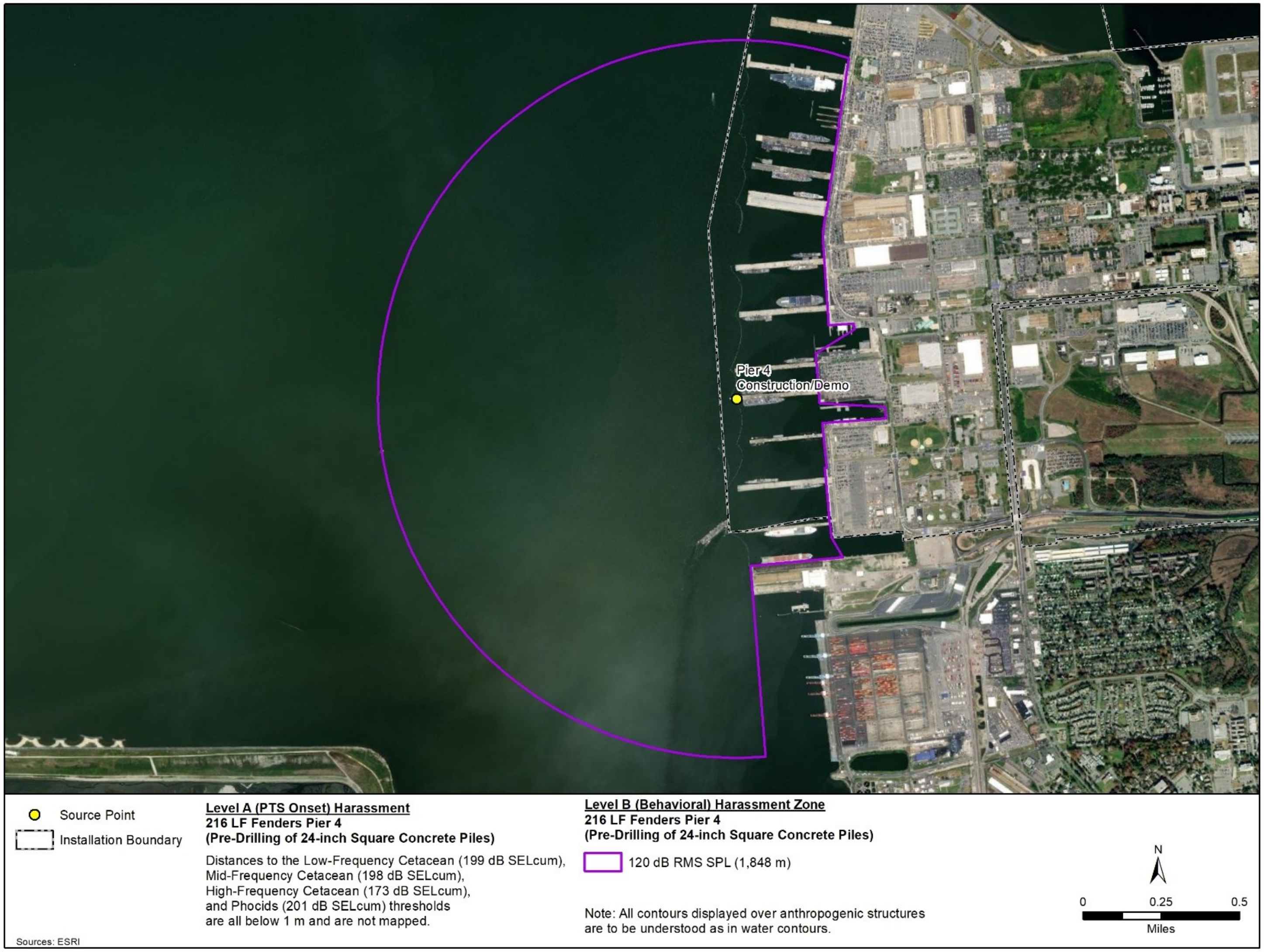

Figure A-31: ZOIs For Level A (PTS Onset) & Level B (Behavioral) Harassment From Vibratory Pile Driving At Pier 4 – 24-Inch Square Concrete

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Table A-1: Maximum Distances To Fish Sound Thresholds From Impact Pile Driving

Section	Pile Size & Count[1]	Total Pile Driving Days[2]	Fishes Without A Swim Bladder					Fishes With A Swim Bladder Not Involved In Hearing; Eggs And Larvae					Fishes With A Swim Bladder Involved In Hearing				
			Onset Of Mortality		Onset Of Injury		TTS	Onset Of Mortality[3]		Onset Of Injury		TTS	Onset Of Mortality		Onset Of Injury		TTS
			> 219 SEL_{cum}	> 213 SPL_{peak}	> 216 SEL_{cum}	> 213 SPL_{peak}	>186 SEL_{cum}	210 SEL_{cum}	> 207 SPL_{peak}	203 SEL_{cum}	> 207 SPL_{peak}	186 SEL_{cum}	207 SEL_{cum}	> 207 SPL_{peak}	203 SEL_{cum}	>207 SPL_{peak}	186 SEL_{cum}
CEP102	42-Inch Steel Pipe	40	4 m	10 m	6 m	10 m	631 m	16 m	25 m	47 m	25 m	631 m	25 m	25 m	47 m	25 m	631 m
	Steel Sheet	40	3 m	7 m	5 m	7 m	489 m	12 m	18 m	36 m	18 m	489 m	19 m	18 m	36 m	18 m	489 m
	24-Inch Square Concrete	72	1 m	0	1 m	0	74 m	2 m	1 m	7 m	1 m	74	4 m	1 m	7 m	1 m	74 m
	18-Inch Square Concrete	14	0	0	0	0	18 m	1 m	0	2 m	0	18 m	0	1 m	2 m	0	18 m
Pier 3	24-Inch Square Concrete	265	1 m	0	1 m	0	74 m	3 m	1 m	7 m	1 m	74 m	4 m	1 m	7 m	1 m	74 m
	24-Inch Square Concrete	98	0	0	1	0	74 m	2 m	1 m	5 m	1 m	74 m	4 m	1 m	5 m	1 m	74 m
	18-Inch Steel	4	2 m	5 m	4 m	5 m	370 m	9 m	12 m	27 m	12 m	370 m	15 m	0	27 m	0	370 m
Pier 4	24-Inch Square Concrete	3	1 m	0	1 m	0	74 m	2 m	1 m	7 m	1 m	74 m	4 m	1 m	7 m	1 m	74 m
CEP175	13-Inch Polymeric	2	0	0	0	0	14 m	0	0	1 m	0	14 m	1 m	0	1 m	0	14 m
CEP176 Wharf	42-Inch Steel	55	4 m	10 m	6 m	10	590 m	15 m	25 m	43 m	25 m	590 m	23 m	25 m	43 m	25 m	590 m
	Steel Sheet	56	3 m	7 m	5 m	7 m	489 m	12 m	18 m	36 m	18 m	489 m	19 m	18 m	36 m	18 m	489 m

Source: Popper et al. 2014

Notes: [1] Due to the lack of studies on fish supporting injury or behavioral disturbance from vibratory pile driving methods, the range of effects on fish focuses on impact pile driving.

[2] Distances are based on maximum number of pile strikes per day for any given pile type installed (See Table 2)

[3] Onset of mortality in eggs and larvae is the same as fishes with swim bladder not involved in hearing; onset of injury and TTS are not quantified for eggs and larvae (see Table 4).

Legend: m = meters; SELcum = Cumulative sound exposure level (decibel referenced to 1 micropascal squared seconds [dB re 1 μPa2-s]); SPLpeak = Peak sound pressure level (decibel referenced to 1 micropascal [dB re 1 μPa]); > indicates that the given effect would occur above the reported threshold; TTS = Temporary Threshold Shift).

Table A-2: Maximum Range To Sea Turtle Sound Thresholds From Impact Pile Driving

Section	Pile Size & Count	Total Pile Driving Days	PTS Weighted (SELcum) Threshold 204 $dB_{re\mu Pa2\text{-}s}$	TTS Weighted (SELcum) Threshold 189 $dB_{re\mu Pa2\text{-}s}$	Behavior Unweighted (rms) Threshold 175 $dB_{re1\mu Pa}$
CEP 102	42-Inch Steel Pipe	40	0.9 m	9.5 m	100 m
	Steel Sheet	40	0.7 m	7.3 m	251 m
	24-Inch Concrete	72	0.1 m	1.3 m	12 m
	18-Inch Concrete	14	0 m	0.3 m	3 m
Pier 3	24-Inch Concrete	265	0.2 m	1.5 m	12 m
	24-Inch Concrete	98	0.1 m	1.1 m	12 m
	18-Inch Steel	4	0.5 m	4.8 m	63 m
Pier 4	24-Inch Concrete	3	0.1 m	1.3 m	12 m
CEP175	13-Inch Poly	2	0	0.2 m	0
CEP176 Wharf	42-Inch Steel	55	0.9 m	8.8 m	100 m
	Steel Sheet	56	0.7 m	7.3 m	251 m

Legend: dB re 1 µPa = dB referenced to a pressure of 1 microPascal; dB re 1 µPa2-s = dB referenced to a pressure of 1 microPascal squared per second; m = meter; PTS = permanent threshold shift; rms = root mean square pressure level; SELcum = cumulative sound exposure level

Table A-3: Maximum Range To Sea Turtle Sound Thresholds From Vibratory Pile Driving / Extracting Or Drilling					
Section	**Pile Size & Count**	**Total Pile Driving Days**	**PTS Weighted (SELcum) Threshold 220 $dB_{re\mu Pa2\text{-}s}$**	**TTS Weighted (SELcum) Threshold 200 $dB_{re\mu Pa2\text{-}s}$**	**Behavior Unweighted (rms) Threshold 175 $dB_{re1\mu Pa}$**
CEP 102 Construction	42-Inch Steel Pipe	40	0	0.9 m	3 m
	Steel Sheet	40	0	0.5 m	3 m
	24-Inch Concrete	72	0	0.1 m	0
	18-Inch Concrete	14	0	0	0
Pier 3 Construction	24-Inch Concrete	265	0	0.1 m	0
	24-Inch Concrete	98	0	0	0
	18-Inch Steel	4	0	0.1 m	1 m
Pier 4 Construction	24-Inch Concrete	3	0	0	0
CEP175 Construction	13-Inch Poly	2	0	0.2 m	1 m
CEP176 Wharf Construction	42-Inch Steel	55	0	0.4 m	1 m
	Steel Sheet	56	0	0.5 m	3 m
CEP102 Demolition	14-Inch Timber	10	0	0.2 m	1 m
	18-Inch Concrete	20	0	0.2 m	1 m
	13-Inch Polymeric	1	0	0.2 m	1 m
Pier 3 Demolition	16-Inch And 18-Inch Concrete Piles	185	0	0.2 m	1 m
	24-Inch Square Concrete	18	0	0.2 m	1 m
	14-Inch Timber	156	0	0.2 m	1 m
Pier 4 Demoltion	14-Inch Timber	9	0	0.2 m	1 m
Demolition Of Existing Pier 3T	18-Inch Square Concrete	72	0	0.2 m	1 m
	14-Inch Timber Piles	22	0	0.2 m	1 m

Legend: dB re 1 µPa = dB referenced to a pressure of 1 microPascal; dB re 1 µPa2-s = dB referenced to a pressure of 1 microPascal squared per second; m = meter; PTS = permanent threshold shift; rms = root mean square pressure level; SELcum = cumulative sound exposure level

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Appendix B
NMFS SPREADSHEET

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USER SPREADSHEET INTRODUCTION

VERSION: 2.2 (2020)

Companion* User Spreadsheet to:

National Marine Fisheries Service (NMFS): 2018 Revision to: Technical Guidance For Assessing the Effects of Anthropogenic Noise on Marine Mammal Hearing: Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts (Version 2.0)

2018 Revised Technical Guidance web page

***For more information on the optional methodology provided within this User Spreadsheet, see Appendix D of Technical Guidance (2018)**

DISCLAIMER: NMFS has provided this spreadsheet as an optional tool to provide estimated effect distances (i.e., isopleths) where PTS onset thresholds may be exceeded. Results provided by this spreadsheet do not represent the entirety of the comprehensive effects analysis, but rather serve as one tool to help evaluate the effects of a proposed action on marine mammal hearing and make findings required by NOAA's various statutes. Input values are the responsibility of the individual user.

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.

INSTRUCTIONS

STEP 1: Determine what spreadsheet is appropriate for activity

HOW TO DETERMINE WHICH TAB TO USE

1) Is the sound source NON-IMPULSIVE or IMPULSIVE? (If it is unclear which category describes your source, consult NOAA)

a) NON-IMPULSIVE (e.g., drilling, vibratory pile driving, tactical sonar): Go to Question 2

b) IMPULSIVE (e.g., explosives, impact pile driving, DTH pile driving, seismic): Go to Question 5

2) Is the NON-IMPULSIVE sound source STATIONARY or MOBILE?

a) STATIONARY: Go to Question 3

b) MOBILE: Go to Question 4

3) Is the NON-IMPULSIVE, STATIONARY source CONTINUOUS or INTERMITTENT?

a) CONTINUOUS: Use Tab A* — RED

*If source is vibratory pile driving: Use Tab A.1 — BRICK

b) INTERMITTENT: Use Tab B — YELLOW

A key distinction between continuous and intermittent sound sources is that intermittent sounds have a more regular (predictable) pattern of bursts of sounds and silent periods (i.e., duty cycle), which continuous sounds do not.

4) Is the NON-IMPULSIVE, MOBILE source CONTINUOUS or INTERMITTENT?

a) CONTINUOUS: Use Tab C ("safe distance" methodology from Sivle et al. 2014) — BLUE

b) INTERMITTENT: Use Tab D ("safe distance" methodology from Sivle et al. 2014) — ORANGE

5) Is the IMPULSIVE sound source STATIONARY or MOBILE?

a) STATIONARY: Use Tab E* — GREEN

*If source is impact pile driving: Use Tab E.1 — EVRGRN

*If source is DTH pile driving/installation: Use Tab E.2 — TEAL

b) MOBILE: Use Tab F ("safe distance" methodology from Sivle et al. 2014) — PURPLE

STEP 2: Within the appropriate tab, fill-in: SAGE CELLS specific to the activity

a) Please provide information used to support values in provided in sage boxes (e.g., surrogate data, direct measurements, etc.)

b) If information is unavailable to fill-out one or more of the sage boxes, please consult NMFS

STEP 3: Estimated PTS isopleths (meter) will be provided in: SKY BLUE CELLS by marine mammal hearing group

STEP 4: When using this spreadsheet to estimate marine mammal takes, please provide a copy of completed tab used to estimate isopleths

ASSUMPTIONS & ADDITIONAL INFORMATION

1) Marine mammals remain stationary during activity

2) Currently, recovery between intermittent sounds is not considered regardless of time between sounds (i.e., all sounds within the accumulation period are counted)

Suggested (Default*) Weighting Factor Adjustments (WFA) for Broadband Sources:

Source	WFA	Example Supporting Sources
Seismic airguns	1 kHz	Breitzke et al. 2008; Tashmukhambetov et al. 2008; Tolstoy et al. 2009
Impact pile driving hammers	2 kHz	Blackwell 2005; Reinhall and Dahl 2011
Vibratory pile driving hammers	2.5 kHz	Blackwell 2005; Dahl et al. 2015
DTH pile driving/installatior	2 kHz	Denes et al. 2016; Denes et al. 2019; Reyff and Heyvaert 2019
Drill vessels/platforms	2 kHz	Greene 1987; Blackwell et al. 2004; Blackwell and Greene 2006

* NMFS acknowledges default WFAs are likely conservative

Marine Mammal Hearing Group
Low-frequency (LF) cetaceans: baleen whales
Mid-frequency (MF) cetaceans: dolphins, toothed whales, beaked whales, bottlenose whales
High-frequency (HF) cetaceans: true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* & *L. australis*
Phocid pinnipeds (PW): true seals
Otariid pinnipeds (OW): sea lions and fur seals

Based on NMFS 2018 Revised Technical Guidance

Literature Cited

Blackwell, S.B. 2005. Underwater Measurements of Pile Driving Sounds during the Port MacKenzie Dock Modifications, 13-16 August 2004. Juneau, Alaska: Federal Highway Administra

Blackwell, S.B., C.R. Greene, Jr., and W.J. Richardson. 2004. Drilling and operational sounds from an oil production island in the ice-covered Beaufort Sea. Jou of the Acoustical Society of America 116: 3199-3211

Blackwell, S.B., and C.R. Green, Jr. 2006. Sounds from an oil production island in the Beaufort Sea in summer: Characteristics and contribution of vess Journal of the Acoustical Society of America 119: 182-196

Breitzke, M., O. Boebel, S. El Naggar, W. Jokat, and B. Werner. 2008 Broad-band calibration of marine seismic sources used by R/V Polarstern for academic resea in polar regions. Geophysical Journal International 174: 505-524

Dahl, P.H., D.R. Dall'Osto, and D.M. Farrell. 2015. The underwater sound field from vibratory pile driving. Journal of the Acoustical Society of America 137: 3544–3

Denes, S. L., G.J. Warner, M.E. Austin, and A.O. MacGillivray. 2016. Hydroacoustic Pile Driving Noise Study – Comprehensive Report. Document 001285, Version 2.0. Technical report by JASCO App Sciences for Alaska Department of Transportation & Public Facilities. Anchorage, AK: JASCO Applied Science

Denes, S., J. Vallarta, and D. Zeddies 2019. Sound Source Characterization of Down-the-Hole Hammering: Thimble Shoal, Virginia. Document 001888, Version 1.0. Technical re by JASCO Applied Sciences for Chesapeake Tunnel Joint Venture. Silver Spring, MD: JASCO Applied Science

Greene, R. 1987. Characteristics of oil industry dredge and drilling sounds in the Beaufort Sea. Journal of the Acoustical Society of America 82: 1315-13

Madsen, P.T. 2005. Marine mammals and noise: Problems with root mean square sound pressure levels for transients. Journal of the Acoustical Society of America 117:3952–3

Reinhall, P.G., and P.H. Dahl. 2011. Underwater Mach wave radiation from impact pile driving: Theory and observation. Journal of the Acoustical Society of America 130: 1209–1

Reyff, J., and C. Heyvaert. 2019. White Pass & Yukon Railroad Mooring Dolphin Installation: Pile Driving and Drilling Sound Source Verification. Cotati, CA: Illingworth & Rodkin,

Sivle, L.D., P.H. Kvadsheim, and M.A. Ainslie. 2014. Potential for population-level disturbance by active sonar in herring. ICES Journal of Marine Science 72: 558-5

Tashmukhambetov, A.M., G.E. Ioup, J.W. Ioup, N.A. Sidorovskaia, and J.J. Newcomb. 2008. Three-dimensional seismic array characterization study: Experiment modeling. Journal of the Acoustical Society of America 123:4094–4108

Tolstoy, M., J. Diebold, L. Doermann, S. Nooner, S.C. Webb, D.R. Bohnenstiehl, T.J. Crone, and R.C. Holmes. 2009. Broadband calibration of the R/V Marcus Langseth four-string seismic sources. Geochemistry Geophysics Geosystems 10: 1-1

Technical questions or suggestion on User Spreadsheet: Please contact Amy Scholik-Schlomer (amy.scholik@noaa.gov)

UPDATES (will be posted when change results in the need to recalculate an isopleth; other non-substantive changes may be made periodically but will not result in a version number change)

Original Version	**Updated Version**	**Change**	**Date posted**
1.0	1.1	Sheet A, error with formula for phocid pinnipe	Aug. 22, 2016
1.1	2.0	Corresponds to 2.0 version of Revised Technical Guidance (2018). Added sheet specific to vibratory pile driving ar explosives and added capabilities to calculate pea sound pressure level isopleths for impulsive source	July 2018
2.0	2.1	Updated version based on comments from 2018 public comment period. Added Tab for DTH	July 2020
2.0	2.2	Updated version based on comments from 2018 public comment period (late) on seismic surveys from IAGC	December 2020

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Construction of 674 LF Relieving Platform (CEP102). 79 bearing piles (bulkhead). ASTM A252 Gr 3 Pipe (42-inch diamter steel pipe)

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)	**213.0**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	177
Number of strikes per pile	2000
Number of piles per day	2
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)	213
Distance of $L_{p,0\text{-}pk}$ measurement (meters)*	10
$L_{p,0\text{-}pk}$ Source level	228.0

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)	**1,001.8**	**35.6**	**1,193.3**	**536.1**	**39.0**
PK Threshold	219	230	202	218	232
PTS PK isopleth to threshold (meters)	**4.0**	**NA**	**54.1**	**4.6**	**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.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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Construction of 674 LF Relieving Platform (CEP102). 79 bearing piles (bulkhead). ASTM A252 Gr 3 Pipe (42-inch diamter steel pipe) UPDATED FROM A PROXY OF 162 to 168 per NMFS Instruction

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 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)	168
Number of piles within 24-h period	2
Duration to drive a single pile (minutes)	240
Duration of Sound Production within 24-h period (seconds)	28800
10 Log (duration of sound production)	44.59
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)	**80.0**	**7.1**	**118.3**	**48.6**	**3.4**

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.

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

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Construction of 674 LF Relieving Platform (CEP102).158 sheet piles (bulkhead). ASTM A572 Gr 60 (steel sheet)

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)	**211.3**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	181
Number of strikes per pile	270
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)	211
Distance of $L_{p,0\text{-}pk}$ measurement (meters)[+]	10
$L_{p,0\text{-}pk}$ Source level	226.0

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)	**773.3**	**27.5**	**921.1**	**413.8**	**30.1**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**2.9**	**NA**	**39.8**	**3.4**	**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[Δ] (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)	

[Δ]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 $\leq$ 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
they need to make sure to download ar
to ensure the built-in calculations funct

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

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Construction of 674 LF Relieving Platform (CEP102).158 sheet piles (bulkhead). ASTM A572 Gr 60 (steel sheet)

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 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)	167
Number of piles within 24-h period	4
Duration to drive a single pile (minutes)	60
Duration of Sound Production within 24-h period (seconds)	14400
10 Log (duration of sound production)	41.58
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)	**43.2**	**3.8**	**63.9**	**26.3**	**1.8**

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.

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

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

VERSION 2.2: 2020

KEY

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Construction of 674 LF Relieving Platform (CEP102). 144 bearing piles (24-inch square concrete)

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)	**200.3**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	163
Number of strikes per pile	2700
Number of piles per day	2
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)	189
Distance of $L_{p,0\text{-}pk}$ measurement (meters)⁺	10
$L_{p,0\text{-}pk}$ Source level	204.0

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)	**142.7**	**5.1**	**169.9**	**76.4**	**5.6**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**NA**	**NA**	**1.4**	**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$^{\Delta}$ (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)	

$^{\Delta}$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 $\leq$ 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
they need to make sure to download ar
to ensure the built-in calculations funct

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

A: STATIONARY SOURCE: Non-Impulsive, Continuous

VERSION 2.2: 2020

KEY

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Construction of 674 LF Relieving Platform (CEP102). PRE-DRILLING of 144 bearing piles (24 inch square concrete) (UPDATED FROM 166.2 to 154 per NMFS Instruction)
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	6
Duration of Sound Production (seconds)	21600
10 Log (duration of sound production)	43.34
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)	**0.8**	**0.0**	**0.7**	**0.4**	**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.

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

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Construction of 674 LF Relieving Platform (CEP102). 81 Fender Piles (18-inch square concrete)

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)	**191.3**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	154
Number of strikes per pile	450
Number of piles per day	12
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)	185
Distance of $L_{p,0\text{-}pk}$ measurement (meters)⁺	10
$L_{p,0\text{-}pk}$ Source level	200.0

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)	**35.8**	**1.3**	**42.7**	**19.2**	**1.4**
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$^{\Delta}$ (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)	

$^{\Delta}$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 $\leq$ 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
they need to make sure to download ar
to ensure the built-in calculations funct

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

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Construction of 674 LF Relieving Platform (CEP102). PRE-DRILLING of 81 Fender Piles (18-inch square concrete) (UPDATED FROM 166.2 to 154 per NMFS Instruction)
Please include any assumptions	
PROJECT CONTACT	

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

STEP 2: WEIGHTING FACTOR ADJUSTMENT

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	6
Duration of Sound Production (seconds)	21600
10 Log (duration of sound production)	43.34
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)	**0.8**	**0.0**	**0.7**	**0.4**	**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.

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

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Construction of 1324 LF of Pier 3. 530 bearing piles (24-inch concrete)

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)	**201.1**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	163
Number of strikes per pile	3200
Number of piles per day	2
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)	189
Distance of $L_{p,0\text{-}pk}$ measurement (meters)⁺	10
$L_{p,0\text{-}pk}$ Source level	204.0

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)	**159.8**	**5.7**	**190.3**	**85.5**	**6.2**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**NA**	**NA**	**1.4**	**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$^{\Delta}$ (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)	

$^{\Delta}$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 $\leq$ 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
they need to make sure to download ar
to ensure the built-in calculations funct

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

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Construction of 1324 LF of Pier 3. PRE-DRILLING of 530 bearing piles (24-inch concrete) (UPDATED FROM 166.2 to 154 per NMFS Instruction)
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.

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

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Construction of 1324 LF of Pier 3. 392 Fender piles (24-inch concrete)

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)	**199.0**

SEL$_{cum}$

Single Strike SEL$_{ss}$ ($L_{E,p,\text{single strike}}$) specified at "x" meters (Cell B32)	163
Number of strikes per pile	1000
Number of piles per day	4
Transmission loss coefficient	15
Distance of single strike SEL$_{ss}$ ($L_{E,p,\text{single strike}}$) measurement (meters)	10

PK

$L_{p,0\text{-pk}}$ specified at "x" meters (Cell G29)	189
Distance of $L_{p,0\text{-pk}}$ measurement (meters)*	10
$L_{p,0\text{-pk}}$ Source level	204.0

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)	**116.8**	**4.2**	**139.1**	**62.5**	**4.6**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**NA**	**NA**	**1.4**	**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$^{\Delta}$ (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)	

$^{\Delta}$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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Construction of 1324 LF of Pier 3. 18 Fender piles (18-inch steel pipe)

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)	**209.5**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	176
Number of strikes per pile	450
Number of piles per day	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)	208
Distance of $L_{p,0\text{-}pk}$ measurement (meters)[+]	10
$L_{p,0\text{-}pk}$ Source level	223.0

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)	**585.5**	**20.8**	**697.4**	**313.3**	**22.8**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**1.8**	**NA**	**25.1**	**2.2**	**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[Δ] (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)	

[Δ] 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
they need to make sure to download ar
to ensure the built-in calculations funct

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

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

VERSION 2.2: 2020

KEY

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Construction of 1324 LF of Pier 3. 18 Fender piles (18-inch steel pipe)

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 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	5
Duration to drive a single pile (minutes)	30
Duration of Sound Production within 24-h period (seconds)	9000
10 Log (duration of sound production)	39.54
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)	**7.9**	**0.7**	**11.7**	**4.8**	**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: 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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Construction of 1324 LF of Pier 3. PRE-DRILLING of 392 Fender piles (24-inch concrete) (UPDATED FROM 166.2 to 154 per NMFS Instruction)
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: 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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Construction of 216 LF fenders. PRE-DRILLING of 36 fender piles (Pier 4) (24-inch concrete) (UPDATED from 166.2 to 154 per NMFS Instruction)
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	6
Duration of Sound Production (seconds)	21600
10 Log (duration of sound production)	43.34
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)	**0.8**	**0.0**	**0.7**	**0.4**	**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.

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

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

VERSION 2.2: 2020

KEY

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Construction of 216 LF fenders. 36 fender piles (Pier 4) (24-inch concrete)

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)	**200.3**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	163
Number of strikes per pile	450
Number of piles per day	12
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)	189
Distance of $L_{p,0\text{-}pk}$ measurement (meters)⁺	10
$L_{p,0\text{-}pk}$ Source level	204.0

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)	**142.7**	**5.1**	**169.9**	**76.4**	**5.6**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**NA**	**NA**	**1.4**	**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$^{\Delta}$ (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)	

$^{\Delta}$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 $\leq$ 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
they need to make sure to download ar
to ensure the built-in calculations funct

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

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Construction of 34 LF of fenders (CEP175). 9 Fender piles (13-inch polymeric)

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)	**188.0**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	153
Number of strikes per pile	450
Number of piles per day	7
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)	**21.5**	**0.8**	**25.6**	**11.5**	**0.8**
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$^{\Delta}$ (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)	

$^{\Delta}$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 $\leq$ 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
they need to make sure to download ar
to ensure the built-in calculations funct**

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

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

VERSION 2.2: 2020

KEY

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Construction of 34 LF of fenders (CEP175). 9 Fender piles (13-inch polymeric)

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 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)	162
Number of piles within 24-h period	7
Duration to drive a single pile (minutes)	30
Duration of Sound Production within 24-h period (seconds)	12600
10 Log (duration of sound production)	41.00
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)	**18.4**	**1.6**	**27.1**	**11.2**	**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.

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

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Construction of 806 LF Bulkhead (CEP176 wharf). 109 bearing piles. ASTM A252 Gr 3 Pipe (42-inch diamter steel pipe)

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)	**212.6**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	177
Number of strikes per pile	1800
Number of piles per day	2
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)	213
Distance of $L_{p,0\text{-}pk}$ measurement (meters)⁺	10
$L_{p,0\text{-}pk}$ Source level	228.0

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)	**933.8**	**33.2**	**1,112.3**	**499.7**	**36.4**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**4.0**	**NA**	**54.1**	**4.6**	**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[Δ] (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)	

[Δ]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 $\leq$ 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
they need to make sure to download ar
to ensure the built-in calculations funct

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

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

VERSION 2.2: 2020

KEY

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Construction of 806 LF Bulkhead (CEP176 wharf). 109 bearing piles. ASTM A252 Gr 3 Pipe (42-inch diamter steel pipe) (UPDATED FROM 162 to 168 per NMFS Instruction)

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 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)	168
Number of piles within 24-h period	2
Duration to drive a single pile (minutes)	240
Duration of Sound Production within 24-h period (seconds)	28800
10 Log (duration of sound production)	44.59
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)	**80.0**	**7.1**	**118.3**	**48.6**	**3.4**

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.

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

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

VERSION 2.2: 2020

KEY

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Construction of 806 LF Bulkhead (CEP176 wharf).221 sheet piles. ASTM A572 Gr 60 (steel sheet)

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)	**211.3**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	181
Number of strikes per pile	270
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)	211
Distance of $L_{p,0\text{-}pk}$ measurement (meters)*	10
$L_{p,0\text{-}pk}$ Source level	226.0

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)	**773.3**	**27.5**	**921.1**	**413.8**	**30.1**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**2.9**	**NA**	**39.8**	**3.4**	**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$^{\Delta}$ (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)	

$^{\Delta}$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.1: Vibratory Pile Driving (STATIONARY SOURCE: Non-Impulsive, Continuous)

VERSION 2.2: 2020

KEY

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Construction of 806 LF Bulkhead (CEP176 wharf).221 sheet piles. ASTM A572 Gr 60 (steel sheet)

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 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)	167
Number of piles within 24-h period	4
Duration to drive a single pile (minutes)	60
Duration of Sound Production within 24-h period (seconds)	14400
10 Log (duration of sound production)	41.58
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)	**43.2**	**3.8**	**63.9**	**26.3**	**1.8**

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Demolition of Existing fender system at CEP102 (14-inch timber)

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 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)	162
Number of piles within 24-h period	4
Duration to drive a single pile (minutes)	60
Duration of Sound Production within 24-h period (seconds)	14400
10 Log (duration of sound production)	41.58
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)	**20.1**	**1.8**	**29.7**	**12.2**	**0.9**

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Demolition of Existing fender system at CEP102 (18-inch concrete)

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 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)	162
Number of piles within 24-h period	4
Duration to drive a single pile (minutes)	60
Duration of Sound Production within 24-h period (seconds)	14400
10 Log (duration of sound production)	41.58
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)	**20.1**	**1.8**	**29.7**	**12.2**	**0.9**

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

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Demolition of Existing fender system at CEP102 (13-inch polymeric)

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 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)	162
Number of piles within 24-h period	4
Duration to drive a single pile (minutes)	60
Duration of Sound Production within 24-h period (seconds)	14400
10 Log (duration of sound production)	41.58
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)	**20.1**	**1.8**	**29.7**	**12.2**	**0.9**

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

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Demolition of Existing Pier 3. 72 fender piles (24-inch square concrete)

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 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)	162
Number of piles within 24-h period	4
Duration to drive a single pile (minutes)	60
Duration of Sound Production within 24-h period (seconds)	14400
10 Log (duration of sound production)	41.58
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)	**20.1**	**1.8**	**29.7**	**12.2**	**0.9**

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

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Demolition of Existing Pier 3. 740 bearing piles (16-inch and 18-inch concrete)

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 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)	162
Number of piles within 24-h period	4
Duration to drive a single pile (minutes)	60
Duration of Sound Production within 24-h period (seconds)	14400
10 Log (duration of sound production)	41.58
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)	**20.1**	**1.8**	**29.7**	**12.2**	**0.9**

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

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Demolition of Existing Pier 3. 624 timber piles (14-inch timber)

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 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)	162
Number of piles within 24-h period	4
Duration to drive a single pile (minutes)	60
Duration of Sound Production within 24-h period (seconds)	14400
10 Log (duration of sound production)	41.58
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)	**20.1**	**1.8**	**29.7**	**12.2**	**0.9**

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

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Demolition of Existing Pier 4. 36 fender piles (14-inch timber)

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 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)	162
Number of piles within 24-h period	4
Duration to drive a single pile (minutes)	60
Duration of Sound Production within 24-h period (seconds)	14400
10 Log (duration of sound production)	41.58
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)	**20.1**	**1.8**	**29.7**	**12.2**	**0.9**

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Demolition of Pier 3T. 286 bearing piles (18-inch concrete)

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 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)	162
Number of piles within 24-h period	4
Duration to drive a single pile (minutes)	60
Duration of Sound Production within 24-h period (seconds)	14400
10 Log (duration of sound production)	41.58
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)	**20.1**	**1.8**	**29.7**	**12.2**	**0.9**

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	Demolition of Pier 3T. 87 fender piles (14-inch timber)

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 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)	162
Number of piles within 24-h period	4
Duration to drive a single pile (minutes)	60
Duration of Sound Production within 24-h period (seconds)	14400
10 Log (duration of sound production)	41.58
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)	**20.1**	**1.8**	**29.7**	**12.2**	**0.9**

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: **Issued Authorizations**

Amended IHA

IHA Renewal

LOA (to be added once issued)

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
1315 East-West Highway
Silver Spring, Maryland 20910

INCIDENTAL HARASSMENT AUTHORIZATION

The United States Navy (Navy) and their designees are hereby authorized under section 101(a)(5)(D) of the Marine Mammal Protection Act (MMPA; 16 U.S.C. 1371(a)(5)(D)) to incidentally harass marine mammals, under the following conditions:

1. This incidental harassment authorization (IHA) is valid from April 1, 2022 through March 31, 2023.

2. This IHA authorizes take incidental to impact and vibratory pile driving and removal, and drilling activities associated with year 1 of the Pier 3 Replacement project at Naval Station Norfolk in Norfolk, Virginia. Hereafter (unless otherwise specified) the term "pile driving" is used to refer to both pile installation and pile removal.

3. General Conditions

   (a) A copy of this IHA must be in the possession of the Holder of the Authorization (Holder), supervisory construction personnel, lead protected species observers (PSOs), and any other relevant designees of the Holder operating under the authority of this IHA at all times that activities subject to this IHA are being conducted.

   (b) The species and/or stocks authorized for taking are humpback whales, bottlenose dolphins, harbor porpoises, harbor seals and gray seals (see Table 1). Authorized take, by Level A and Level B harassment only, is limited to the species and numbers listed in Table 1.

   (c) The taking by serious injury or death of any of the species listed in Table 1 or any taking of any other species of marine mammal is prohibited and may result in the modification, suspension, or revocation of this IHA. Any taking exceeding the authorized amounts listed in Table 1 is prohibited and may result in the modification, suspension, or revocation of this IHA.

   (d) The Holder must ensure that construction supervisors and crews, the monitoring team, and relevant Navy staff are trained prior to the start of activities subject to this IHA, so that responsibilities, communication procedures, monitoring protocols, and operational procedures are clearly understood. New personnel joining during the project must be trained prior to commencing work.

4. Mitigation Requirements

(a) The Holder must employ PSOs and establish monitoring locations as described in section 5 of this IHA and the Monitoring Plan (Monitoring Plan; attached). The Holder must monitor the project area to the maximum extent possible based on the required number of PSOs, required monitoring locations, and environmental conditions.

(b) Monitoring must take place from 30 minutes prior to initiation of pile driving or drilling activity (i.e., pre-start clearance monitoring) through 30 minutes post-completion of pile driving and/or drilling activity.

(c) If a marine mammal is observed entering or within the shutdown zones indicated in Table 2 and 3, pile driving and drilling activity must be delayed or halted. Pile driving must be commenced or resumed as described in condition 4(e) of this IHA.

(d) Pre-start clearance monitoring must be conducted during periods of visibility sufficient for the lead PSO to determine that the shutdown zones indicated in Table 2 and 3 are clear of marine mammals. Pile driving and drilling may commence following 30 minutes of observation when the determination is made that the shutdown zones are clear of marine mammals.

(e) If pile driving and/or drilling is delayed or halted due to the presence of a marine mammal, the activity may not commence or resume until either the animal has voluntarily exited and been visually confirmed beyond the shutdown zone indicated in Table 2 and 3 or 15 minutes have passed without re-detection of the animal.

(f) The Holder must use soft start techniques when impact pile driving. Soft start requires contractors to provide an initial set of three strikes at reduced energy, followed by a 30-second waiting period, then two subsequent reduced-energy strike sets. A soft start must be implemented at the start of each day’s impact pile driving and at any time following cessation of impact pile driving for a period of 30 minutes or longer.

(g) Pile driving and drilling activities must be halted (as described in condition 4(c) of this IHA) upon observation of either a species for which incidental take is not authorized or a species for which incidental take has been authorized but the authorized number of takes has been met, entering or within the harassment zone (as shown in Table 2 and 3).

(h) The Holder, construction supervisors and crews, PSOs, and relevant Navy staff must avoid direct physical interaction with marine mammals during construction activity. If a marine mammal comes within 10 meters of such activity, operations must cease and vessels must reduce speed to the minimum level required to maintain steerage and safe working conditions, as necessary to avoid direct physical interaction.

5. Monitoring Requirements

(a) Marine mammal monitoring must be conducted in accordance with the conditions in this section and the Monitoring Plan (attached) and this IHA.

(b) Monitoring must be conducted by qualified, in accordance with the following conditions:

(i) PSOs must be independent (i.e., not construction personnel) and have no other assigned tasks during monitoring periods.

(ii) At least one PSO must have prior experience performing the duties of a PSO during construction activity pursuant to a NMFS-issued incidental take authorization.

(iii) Other PSOs may substitute other relevant experience, education (degree in biological science or related field), or training for prior experience performing the duties of a PSO during construction activity pursuant to a NMFS-issued incidental take authorization.

(iv) Where a team of three or more PSOs is required, a lead observer or monitoring coordinator must be designated. The lead observer must have prior experience performing the duties of a PSO during construction activity pursuant to a NMFS-issued incidental take authorization.

(c) The Holder must establish monitoring locations as described in the Monitoring Plan (attached). For all pile driving and drilling activities, a minimum of one PSO must be assigned to each active pile driving and drilling location to monitor the shutdown zones. Monitoring must be conducted by a minimum of two PSOs for impact driving, and a minimum of three PSOs for vibratory and drilling activities. PSOs must be located at the best vantage point(s) practicable to monitor for marine mammals and implement shutdown/delay procedures. These locations include: the Northernmost Jetty, Pier 14, Pier 8, Existing Pier 3, Pier 2, and Pier 1.

(d) PSOs must record all observations of marine mammals, regardless of distance from the pile being driven, as well as the additional data indicated in section 6 of this IHA.

(e) Acoustic monitoring must be conducted in accordance with the Acoustic Monitoring Plan (attached).

(i) The purpose of acoustic monitoring, or sound source verification (SSV), for this project is to characterize underwater noise from pile driving and drilling activities during various types of pile driving, extraction, and drilling associated with this project.

(ii) Monitoring must include two underwater positions. One underwater location must be at the standard 10 meters from the sound source, while the other positions must be located at a distance of at least 20 times water depth at the pile. If the contractor determines that this distance interferes with shipping lanes or vessel traffic, or if there are other reasons why these criteria cannot be achieved, the Acoustic Monitoring Plan must offer an alternate site as close to the criteria as possible for NMFS' approval.

(iii) Measurements and acoustic monitoring must be conducted for 10 percent of each pile type identified in Table 4 during the entire pile-driving/extraction/drilling event. However, during data analysis, only periods of maximum hammer energy must be characterized.

(iv) Environmental data must 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 contributed to influencing the airborne and underwater sound levels (e.g., aircraft, boats, etc.).

(f) The harassment and/or shutdown zones (Table 2 and 3) may be modified with NMFS' approval following NMFS' acceptance of an acoustic monitoring report.

6. Reporting

(a) The Holder must submit its draft reports on all monitoring conducted under this IHA within 90 calendar days of the completion of monitoring or 60 calendar days prior to the requested issuance of any subsequent IHA for construction activity at the same location, whichever comes first. A final report must be prepared and submitted within 30 calendar days following receipt of any NMFS comments on the draft report. If no comments are received from NMFS within 30 calendar days of receipt of the draft report, the report will be considered final.

(b) All draft and final monitoring reports must be submitted to *PR.ITP.MonitoringReports@noaa.gov* and *kim.corcoran@noaa.gov*.

(c) The marine mammal report must contain the informational elements described in the Monitoring Plan and, at minimum, must include:

(i) Dates and times (begin and end) of all marine mammal monitoring;

(ii) Construction activities occurring during each daily observation period, including:

A. The number and type of piles that were driven and the method (e.g., impact, vibratory);

B. Total duration of driving time for each pile (vibratory driving) or hole (drilling) and number of strikes for each pile (impact driving); and

(iii) PSO locations during marine mammal monitoring;

(iv) Environmental conditions during monitoring periods (at beginning and end of PSO shift and whenever conditions change significantly), including Beaufort sea state and any other relevant weather conditions including cloud cover, fog, sun glare, and overall visibility to the horizon, and estimated observable distance;

(v) Upon observation of a marine mammal, the following information:

A. Name of PSO who sighted the animal(s) and PSO location and activity at time of sighting;

B. Time of sighting;

C. Identification of the animal(s) (e.g., genus/species, lowest possible taxonomic level, or unidentified), PSO confidence in identification, and the composition of the group if there is a mix of species;

D. Distance and location of each observed marine mammal relative to the pile being driven or hole being drilled for each sighting;

E. Estimated number of animals (min/max/best estimate);

F. Estimated number of animals by cohort (adults, juveniles, neonates, group composition, etc.);

G. Animal's closest point of approach and estimated time spent within the harassment zone;

H. 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);

(vi) Number of marine mammals detected within the harassment zones, by species; and

(vii) Detailed information about implementation of any mitigation (e.g., shutdowns and delays), a description of specific actions that ensued, and resulting changes in behavior of the animal(s), if any.

(d) The Holder must submit all PSO datasheets and/or raw sighting data with the draft report, as specified in condition 6(b) of this IHA.

(e) The acoustic monitoring report must contain the informational elements described in the Acoustic Monitoring Plan and, at minimum, must include:

(i) Hydrophone equipment and methods: recording device, sampling rate, distance (m) from the pile or hole where recordings were made; depth of water and recording device(s);

(ii) Type and size of pile being driven, substrate type, method of driving during recordings (e.g., hammer model and energy), and total pile driving or drilling duration;

(iii) For impact pile driving (per pile): Number of strikes and strike rate; depth of substrate to penetrate; pulse duration and mean, median, and maximum sound levels (dB re: 1 μPa): root mean square sound pressure level (SPL_{rms}); cumulative sound exposure level (SEL_{cum}), peak sound pressure level (SPL_{peak}), and single-strike sound exposure level (SEL_{s-s});

(iv) For vibratory driving/removal and/or drilling (per pile): Duration of driving per pile; depth of substrate to penetrate (drilling only); mean, median, and maximum sound levels (dB re: 1 μPa): root mean square sound pressure level (SPL_{rms}), cumulative sound exposure level (SEL_{cum}) (and timeframe over which the sound is averaged);

(v) One-third octave band spectrum and power spectral density plot; and

(vi) Environmental data and conditions as listed in 5(e)(vi) and project specific information as listed in 5(e)(vii) on this IHA.

(f) Reporting injured or dead marine mammals:

In the event that personnel involved in the construction activities discover an injured or dead marine mammal, the Holder must report the incident to the Office of Protected Resources (OPR), NMFS (*PR.ITP.MonitoringReports@noaa.gov* and *kim.corcoran@noaa.gov*) and to the Northeast regional stranding network (866-755-6622) as soon as feasible. If the death or injury was clearly caused by the specified activity, the Holder must immediately cease the activities until NMFS OPR is able to review the circumstances of the incident and determine what, if any, additional measures are appropriate to ensure compliance with the terms of this IHA. The Holder must not resume their activities until notified by NMFS.

The report must include the following information:

(i) Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable);

(ii) Species identification (if known) or description of the animal(s) involved;

(iii) Condition of the animal(s) (including carcass condition if the animal is dead);

(iv) Observed behaviors of the animal(s), if alive;

(v) If available, photographs or video footage of the animal(s); and

(vi) General circumstances under which the animal was discovered.

7. This Authorization may be modified, suspended or revoked if the Holder fails to abide by the conditions prescribed herein (including, but not limited to, failure to comply with monitoring or reporting requirements), or if NMFS determines: (1) the authorized taking is likely to have or is having more than a negligible impact on the species or stocks of affected marine mammals, or (2) the prescribed measures are likely not or are not effecting the least practicable adverse impact on the affected species or stocks and their habitat.

8. Renewals

On a case-by-case basis, NMFS may issue a one-time, one-year Renewal IHA following notice to the public providing an additional 15 days for public comments when (1) up to another year of identical, or nearly identical, activities (or a subset of those activities) are planned or (2) the specified activities will not be completed by the time the IHA expires and a Renewal would allow for completion of the activities, provided all of the following conditions are met:

(a) A request for renewal is received no later than 60 days prior to the needed Renewal IHA effective date (note a Renewal IHA expiration date cannot extend beyond one year from expiration of this IHA).

(b) The request for renewal must include the following:

(i) An explanation that the activities to be conducted under the requested Renewal IHA are identical to the activities analyzed for this IHA, are a subset of the activities, or include changes so minor (e.g., reduction in pile size) 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).

(ii) 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.

(c) Upon review of the request for Renewal, the status of the affected species or stocks, and any other pertinent information, NMFS determines that there are no more than minor changes in the activities, the mitigation and monitoring measures will remain the same and appropriate, and the findings made in support of this IHA remain valid.

DAMON RANDALL.KIMBERLY.BETH.1365821093

Digitally signed by DAMON RANDALL.KIMBERLY.BETH.1365821093
Date: 2023.01.09 14:56:50 -05'00'

Kimberly Damon-Randall,
Director, Office of Protected Resources
National Marine Fisheries Service

Table 1. Authorized Incidental Take.

Common name	Scientific name	Stock	Level A harassment	Level B harassment
Humpback whale	*Megaptera novaeangliae*	Gulf of Marine Stock	0	12
Bottlenose dolphin	*Tursiops truncatus*	Western North Atlantic Coastal, Northern Migratory Stock	0	14841
		Western North Atlantic Coastal, Southern Migratory Stock	0	14841
		Northern North Carolina Estuarine Stock	0	200
Harbor porpoise	*Phocoena phocoena*	Gulf of Maine/Bay of Fundy Stock	10	12
Harbor seal	*Phoca vitulina*	Western North Atlantic Stock	152	1092
Gray seal	*Halichoerus grypus*	Western North Atlantic Stock	1	2

Table 2. Shutdown and Harassment Zones for individual pile driving activities.

Pile size, type, and method	Minimum shutdown zone (m)			Harassment zone (m)[1]
	Humpback whales	Porpoises	All Other Species	
Vibratory driving, 14-inch Timber Piles	30	30	30	6,310
Vibratory driving, 13-inch Polymeric Piles	30	30	30	6,310
Impact Driving, 13-inch Polymeric Piles	30	30	30	10
Vibratory Driving, 16-inch an 18-inch Concrete Piles	30	30	30	6,310
Impact Driving, 16-inch an 18-inch Concrete Piles	45	45	45	30
Vibratory Driving, 24-inch Concrete Piles	10	10	10	1850
Impact Driving, 24-inch Concrete Piles	160	500	200	120
Vibratory Driving, 28-inch Steel Sheet Piles	65	65	65	13,600
Impact Driving, 28-inch Steel Sheet Piles	775	500	200	2,520
Vibratory Driving, 42-inch Steel Pipe Piles	50	120	50	15,850
Impact Driving, 42-inch Steel Pipe Piles	1,005	500	200	1000
Pre-Drilling Activities	20	500	200	1850

1 Rounded to the nearest 10

Table 3. Shutdown and Harassment Zones for Concurrent Pile Driving Activities.

Activity	Shutdown Zones (m)			Harassment Zones (m)[1]
	Humpback whale	Harbor porpoise	Dolphins and Seals	
Vibratory Remove two 14-inch timber piles	55	55	35	10000
Vibratory Remove 18-inch concrete and 14-inch timber piles	55	55	35	10000
Vibratory Remove 14-inch timber and 18-inch concrete piles at Pier 3T and rotary drill for 24-inch concrete piles at Pier 4	60	60	35	11660
Vibratory Remove 14-inch timber at Pier 3T and Vibratory install 42-inch pipe at either CEP-176 or CEP-102	200	200	50	18480
Vibratory Remove 18-inch concrete at Pier 3T and Vibratory install 42-inch pipe at either CEP-176 or CEP-102	200	200	50	18480
Vibratory Remove 14-inch timber piles at Pier 3T and rotary drill for 24-inch concrete piles at new Pier 3	45	45	30	7360
Vibratory Remove 18-inch concrete piles at Pier 3T and rotary drill for 24-inch concrete piles at new Pier 3	45	45	30	7360

1 Rounded to the nearest 10

Table 4. Acoustic Monitoring Summary

Pile Type	Count	Method of Install/Removal	Number Monitored
13-inch polymeric	14	Vibratory	5
13-inch polymeric	14	Impact	5
13-inch polymeric	14	Drilling	5
16- or 18- inch concrete	308	Vibratory	10
24-inch concrete	47	Impact	10
42-inch steel pipe	113	Vibratory	10
42-inch steel pipe	113	Impact	10
28-inch steel sheet	229	Vibratory	10
28-inch steel sheet	229	Impact	10

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
1315 East-West Highway
Silver Spring, Maryland 20910

INCIDENTAL HARASSMENT AUTHORIZATION

The United States Navy (Navy) and its designees are hereby authorized under section 101(a)(5)(D) of the Marine Mammal Protection Act (MMPA; 16 U.S.C. 1371(a)(5)(D)) to incidentally harass marine mammals, under the following conditions:

1. This incidental harassment authorization (IHA) is valid for one year from the date of issuance.

2. This IHA authorizes take incidental to impact and vibratory pile driving and removal, and drilling activities associated with the Pier 3 Replacement project at Naval Station Norfolk in Norfolk, Virginia. Hereafter (unless otherwise specified) the term "pile driving" is used to refer to both pile installation and pile removal.

3. General Conditions

   (a) A copy of this IHA must be in the possession of the Holder of the Authorization (Holder), supervisory construction personnel, lead protected species observers (PSOs), and any other relevant designees of the Holder operating under the authority of this IHA at all times that activities subject to this IHA are being conducted.

   (b) The species and/or stocks authorized for taking are humpback whales, bottlenose dolphins, harbor porpoises, harbor seals, and gray seals (see Table 1). Authorized take, by Level A and Level B harassment only, is limited to the species and numbers listed in Table 1.

   (c) The taking by serious injury or death of any of the species listed in Table 1 or any taking of any other species of marine mammal is prohibited and may result in the modification, suspension, or revocation of this IHA. Any taking exceeding the authorized amounts listed in Table 1 is prohibited and may result in the modification, suspension, or revocation of this IHA.

   (d) The Holder must ensure that construction supervisors and crews, the monitoring team, and relevant Navy staff are trained prior to the start of activities subject to this IHA, so that responsibilities, communication procedures, monitoring protocols, and operational procedures are clearly understood. New personnel joining during the project must be trained prior to commencing work.

4. Mitigation Requirements

(a) The Holder must employ PSOs and establish monitoring locations as described in section 5 of this IHA and the Marine Mammal Monitoring Plan (Monitoring Plan; attached). The Holder must monitor the project area to the maximum extent possible based on the required number of PSOs, required monitoring locations, and environmental conditions.

(b) Monitoring must take place from 30 minutes prior to initiation of pile driving or drilling activity (i.e., pre-start clearance monitoring) through 30 minutes post-completion of pile driving and/or drilling activity.

(c) If a marine mammal is observed entering or within the shutdown zones indicated in Tables 2 and 3, pile driving and drilling activity must be delayed or halted. Pile driving must be commenced or resumed as described in condition 4(e) of this IHA.

(d) Pre-start clearance monitoring must be conducted during periods of visibility sufficient for the lead PSO to determine that the shutdown zones indicated in Tables 2 and 3 are clear of marine mammals. Pile driving and drilling may commence following 30 minutes of observation when the determination is made that the shutdown zones are clear of marine mammals.

(e) If pile driving and/or drilling is delayed or halted due to the presence of a marine mammal, the activity may not commence or resume until either the animal has voluntarily exited and been visually confirmed beyond the shutdown zone indicated in Tables 2 and 3 or 15 minutes have passed without re-detection of the animal.

(f) The Holder must use soft start techniques when impact pile driving. Soft start requires contractors to provide an initial set of three strikes at reduced energy, followed by a 30-second waiting period, then two subsequent reduced-energy strike sets. A soft start must be implemented at the start of each day’s impact pile driving and at any time following cessation of impact pile driving for a period of 30 minutes or longer.

(g) Pile driving and drilling activities must be halted (as described in condition 4(c) of this IHA) upon observation of either a species for which incidental take is not authorized or a species for which incidental take has been authorized but the authorized number of takes has been met, entering or within the harassment zone (as shown in Tables 2 and 3).

(h) The Holder, construction supervisors and crews, PSOs, and relevant Navy staff must avoid direct physical interaction with marine mammals during construction activity. If a marine mammal comes within 10 meters of such activity, operations must cease and vessels must reduce speed to the minimum level required to maintain steerage and safe working conditions, as necessary to avoid direct physical interaction.

5. Monitoring Requirements

(a) Marine mammal monitoring must be conducted in accordance with the conditions in this section and the Monitoring Plan (attached) and this IHA.

(b) Monitoring must be conducted by qualified, NMFS-approved PSOs, in accordance with the following conditions:

(i) PSOs must be independent of the activity contractor (for example, employed by a subcontractor) and have no other assigned tasks during monitoring periods.

(ii) At least one PSO must have prior experience performing the duties of a PSO during construction activity pursuant to a NMFS-issued incidental take authorization.

(iii) Other PSOs may substitute other relevant experience, education (degree in biological science or related field), or training for prior experience performing the duties of a PSO during construction activity pursuant to a NMFS-issued incidental take authorization.

(iv) Where a team of three or more PSOs is required, a lead observer or monitoring coordinator must be designated. The lead observer must have prior experience performing the duties of a PSO during construction activity pursuant to a NMFS-issued incidental take authorization.

(c) The Holder must establish monitoring locations as described in the Monitoring Plan (attached). For all pile driving and drilling activities, a minimum of one PSO must be assigned to each active pile driving and drilling location to monitor the shutdown zones. Monitoring must be conducted by a minimum of two PSOs for impact driving, and a minimum of three PSOs for vibratory and drilling activities. PSOs must be located at the best vantage point(s) practicable to monitor marine mammals and implement shutdown/delay procedures. These locations include: the Northernmost Jetty, Pier 14, Pier 8, Existing Pier 3, Pier 2, and Pier 1.

(d) PSOs must record all observations of marine mammals, regardless of distance from the pile being driven, as well as the additional data indicated in section 6 of this IHA.

(e) Acoustic monitoring must be conducted in accordance with the Acoustic Monitoring Plan (attached).

(i) The purpose of acoustic monitoring, or sound source verification (SSV), for this project is to characterize underwater noise from pile driving and drilling activities during various types of pile driving, extraction, and drilling associated with this project.

(ii) Monitoring must include two underwater positions. One underwater location must be at the standard 10 meters from the sound source, while the other positions must be located at a distance of at least 20 times water depth at the pile. If the contractor determines that this distance interferes with shipping lanes or vessel traffic, or if there are other reasons why these criteria cannot be achieved, the Acoustic Monitoring Plan must offer an alternate site as close to the criteria as possible for NMFS' approval.

(iii) Measurements and acoustic monitoring must be conducted for 10 percent of each pile type identified in Table 4 during the entire pile-driving/extraction/drilling event. However, during data analysis, only periods of maximum hammer energy must be characterized.

(iv) Environmental data must 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 be contributed to influencing the airborne and underwater sound levels (e.g., aircraft, boats, etc.).

(f) The harassment and/or shutdown zones (Tables 2 and 3) may be modified with NMFS' approval following NMFS' acceptance of an acoustic monitoring report.

6. Reporting

(a) The Holder must submit its draft report(s) on all monitoring conducted under this IHA within 90 calendar days of the completion of monitoring or 60 calendar days prior to the requested issuance of any subsequent IHA for construction activity at the same location, whichever comes first. A final report must be prepared and submitted within 30 calendar days following receipt of any NMFS comments on the draft report. If no comments are received from NMFS within 30 calendar days of receipt of the draft report, the report shall be considered final.

(b) All draft and final monitoring reports must be submitted to *PR.ITP.MonitoringReports@noaa.gov* and *itp.taylor@noaa.gov*.

(c) The marine mammal report must contain the informational elements described in the Monitoring Plan and, at minimum, must include:

(i) Dates and times (begin and end) of all marine mammal monitoring;

(ii) Construction activities occurring during each daily observation period, including:

A. The number and type of piles that were driven and the method (e.g., impact, vibratory);

B. Total duration of driving time for each pile (vibratory driving) and number of strikes for each pile (impact driving); and

(iii) PSO locations during marine mammal monitoring;

(iv) Environmental conditions during monitoring periods (at beginning and end of PSO shift and whenever conditions change significantly), including Beaufort sea state and any other relevant weather conditions including cloud cover, fog, sun glare, and overall visibility to the horizon, and estimated observable distance;

(v) Upon observation of a marine mammal, the following information:

A. Name of PSO who sighted the animal(s) and PSO location and activity at time of sighting;

B. Time of sighting;

C. Identification of the animal(s) (e.g., genus/species, lowest possible taxonomic level, or unidentified), PSO confidence in identification, and the composition of the group if there is a mix of species;

D. Distance and location of each observed marine mammal relative to the pile being driven for each sighting;

E. Estimated number of animals (min/max/best estimate);

F. Estimated number of animals by cohort (adults, juveniles, neonates, group composition, etc.);

G. Animal's closest point of approach and estimated time spent within the harassment zone;

H. 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);

(vi) Number of marine mammals detected within the harassment zones, by species; and

(vii) Detailed information about implementation of any mitigation (e.g., shutdowns and delays), a description of specific actions that ensued, and resulting changes in behavior of the animal(s), if any.

(d) The Holder must submit all PSO datasheets and/or raw sighting data with the draft report, as specified in condition 6 (b) of this IHA.

(e) The acoustic monitoring report must contain the informational elements described in the Acoustic Monitoring Plan and, at minimum, must include:

(i) Hydrophone equipment and methods: recording device, sampling rate, distance (m) from the pile where recordings were made; depth of water and recording device(s);

(ii) 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;

(iii) For impact pile driving (per pile): Number of strikes and strike rate; depth of substrate to penetrate; pulse duration and mean, median, and maximum sound levels (dB re: 1 µPa): root mean square sound pressure level (SPL_{rms}); cumulative sound exposure level (SEL_{cum}), peak sound pressure level (SPL_{peak}), and single-strike sound exposure level (SEL_{s-s});

(iv) For vibratory driving/removal and/or drilling (per pile): Duration of driving per pile; mean, median, and maximum sound levels (dB re: 1 µPa): root mean square sound pressure level (SPL_{rms}), cumulative sound exposure level (SEL_{cum}) (and timeframe over which the sound is averaged);

(v) One-third octave band spectrum and power spectral density plot; and

(vi) Environmental data and conditions as listed in 5(e)(iv) and project specific information as listed in 5(e)(iii) on this IHA.

(f) Reporting injured or dead marine mammals:

In the event that personnel involved in the construction activities discover an injured or dead marine mammal, the Holder must report the incident to the Office of Protected Resources (OPR), NMFS (*PR.ITP.MonitoringReports@noaa.gov* and *itp.taylor@noaa.gov*) and to the Northeast regional stranding network (866-755-6622) as soon as feasible. If the death or injury was clearly caused by the specified activity, the Holder must immediately cease the activities until NMFS OPR is able to review the circumstances of the incident and determine what, if any, additional measures are appropriate to ensure compliance with the terms of this IHA. The Holder must not resume their activities until notified by NMFS.

The report must include the following information:

(i) Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable);

(ii) Species identification (if known) or description of the animal(s) involved;

(iii) Condition of the animal(s) (including carcass condition if the animal is dead);

(iv) Observed behaviors of the animal(s), if alive;

(v) If available, photographs or video footage of the animal(s); and

(vi) General circumstances under which the animal was discovered.

7. This Authorization may be modified, suspended or revoked if the Holder fails to abide by the conditions prescribed herein (including, but not limited to, failure to comply with monitoring or reporting requirements), or if NMFS determines: (1) the authorized taking is likely to have or is having more than a negligible impact on the species or stocks of affected marine mammals or (2) the prescribed measures are likely not or are not effecting the least practicable adverse impact on the affected species or stocks and their habitat.

____

For Kimberly Damon-Randall,
Director, Office of Protected Resources
National Marine Fisheries Service

Table 1. Authorized Incidental Take.

Common name	Scientific name	Stock	Individual Activities		Concurrent Activities	
			Level A harassment	Level B harassment	Level A harassment	Level B harassment
Bottlenose dolphin	*Tursiops truncatus*	Western North Atlantic Coastal, Northern Migratory Stock	0	1,281	0	486
		Western North Atlantic Coastal, Southern Migratory Stock		1,280		485
		Northern North Carolina Estuarine Stock		200		200
Harbor seal	*Phoca vitulina*	Western North Atlantic	57	759	53	478
Gray seal	*Halichoerus grypus*	Western North Atlantic	0	1	0	1
Harbor porpoise	*Phocoena phocoena*	Gulf of Maine/Bay of Fundy	2	2	0	2
Humpback whale	*Megaptera novaeangliae*	Gulf of Maine	0	4	0	2

Table 2. Shutdown and Harassment Zones for Individual Pile Driving Activities [1]

Pile size, type, and method	Minimum shutdown zone (m)			Harassment zone (m)
	Humpback whale	Porpoises	All Other Species	
Impact Driving, 42-inch Steel Pipe Pile	1,005	500	200	1000
Vibratory Driving, 42-inch Steel Pipe Pile	50	120	50	15,850
Impact Driving, 28-inch Steel Sheet Piles	775	500	200	2,520
Vibratory Driving, 28-inch Steel Sheet Piles	65	65	65	13,600
Impact Driving, 13-inch	30	30	30	10

Polymeric Piles				
Vibratory Driving, 13-inch Polymeric Piles	30	30	30	6,310
Impact Driving, 24-inch Concrete Piles	160	500	200	120
Vibratory Driving, 24-inch Concrete Piles	10	10	10	1,850

[1] Rounded to the nearest 10 m

Table 3. Shutdown and Harassment Zone for Concurrent Pile Driving Activities [1]

Pile sizes, type, and method	Minimum shutdown zone (m)			Harassment zone (m)
	Humpback whale	Porpoises	All Other Species	
Vibratory removal 18-inch concrete piles and vibratory installation 42-inch steel pipe piles	200	200	50	18,480
Vibratory removal 18-inch concrete piles and pre-drilling for preparation of 24-in concrete pile install	45	45	30	7,360

[1] Rounded to the nearest 10 m

Table 4. Acoustic Monitoring Summary [1]

Pile Type	Count	Method of Install/Removal	Number Monitored
13-inch polymeric	9	Vibratory	5
13-inch polymeric	9	Impact	5
13-inch polymeric	9	Drilling	5
24-inch concrete	11	Impact	10
42-inch steel pipe	103	Impact	10
42-inch steel pipe	103	Vibratory	10
28-inch steel sheet	221	Impact	10
28-inch steel sheet	221	Vibratory	10

[1] Acoustic monitoring will be conducted for activities for which measurements are needed.

Appendix C: Data Collection Sheet

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* Name and Location**	**Visibility Info (e.g. wind, glare, swell)**	**Construction Activity (Including Number and Type of Piles)**	**Species**	**Distance to Animal (from Observer) and Closest Point of Approach to the Activity**	**# of Animals Group Size (min/max/best) # of Calves**	**Animal Movement Relative to Pile Driving Equipment/ Time in Harassment Zone**	**Behavior Change/ Response to Activity/ Shutdown Info**
Start Monitoring – End Monitoring Soft Start – Vibratory – Impact Sighting – Delay – Shutdown	: :					m	/ / ___ calves	toward or away parallel none Time in Harassment Zone:	
Start Monitoring – End Monitoring Soft Start – Vibratory – Impact Sighting – Delay – Shutdown	: :					m	/ / ___ calves	toward or away parallel none Behavior Code: _________	
Start Monitoring – End Monitoring Soft Start – Vibratory – Impact Sighting – Delay – Shutdown	: :					m	/ / ___ calves	toward or away parallel none Behavior Code: _________	
Start Monitoring – End Monitoring Soft Start – Vibratory – Impact Sighting – Delay – Shutdown	: :					m	/ / ___ calves	toward or away parallel none Behavior Code: _________	

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

Sighting Form revised October 15, 2013

INSTALLATION NRM CONTACT INFORMATION: [Glenn Redavid; EMAIL glenn.t.redavid.civ@us.navy.mil; PHONE NUMBER 757-341-0497]

Appendix D: LOA Application

REQUEST FOR LETTER OF AUTHORIZATION
UNDER THE MARINE MAMMAL PROTECTION ACT
FOR THE
DEMOLITION AND RECONSTRUCTION OF PIER 3
AT
NAVAL STATION NORFOLK, NORFOLK, VIRGINIA
April 1, 2023, through March 31, 2027

Submitted to:

Office of Protected Resources,

National Marine Fisheries Service,

National Oceanographic and Atmospheric Administration

Prepared by:

Naval Facilities Engineering Systems Command Mid-Atlantic

September 2022

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ACRONYMS AND ABBREVIATIONS

μPa	micropascal
°F	degrees Fahrenheit
°C	degrees Celsius
BMPs	best management practices
CBBT	Chesapeake Bay Bridge Tunnel
CFR	Code of Federal Regulations
CIDMMA	Craney Island Dredge Management Area
CV	coefficient of variation
CWA	Clean Water Act
dB	decibel
dBA	decibel with A-weighting filter
dB SEL_{cum}	cumulative sound exposure level
DO	Dissolved Oxygen
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FR	Federal Register
ft	foot/feet
Hz	hertz
IHA	Incidental Harassment Authorization
JEBLC	Joint Expeditionary Base Little Creek
JMSPH	James River at Hampton Roads Harbor Polyhaline
kHz	kilohertz
km	kilometer
km^2	square kilometer
LOA	Letter of Authorization
m	meter
PCB	Polychlorinated Biphenyl
PSO	Protected Species Observer
MLW	Mean Low Water
MMPA	Marine Mammal Protection Act
NAVBASE	Naval Base
NAVFAC	Naval Facilities Engineering Systems Command
NAVSTA	Naval Station
Navy	United States Department of the Navy
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
PSO	Protected Species Observer
PTS	permanent threshold shift
R&D	Research and Development
re 1 μPa	referenced at 1 micropascal
ROI	Region of Influence
RMS	root mean square

sec	second
SEL	sound exposure level
SMC	Southern Migratory Coastal
SMMP	Site Management and Monitoring Plan
SPL	sound pressure level
sq km	square kilometer
TL	transmission loss
TTS	temporary threshold shift
U.S.	United States
UME	Unusual Mortality Event
WSDOT	Washington State Department of Transportation
WWII	World War II

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1 INTRODUCTION AND 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

(Navy) submits this application to National Marine Fisheries Service (NMFS) for a Letter of Authorization (LOA) for the incidental taking of marine mammal species during construction activities associated with the proposed replacement of Pier 3 at Naval Station (NAVSTA) Norfolk in Norfolk, VA (Figure 1-1). This application follows the IHA request submitted to NMFS in July 2020 and covers remaining activities for the pier replacement from April 1, 2023 through March 31, 2027. During this period demolition and construction activities will occur at existing Pier 3, new Pier 3, CEP-176 wharf, CEP-102 relieving platform, and on fender system of CEP-175 bulkhead. Code of Federal Regulations (CFR) 50 216.104 sets out 14 specific items that must be included in requests for take pursuant to Section 101(a)(5)(A) of the MMPA; those 14 items are represented by the 14 chapters of this application.

NAVSTA Norfolk, a Command of the United States (U.S.) Navy, proposes to construct a new Pier 3 immediately north of the existing Pier 3 and align it with new bulkhead of CEP-176 wharf, providing a continuous berthing structure along the north side of a new submarine pier/wharf structure. Project scope includes construction of new Pier 3, demolition of existing Pier 3, construction of new wharf CEP-176, construction of new relieving platform CEP-102, demolition of pier 3T, replacement a portion of fender system at Pier 4, and construction of new portion of fender system at CEP-175 bulkhead (Figure 1-2). Section 1.2, below, outlines the various project phases, in order.

The current Pier 3 was constructed in 1944 to support Convoy Escort Ships used during World War II (WWII) and is currently operating more than 30 years beyond its original expected life. Pier 3, CEP-176 bulkhead, and CEP-102 bulkhead are currently in a deteriorated state and their condition and size will not provide minimum operation requirements to berth the new Virginia Class submarines that will be homeported at NAVSTA Norfolk.

In-water activities are expected to occur over a period of 5 years. An Incidental Harassment Application (IHA) application has been prepared and submitted for Year 1 construction and demolition activities from April 1, 2022 through March 31, 2023 (NMFS, 2022). This LOA request is for construction Years 2 through 5. A detailed description of the project is provided in Chapter 1.2. Dates and duration of in-water activities expected to result in incidental taking of marine mammals are described in Chapter 2.

Figure 1-1 Site Location Map for Naval Station Norfolk

Figure 1-2 Project Site Map

1.2 Project Description

Project scope associated with this LOA period includes construction of new pier 3, demolition of existing pier 3, construction of new CEP-176 wharf, construction of new CEP-102 relieving platform, and construction of a portion of fender system at CEP-175. Specific work on the project is described below. For pile information, see Table 1-2.

1.2.1 CEP-175 Fender System

A fender system will be constructed at CEP-175 bulkhead where Pier 3T previously abutted. Fender polymeric piles will be installed to coordinate with the existing CEP-175 fender system. Piles will be installed with either impact or vibratory hammer. Pre-drilling may be utilized to assist with concrete fender piles installation. However, use of pre-drilling for fender pile installation is not likely.

1.2.2 Pier 3 Construction

The new pier 3 will consist of a cast in place concrete deck supported by concrete bearing piles. A fender system will be constructed on three sides of the pier consisting of concrete and steel fender piles. Piles will be installed with impact hammer. Pre-drilling may be utilized to assist with concrete fender piles installation.

1.2.3 Demolition of Existing Pier 3

The existing Pier 3 will be completely demolished and will not be replaced. Demolition of Pier 3 involves removal of concrete bearing piles, concrete fender piles, and timber fender piles. All piles will be removed with a vibratory hammer. All materials will be disposed of at an upland disposal facility. All pier elements will be removed including concrete deck, utilities, fender elements, etc. and disposed of at an upland facility. Dredging will be performed at footprint of existing Pier 3 to allow for safe berthing and maneuvering.

1.2.4 CEP-176 Wharf

The CEP-176 wharf construction will consist of construction a steel combi-wall bulkhead and a platform on the landside of the bulkhead. The combi-wall bulkhead will be constructed of steel pipe bearing piles and steel sheet piles. The steel combi-wall bulkhead will be constructed on the waterside of the existing concrete bulkhead. Steel combi-wall piles will be installed with either an impact or vibratory hammer. Once the project is awarded, the contractor will determine the best method of installation after review of the test pile results. Dredging will be performed along the face of the CEP-176 bulkhead to allow for safe berthing and maneuvering.

1.2.5 CEP-102 Relieving Platform

The CEP-102 relieving platform construction will consist of demolition of existing fender system and construction of a combi-wall bulkhead with a relieving platform on the waterside of the bulkhead.

The combi-wall bulkhead will be constructed on the waterside of the existing concrete bulkhead. The combi-wall bulkhead will be constructed with steel pipe and steel sheet piles that will be installed with either an impact or vibratory hammer. Once the project is awarded, the contractor will determine the best method of installation after review of the test pile results.

The relieving platform will be constructed of a cast in place concrete deck supported by concrete piles. A fender system will be constructed along the platform consisting of concrete fender piles. Piles will be installed with impact hammer. Pre-drilling may be utilized to assist with concrete pile installation.

The existing concrete pile and polymeric piles fender system along CEP-102 bulkhead will be demolished with vibratory hammer.

Dredging will be performed along the face of the CEP-102 platform to allow for safe berthing and maneuvering.

CEP-102 fender demolition and construction of relieving platform, bulkhead, and fender system will be performed in two phases. An approximately 50-foot-long portion will be constructed concurrently with construction of the new Pier 3. The remaining portion of CEP-102 will be constructed after demolition of the existing pier 3 is complete.

1.3 In-Water Construction Activities

1.3.1 Dredging

Work includes the removal of sediments at the existing Pier 3 footprint, along CEP-176, and along CEP-102 to the depth of current maintenance dredge limit of -38 mean low low water (-39 maximum overdredge) at NAVSTA Norfolk. Mechanical dredging equipment via a clamshell bucket will be used. Any debris removed from the project area would be separated from dredged sediments and would be disposed of at an approved upland disposal area. All dredged sediments will be deposited in the Craney Island Dredge Material Management Area (CIDMMA) rehandling basin. Sediments would be transferred to the CIDMMA rehandling basin by bottom-dumping scows/barges.

Dredging operations do not pose a risk of physical injury to marine mammals due to the slow movement of these operations and the ease of avoidance by marine mammals. Noise created during dredging operations is unlikely to exceed that generated by other normal installation activities and is therefore not expected to result in injury or harassment of marine mammals. Therefore, no incidental takes are expected during this activity, and dredging and disposal is not discussed further in this document.

1.3.2 Pile Removal

Piles are anticipated to be removed with a vibratory hammer; however, direct pull or clamshell removal may be used depending on site conditions. All three pile removal methods are described below.

All materials and waste would be disposed of in accordance with applicable federal and state requirements.

1.3.2.1 Vibratory Extraction

Vibratory extraction using a barge-mounted crane with a vibratory driver is a common method for removing all pile types. The vibratory driver is a large mechanical device (5 to 16 tons) suspended from a crane by a cable and positioned on top of a pile. The pile is then loosened from the sediments by activating the driver and slowly lifting up on the driver with the aid of the crane. Once the pile is released from the sediments, the crane continues to raise the driver and pull the pile from the sediment. The driver is typically shut off once the pile is loosened from the sediments. The pile is then pulled from the water and placed on a barge. Vibratory extraction usually takes between less than 1 minute (for timber piles) to 30 minutes per pile depending on the pile size, type, and substrate conditions.

1.3.2.2 Clamshell

In some cases, removal with a vibratory driver is not possible because the pile may break apart from the force of the clamp and the vibration. If piles break or are damaged, a clamshell apparatus may be lowered from the crane in order to remove pile stubs. A clamshell is a hinged steel apparatus that operates similar to a set of steel jaws. The bucket is lowered from a crane and the jaws grasp the pile stub as the crane pulls upward. The use and size of the clamshell bucket would be minimized to reduce the potential for generating turbidity from disturbing and resuspending bottom sediment during pile removal.

1.3.2.3 Direct Pull

Based on site conditions, piles may be removed by wrapping the piles with a cable or chain and pulling them directly from the sediment with a crane. In some cases, depending on access and location, piles may be cut at or below the mud-line.

1.3.3 Pile Installation

Pile installation/removal would occur using land-based or barge-mounted cranes, as appropriate. Concrete piles will be installed using an impact hammer. Steel piles and polymeric piles can be installed using an impact hammer or vibratory hammer. Hammers can be steam, air, or diesel drop, single-acting, double-acting, differential-acting, or hydraulic type. Additionally, pre-drilling with a rotary drill may occur for installation of concrete piles (see notes in Table 2-1). Pre-drilling is not permitted for installation of the steel piles on this project and installation of concrete bearing piles at Pier 3.

Impact hammers are the most common pile driving method used to install piles of various sizes (Caltrans 2015, 2020). Impact hammers typically produce greater source levels of noise than vibratory hammers and are an impulsive noise source. Impact pile drivers are piston-type drivers that use various means to lift a piston (ignition, hydraulics, or steam) to a desired height and drop the piston (via gravity) against the head of the pile in order to drive it into the substrate. The size and type of impact driver used depends on the energy needed to drive a certain type of pile in various substrates to the necessary depth. The magnitude and characteristics of underwater noise generated by a pile strike depends on the energy of the strike and the pile size and composition. A model of impact hammer that may be used for the project is the APE D36-26 impact hammer.

Impact hammers would utilize soft start techniques to minimize noise impacts in the water column. The Navy does not yet know what type/size of hammers would be used to complete the work. The Navy has modeled for all of those potential scenarios. Level A (PTS onset) and Level B (behavioral) takes have been calculated based on the largest harassment zones for Level A (impact) and Level B (vibratory); therefore, takes are likely overestimated in this application. For purposes of this analysis, underwater noise was modeled without accounting for potential noise minimization measures.

Vibratory hammers are routinely used to install piles when permitted by the sediment type. Vibratory hammers typically produce lower source levels of noise than impact hammers, and they can be considered as an alternative to impact hammers in order to reduce underwater sound during construction activities (ICF Jones and Stokes and Illingworth and Rodkin, Inc. 2012). They are considered a non-impulsive noise source as the hammer continuously drives the pile into the substrate. A vibratory hammer operates by using counterweights that spin to create a vibration. The vibration of the hammer causes the pile to vibrate at a high speed. The vibrating pile then causes the soil underneath it to “liquefy” and allow the pile to move easily into or out of the sediment. A model of vibratory hammer likely to be used for the project is the MKT vibratory hammer.

1.3.4 Pre-Drilling

Rotary drilling is considered an intermittent, non-impulsive noise source, similar to vibratory pile driving. Little information is available regarding source levels for in-water drilling activities associated with nearshore pile installation. It is generally assumed that drilling would produce less in-water noise than both impact and vibratory pile driving. Pre-drilling would be used as necessary to remove sand with shell fragments or any obstructions in order to accelerate pile driving. A project at Santa Rosa Island in California recorded source levels for auger drilling and was used as a proxy source for purposes of this application, as directed by NMFS.

1.3.5 Construction Access and Project Staging

Barges would be used as platforms for conducting in-water work activities and to haul materials and equipment to and from work sites. Barges would be moored with spuds or anchors. Potential laydown and staging areas identified on land include the area across from Pier 2 and a small area along the Pier 3T basin.

1.3.6 Concurrent Activities

In order to maintain project schedules, it is likely that multiple pieces of equipment would operate at the same time within the project area. Table 1-1 provides a summary of the possible equipment combinations by structure and construction year where a maximum of four in-water activities may be occurring simultaneously. An analysis of concurrent activities with respect to noise generation from multiple sources is provided in Chapter 6.8.2.

Table 1-1 Summary of Multiple Equipment Scenarios

	Structure	*Pile Types*	*Total Equipment Quantity*	*Equipment (Quantity)*
Year 2	CEP-176	Driving 42-inch Steel pipe and 28-inch steel sheet	2	Vibratory Hammer (2)
			2	Impact Hammer (2)
			2	Vibratory Hammer (1), Impact Hammer (1)
	CEP-176	Driving two 42-inch steel pipe	2	Vibratory Hammer (2)
			2	Impact Hammer (2)
			2	Vibratory Hammer (1), Impact Hammer (1)
	CEP-176 and CEP-102	Driving 42-inch steel pipe at CEP-176 and driving precast concrete bearing piles on CEP-102	2	Vibratory Hammer (1), Rotary Drill (1)
			2	Vibratory Hammer (1), Impact Hammer (1)
			2	Impact Hammer (1), Rotary Drill (1)
	CEP-176 and CEP-175	Driving 42-inch steel pipe at CEP-176 and driving polymeric fender piles at CEP-175	2	Vibratory Hammer (1), Impact Hammer (1)

Table 1-1 Summary of Multiple Equipment Scenarios

	Structure	*Pile Types*	*Total Equipment Quantity*	*Equipment (Quantity)*
Year 3	Pier 3	Driving of Precast bearing piles	2	Rotary Drill (2)
			2	Impact Hammer (1), Rotary Drill (1)
			2	Impact Hammer (2)
	CEP-102	Driving 42-inch Steel pipe and 28-inch steel sheet	2	Vibratory Hammer (2)
			2	Impact Hammer (2)
			2	Vibratory Hammer (1), Impact Hammer (1)
Year 4	Existing Pier 3 and CEP-102	Extraction of 14-inch timber piles from Pier 3 and Driving of 42-inch steel pipe, sheet piles, and precast concrete piles	4	Vibratory Hammer (3), Rotary Drill (1)
			4	Vibratory (2), Impact Hammer (2), Rotary Drill (1)
			4	Vibratory (1), Impact Hammer (3)
Year 4-5	Existing Pier 3 and CEP-102	Extraction of 16- to 18-inch concrete piles from Pier 3 and Driving of 24-inch precast concrete bearing piles	2	Vibratory Hammer (1), Rotary Drill (1)
			2	Vibratory Hammer (1), Impact Hammer (1)

Source: NAVFAC Midlant, 2022

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 construction will be conducted from April 1, 2022 through March 31, 2027. The Navy will coordinate with NMFS to ensure that impacts to managed and protected species and their habitat are minimized. This LOA request covers work during construction Years 2 through 5, from April 1, 2023–March 31, 2027. An IHA Application for Year 1 activities has been submitted and will cover in-water work occurring April 1, 2022 through March 30, 2023 (NMFS, 2022). Table 2-1 provides the estimated construction schedule and production rates for proposed construction activities considered in this LOA.

No in-water work would begin at the project site until the Navy has received all required permits and approvals.

2.2 Project Location Description

NAVSTA Norfolk, the center of naval operations on the east coast, is part of the world's largest naval complex and is the primary homeport of the U.S. Atlantic Fleet. NAVSTA Norfolk supports the operational readiness of the U.S. Atlantic Fleet, providing facilities and services to enable mission accomplishment.

The station occupies 4,600 acres of land on a peninsula known as Sewell's Point in the northwest corner of Norfolk, Virginia, near the mouth of the Chesapeake Bay (see Figure 1-1). The station is bordered by the Chesapeake Bay and Willoughby Bay to the north, the Elizabeth River to the west, and the City of Norfolk to the east and south. NAVSTA Norfolk includes Chambers Field (formerly known as Naval Air Station Norfolk), Fleet Industrial Supply Center, Naval Facilities Engineering Command Mid-Atlantic, Fleet Training Center, and numerous other tenants. The station is home to 59 ships (including five aircraft carriers), 187 aircraft, 18 aircraft squadrons, and 326 tenant commands. Waterfront structures include 13 large piers, numerous small piers, and bulkheads.

2.2.1 Bathymetric Setting

NAVSTA Norfolk is located within the James River at Hampton Roads Harbor Polyhaline (JMSPH) drainage basin in the Chesapeake Bay.

The bathymetry of the Proposed Action area reflects the effects of natural sedimentation and erosion processes combined with modifications from dredging to maintain permitted depths in support of navigational safety, both within the Hampton Roads Harbor and in the adjacent portions of the lower James River and Chesapeake Bay. The tidal range in the area is approximately 2.85 feet. Tides are diurnal with two high tides and two low tides per day (USACE and Port of Virginia, 2017).

Table 2-1 In-water Activities for LOA Construction Years 2 - 5 (April 1, 2023 – March 31, 2027)

Estimated Schedule	*Activity*	*Total Amount and Estimated Dates*	*Activity Component*	*Method*	*Daily Production Rate*	*Total Production Days*
April 1, 2023 – March 31, 2024	CEP-176 Bulkhead	Install 103 bearing piles *Apr-23 to May-23*	42-inch diameter steel pipe	Impact or Vibratory Hammer	4 piles/day	26
April 1, 2023 – March 31, 2024	CEP-176 Bulkhead	Install 221 sheet piles *Apr-23 to May-23*	28-inch wide steel sheet	Impact or Vibratory Hammer	14 piles/day	16
April 1, 2023 – March 31, 2024	CEP-175 Bulkhead	Install 9 fender piles *Apr-23 to May-23*	13-inch dia. polymeric piles	Impact or Vibratory Hammer (Note 1)	5 piles/day	2
April 1, 2023 – March 31, 2024	CEP-102 Platform Phase 2 Portion 113-108	Install 11 bearing piles *May-23*	24-inch square precast concrete	Impact Hammer (Note 1)	2 piles/day	6
April 1, 2023 – March 31, 2024	Pier 3	Install 280 bearing piles *May-23 to Sep-23*	24-inch square precast concrete	Impact Hammer	4 piles/day	70
April 1, 2023 – March 31, 2024	CEP-102 Platform Phase 2 Portion 113-108	Install 6 fender piles *Jul-23*	18-inch square precast concrete	Impact Hammer (Note 1)	4 piles/day	2
April 1, 2023 – March 31, 2024	Pier 3	Install 250 bearing piles *Jul-23 to Nov-23*	24-inch square precast concrete	Impact Hammer	4 piles/day	63
April 1, 2024 – March 31, 2025	Pier 3	Install 409 fender piles *Jun-24 to Oct-24*	24-inch precast concrete square	Impact Hammer (Note 1)	6 piles/day	69
April 1, 2024 – March 31, 2025	Pier 3	Install 18 fender piles *Jun-24 to Nov-24*	18-inch diameter steel pipe	Impact Hammer	6 piles/day	3
April 1, 2024 – March 31, 2025	CEP-102 Bulkhead South Portion 188-163	Install 26 bearing piles *Dec-24 to Jan-25*	42-inch diameter steel pipe	Impact or Vibratory Hammer	2 piles/day	13

Table 2-1 In-water Activities for LOA Construction Years 2 - 5 (April 1, 2023 – March 31, 2027)

Estimated Schedule	*Activity*	*Total Amount and Estimated Dates*	*Activity Component*	*Method*	*Daily Production Rate*	*Total Production Days*
April 1, 2024 – March 31, 2025	CEP-102 Bulkhead South Portion 188-163	Install 53 sheet piles *Jan-25*	28-inch wide steel sheet	Impact or Vibratory Hammer	14 piles/day	4
April 1, 2024 – March 31, 2025	CEP-102 Bulkhead South Portion 188-163	Extract 26 fender piles *Feb-25*	18-inch square precast concrete	Vibratory Hammer	9 piles/day	3
April 1, 2025 – March 31, 2026	CEP-102 Platform South Portion 188-163	Install 40 bearing piles *Apr-25 to May-25*	24-inch square precast concrete	Impact Hammer (Note 1)	2 piles/day	20
April 1, 2025 – March 31, 2026	Existing Pier 3	Extract 624 fender piles *Aug-25 to Sep-25*	14-inch diameter timber	Vibratory Hammer	25 piles/day	25
April 1, 2025 – March 31, 2026	CEP-102 Platform South Portion 188-163	Install 25 fender piles *Sept-25*	18-inch square precast concrete	Impact Hammer (Note 1)	4 piles/day	7
April 1, 2025 – March 31, 2026	CEP-102 Bulkhead Center Portion 163-114	Install 50 bearing piles *Sep-25 to Oct-25*	42-inch diameter steel pipe	Impact or Vibratory Hammer	2 piles/day	25
April 1, 2025 – March 31, 2026	Existing Pier 3	Extract 72 fender piles *Sep-25 to Oct-25*	24-inch square precast concrete	Vibratory Hammer	12 piles/day	6
April 1, 2025 – March 31, 2026	CEP-102 Bulkhead Center Portion 163-114	Install 102 sheet piles *Oct-25*	28-inch wide steel sheet	Impact or Vibratory Hammer	14 piles/day	8
April 1, 2025 – March 31, 2026	CEP-102 Bulkhead Center Portion 163-114	Extract 36 fender piles *Nov-25*	18-inch square precast concrete	Vibratory Hammer	9 piles/day	4
April 1, 2025 – March 31, 2026	Existing Pier 3	Extract 873 bearing piles *Nov-25 to Mar-26*	16-inch and 18-inch square precast concrete	Vibratory Hammer	10 piles/day	88
April 1, 2025 – March 31, 2026	CEP-102 Platform Center Portion 163-114	Install 41 bearing piles *Feb-26 to Mar-26*	24-inch square precast concrete	Impact Hammer (Notes 1)	2 piles/day	21

Table 2-1 In-water Activities for LOA Construction Years 2 - 5 (April 1, 2023 – March 31, 2027)

Estimated Schedule	***Activity***	***Total Amount and Estimated Dates***	***Activity Component***	***Method***	***Daily Production Rate***	***Total Production Days***
April 1, 2026 – March 31, 2027	Existing Pier 3	Extract 30 bearing piles *Apr-26*	16-inch and 18-inch square precast	Vibratory Hammer	10 piles/day	3
April 1, 2026 – March 31, 2027	CEP-102 Platform Center Portion 163-114	Install 32 bearing piles *April-26*	24-inch square precast concrete	Impact Hammer (Notes 1)	2 piles/day	16
April 1, 2026 – March 31, 2027	CEP-102 Platform Center Portion 163-114	Install 50 fender piles *April-26*	18-inch square precast concrete	Impact Hammer (Note 1)	4 piles/day	13
	Total piles installed/removed	1,726/1,661				

Source: NAVFAC Midlant 2022

Notes: 1 - Pre-drilling is permitted to assist with pile installation.; Estimated construction schedule as delays may occur due to equipment failure or weather.

Twenty-five significant navigation projects have been constructed within the Norfolk Harbor, ranging in depth from 6 feet to 50 feet when measured at mean low water (MLW). The major deep-draft channels serving Norfolk Harbor are authorized to a depth of 55 feet below MLW. The Norfolk Harbor Reach portion of the Federal Navigation Channel offshore from NAVSTA Norfolk has a permitted dredge depth of -55 feet mean lower low water, but it is maintained at a depth of -50 feet mean lower low water. The Navy deepened the channels from the Craney Island Reach of the Norfolk Harbor and Channels Project through Lambert's Bend and from Lambert's Bend to the Norfolk Naval Shipyard to a depth of 47 feet to meet Navy operational needs. Both of these reaches are maintained with 3 feet of overdredge (USACE and Port of Virginia, 2017). Other deep-draft channels, anchorages, and turning basins in Norfolk Harbor are maintained at depths varying from 24 to 50 feet below MLW.

The annual shoaling rate for NAVSTA Norfolk was estimated as 1 to 2 feet per year (Hoffman, 1980). On average, maintenance dredging of the Navigation Channel occurs every 2 years (USACE and Port of Virginia, 2018).

2.2.2 Shorelines

The shorelines in the NAVSTA Norfolk area are highly modified with bulkheads to support the infrastructure of the Naval station.

2.2.3 Water Quality

Water quality within the project area reflects the water quality of the Chesapeake Bay mainstem and tributaries, including the Elizabeth River, James River, Lafayette River, Lynnhaven River, and Norfolk Harbor proper, many of which are considered impaired waterways. Water quality at NAVSTA Norfolk also reflects permitted discharges (e.g., stormwater) and periodic maintenance dredging operations.

In general, water salinities in the Hampton Roads Harbor typically range from 20 to 30 parts per thousand and dissolved oxygen (DO) concentrations meet the criteria for open water designated use (5.0 milligrams per liter) (USACE and Port of Virginia, 2018). Per the Virginia Department of Environmental Quality's 2018 Impairment Summary, waters immediately adjacent to NAVSTA Norfolk are not impaired with respect to DO, chlorophyll a, submerged aquatic vegetation, and benthic community.

However, the JMSPH watershed presently (2018) is not supporting aquatic life, fish consumption, or open water beneficial uses. The Chesapeake Bay and Tidal Tributaries, including portions of the James River, do not support fish consumption because of a fish advisory for elevated polychlorinated biphenyl (PCB) concentrations in anadromous striped bass. The Chesapeake Bay segment of JMSPH is impaired for aquatic life due to estuarine bioassessments (defined as an inadequate benthic community based on the Chesapeake Bay Benthic Index of Biological Integrity). Insufficient information is available to assess impairments related to wildlife use or shellfish.

2.2.4 Sediments

Sediment characterizations at NAVSTA Norfolk have been conducted in support of periodic maintenance dredging operations that are required to maintain permitted depths and ensure navigational safety, as well as in support of natural resources surveys. NAVSTA Norfolk sediments are dominated by silt-clay size particles (Tetra Tech, Inc., 2016). No elevated concentrations (greater than 500 milligrams per kilogram [or parts per million]) of total petroleum hydrocarbons occurred in samples taken at multiple locations at Piers 3, 3T, or 4 (CH2M, 2018).

2.2.5 Ambient Sound

2.2.5.1 Underwater Sound

Underwater ambient sound in the vicinity of NAVSTA Norfolk is comprised of sounds produced by a number of natural and anthropogenic sources and varies both geographically and temporally. Natural sound sources include wind, waves, precipitation, and biological sources such as shrimp, fish, and cetaceans. These sources produce sound in a wide variety of frequency ranges (Urick, 1983; Richardson et al., 1995) and can vary over both long (days to years) and short (seconds to hours) time scales. In shallow waters, precipitation may contribute up to 35 decibels (dB) to the existing sound level, and increases in wind speed of 5 to 10 knots can cause a 5 dB increase in ambient ocean sound between 20 hertz and 100 kilohertz (Urick, 1983).

Human-generated sound is a significant contributor to the ambient acoustic environment. Normal port activities include vessel traffic from large ships, support vessels and security boats, and loading and maintenance operations, which all generate underwater sound (Urick, 1983). NAVSTA Norfolk is located in close proximity to shipping channels as well as several Port of Virginia facilities which altogether have an annual average 1,459 vessel calls (Port of Virginia, 2019). Other sources of human-generated underwater sound not specific to naval installations include sounds from echo sounders on commercial and recreational vessels, industrial ship noise, and noise from recreational boat engines. Ship and small boat noise comes from propellers and other on-board rotating equipment.

The underwater acoustic environment will vary depending on the amount of anthropogenic activity, weather conditions, and tidal currents. At high-use installations such as NAVSTA Norfolk, anthropogenic noise may dominate the ambient soundscape. In areas with less anthropogenic activity, ambient sound is likely to be dominated by sound from natural sources.

Underwater ambient sound was recorded at 10 meters (m) from pile driving locations prior to and following pile driving events at NAVSTA Norfolk Pier 4 (Illingworth and Rodkin, 2017) in October 2014. Anthropogenic noise resulted primarily from transient vessel traffic and local work-site compressors and generators. During two days of recording, 1-second underwater sound levels averaged 122 and 123 dB root mean square (RMS) (range 118-132 dB).

2.2.5.2 Airborne Sound

Airborne sound is produced by common industrial equipment, including trucks, cranes, compressors, generators, pumps, and other equipment that might typically be employed along industrial waterfronts. Sound levels are highly variable based on the types and operational states of equipment at the recording location, and sound levels may vary within a single installation such as NAVSTA Norfolk, with some piers/wharves very loud and others relatively quiet.

Airborne ambient sound was recorded 15 m from pile driving locations but outside of pile driving events at NAVSTA Norfolk Pier 4 (Illingworth and Rodkin, 2017) in October 2014. RMS maximum sound level ranged from 72 to 100 A-weighted sound level (dBA) and 1-minute equivalent continuous sound level over a period of time ranged from 66 to 88 dBA on one day of monitoring, and maximum sound level ranged from 76 to 85 dBA and the equivalent continuous sound level ranged from 66 to 81 dBA on another.

3 MARINE MAMMAL SPECIES AND NUMBERS

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

3.1 Marine Mammal Species Likely to be Found within the Region of Influence

Five marine mammal species are included in this application for an LOA because surveys, monitoring, and stranding reports have detected them within the project area (Table 3-1). Reports that were evaluated for this application are listed in Table 3-1 and include nearshore at-sea surveys conducted on behalf of the Navy in the mouth of the Chesapeake Bay and the Navy's Virginia Capes training and testing area east of Virginia Beach, marine mammal stranding reports, and pinniped tracking and haul out monitoring in the vicinity of the Chesapeake Bay Bridge Tunnel (CBBT). Sightings of marine mammals in shipboard surveys and haul out monitoring are the most useful evidence of the occurrence of a species in the area, but where sightings are scarce, the summaries below also utilize stranding reports as an indicator of the frequency of occurrence of a species.

The following sections summarize available data on the occurrence of the potentially affected species in these survey and monitoring areas and describe qualitatively the likelihood of encountering any of these species in the vicinity of the proposed activities. Additional information on population abundance and trends for each marine mammal stock as a whole is also presented below. Section 4 (Affected Species Status and Distribution) contains information on the distribution and status of each potentially affected species.

3.2 Estimates of Abundance within the Region of Influence

Estimating potential marine mammal abundance over time and space is challenging because the animals are highly mobile and often difficult to detect. Marine mammal species are not distributed evenly, but occur in groups in areas that are biased towards greater importance, such as areas of high prey abundance, haul out sites, or areas with lower predation risk, etc. Many species are not resident in the area year round, but are occasionally or seasonally present. When they are detected, it may not be clear whether they are seasonally resident, migrating through the area in a predictable manner, or outliers that are not conforming to some pattern. Patterns in the occurrences of many marine mammal species are still being worked out, making it difficult, in a relatively limited area like the project area, to understand how abundant the species may be.

Methods used to estimate marine mammal stock abundance and population trends are described in NMFS stock assessment reports, and may utilize data from at-sea surveys and monitoring of identifiable individuals, among other methods. Stock assessment reports account for many sources of uncertainty in abundance estimates. For example, surveys generally cannot cover the entire area in which the species may occur at a given time. An additional complication is the overlap of various stocks, such as common bottlenose dolphin, in a survey area.

Table 3-1 lists the species that may occur within the vicinity of NAVSTA Norfolk, population abundance, and estimated densities as well as relative frequency and season of occurrence within the proposed project area.

Table 3-1 Marine Mammals Potentially Present Within the Lower Chesapeake Bay

Species and Stock[1]	***Stock Abundance***	***Relative Occurrence***	***Season(s) of Occurrence***	***Density in the Project Area (individuals/km²)***
Humpback whale (*Megaptera novaeangliae*) Gulf of Maine stock	1,396[1]	Likely	Year-round with peak in fall through spring	n/a[2]
Bottlenose dolphin (*Tursiops truncatus*) • Western North Atlantic Northern Migratory Coastal stock • Western North Atlantic Southern Migratory Coastal stock • Northern North Carolina Estuarine System Stock	• NM stock: 6,639[1] • SM stock: 3,751[1] • NC ES stock: 823[1]	• NM stock: Likely • SM stock: Likely • NC ES stock: Rare	Spring to fall (May through October)	1.38[3]
Harbor porpoise (*Phocoena phocoena*) Gulf of Maine/Bay of Fundy stock	95,543[1]	Rare	Winter to spring	n/a[2]
Harbor seal (*Phoca vitulina*) Western North Atlantic stock	75,834[1]	Likely	Winter to spring (December through April)	n/a[2]
Gray seal (*Halichoerus grypus*) Western North Atlantic stock	27,131[1]	Rare	Winter to spring (December through April)	n/a[2]

Notes:
1. NMFS Marine Mammal Stock Assessment Reports online at https://www.fisheries.noaa.gove/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-region.
2. No density estimates found for Chesapeake Bay. Species assumed to be absent in lower Chesapeake Bay in Navy Marine Species Density Database (Navy, 2017), methods used to calculate takes from IHA Year 1 (NMFS, 2022).
3. Engelhaupt et al., 2016

Key: CV = coefficient of variation; ES = Estuarine System; N/A = not available; NC = North Carolina; NM = Northern Migratory; N_{min} is the minimum estimate of stock abundance (in some cases, CV is not applicable); SM = Southern Migratory; km² = square kilometers.

3.2.1 Humpback Whale

The Navy's nearshore survey effort for humpback whales (Aschettino et al., 2015, 2016, 2017, 2018, 2019, 2020a, 2021) has identified high levels of occurrence in waters in and around the mouth of the Chesapeake Bay and the Virginia coast. The number of humpback whales identified in this study reflects the level of effort and study objectives in each field season, among other variables, but the number of unique humpback whales identified each season (31 during the 2014–15 field season, 38 during the 2015–16 field season, 59 during the 2016–2017 field season, 28 during the 2017–2018 field season, 37 during the 2018–2019 field season, 28 during the 2019–2020 field season [Aschettino et al., 2021]) indicates the importance of the study area to this species. Several satellite-tagged humpback whales were detected west of the CBBT, including two individuals with locations near NAVSTA Norfolk and Joint Expeditionary Base Little Creek (JEBLC) (Aschettino et al., 2017; 2020b). Group size was not reported in these surveys but appears to have been one to two individuals, most of which were juveniles.

Thirty-three humpback whale strandings were reported in Virginia between 1988 and 2013, of which 11 were within the Chesapeake Bay (Barco & Swingle, 2014). Additional strandings have been reported in Virginia in subsequent years (one in 2015, four in 2016, eight in 2017, five in 2018, three in 2019) (Swingle et al., 2017; Swingle et al., 2018; Costidis et al., 2019). Most of these animals showed signs of ship strikes or entanglement. In response to the increasing numbers of humpback whale strandings along the Atlantic coast from Maine through North Carolina, NMFS declared an unusual mortality event (UME) in 2016. Strandings involved primarily juvenile whales and occurred in all seasons, but were most common in the spring.

The 2019 NMFS stock assessment for the Gulf of Maine stock of humpback whales reported a count of 1,396 individuals as the minimum number alive in 2016 (NMFS, 2019a). A UME was declared following elevated humpback whale mortalities along the Atlantic coast from Maine to Florida beginning in January 2016 (National Oceanic and Atmospheric Administration [NOAA] Fisheries, 2021). About half of the whales examined showed evidence of vessel strike or entanglement. As of June 2021, a total of 150 humpback whale mortalities have been reported, including 24 in Virginia. Current data suggest that the Gulf of Maine humpback whale stock is steadily increasing in numbers (NMFS, 2018a). This is consistent with an estimated average growth trend of 3.1 percent (standard error = 0.005) in the North Atlantic population overall for the period 1979 to 1993 (Stevick et al., 2003).

3.2.2 Bottlenose Dolphin

Bottlenose dolphins are the most abundant marine mammal species encountered in surveys and stranding reports on the coast off Virginia Beach, Virginia, and in the Chesapeake Bay near NAVSTA Norfolk and JEBLC Fort Story (Barco & Swingle, 2014; Engelhaupt et al., 2014, 2015, 2016). They occur in greatest numbers in this area annually from May through October. Densities in the nearshore zone were calculated as 3.88 individuals/square kilometer (km^2) in fall, 0.63 individuals/ km^2 in winter, 1.0 individuals/ km^2 in spring, and 3.55 individuals/ km^2 in summer (Engelhaupt et al., 2016). Bottlenose dolphins are also the most commonly stranded marine mammal in the state, with strandings mostly occurring from April through October, which corresponds to their abundance in shipboard surveys (Swingle et al., 2015). Barco and Swingle (2014) reported 1,593 strandings from 1988 to 2013, including a UME that peaked in Virginia in 2013. Strandings in subsequent years ranged from 67 to 101 animals (Swingle et al., 2014, 2015, 2016, 2017).

The 2017 NMFS stock assessment for three bottlenose dolphin stocks that may be in the project area reported an estimated abundance of 6,639 (coefficient of variation [CV] = 0.41) for the Northern Migratory Coastal stock, 3,751 (CV = 0.60) for the Southern Migratory Coastal stock, and 823 (CV = 0.06) for the Northern North Carolina Estuarine System stock (NMFS, 2018a). An analysis of trends in abundance for common bottlenose dolphins coast-wide from New Jersey to Florida indicated a statistically significant decline in population size between 2011 and 2016 (Garrison et al., 2017), which may be a result of the UME that occurred during 2013–2015.

3.2.3 Harbor Porpoise

Reports from marine mammal surveys in the Chesapeake Bay in the vicinity of NAVSTA Norfolk and the nearshore off Virginia Beach mention one sighting of a group of two harbor porpoises in 2015 (Engelhaupt et al., 2016), and passive acoustic recorders detected the species in low numbers near NAVSTA Norfolk and JEBLC during winter and spring deployments from August 2012 to September 2013 (Engelhaupt et al., 2014). Stranding reports from 2004 to 2013 cite 89 harbor porpoise strandings along the mouth of the Chesapeake Bay and ocean-facing beaches on the Virginia Beach coastline (Barco & Swingle, 2014). Subsequent stranding reports from Virginia cite from one to five strandings annually from 2014 through 2018 (Swingle et al., 2015, 2016, 2017, 2018; Costidis et al., 2019). All of these reports indicate that harbor porpoises are most likely to be present in the region in winter and spring months, and observations of the species off the coasts of Maryland (Wingfield et al., 2017) and New Jersey (Whitt et al., 2015) support this finding.

The 2019 NMFS stock assessment for the Gulf of Maine/Bay of Fundy stock reported an estimated abundance of 95,543 (f = 0.31) (NMFS, 2019a). A trend analysis has not been conducted for this stock.

Stranding reports discuss wide historic fluctuations in harbor porpoise strandings in Virginia, ranging from 40 porpoises in 1999 and 30 in 2001 to 2 each in 2011 and 2012 (Costidis et al., 2019), and 5 or fewer from 2014 to 2018 (Swingle et al., 2015, 2016, 2017, 2018; Costidis et al., 2019). These fluctuations in stranding numbers have not been correlated to fluctuations in population or stock abundance, threats such as potential fisheries bycatch, or other factors.

3.2.4 Harbor Seal

Harbor seals are the most common pinnipeds in Virginia, and haul out on rocks around the portal islands of the CBBT and on mud flats on the nearby southern tip of the Eastern Shore from December through April. Surveys at the CBBT haul out sites recorded 112 harbor seal sightings during the 2014–2015 season, 186 sightings during the 2015–2016 season, 308 sightings during the 2016–2017 season, and 340 sightings during the 2017–2018 season (Rees et al., 2016; Jones et al., 2018). Sightings recorded during the 2018–2019 and 2019–2020 seasons were 82 and 29, respectively. Although these numbers appeared to show a decline from previous seasons, it was noted that sampling methodology changes and unequal survey efforts from previous surveys likely affected the results (Jones and Rees 2021). The Eastern Shore site had a best total estimate of 105 sightings during the 2015–2016 season, 196 sightings during the 2017–2018 season, 160 sightings during the 2018–2019 season, and 156 sightings during the 2019–2020 season (Jones et al., 2018, Jones and Rees 2021).

Harbor seals strand in low numbers on the coast of Virginia and Chesapeake Bay. From 1988 to 2013, 82 strandings were reported (Barco & Swingle, 2014), and in the following years from 1 to 4 stranded harbor seals were reported each year (Swingle et al., 2015, 2016, 2017, 2018; Costidis et al., 2019).

The 2019 NMFS stock assessment for the Western North Atlantic stock reported 75,834 (CV = 0.15) (NMFS, 2019a). This stock is present primarily in U.S. waters. Several researchers consider that harbor and gray seal distribution along the U.S. Atlantic coast appears to be expanding or shifting (DiGiovanni et al., 2011; DiGiovanni et al., 2018; Johnston et al., 2015). This range expansion may be due to rapid growth of gray seal populations in Canada and the Northeastern United States (Cammen et al., 2018). Count trend data for harbor and gray seals in southern New England and Long Island index sites from 1986 to 2011 indicate that harbor and gray seals are showing an increased use of their more southerly range and are extending their time spent at these haul out sites (DiGiovanni et al., 2011).

3.2.5 Gray Seal

Haul out monitoring conducted during 2014–2015 and 2015–2016 at the CBBT reported only one individual for both survey seasons (Rees et al., 2016). Haul out monitoring conducted during 2016–2017 and 2017–2018 at the CBBT and the southern tip of the Eastern Shore of Virginia, reported only one individual at the Eastern Shore for the 2017–2018 season (Jones et al., 2018). No gray seals were recorded during the 2019–2020 season at CBBT and only one gray seal was recorded during the Eastern Shore survey (Jones and Rees 2021).

Gray seals strand in low numbers on the coast of Virginia and the Chesapeake Bay. From 1988 to 2013, 15 strandings were reported (Barco & Swingle, 2014), and in the following years from zero to four stranded gray seals were reported each year (Swingle et al., 2015, 2016, 2017, 2018; Costidis et al. 2019).

The 2019 NMFS stock assessment for the Western North Atlantic stock reported 27,131 (CV = 0.19) in U.S. waters (NMFS, 2019a). An additional portion of the stock occurs in Canadian waters. Gray seal abundance is likely increasing in U.S. and Canadian waters (NMFS, 2019a).

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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 Humpback Whale

4.1.1 Status and Management

A recent status review identified 15 distinct population segments globally based primarily on breeding areas (Bettridge et al., 2015). Partially based on this status review, NMFS issued a final rule to divide the globally listed species into 14 distinct population segments and revise the listing status of each breeding population (81 Federal Register [FR] 62260–62320, September 8, 2016). After evaluating the danger of extinction of each distinct population segment, four distinct population segments (Cape Verde Islands/Northwest Africa, Western North Pacific, Central America, and Arabian Sea) are currently listed under the Endangered Species Act (ESA) as endangered and one distinct population segment (Mexico) is listed as threatened. The remaining nine distinct population segments, including the West Indies distinct population segment that occurs within the project area, do not warrant listing under the ESA because they are neither in danger of extinction nor likely to become so in the foreseeable future. All humpback whales feeding in the North Atlantic are considered part of the West Indies distinct population segment (Bettridge et al., 2015), including the Gulf of Maine stock. The West Indies distinct population segment feeding range primarily includes the Gulf of Maine, eastern Canada, and western Greenland (80 FR 22304–22345, April 21, 2015) and breeding grounds include waters of the Dominican Republic and Puerto Rico (81 FR 62260–62320, September 8, 2016).

For management purposes in U.S. waters, NMFS identified stocks that are based on feeding areas. Although the Western North Atlantic population was once treated as a single management stock, the Gulf of Maine stock has been identified as a discrete subpopulation based on strong fidelity of humpbacks feeding in that region (NMFS, 2019a). The Gulf of Maine stock is the only stock of humpbacks in the Atlantic managed under NMFS jurisdiction. However, it should be noted that several other discrete humpback whale subpopulations, based on feeding grounds, are present in the Western North Atlantic, including the Gulf of St. Lawrence, Newfoundland/Labrador, and western Greenland (NMFS, 2019a). The Gulf of Maine stock is designated as Strategic by NMFS.

4.1.2 Distribution

Humpback whales are distributed worldwide in all major oceans and most seas. Most humpback whale sightings are in nearshore and continental shelf waters; however, humpback whales frequently travel through deep oceanic waters during migration (Calambokidis et al., 2001; Clapham & Mattila, 1990). Humpback whales of the Western North Atlantic are typically found in Labrador Current, North Atlantic Gyre, and Gulf Stream open ocean areas during seasonal migrations from northern latitude feeding grounds, occupied during the summer, to southern latitude calving and breeding grounds occupied in the winter (NMFS, 2019a). The Gulf of St. Lawrence, Newfoundland Grand Banks, West Greenland, and Scotian Shelf are summer feeding grounds for humpbacks (Cetacean and Turtle Assessment Program, 1982; Kenney & Winn 1986; Stevick et al., 2006; Whitehead, 1982). The Gulf of Maine is also one of the principal summer feeding grounds for humpback whales in the North Atlantic. The largest numbers of humpback whales are present from mid-April to mid-November. Other feeding locations in this ecosystem are Stellwagen Bank, Jeffreys Ledge, the Great South Channel, the edges and shoals of Georges Bank, Cashes Ledge, and Grand Manan Banks (Cetacean and Turtle Assessment Program, 1982; Kenney & Winn, 1986; Stevick et al., 2006; Whitehead, 1982). LaBrecque et al. (2015) delineated a humpback whale feeding area in the Gulf of Maine, Stellwagen Bank, and Great South Channel, substantiated through vessel-and aerial-based survey data, photo-identification data, radio-tracking data, and expert judgment. Humpback whales feed in this area from March through December. Humpback feeding habitats are typically shallow banks or ledges with high seafloor relief (Hamazaki, 2002; Payne et al., 1990).

On breeding grounds, females with calves occur in much shallower waters than other groups of whales, and breeding adults use deeper more offshore waters (Smultea, 1994; Ersts & Rosenbaum, 2003). The habitat requirements of wintering humpbacks appear to be controlled by the conditions necessary for calving, such as warm water and relatively shallow, low-relief ocean bottom in protected areas, created by islands or reefs (Clapham, 2000; Craig & Herman, 2000; Smultea, 1994).

4.1.3 Site-Specific Occurrence

Although humpback whales are migratory between feeding areas and calving areas, individual variability in the timing of migrations may result in the presence of individuals in high-latitude areas throughout the year (Straley, 1990). Records of humpback whales off the U.S. mid-Atlantic coast (New Jersey to North Carolina) from January through March suggest these waters may represent a supplemental winter feeding ground used by juvenile and mature humpback whales of U.S. and Canadian North Atlantic stocks (LaBrecque et al., 2015).

Humpback whales are most likely to occur near the mouth of the Chesapeake Bay and coastal waters of Virginia Beach between January and March; however, they could be found in the area year-round, based on shipboard sighting and stranding data (Barco & Swingle, 2014; Aschettino et al., 2015, 2016, 2017, 2018). Photo-identification data support the repeated use of the mid-Atlantic region by individual humpback whales. Results of the vessel surveys show site fidelity in the survey area for some individuals and a high level of occurrence within shipping channels—an important high-use area by both the U.S. Department of the Navy and commercial traffic (Aschettino et al., 2015, 2016, 2017, 2018). Nearshore surveys conducted in early 2015 reported 61 individual humpback whale sightings, and 135 individual humpback whale sightings in late 2015 through May 2016 (Aschettino et al., 2016). Subsequent surveys confirmed the occurrence of humpback whales in the nearshore survey area: 248 individuals were detected in 2016–2017 surveys (Aschettino et al., 2017), 32 individuals were detected in 2017–2018 surveys (Aschettino et al., 2018), and 80 individuals were detected in 2019 surveys (Aschettino et al., 2019). Sightings in the Hampton Roads area in the vicinity of NAVSTA Norfolk were reported in nearshore surveys and through tracking of satellite-tagged whales in 2016, 2017, 2019, and 2021 (Aschettino et al, 2021). The numbers of whales detected, most of which were juveniles, reflect the varying level of survey effort and changes in survey objectives from year to year, and do not indicate abundance trends over time.

4.2 Bottlenose Dolphin

4.2.1 Status and Management

Along the U.S. East Coast and northern Gulf of Mexico, the bottlenose dolphin stock structure is well studied. There are currently 53 management stocks identified by NMFS in the Western North Atlantic and

Gulf of Mexico, including oceanic, coastal, and estuarine stocks (Hayes et al., 2017; Waring et al., 2015; Waring et al., 2016).

There are two morphologically and genetically distinct bottlenose dolphin morphotypes (distinguished by physical differences) described as coastal and offshore forms (Duffield et al., 1983; Duffield, 1986). The offshore form is larger in total length and skull length, and has wider nasal bones than the coastal form. Both inhabit waters in the Western North Atlantic Ocean and Gulf of Mexico (Curry & Smith, 1997; Hersh & Duffield, 1990; Mead & Potter, 1995) along the U.S. Atlantic coast. The coastal morphotype of bottlenose dolphin is continuously distributed along the Atlantic coast south of Long Island, New York, around the Florida peninsula, and along the Gulf of Mexico coast. This type typically occurs in waters less than 25 m deep (Waring et al., 2015). The range of the offshore bottlenose dolphin includes waters beyond the continental slope (Kenney, 1990), and offshore bottlenose dolphins may move between the Gulf of Mexico and the Atlantic (Wells et al., 1999).

Two coastal stocks are likely to be present in the project area: Western North Atlantic Northern Migratory Coastal stock and Western North Atlantic Southern Migratory Coastal (SMC) stock, both of which are designated as Strategic and Depleted under the MMPA. The Northern North Carolina Estuarine System stock may also be present, and is designated as Strategic by NMFS.

4.2.2 Distribution

The bottlenose dolphin occurs in tropical to temperate waters of the Atlantic Ocean as well as inshore, nearshore, and offshore waters of the Gulf of Mexico and U.S. East Coast (Hayes et al., 2017; Waring et al., 2015; Waring et al., 2016). They generally do not range north or south of 45° latitude (Jefferson et al., 2015; Wells & Scott, 2008). They occur in most enclosed or semi-enclosed seas in habitats ranging from shallow, murky, estuarine waters to deep, clear offshore waters in oceanic regions (Jefferson et al., 2015; Wells & Scott, 2008). Open ocean populations occur far from land; however, population density appears to be highest in nearshore areas (Scott & Chivers, 1990). Bottlenose dolphins occur in the North Atlantic Gyre and Gulf Stream open ocean areas.

4.2.3 Site-Specific Occurrence

Bottlenose dolphins are the most abundant marine mammal along the Virginia coast and within the Chesapeake Bay, typically traveling in groups of 2 to 15 individuals, but occasionally in groups of over 100 individuals (Engelhaupt et al., 2014, 2015, 2016). Several coastal stocks could be present in the project area, overlapping in their distribution in certain seasons (NMFS, 2018a). Bottlenose dolphins of the Western North Atlantic Northern Migratory Coastal stock winter along the coast of North Carolina and migrate as far north as Long Island, New York, in the summer. They are rarely found north of North Carolina in the winter (NMFS, 2018a). The SMC stock occurs in waters of southern North Carolina from October to December, moving south during winter months and north to North Carolina during spring months. During July and August, the SMC stock is presumed to occupy coastal waters north of Cape Lookout, North Carolina, to the Eastern Shore of Virginia (NMFS, 2018a). It is possible that these animals also occur inside the Chesapeake Bay and in nearshore coastal waters. The North Carolina Estuarine System stock dolphins may also occur in the Chesapeake Bay during July and August (NMFS, 2018a).

Vessel surveys conducted along coastal and offshore transects from NAVSTA Norfolk to Virginia Beach in most months from August 2012 to August 2015 reported bottlenose dolphins throughout the survey area, including the vicinity of NAVSTA Norfolk (Engelhaupt et al., 2014, 2015, 2016). The final results from this project confirmed earlier findings that bottlenose dolphins are common in the study area, with highest densities in the coastal waters in summer and fall months. Peak estimated abundance in coastal waters of the study area is 1,203 individuals present during the fall (density = 3.88 individuals per km^2), and 1,101 individuals in summer (density = 3.55 individuals per km^2). However, bottlenose dolphins do not completely leave this area during colder months, with approximately 200–300 individuals still present in winter and spring months (Engelhaupt et al., 2016).

4.3 Harbor Porpoise

4.3.1 Status and Management

The Gulf of Maine-Bay of Fundy stock occurs off the mid-Atlantic states and is the only stock under NMFS management in the region. Harbor porpoises are not listed as depleted under the MMPA, nor are they listed under the ESA.

4.3.2 Distribution

Harbor porpoises inhabit cool temperate-to-subpolar waters, often where prey aggregations are concentrated (Watts & Gaskin, 1985). Thus, they are frequently found in shallow waters, most often near shore, but they sometimes move into deeper offshore waters. Harbor porpoises are rarely found in waters warmer than 63 degrees Fahrenheit (°F) (17 degrees Celsius [°C]) (Read, 1999) and closely follow the movements of their primary prey, Atlantic herring (Gaskin, 1992).

In the Western North Atlantic, harbor porpoise range from Cumberland Sound on the east coast of Baffin Island, southeast along the eastern coast of Labrador to Newfoundland and the Gulf of St. Lawrence, then southwest to about 34 degrees North on the coast of North Carolina (Waring et al., 2016).

Harbor porpoises are seen from the coastline to deep waters (greater than 5,906 feet) (Westgate et al., 1998), although most of the population is found over the continental shelf. During winter (January to March), intermediate densities of harbor porpoises can be found in waters off New Jersey to North Carolina, and lower densities are found in waters off New York to New Brunswick, Canada (Waring et al., 2016). Harbor porpoises sighted off the mid-Atlantic states during winter include porpoises from other Western North Atlantic populations (Rosel et al., 1999). There does not appear to be a temporally coordinated migration or a specific migratory route to and from the Bay of Fundy region (Waring et al., 2016). During fall (October to December) and spring (April to June), harbor porpoises are widely dispersed from New Jersey to Maine, with lower densities farther north and south (LaBrecque et al., 2015).

4.3.3 Site-Specific Occurrence

Based on stranding reports, passive acoustic recorders, and shipboard surveys, harbor porpoise occur in coastal waters primarily in winter and spring months, but there is little information on their presence in the Chesapeake Bay. They do not appear to be abundant in the NAVSTA Norfolk area in most years, but this is confounded by wide variations in stranding occurrences over the past decade.

4.4 Harbor Seal

4.4.1 Status and Management

Harbor seals are not listed as depleted under the MMPA, nor are they listed under the ESA. The Western North Atlantic stock occurs in the project area.

4.4.2 Distribution

The harbor seal is one of the most widely distributed seals, found in temperate to polar coastal waters of the northern hemisphere (Jefferson et al., 2015). Harbor seals occur in nearshore waters and are rarely found more than 20 kilometers from shore, where they frequently occupy bays, estuaries, and inlets (Baird, 2001). Individual seals have been observed several kilometers upstream in coastal rivers (Baird, 2001). Haul out sites vary but include intertidal and subtidal rock outcrops, sandbars, sandy beaches, and even peat banks in salt marshes (Burns, 2008; Gilbert & Guldager, 1998; Prescott, 1982; Schneider & Payne, 1983; Wilson, 1978). On the western Atlantic coast, their approximate year-round coastal range includes the Gulf of St. Lawrence, Scotian Shelf, Gulf of Maine, Bay of Fundy, and northeast U.S. continental shelf south to the Virginia/North Carolina border.

Harbor seals are found year-round in the coastal waters of eastern Canada and Maine; from September to May they also occur from southern New England to New Jersey (NMFS, 2018a; Katona et al., 1993). A general southward movement from the Bay of Fundy to southern New England waters occurs in autumn and early winter (Barlas, 1999; Jacobs & Terhune, 2000; Rosenfeld et al., 1988; Whitman & Payne, 1990). A northward movement from southern New England to Maine and eastern Canada occurs before the pupping season, which takes place from mid-May through June along the Maine coast (DeHart, 2002; Kenney, 1994; Richardson et al., 1995; Whitman & Payne, 1990; Wilson, 1978). Pupping sites are on the Maine coast, although anecdotal reports suggest that some pupping is occurring at high-use haul out sites off Manomet, Massachusetts, and the Isles of Shoals, Maine (Hayes et al., 2017).

Harbor seal distribution along the U.S. Atlantic coast has shifted in recent years, with an increased number of seals reported from southern New England to the mid-Atlantic region (DiGiovanni et al., 2011; Hayes et al., 2017; Kenney, 2019; Waring et al., 2016). Regular sightings of seals in Virginia have become a common occurrence in winter and early spring (Costidis et al., 2019). Winter haul out sites for harbor seals have been documented in the Chesapeake Bay at the CBBT, on the Virginia Eastern Shore, and near Oregon Inlet, North Carolina (Waring et al., 2016; Rees et al., 2016; Jones et al., 2018).

4.4.3 Site-Specific Occurrence

Harbor seals regularly haul out on rocks around the portal islands of the CBBT and on mud flats on the nearby southern tip of the Eastern Shore from December through April (Rees et al., 2016; Jones et al., 2018). Seals captured in 2018 on the Eastern Shore and tagged with satellite-tracked tags that lasted from 2 to 5 months spent at least 60 days in Virginia waters before departing the area. All tagged seals returned regularly to the capture site while in Virginia waters, but individuals utilized offshore and Chesapeake Bay waters to different extents (Ampela et al., 2019). The area that was utilized most heavily was near the Eastern Shore capture site, but some seals ranged into the Chesapeake Bay.

4.5 Gray Seal

4.5.1 Status and Management

The Western North Atlantic stock of gray seal occurs in the project area. Gray seals are not listed as depleted under the MMPA, nor are they listed under the ESA.

4.5.2 Distribution

The Western North Atlantic stock is centered in the Canadian Maritimes, including the Gulf of St. Lawrence and the Atlantic coasts of Nova Scotia, Newfoundland, and Labrador, Canada, and the northeast U.S.

continental shelf (Hayes et al., 2017). However, gray seals range south into the northeastern United States, with strandings and sightings as far south as North Carolina (Hammill et al., 1998; Waring et al., 2004). Gray seal distribution along the U.S. Atlantic coast has shifted in recent years, with an increased number of seals reported in southern New England (DiGiovanni et al., 2011; Kenney, 2019; Waring et al., 2016). Recent sightings included a gray seal in the lower Chesapeake Bay during the winter of 2014 to 2015 (Rees et al., 2016). Along the coast of the U.S., gray seals are known to pup at three or more colonies in Massachusetts and Maine.

The gray seal is considered a coastal species and may forage far from shore but does not appear to leave the continental shelf regions (Lesage & Hammill, 2001). Gray seals haul out on land-fast ice, exposed reefs, or beaches of undisturbed islands (Hall & Thompson, 2009; Lesage & Hammill, 2001). Remote uninhabited islands tend to have the largest gray seal haul outs (Reeves et al., 1992).

4.5.3 Site-Specific Occurrence

Gray seals are uncommon in Virginia and in the Chesapeake Bay, based on rare stranding reports and two documented occurrences at the harbor seal haul out sites at the CBBT and Eastern Shore of Virginia.

5 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 Take Authorization Request

Under Section 101 (a)(5)(A) of the MMPA, the Navy requests a Letter of Authorization for the take of marine mammals incidental to noise generated during pile extraction, pile driving, and drilling activities described in this application. As described in detail in Chapter 6, the Navy requests an LOA for takes of marine mammals listed in Table 5-1 for the period of 1 April 2023 – 31 March 2027.

Table 5-1 Total Underwater Exposure Estimates by Species for Individual and Concurrent Activities

LOA Construction Year	*Species*	*Individual Activities*		*Concurrent Activities*	
		Level A (PTS Onset)	*Level B (Behavioral)*	*Level A (PTS Onset)*	*Level B (Behavioral)*
Year 2 April 2023-March 2024	Humpback whale	0	6	0	2
	Bottlenose dolphin	0	2,619	0	5,609
	Harbor porpoise	2	4	0	1
	Harbor seal	57	949	25	832
	Gray seal	0	1	0	1
Year 3 April 2024-March 2025	Humpback whale	0	3	0	1
	Bottlenose dolphin	0	3,061	0	1,440
	Harbor porpoise	0	3	0	1
	Harbor seal	4	309	7	537
	Gray seal	0	0	0	1
Year 4 April 2025-March 2026	Humpback whale	0	7	0	1
	Bottlenose dolphin	0	13,190	0	3,023
	Harbor porpoise	2	5	0	1
	Harbor seal	0	1,809	26	232
	Gray seal	0	2	0	0
Year 5 April 2026-March 2027	Humpback whale	0	2	0	3
	Bottlenose dolphin	0	383	0	6,620
	Harbor porpoise	0	1	0	3
	Harbor seal	0	435	0	1,115
	Gray seal	0	2	0	1

Key: LOA = Letter of Authorization; PTS = permanent threshold shift

Except with respect to certain activities not pertinent here, the Marine Mammal Protection Act 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] (16 United States Code section 1362, see also 50 CFR part 216.3).

5.2 Method of Incidental Taking

This authorization request considers noise from vibratory pile extraction and installation, impact pile installation, and pre-drilling as outlined in Section 1 (Introduction and Description of Activities) that has the potential to disturb or displace marine mammals, resulting in Level A and Level B harassment as defined above. Impact pile driving has the potential to produce a permanent threshold shift (PTS) in the ability of marine mammals to hear, resulting in Level A harassment. Level A (PTS onset) harassment will 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.

- All pile driving will either not start or be halted if marine mammals approach a "shutdown zone". The shutdown zones for each species and activity are shown in Table 5-2, below. For humpback whales, work will shut down anytime this species enters a Level A disturbance zone. For all other species, the shutdown zones are shown in Table 5-2.
- A "take" will be recorded if a marine mammal enters a "disturbance zone" but does not approach or enters the shutdown zone for that activity and species. The disturbance zone will be the Level B (behavioral) harassment zone and, where present, the Level A (PTS onset) harassment zone beyond the shutdown zones shown in Table 5-2. Work will be allowed to proceed without cessation while marine mammals are in the disturbance zones and a Level A or Level B "take" would be recorded. Marine mammal behavior within the disturbance zone will be monitored and documented.
- Where the Level B (behavioral) harassment zone is too large to practically monitor due to the size of the zone and limited potential for land-based protected species observers (PSOs) in the surrounding environment, the Navy proposes to monitor a portion of the Level B harassment zone on all pile driving days.
- 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. Soft start requires contractors to provide an initial set of strikes at reduced energy, followed by a 30-second waiting period, then two subsequent reduced energy strike sets. A soft start will be implemented at the start of each day's impact pile driving and any time following cessation of impact pile driving for a period of 30 minutes or longer.
- All pile driving and drilling activities would occur during daylight hours.

Replacement of Pier 3 and associated construction activities at the various bulkheads are 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 impact reduction and mitigation measures proposed.

Table 5-2 Proposed Shutdown Zone Distances by Year and Activity

LOA Year	*Pile type, size, and driving method*	*Level A Shutdown Distance (m) for Humpback Whales[1]*	*Level A Shutdown Distance (m) for Harbor Porpoise*	*Level A Shutdown Distance (m) for all other Species*
Year 2	Impact Install 42-inch steel pipe piles	1,490	500[2]	200[2]
	Vibratory Install 42-inch stee pipe piles	140	200	70
	Impact Install 28-inch steel sheet piles	1,790	500[2]	200[2]
	Vibratory Install 28-inch steel sheet piles	110	150	80
	Impact Install 13-inch polymeric piles	20	30	30
	Vibratory Install 13-inch polymeric piles	20	30	30
	Impact Install 24-inch precast concrete bearing piles	260	500[2]	200[2]
	Impact Install 18-inch precast concrete fender piles	10	10	10
	Pre-drilling	10	10	10
Year 3	Impact Install 24-inch precast concrete fender piles	40	50	30
	Impact Install 18-inch steel piles	700	500[2]	200[2]
	Impact Install 42-inch steel pipe piles	1,010	500[2]	200[2]
	Vibratory Install 42-inch steel pipe piles	90	120	50
	Impact Install 28-inch steel sheet piles	1,790	500[2]	200[2]
	Vibratory Install 28-inch steel sheet piles	110	150	70
	Vibratory Extract 18-inch precast concrete fender piles	40	60	30
	Pre-drilling	10	10	10
Year 4	Impact Install 24-inch precast concrete bearing piles	120	150	70
	Vibratory Extract 14-inch timber piles	70	110	50

Table 5-2 Proposed Shutdown Zone Distances by Year and Activity

LOA Year	***Pile type, size, and driving method***	***Level A Shutdown Distance (m) for Humpback Whales[1]***	***Level A Shutdown Distance (m) for Harbor Porpoise***	***Level A Shutdown Distance (m) for all other Species***
	Impact Install 18-inch precast concrete fender piles	10	10	10
	Impact Install 42-inch steel pipe piles	1,010	500[2]	200[2]
	Vibratory Install 42-inch steel pipe piles	90	120	50
	Vibratory Extract 24-inch concrete fender piles	50	70	30
	Impact Install 28-inch steel sheet piles	1,790	500[2]	200[2]
	Vibratory Install 28-inch steel sheet piles	120	150	70
	Vibratory Extract 18-inch precast concrete fender piles	40	60	30
	Vibratory Extract 16- to 18-inch precast concrete bearing piles	40	60	30
	Pre-drilling	10	10	10
Year 5	Vibratory Extract 16- to 18-inch precast concrete bearing piles	40	60	30
	Impact Install 24-inch precast concrete bearing piles	120	150	70
	Impact Install 18-inch precast concrete fender piles	10	10	10
	Pre-drilling	10	10	10

Notes:

1. Work will shut down if a humpback whale is sighted in any Level A zone, therefore, there would be no Level A takes of this species.
2. Shut down zones agreed to with NMFS during project discussions.

Key: m = meter

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 the Level A (PTS onset) zone in entirety and to monitor portions of the Level B (behavioral) zone (see Table 11-1). If a marine mammal enters the "disturbance zone," it will be noted as either a Level A or Level B take authorized in the LOA. Sound producing activities will 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 will minimize the number of Level A (PTS onset) acoustic exposures, it is possible that an animal could be present undetected within the Level A (PTS onset) zone during impact pile driving. Therefore, the Navy requests authorization for potential Level A (PTS onset) takes associated with this activity.

A standard shutdown zone of 10 m (33 feet [ft]) will also be applied to prevent non-acoustic injury to marine mammals from all potentially hazardous in-water activities occurring in the project area.

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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 driving (which includes vibratory extraction) will temporarily increase the local underwater and airborne noise environment near the project area. Research suggests that increased noise may impact marine mammals in several ways depending on many factors, as detailed in Section 7 (Impacts to Marine Mammal Species or Stocks). 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), there are many unknowns in assessing impacts such as the potential interaction of different effects and the significance of responses by marine mammals to sound exposures (Nowacek et al., 2007; Southall et al., 2007). Furthermore, many other factors besides the received level of sound may affect an animal's reaction, such as the animal's physical condition, behavioral context (i.e., foraging, mating, and migration), prior experience with the sound, and proximity to the source of the sound.

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 at NAVSTA Norfolk based on historical occurrence, density, or by site-specific survey as outlined in Section 6.12;
- 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 6.13); and
- adjusting take request, as appropriately determined by NMFS in 87 FR 3976.

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, construction activities, geophysical explorations, commercial and military sonars, and other 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*
Dredging	1-500	161–186 dB RMS re 1 µPa at 1 m	Richardson et al., 1995; DEFRA, 2003; Reine & Dickerson, 2014
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^{2}sec SEL at 1 m	McKenna, 2011
Tug docking gravel barge	200–1,000	149 dB RMS at 100 m	Blackwell and Greene, 2002

Key: dB = decibel; Hz = hertz; m = meter; dB re 1 µPa = decibels referenced to 1 micropascal; dB re 1 µPa^{2}sec = decibels referenced to 1 micropascal-squared second; RMS = root mean square; SEL = sound exposure level; sec = second; DEFRA Department for Environment, Food and Rural Affairs

In-water construction activities associated with the proposed projects include impact and vibratory pile driving as well as rock hammering and 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 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), are brief, broadband, atonal transients (Harris 1998) and occur either as isolated events or repeated in some succession (Southall et al. 2007, 2019). 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, 2019). Impulsive sounds generally have a greater capacity to induce physical injury compared with sounds that lack these features (Southall et al. 2007, 2019).

Non-impulsive sounds (referred to as non-pulsed in Southall et al, 2007, 2019) can be tonal, broadband, or both. They lack the rapid rise time 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).

In some environments, the duration of both impulsive and non-impulsive sounds can be extended due to reverberations. Appendix A provides additional information on the fundamentals of underwater sound and a review of pile driving sound pressure levels (SPLs) from similar projects as those proposed in this application.

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, and 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 (Au, 1993; Nachtigall et al., 2007; Schusterman, 1981; Wartzok & Ketten, 1999). Behavioral audiograms, which are plots of animals' exhibited 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 recently been adapted for use on non-humans, including marine mammals (Dolphin, 2000). 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.

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). Table 6-2 provides sound production and hearing capabilities for marine mammal species that are assessed in this application.

Table 6-2 Hearing and Vocalization Ranges for Marine Mammal Functional Hearing Groups Potentially Present in the Action Area

Functional Hearing Group	*Relevant Species*	*Functional Hearing Range* [1]
Low-frequency cetaceans	Humpback whale	7 Hz to 35 kHz
Mid-frequency cetaceans	Bottlenose dolphin	150 Hz to 160 kHz
High-frequency cetaceans	Harbor porpoise	275 Hz to 160 kHz
Phocid pinnipeds	Harbor seal and gray seal	In-water: 50 Hz to 86 kHz In-air: 75 Hz to 30 kHz

Notes: In-water hearing data from NMFS, 2018b. In-air data from Schusterman, 1981; Hemilä et al., 2006; Southall et al., 2007, 2019.
Key: Hz = Hertz; kHz = kilohertz

6.4 Sound Exposure Criteria and Thresholds

To date, no studies have been conducted that examine impacts to marine mammals from pile driving sounds from which empirical noise thresholds have been established. NMFS uses underwater sound exposure thresholds to determine when an activity could result in Level A (PTS Onset) or Level B (Behavioral) harassment to marine mammals (FR 70: 1871) (Table 6-3).

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

Marine Mammals	*Airborne Noise (impact and vibratory pile driving) (re 20 µPa)[1]*	*Underwater Vibratory Pile Driving Noise (non-impulsive sounds)[2]*		*Underwater Impact Pile Driving Noise (impulsive sounds)[2]*	
	Disturbance Guideline (haul out)[3]	*Level A Injury (PTS onset) Threshold[4]*	*Level B Disturbance Threshold*	*Level A (PTS onset) Threshold[5,6]*	*Level B Disturbance Threshold*
Low-Frequency Cetaceans	Not applicable	199 dB SEL_{CUM}[7]	120 dB RMS	219 dB Peak[4] 183 dB SEL_{CUM}[7]	160 dB RMS
Mid-Frequency Cetaceans	Not applicable	198 dB SEL_{CUM}[7]	120 dB RMS	230 dB Peak[4] 185 dB SEL_{CUM}[7]	160 dB RMS
High-Frequency Cetaceans	Not applicable	173 dB SEL_{CUM}[7]	120 dB RMS	202 dB Peak[4] 155 dB SEL_{CUM}[7]	160 dB RMS
Phocid pinnipeds	Harbor Seal - 90 dB RMS (unweighted) Other Phocids - 100 dB RMS (unweighted)	201 dB SEL_{CUM}[7]	120 dB RMS	218 dB Peak[4] 185 dB SEL_{CUM}[7]	160 dB RMS

Notes:

1. Airborne disturbance thresholds not specific to pile driver type.
2. Underwater root means square (RMS) and Peak sound pressure level have a reference value of 1 micropascal. Cumulative sound exposure level (SEL_{CUM}) has a reference value of decibels at 1 micropascal-squared second (1 μPa^2sec).
3. Sound level at which pinniped haul out disturbance has been documented. This is not considered an official threshold, but is used as a guideline.
4. Flat weighted or unweighted peak sound pressure level within the generalized hearing range.
5. Dual metric acoustic thresholds for impulsive sounds: whichever results in the largest isopleth for calculating permanent threshold shift (PTS) onset is used in the analysis.
6. Values presented as the sound exposure level (SEL) threshold are only the values for the species group's best hearing sensitivity because it is frequency weighted. Frequency weighted thresholds are determined from the minimum value of the exposure function and the weighting function at its peak (i.e., area of best sensitivity; equivalent to K+C).
7. Cumulative SEL over 24 hours.

Key: dB = decibel; Peak = peak pressure; PTS = permanent threshold shift; re 20 µPa = referenced to 20 micropascal; RMS = root mean square; SEL_{CUM} = cumulative sound exposure level

NMFS (2018b) equates the onset of PTS (i.e., permanent auditory injury) with Level A harassment under the MMPA and "harm" under the ESA, and has developed acoustic threshold levels for determining the onset of PTS in marine mammals exposed to underwater impulsive and non-impulsive sound sources. The Level A criteria use cumulative sound exposure level (SEL) metrics (dB SELcum) and peak pressure (dB peak) rather than the previously used dB RMS metric (see Table 6-3). NMFS also established thresholds for temporary threshold shift (TTS) (i.e., temporary reduced hearing sensitivity following exposure to intense sounds) in the 2018 guidance document. The onset of TTS is a form of Level B harassment under the MMPA and "harassment" under the ESA. NMFS did not state the thresholds for other forms of behavioral disturbance in the 2018 guidance document, and thus earlier thresholds for Level B harassment are still accepted. Level B harassment is considered to occur when marine mammals are exposed to impulsive underwater sounds greater than 160 dB RMS referenced to 1 micropascal (re 1 µPa) from impact pile driving and to non-impulsive underwater sounds greater than 120 dB RMS re 1 μPa (70 FR 1871) (see Table 6-3). NMFS does not currently recommend calculations of TTS exposures separate from assessments of Level B harassment using the earlier thresholds for behavioral disturbance (81 FR 51693). Therefore, harassment zones for TTS were not estimated in this analysis. All forms of harassment, either auditory or behavioral, constitute "incidental take" under these statutes.

NMFS uses generic sound exposure thresholds to determine when an activity in the ocean that produces airborne sound might result in impacts to a marine mammal (70 FR 1871). Construction-period airborne noise would have little impact on cetaceans because they generally do not have their ears in the air and because noise from airborne sources would not transmit as well underwater (Richardson et al., 1995; Urick, 1983). In contrast, pinnipeds spend significant amounts of time out of the water while hauled out. In the water, when not actively diving, they often orient their bodies vertically in the water column and hold their heads above the water surface. Consequently, airborne noise may be a concern for 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 injury 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 μPa (unweighted), and is 100 dB RMS referenced to 20 μPa (unweighted) for all other phocid seals, including gray seals.

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.

To date, there is little research or data supporting a response by pinnipeds or non-delphinid cetaceans to non-impulsive sounds from vibratory pile driving as low as the 120 dB threshold. 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 and harbor porpoises in response to estimated received levels of 99 to 132 decibels referenced to 1 micropascal (dB re 1 μPa) 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 1 μPa. 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 1 μPa. 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 will 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 & 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 & Brumm, 2010).

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 to 1.5 kHz, which is likely to overlap the frequencies of vocalizations produced by species that may occur in the 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 impact pile driving are greater, the zone of potential masking effects from vibratory pile driving may be as large or greater due to the duration and continuous nature of vibratory pile driving. The potential for masking differs between species, depending on the overlap between pile driving noise and the animals' hearing and vocalization frequencies. In this respect, harbor porpoises, which use HF sound, are probably less vulnerable to masking from pile driving than pinnipeds. In addition, cetaceans that may be subject to masking are transitory within the vicinity of the Proposed Action area. The animals most likely to be at risk for vocalization masking would be pinnipeds (harbor seals and gray seals). Animals will often compensate for increasing noise levels by increasing the signal level, repetition rate, duration, or changing the frequency, of their vocalizations, a phenomenon termed the "Lombard effect" (Hotchkin & Parks, 2013). 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 (which may help signalers compensate for masking) (Brumm & Slabbekoorn, 2005; Brumm & 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 zones of behavioral harassment estimated for vibratory and impact pile driving and drilling.

6.7 Modeling Potential Noise Impacts from Pile Driving

6.7.1 Underwater Sound Propagation

Pile driving will generate underwater noise that potentially could result in disturbance 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 source 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. This value was used to model the estimated range from pile driving activity to various expected SPLs at potential project structures. This model follows a geometric propagation loss based on the distance from the driven pile, resulting in a 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 from the driven pile of the initial measurement.

The degree to which underwater noise propagates away from a noise source is dependent on a variety of factors, most notably by the bathymetry and presence or absence of reflective or absorptive conditions including the sea surface and sediment type. The TL model described above was used to calculate the expected noise propagation from both impact and vibratory pile driving, vibratory pile extraction, and pre-drilling activities. This TL model used representative source levels for previous pile driving projects to estimate harassment zones, or area exceeding the noise criteria.

6.7.2 Underwater Noise from In-water Construction

The intensity of pile driving sound is greatly influenced by factors such as the type of piles, 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 Action were evaluated. Data from prior pile driving projects within the mid-Atlantic region were reviewed in the analysis in addition to other known pile driving projects. The evaluation is presented in Appendix A and the representative SPLs used in the analysis are presented in Table 6-4.

For the analyses that follow, the TL model described above was used to calculate the expected harassment zones at representative pile driving locations within which pile driving noise would equal or exceed the thresholds for Level A injury (PTS onset) and Level B (behavioral disturbance) for each marine mammal functional hearing group. For vibratory and impact behavioral zones and peak injury zones, a representative source level (Table 6-4) 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 Spreadsheet contains default weighting factor adjustments (WFAs) for different types of broadband sources (NMFS, 2018b). The WFAs assign a single frequency to represent the sound spectrum of the source, approximating what the animal is exposed to. The weighting factor adjustment 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, NMFS' (2018a) Technical Guidance was followed, and the Optional User Spreadsheet (NMFS, 2018b) was used. See Appendix A for calculated distances to Level A (PTS onset) thresholds.

Table 6-4 Underwater Noise Proxy Source Levels Used for Acoustic Modeling

Pile Size and Type	*Installation Method*	*Average Peak SPL (dB re 1 μPa)*	*Average RMS SPL (dB re 1 μPa)*	*Average SEL (dB re 1 μPa² sec)*	*Source*
42-inch steel pipe pile	Impact	213	190	177	Navy, 2015
	Vibratory	N/A	168	N/A	Sitka, 2017
28-inch steel sheet pile	Impact[1]	211	196	181	NAVFAC SW, 2020
	Vibratory[2]	N/A	167	167	Navy, 2015
24-inch concrete pile	Impact	189	176	163	Illingworth and Rodkin, 2017
	Vibratory Removal[3]	185	162	157	Caltrans, 2020
18-inch concrete pile	Impact[3]	185	166	154	Caltrans, 2020
	Vibratory Removal[4]	185	162	157	Caltrans, 2020
14-inch timber pile	Vibratory Install / Removal	185	162	157	Caltrans, 2020
13-inch polymeric	Impact	177	153	153	Denes et al., 2016
	Vibratory[5]	185	162	157	Caltrans, 2020
Multiple pile types/sizes[6]	Rotary Drilling	N/A	154	N/A	Dazey et al., 2012

Notes: All SPLs are unattenuated; dB=decibels; N/A = Not applicable; SEL= sound exposure level; rms = root mean square; NAVFAC SW = Naval Facilities Engineering Systems Command, Southwest; Caltrans = California Department of Transportation; single strike SEL are the proxy source levels presented for impact pile driving and were used to calculate distances to PTS.

Sources:

1. A proxy value for impact pile driving 28-inch steel sheet piles could not be found so the proxy for a 30-inch steel pipe pile has been used (NAVFAC SW, 2020 [p. A-4]).
2. A proxy value for vibratory pile driving 28-inch steel sheet piles could not be found so a proxy for a 30-inch steel pipe pile has been used (Navy, 2015 [p. 14]).
3. Data on vibratory extraction of concrete piles is not available. Please see p. 28479 of 84 FR 28474 where it was suggested that proxy source sound levels for timber piles be used as they are expected to have similar sound levels to concrete.
4. Proxy data for 18-inch octagonal piles.
5. Vibratory proxy for polymeric/plastic piles unavailable; assume SPL to be consistent with timber.
6. See Table 2-1 for pile types/sizes that may use pre-drilling, as needed.

Key: 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, measures underwater SEL.

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 four hearing groups are provided in Tables 6-5 and 6-6 and depicted in Figures 6-1 through 6-35 for impact pile driving and vibratory pile driving/extracting and drilling activities by LOA construction year.

Maximum distances are provided for the behavioral thresholds for in-water construction activities. Areas encompassed within the threshold (harassment zones) were calculated by using a Geographic Information System to clip the maximum calculated distances to the extent of the region of influence (ROI). Sound source locations were chosen to model the greatest possible affected areas from a representative pile location.

Table 6-5 Calculated Maximum Distances Corresponding to MMPA Thresholds for Underwater Sound from Impact Pile Driving Noise*

Figure and Construction Year	*LOA Year/Activity*	*Location and Pile Purpose*	*Pile Count, Size, Estimated Dates*	*Total Pile Driving Days*	*Level A (PTS Onset) Harassment*				*Level B (Behavioral) Harassment All Species*
					LF Cetaceans	*MF Cetaceans*	*HF Cetaceans*	*Phocids*	
					Maximum Distance to 183 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)	*Maximum Distance to 185 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 155 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 185 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 160 dB RMS SPL Threshold (m)/Area of Harassment Zone (km^2)*
6-1 Year 2	April 1, 2023 – March 31, 2024	CEP-176 Bulkhead – bearing piles	103, 42-inch Steel Pipe *April 2023 to May-2023*	26	1,482.4/0.86	52.7/0.0044	1,765.7/1.22	793.3/0.27	1,000/0.41
6-2 Year 2	April 1, 2023 – March 31, 2024	CEP-176 Bulkhead - sheet piles	221, 28-inch wide sheets *April 2023 to May 2023*	16	1,782.6/1.24	63.4/0.0063	2,123.4/1.75	954.0/0.37	2,512/2.43
6-3 Year 2	April 1, 2023 – March 31, 2024	CEP-175 Bulkhead	9, 13-inch diameter polymeric piles April 2023 to May 2023	2	17.1/0.00046	0.6/0.000001	20.4/0.00065	9.2/0.00013	3/0.000014
6-4 Year 2	April 1, 2023 – March 31, 2024	CEP-102 Platform	11, 24-inch square	6	116.8/0.023	4.2/0.000055	139.1/0.032	62.5/0.0070	117/0.023

Table 6-5 Calculated Maximum Distances Corresponding to MMPA Thresholds for Underwater Sound from Impact Pile Driving Noise*

Figure and Construction Year	*LOA Year/Activity*	*Location and Pile Purpose*	*Pile Count, Size, Estimated Dates*	*Total Pile Driving Days*	*Level A (PTS Onset) Harassment*				*Level B (Behavioral) Harassment All Species*
					LF Cetaceans	*MF Cetaceans*	*HF Cetaceans*	*Phocids*	
					Maximum Distance to 183 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km²)	*Maximum Distance to 185 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km²)*	*Maximum Distance to 155 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km²)*	*Maximum Distance to 185 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km²)*	*Maximum Distance to 160 dB RMS SPL Threshold (m)/Area of Harassment Zone (km²)*
		Phase 2 Portion 113-108 – bearing piles	precast concrete *May 2023*						
6-5 Year 2	April 1, 2023 – March 31, 2024	Pier 3 – bearing piles	280, 24-inch square precast concrete *May 2023 to September 2023*	70	253.6/0.20	9.0/0.00025	302.1/0.29	135.7/0.058	117/0.043
6-6 Year 2	April 1, 2023 – March 31, 2024	CEP-102 Platform Phase 2 Portion 113-108 – fender piles	6, 18-inch square precast concrete *July 2023*	2	7.1/0.00016	0.3/0	8.5/0.00021	3.8/0.000045	25/0.0013

Table 6-5 Calculated Maximum Distances Corresponding to MMPA Thresholds for Underwater Sound from Impact Pile Driving Noise*

Figure and Construction Year	*LOA Year/Activity*	*Location and Pile Purpose*	*Pile Count, Size, Estimated Dates*	*Total Pile Driving Days*	*Level A (PTS Onset) Harassment*				*Level B (Behavioral) Harassment All Species*
					LF Cetaceans	*MF Cetaceans*	*HF Cetaceans*	*Phocids*	
					Maximum Distance to 183 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km²)	*Maximum Distance to 185 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km²)*	*Maximum Distance to 155 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km²)*	*Maximum Distance to 185 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km²)*	*Maximum Distance to 160 dB RMS SPL Threshold (m)/Area of Harassment Zone (km²)*
6-5 Year 2	April 1, 2023 – March 31, 2024	Pier 3 – bearing piles	250, 24-inch square precast concrete *July 2023 to November 2023*	63	253.6/0.20	9.0/0.00025	302.1/0.29	135.7/0.058	117/0.043
6-7 Year 3	April 1, 2024 – March 31, 2025	Pier 3 – fender piles	409, 24-inch square precast concrete *July 2024 to October 2024*	69	37.2/0.0043	1.3/0.000005	44.4/0.0062	19.9/0.0012	117/0.043

Table 6-5 Calculated Maximum Distances Corresponding to MMPA Thresholds for Underwater Sound from Impact Pile Driving Noise*

Figure and Construction Year	*LOA Year/Activity*	*Location and Pile Purpose*	*Pile Count, Size, Estimated Dates*	*Total Pile Driving Days*	*Level A (PTS Onset) Harassment*				*Level B (Behavioral) Harassment All Species*
					LF Cetaceans	*MF Cetaceans*	*HF Cetaceans*	*Phocids*	
					Maximum Distance to 183 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)	*Maximum Distance to 185 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 155 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 185 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 160 dB RMS SPL Threshold (m)/Area of Harassment Zone (km^2)*
6-8 Year 3	April 1, 2024 – March 31, 2025	Pier 3 – fender piles	18, 18-inch steel pipe *June 2024 to November 2024*	3	661.2/1.21	23.5/0.0017	787.6/1.60	353.8/0.39	25/0.0020
6-9 Year 3	April 1, 2024 – March 31, 2025	CEP-102 Bulkhead South Portion 188-163 – bearing piles	26, 42-inch steel pipe *December 2024 to January 2025*	13	1,001.8/1.38	35.6/0.0025	1,193.3/1.90	536.1/0.45	1,000/1.37
6-10 Year 3	April 1, 2024 – March 31, 2025	CEP-102 Bulkhead South Portion 188-163 – sheet piles	53, 28-inch wide steel sheet piles *January 2025*	4	1,782.6/4.08	63.4/0.0072	2,123.4/5.73	954.0/1.26	2,512/7.96

Table 6-5 Calculated Maximum Distances Corresponding to MMPA Thresholds for Underwater Sound from Impact Pile Driving Noise*

Figure and Construction Year	*LOA Year/Activity*	*Location and Pile Purpose*	*Pile Count, Size, Estimated Dates*	*Total Pile Driving Days*	*Level A (PTS Onset) Harassment*				*Level B (Behavioral) Harassment All Species*
					LF Cetaceans	*MF Cetaceans*	*HF Cetaceans*	*Phocids*	
					Maximum Distance to 183 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km²)	*Maximum Distance to 185 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km²)*	*Maximum Distance to 155 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km²)*	*Maximum Distance to 185 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km²)*	*Maximum Distance to 160 dB RMS SPL Threshold (m)/Area of Harassment Zone (km²)*
6-11 Year 4	April 1, 2025 – March 31, 2026	CEP-102 Platform South Portion 188-163 – bearing piles	40, 24-inch square precast concrete *April 2025 to May 2025*	20	116.8/0.023	4.2/0.000055	139.1/0.032	62.5/0.0070	117/0.023
6-12 Year 4	April 1, 2025 – March 31, 2026	CEP-102 Platform South Portion 188-163 – fender piles	25, 18-inch square precast concrete *September 2025*	7	7.1/0.00016	0.3/0	8.5/0.00021	3.8/0.000045	25/0.0013
6-13 Year 4	April 1, 2025 – March 31, 2026	CEP-102 Bulkhead Center Portion 163-114 – bearing piles	50, 42-inch steel pipe *September 2025 to October 2025*	25	1,001.8/1.38	35.6/0.0025	1,193.3/1.90	536.1/0.45	1,000/1.38

Table 6-5 Calculated Maximum Distances Corresponding to MMPA Thresholds for Underwater Sound from Impact Pile Driving Noise*

Figure and Construction Year	*LOA Year/Activity*	*Location and Pile Purpose*	*Pile Count, Size, Estimated Dates*	*Total Pile Driving Days*	*Level A (PTS Onset) Harassment*				*Level B (Behavioral) Harassment All Species*
					LF Cetaceans	*MF Cetaceans*	*HF Cetaceans*	*Phocids*	
					Maximum Distance to 183 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)	*Maximum Distance to 185 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 155 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 185 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 160 dB RMS SPL Threshold (m)/Area of Harassment Zone (km^2)*
6-14 Year 4	April 1, 2025 – March 31, 2026	CEP-102 Bulkhead Center Portion 163-114 – sheet piles	102, 28-inch wide steel sheet piles *October 2025*	8	1,782.6/4.08	63.4/0.0072	2,123.4/5.73	954.0/1.26	2,512/7.96
6-15 Year 4	April 1, 2025 – March 31, 2026	CEP-102 Platform Center Portion 163-114 – bearing piles	41, 24-inch square precast concrete February 2026 to March 2026	21	116.8/0.023	4.2/0.000055	139.1/0.032	62.5/0.0070	117/0.023

Table 6-5 Calculated Maximum Distances Corresponding to MMPA Thresholds for Underwater Sound from Impact Pile Driving Noise*

Figure and Construction Year	*LOA Year/Activity*	*Location and Pile Purpose*	*Pile Count, Size, Estimated Dates*	*Total Pile Driving Days*	*Level A (PTS Onset) Harassment*				*Level B (Behavioral) Harassment All Species*
					LF Cetaceans	*MF Cetaceans*	*HF Cetaceans*	*Phocids*	
					Maximum Distance to 183 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)	*Maximum Distance to 185 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 155 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 185 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 160 dB RMS SPL Threshold (m)/Area of Harassment Zone (km^2)*
6-16 Year 5	April 1, 2026 – March 31, 2027	CEP-102 Platform Center Portion 163-114 – bearing piles	32, 24-inch square precast concrete April 2026	16	116.8/0.023	4.2/0.000055	139.1/0.032	62.5/0.0070	117/0.023
6-17 Year 5	April 1, 2026 – March 31, 2027	CEP-102 Platform Center Portion 163-114 – fender piles	50, 18-inch square precast concrete April 2026	13	7.1/0.00016	0.3/0	8.5/0.00021	3.8/0.000045	25/0.0013

Notes:*- To determine underwater harassment zones, radial distances from the source were truncated along the shoreline using geographic information system (GIS). Proxy sources used were unattenuated SPLs.

(a) Injury thresholds are dB SEL_{CUM}, as listed in Table 6-3.

(b) Behavioral disturbance thresholds are dB RMS, as listed in Table 6-3.

(c) Harassment Zones calculated using GIS data as determined by transmission loss modeling.

Source: NAVFAC Midlant, 2022.

Key: dB = decibels; LF = low-frequency; MF = mid-frequency; HF = high-frequency; m = meter, m^2 = square meters; PTS = permanent threshold shift; RMS = root mean square; SEL_{CUM} = cumulative sound exposure level.

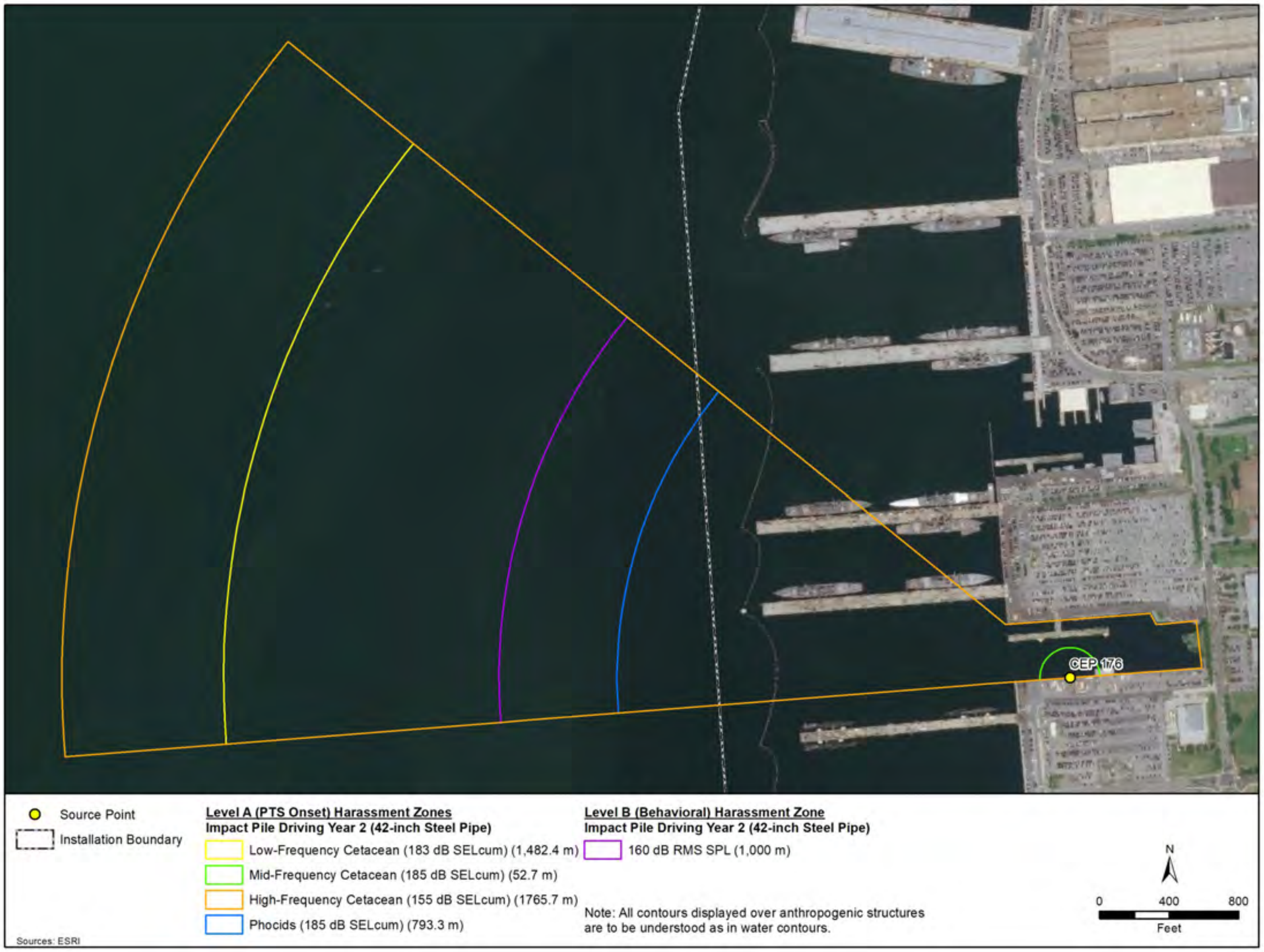

Figure 6-1 Year 2-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Impact Pile Driving of 42-inch Steel Piles at CEP-176 Bulkhead

Figure 6-2 Year 2-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Impact Pile Driving 28-inch Steel Sheet Piles at CEP-176 Bulkhead

Figure 6-3 Year 2-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Impact Pile Driving 13-inch Polymeric Piles at CEP-175 Bulkhead

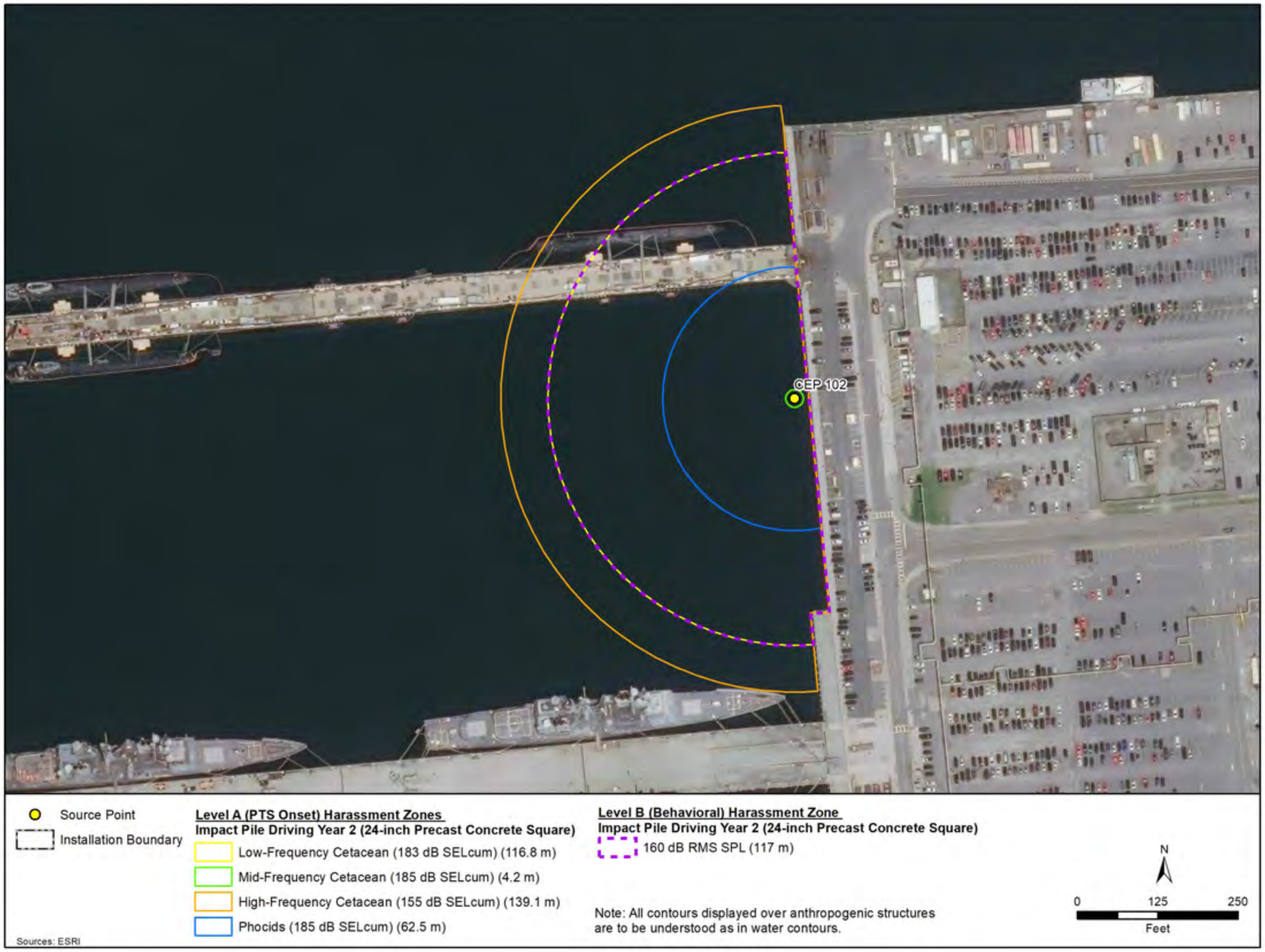

Figure 6-4 Year 2 -Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Impact Pile Driving 24-inch Square Precast Concrete Piles at CEP-102 Platform Location

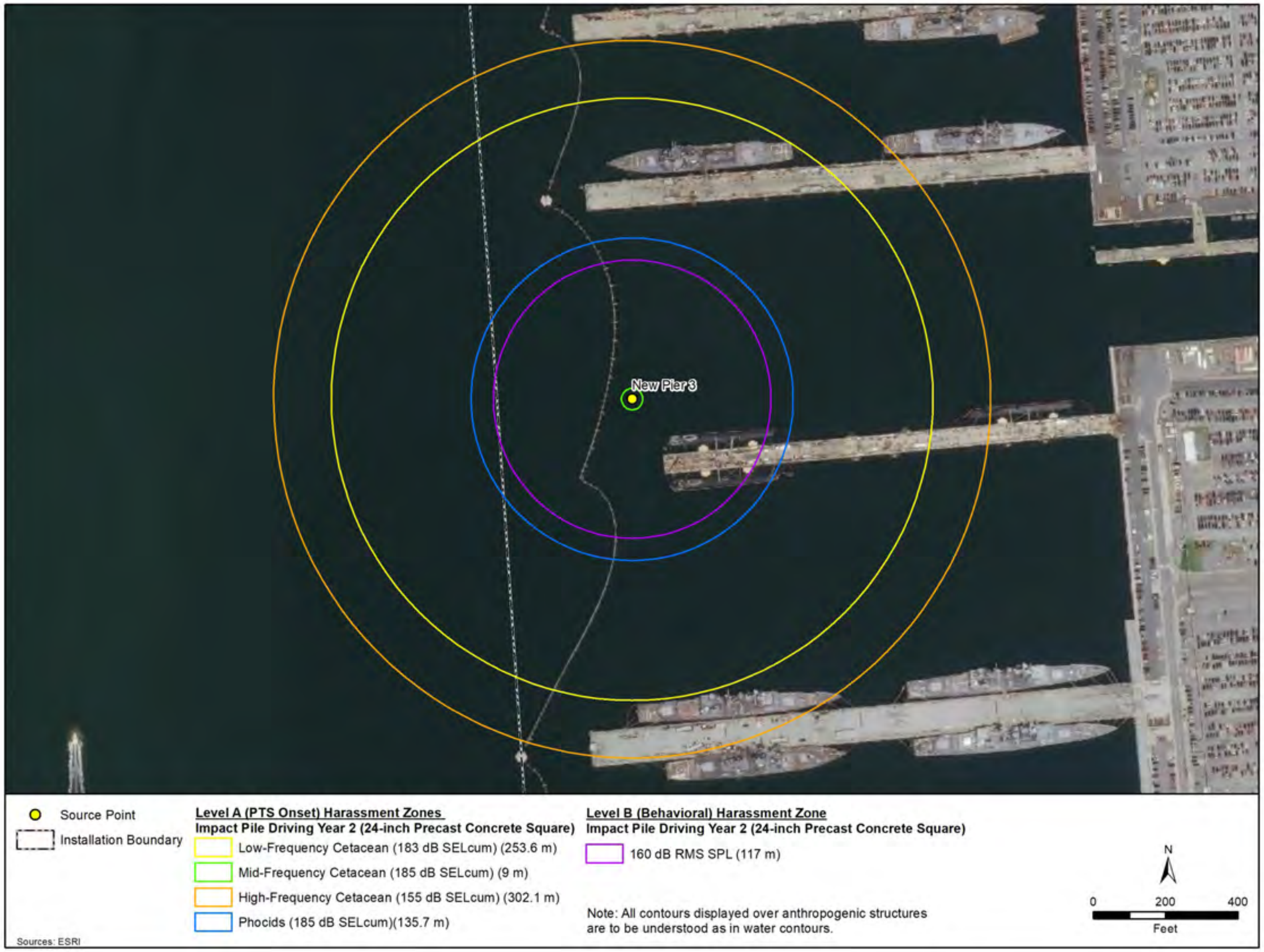

Figure 6-5 Year 2 -Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Impact Pile Driving 24-inch Square Precast Concrete Piles at the New Pier 3 Location

Figure 6-6 Year 2-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Impact Pile Driving of 18-inch Square Precast Concrete Piles at CEP-102 Platform Location

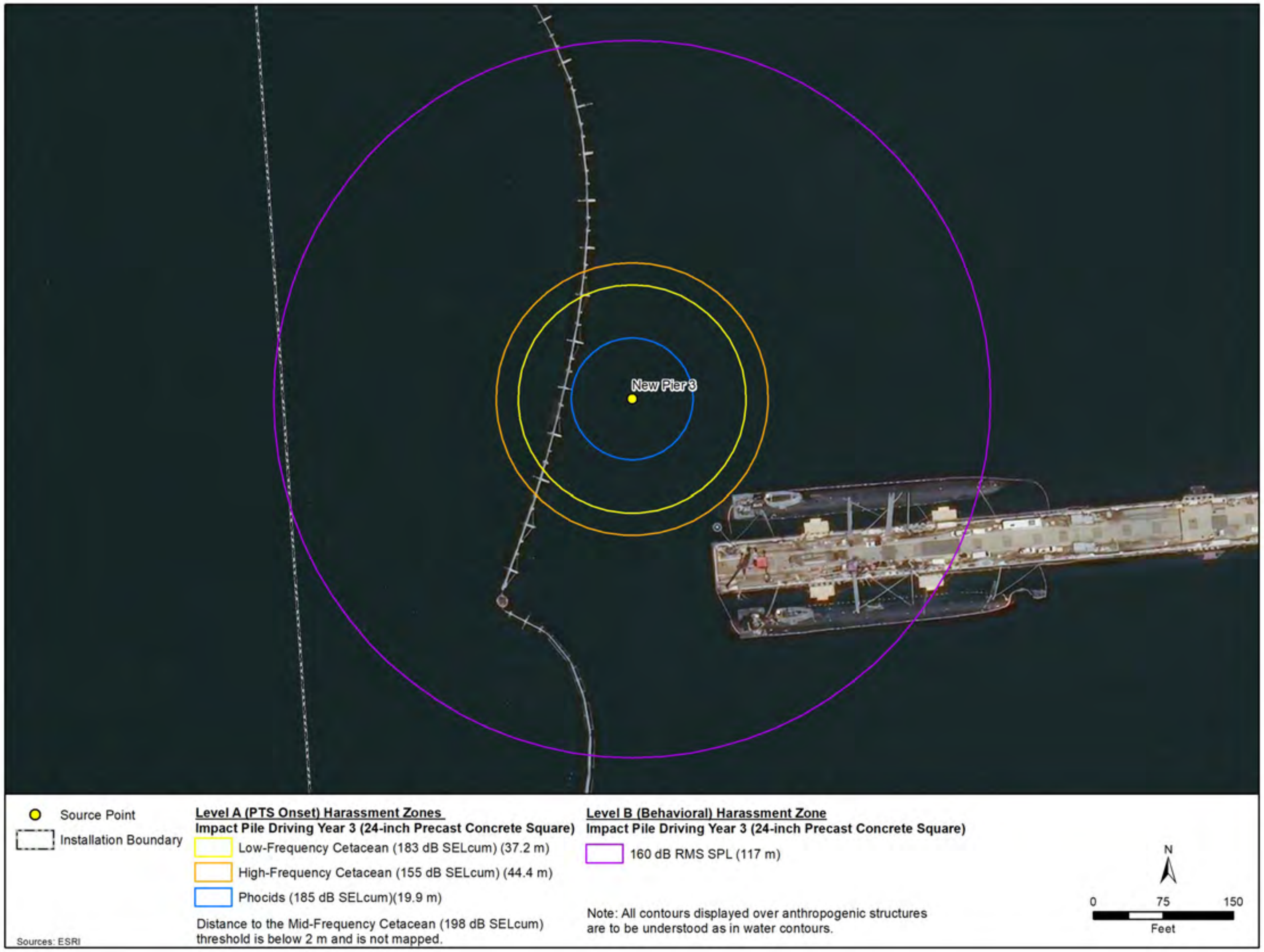

Figure 6-7 Year 2-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Impact Pile Driving of 24-inch Square Concrete Piles at the New Pier 3 Location

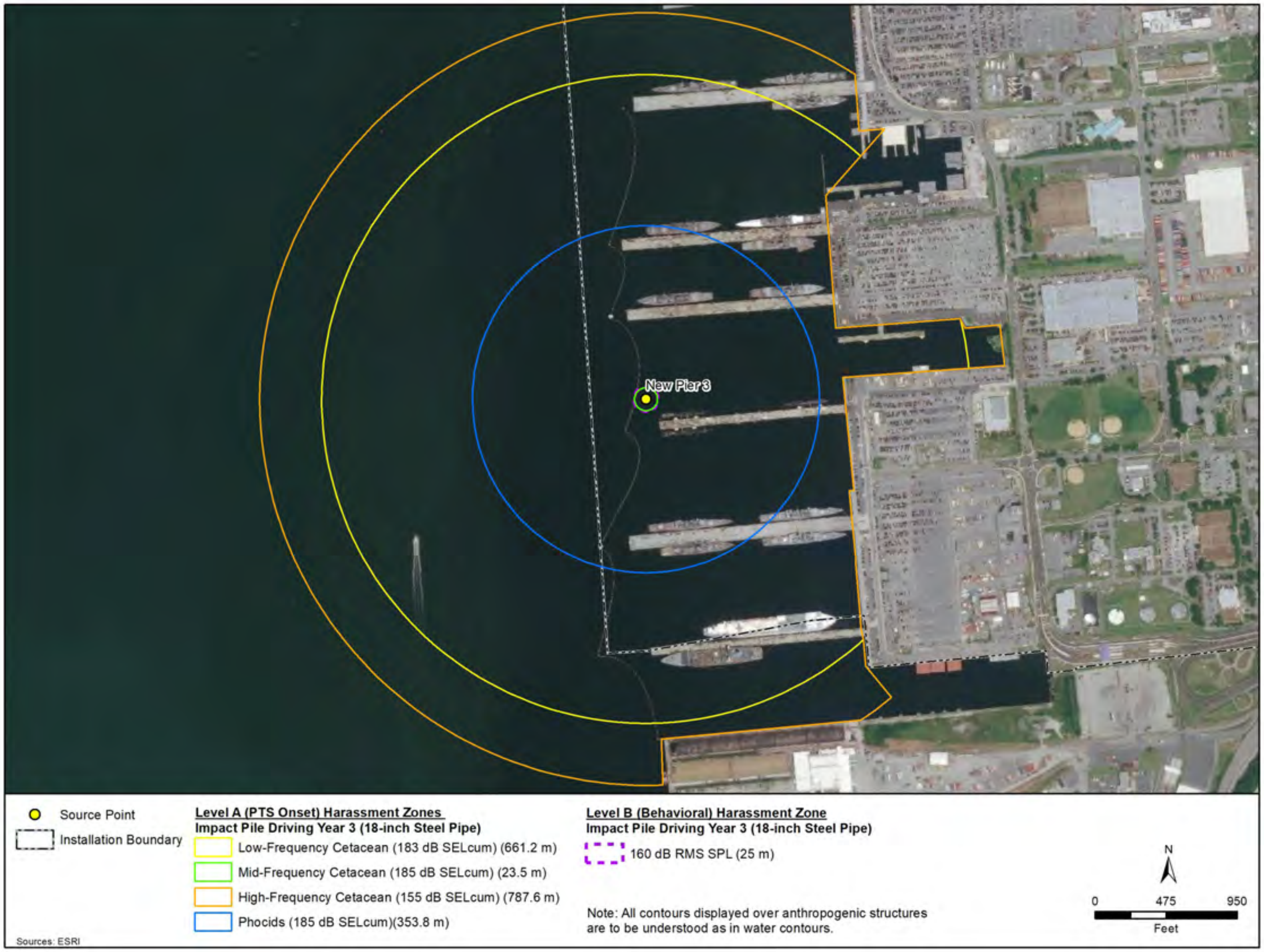

Figure 6-8 Year 3- Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Impact Pile Driving 18-inch Steel Pipe Piles at New Pier 3 Location

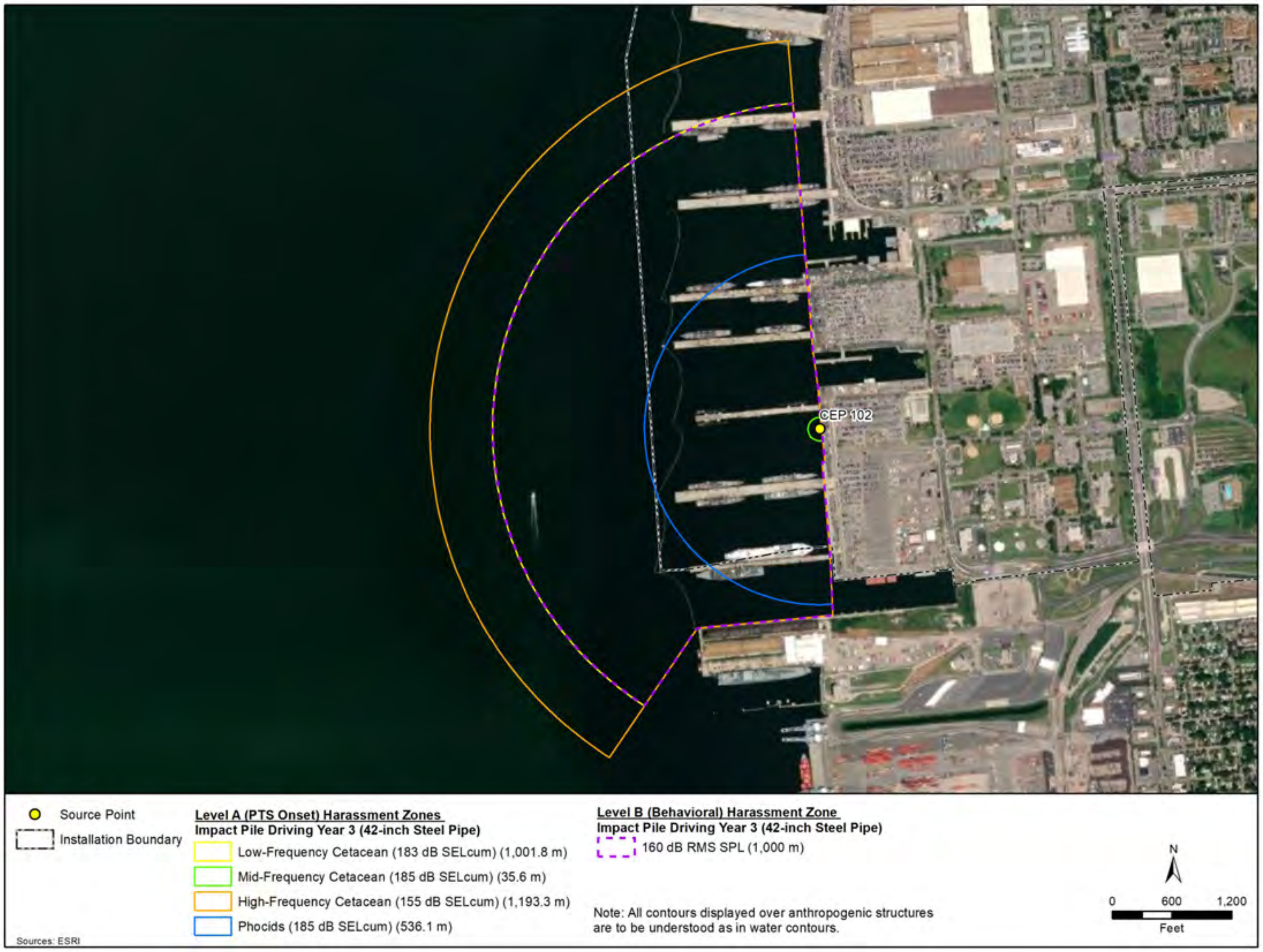

Figure 6-9 Year 3-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Impact Pile Driving 42-inch Steel Pipe Piles at CEP-102 Bulkhead South

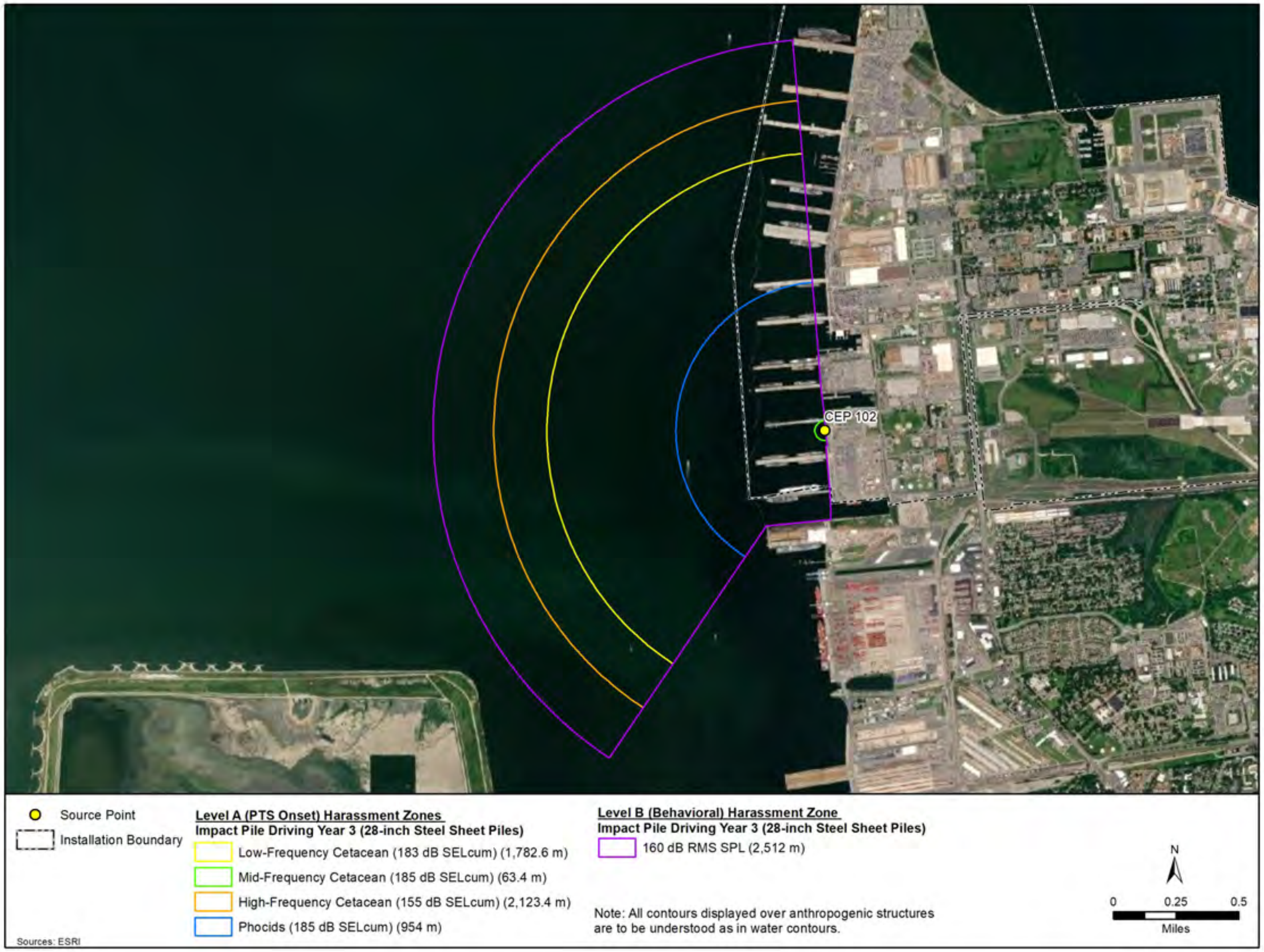

Figure 6-10 Year 3-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Impact Pile Driving 28-inch Steel Sheet Piles at CEP-102 Bulkhead South

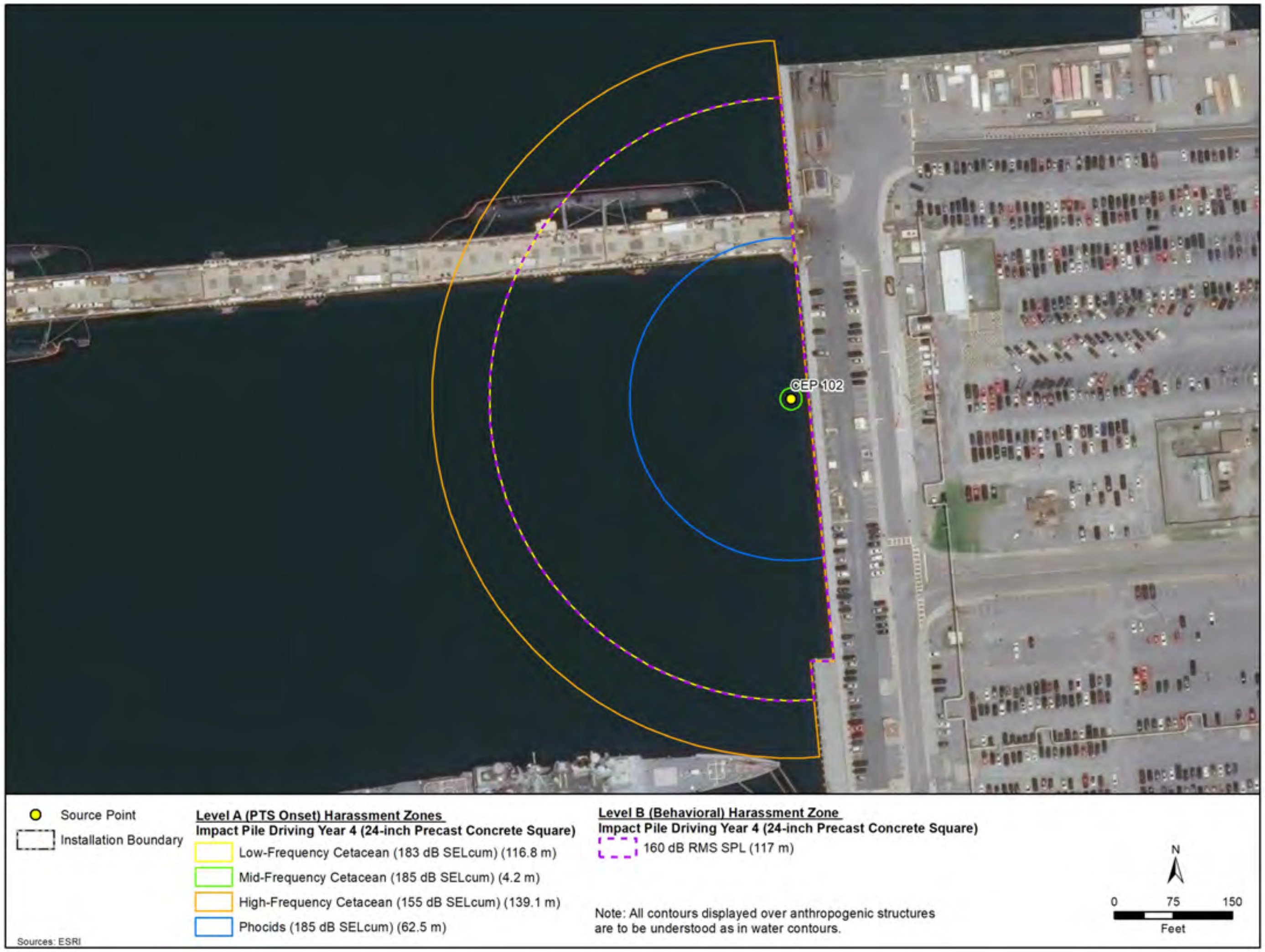

Figure 6-11 Year 4-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Impact Pile Driving 24-inch Square Precast Concrete Piles at CEP-102 Platform South

Figure 6-12 Year 4-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Impact Pile Driving 18-inch Square Precast Concrete Piles at CEP-102 Platform Center

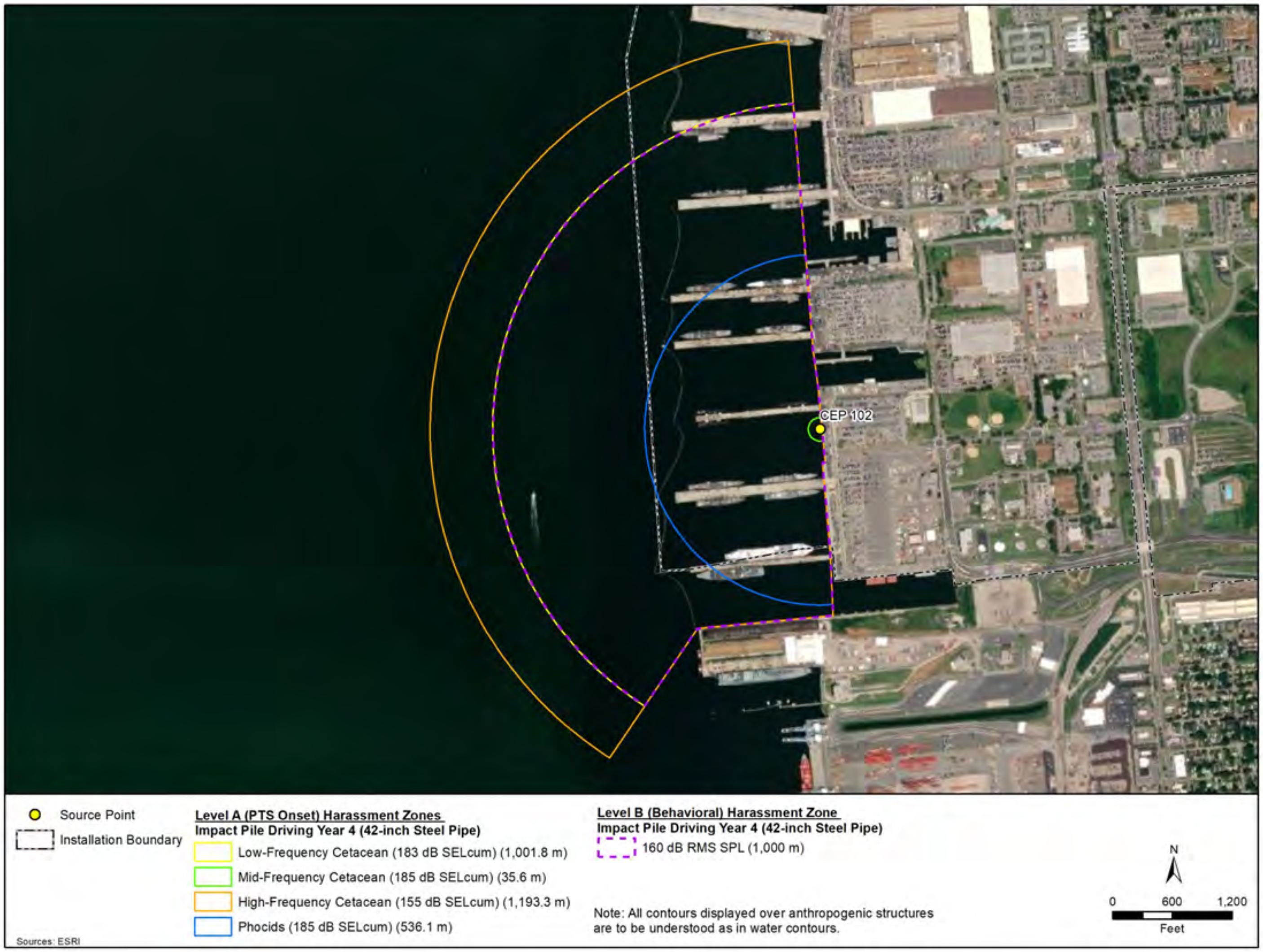

Figure 6-13 Year 4-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Impact Pile Driving 42-inch Steel Pipe Piles at CEP-102 Platform Center

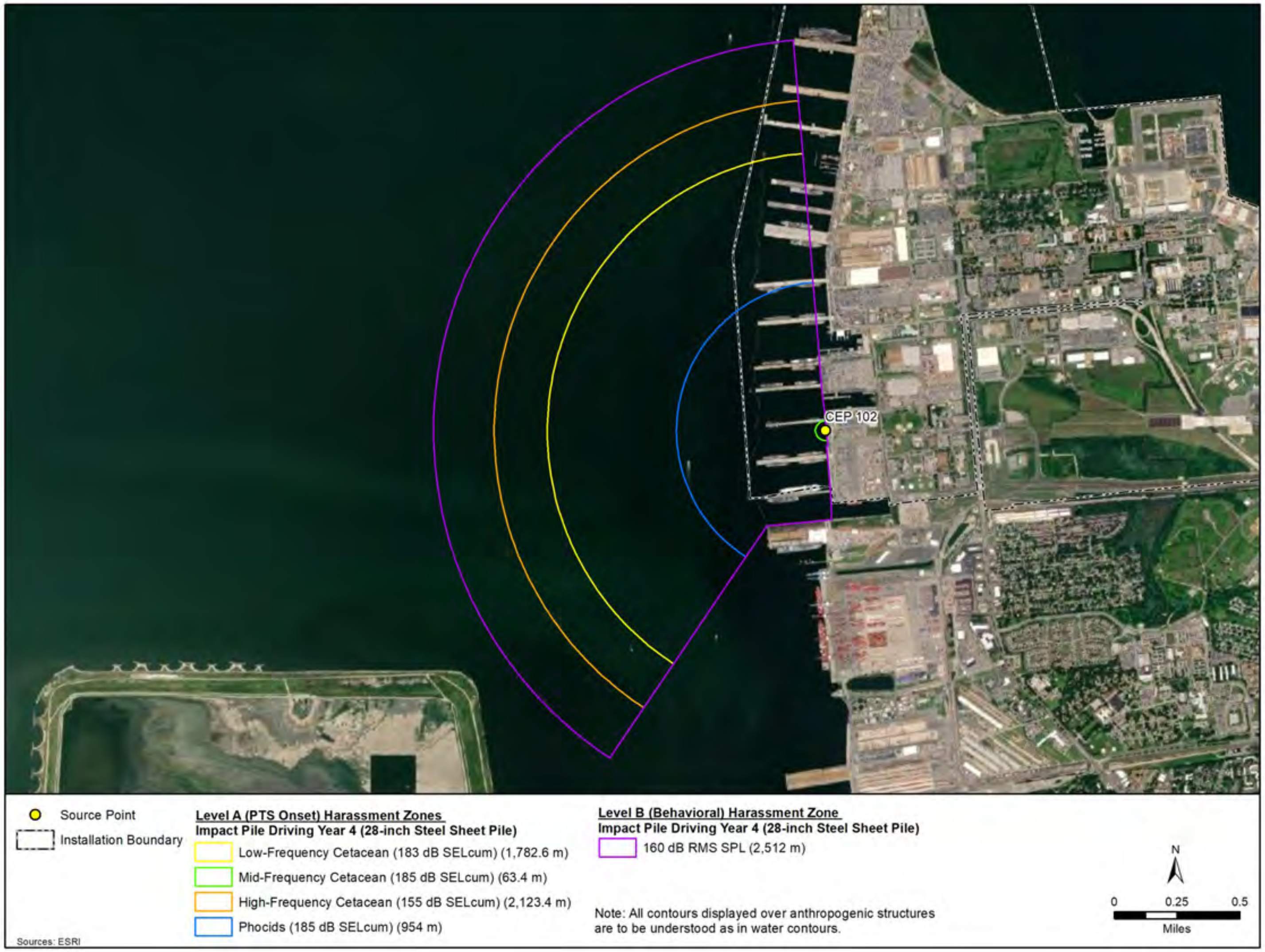

Figure 6-14 Year 4-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Impact Pile Driving 28-inch Steet Sheet Piles at CEP-102 Bulkhead Center

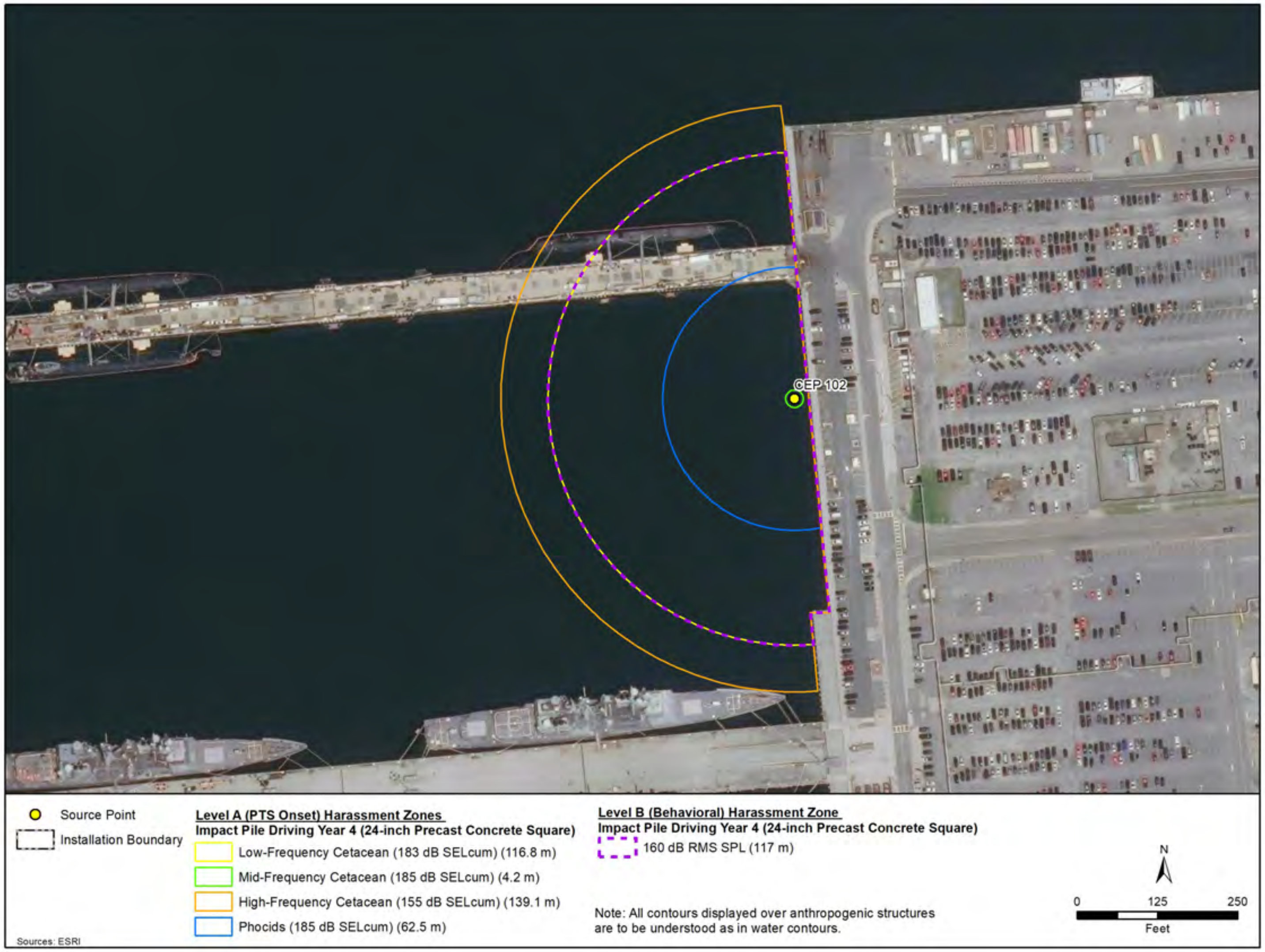

Figure 6-15 Year 4-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Impact Pile Driving 24-inch Square Precast Concrete Piles at CEP-102 Platform Center

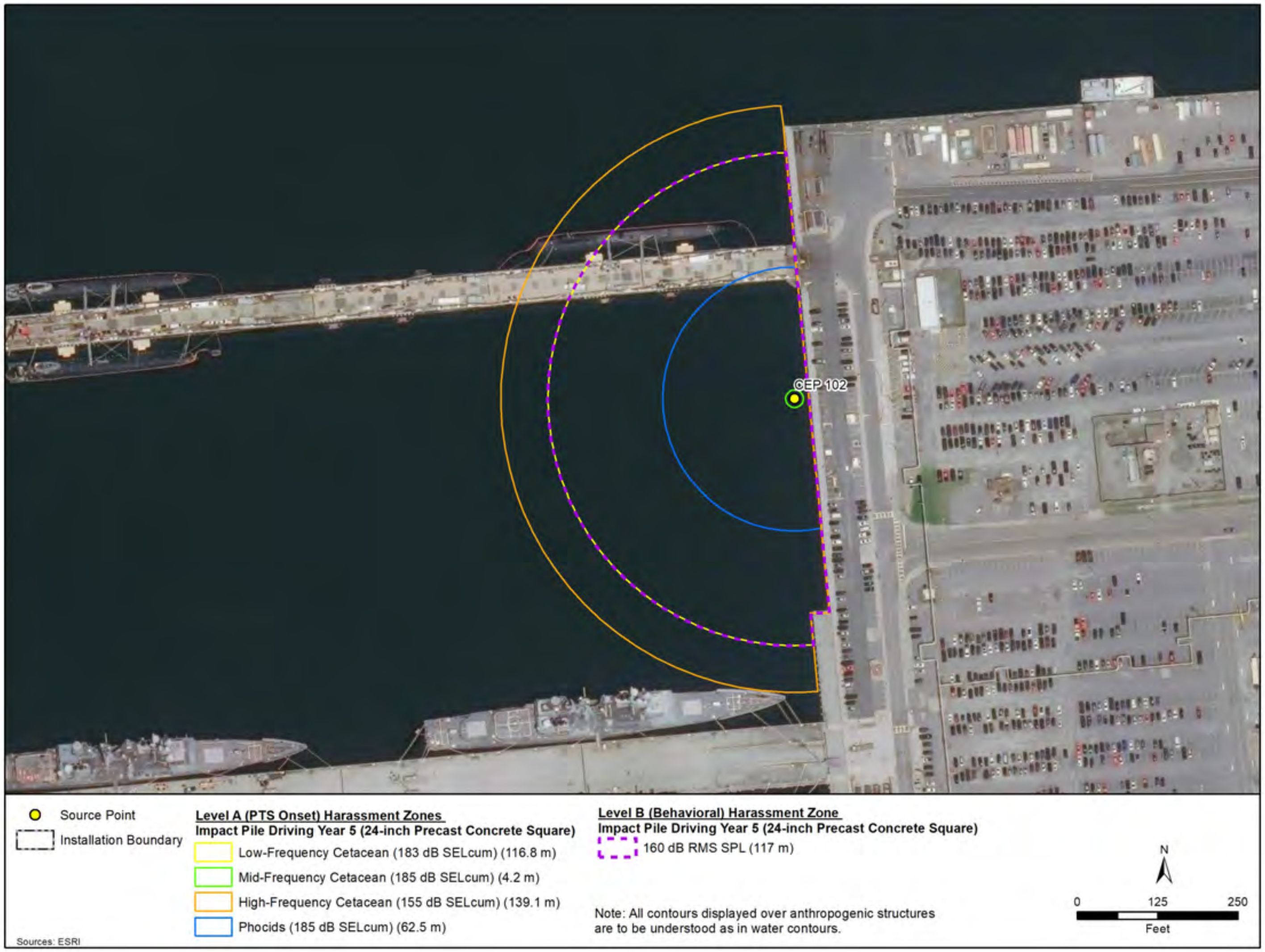

Figure 6-16 Year 5-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Impact Pile Driving 24-inch Square Precast Concrete Piles at CEP-102 Platform Center

Figure 6-17 Year 5-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Impact Pile Driving 18-inch Square Precast Concrete Piles at CEP-102 Platform Center

Table 6-6 Calculated Maximum Distances Corresponding to MMPA Thresholds for Underwater Sound from Non-Impulsive Noise (Vibratory Pile Driving/Extraction or Rotary Drilling)*

Figure	*LOA Year/Activity*	*Location and Pile Purpose*	*Pile Count, Size, Estimated Dates*	*Total Pile Driving Days*	*Level A (PTS Onset) Harassment*				*Level B (Behavioral) Harassment All Species*
					LF Cetaceans	*MF Cetaceans*	*HF Cetaceans*	*Phocids*	
					Maximum Distance to 199 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)	*Maximum Distance to 198 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 173 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 201 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 120 dB RMS SPL Threshold(m)/Area of Harassment Zone (km^2)*
6-18 Year 2	April 1, 2023 -March 31, 2024 Vibratory Pile Driving	CEP-176 Bulkhead – bearing piles	103, 42-inch steel pipe *April 2023 to May 2023*	26	127.0/0.022	11.3/0.00021	187.8/0.037	77.2/0.0094	15,849/45.97
6-19 Year 2	April 1, 2023 -March 31, 2024 Vibratory Pile Driving	CEP-176 Bulkhead – sheet piles	221, 28-inch wide steel sheet piles *April 2023 to May 2023*	16	99.7/0.016	8.8/0.00013	147.3/0.027	60.6/0.0058	13,594/39.97
6-20 Year 2	April 1, 2023 – March 31, 2024 Vibratory Pile Driving	CEP-175 Bulkhead	9, 13-inch diameter polymeric piles	2	14.7/0.00034	1.3/0.000003	21.7/0.00074	8.9/0.00012	6,310/11.08

Table 6-6 Calculated Maximum Distances Corresponding to MMPA Thresholds for Underwater Sound from Non-Impulsive Noise (Vibratory Pile Driving/Extraction or Rotary Drilling)*

Figure	*LOA Year/Activity*	*Location and Pile Purpose*	*Pile Count, Size, Estimated Dates*	*Total Pile Driving Days*	*Level A (PTS Onset) Harassment*				*Level B (Behavioral) Harassment All Species*
					LF Cetaceans	*MF Cetaceans*	*HF Cetaceans*	*Phocids*	
					Maximum Distance to 199 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)	*Maximum Distance to 198 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 173 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 201 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 120 dB RMS SPL Threshold(m)/Area of Harassment Zone (km^2)*
			April 2023 to May 2023						
6-21 Year 2	April 1, 2023 -March 31, 2024 Rotary Drilling	CEP-102 Platform Phase 2 Portion 113-108 – bearing piles	11, 24-inch square precast concrete *May 2023*	6	0.8/0.000002	0.0/0	0.7/0.000002	0.4/0.000001	1,848/4.38
6-21 Year 2	April 1, 2023 -March 31, 2024 Rotary Drilling	CEP-102 Platform Phase 2 Portion 113-108 – fender piles	6, 18-inch square precast concrete *July 2023*	2	0.6/0.000001	0.0/0	0.5/0.000001	0.3/0	1,848/4.38
6-22 Year 3	April 1, 2024 – March 31, 2025 Rotary Drilling	Pier 3 – fender piles	409, 24-inch square precast concrete	69	1.2/0.000005	0.1/0	1.1/0.000004	0.7/0.000002	1,848/6.53

Table 6-6 Calculated Maximum Distances Corresponding to MMPA Thresholds for Underwater Sound from Non-Impulsive Noise (Vibratory Pile Driving/Extraction or Rotary Drilling)*

Figure	*LOA Year/Activity*	*Location and Pile Purpose*	*Pile Count, Size, Estimated Dates*	*Total Pile Driving Days*	*Level A (PTS Onset) Harassment*				*Level B (Behavioral) Harassment All Species*
					LF Cetaceans	*MF Cetaceans*	*HF Cetaceans*	*Phocids*	
					Maximum Distance to 199 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km²)	*Maximum Distance to 198 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km²)*	*Maximum Distance to 173 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km²)*	*Maximum Distance to 201 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km²)*	*Maximum Distance to 120 dB RMS SPL Threshold(m)/Area of Harassment Zone (km²)*
			June 2024 to October 2024						
6-23 Year 3	April 1, 2024 – March 31, 2025 Vibratory Installation	CEP-102 Bulkhead South Portion 188-163 – bearing piles	26, 42-inch steel pipe *December 2024 to January 2025*	13	80.0/0.011	7.1/0.00016	118.3/0.023	48.6/0.043	15,849/98.91
6-24 Year 3	April 1, 2024 – March 31, 2025 Vibratory Installation	CEP-102 Bulkhead South Portion 188-163 – sheet piles	53, 28-inch wide steel sheet piles *January 2025*	4	99.7/0.017	8.8/0.00023	147.3/0.036	60.6/0.0066	13,594/90.63
6-25 Year 3	April 1, 2024 – March 31, 2025	CEP-102 Bulkhead South Portion	26, 18-inch square precast concrete	3	34.5/0.0023	3.1/0.00003	50.9/0.0047	20.9/0.00096	6,310/39.74

Table 6-6 Calculated Maximum Distances Corresponding to MMPA Thresholds for Underwater Sound from Non-Impulsive Noise (Vibratory Pile Driving/Extraction or Rotary Drilling)*

Figure	*LOA Year/Activity*	*Location and Pile Purpose*	*Pile Count, Size, Estimated Dates*	*Total Pile Driving Days*	*Level A (PTS Onset) Harassment*				*Level B (Behavioral) Harassment All Species*
					LF Cetaceans	*MF Cetaceans*	*HF Cetaceans*	*Phocids*	
					Maximum Distance to 199 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)	*Maximum Distance to 198 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 173 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 201 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 120 dB RMS SPL Threshold(m)/Area of Harassment Zone (km^2)*
	Vibratory Extraction	188-163 – fender piles	*February 2025*						
6-26 Year 4	April 1, 2025 – March 31, 2026 Rotary Drilling	CEP-102 Platform South Portion 188-163 – bearing piles	40, 24-inch square precast concrete *April 2025 to May 2025*	20	0.8/0.000002	0.0/0	0.7/0.000002	0.4/0.000001	1,848/4.38
6-27 Year 4	April 1, 2025 – March 31, 2026 Vibratory Extraction	Existing Pier 3 – fender piles	624, 14-inch timber August 2025 to September 2025	25	68.1/0.015	6.0/0.00011	100.7/0.032	41.4/0.0054	6,310/49.93
6-26 Year 4	April 1, 2025 – March 31, 2026	CEP-102 Platform South Portion	25, 18-inch square precast concrete	7	0.6/0.000001	0.0/0	0.5/0.000001	0.3/0	1,848/4.38

Table 6-6 Calculated Maximum Distances Corresponding to MMPA Thresholds for Underwater Sound from Non-Impulsive Noise (Vibratory Pile Driving/Extraction or Rotary Drilling)*

Figure	*LOA Year/Activity*	*Location and Pile Purpose*	*Pile Count, Size, Estimated Dates*	*Total Pile Driving Days*	*Level A (PTS Onset) Harassment*				*Level B (Behavioral) Harassment All Species*
					LF Cetaceans	*MF Cetaceans*	*HF Cetaceans*	*Phocids*	
					Maximum Distance to 199 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)	*Maximum Distance to 198 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 173 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 201 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 120 dB RMS SPL Threshold(m)/Area of Harassment Zone (km^2)*
	Rotary Drilling	188-163 – fender piles	*September 2025*						
6-28 Year 4	April 1, 2025 – March 31, 2026 Vibratory Installation	CEP-102 Bulkhead Center Portion 163-114 – bearing piles	50, 42-inch steel pipe piles September 2025 to October 2025	25	80.0/0.011	7.1/0.00016	118.3/0.023	48.6/0.0044	15,849/98.91
6-29 Year 4	April 1, 2025 – March 31, 2026 Vibratory Extraction	Existing Pier 3 – fender piles	72, 24-inch square precast concrete September 2025 to October 2025	7	41.7/0.0054	3.7/0.000043	61.7/0.012	25.4/0.0020	6,310/49.93
6-30 Year 4	April 1, 2025 – March 31, 2026	CEP-102 Bulkhead Center	102, 28-inch steel sheet piles	8	99.7/0.017	8.8/0.00023	147.3/0.036	60.6/0.0066	13,594/90.63

Table 6-6 Calculated Maximum Distances Corresponding to MMPA Thresholds for Underwater Sound from Non-Impulsive Noise (Vibratory Pile Driving/Extraction or Rotary Drilling)*

Figure	*LOA Year/Activity*	*Location and Pile Purpose*	*Pile Count, Size, Estimated Dates*	*Total Pile Driving Days*	*Level A (PTS Onset) Harassment*				*Level B (Behavioral) Harassment All Species*
					LF Cetaceans	*MF Cetaceans*	*HF Cetaceans*	*Phocids*	
					Maximum Distance to 199 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)	*Maximum Distance to 198 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 173 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 201 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 120 dB RMS SPL Threshold(m)/Area of Harassment Zone (km^2)*
	Vibratory Installation	Portion 163-114 – sheet piles	October 2025						
6-31 Year 4	April 1, 2025 – March 31, 2026 Vibratory Extraction	CEP-102 Bulkhead Center Portion 163-114 – fender piles	36, 18-inch square precast concrete *November 2025*	4	34.5/0.0023	3.1/0.00003	50.9/0.0047	20.9/0.00096	6,310/39.74
6-32 Year 4	April 1, 2025 – March 31, 2026 Vibratory Extraction	Existing Pier 3 – bearing piles	873, 16- and 18-inch square precast concrete November 2025 to March 2026	88	37.0/0.0043	3.3/0.000034	54.6/0.0093	22.5/0.0016	6,310/49.93

Table 6-6 Calculated Maximum Distances Corresponding to MMPA Thresholds for Underwater Sound from Non-Impulsive Noise (Vibratory Pile Driving/Extraction or Rotary Drilling)*

Figure	*LOA Year/Activity*	*Location and Pile Purpose*	*Pile Count, Size, Estimated Dates*	*Total Pile Driving Days*	*Level A (PTS Onset) Harassment*				*Level B (Behavioral) Harassment All Species*
					LF Cetaceans	*MF Cetaceans*	*HF Cetaceans*	*Phocids*	
					Maximum Distance to 199 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)	*Maximum Distance to 198 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 173 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 201 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km^2)*	*Maximum Distance to 120 dB RMS SPL Threshold(m)/Area of Harassment Zone (km^2)*
6-33 Year 4	April 1, 2025 – March 31, 2026 Rotary Drilling	CEP-102 Platform Center Portion 163-114 – bearing piles	41, 24-inch square precast concrete February 2026 to March 2026	21	0.8/0.000002	0.0/0	0.7/0.000002	0.4/0.000001	1,848/4.38
6-34 Year 5	April 2026 Rotary Drilling	CEP-102 Platform Center Portion 163-114 – bearing piles	32, 24-inch square precast concrete April 2026	16	0.8/0.000002	0.0/0	0.7/0.000002	0.4/0.000001	1,848/4.38
6-35 Year 5	April 1, 2026 – March 31, 2027 Vibratory Extraction	Existing Pier 3	Extract 30, 16- to 18-inch square concrete	3	37.0/0.0043	3.3/0.000034	54.6/0.0093	22.5/0.0016	6,310/49.93

Table 6-6 Calculated Maximum Distances Corresponding to MMPA Thresholds for Underwater Sound from Non-Impulsive Noise (Vibratory Pile Driving/Extraction or Rotary Drilling)*

Figure	*LOA Year/Activity*	*Location and Pile Purpose*	*Pile Count, Size, Estimated Dates*	*Total Pile Driving Days*	*Level A (PTS Onset) Harassment*				*Level B (Behavioral) Harassment All Species*
					LF Cetaceans	*MF Cetaceans*	*HF Cetaceans*	*Phocids*	
					Maximum Distance to 199 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km²)	*Maximum Distance to 198 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km²)*	*Maximum Distance to 173 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km²)*	*Maximum Distance to 201 dB SEL_{cum} Threshold (m)/Area of Harassment Zone (km²)*	*Maximum Distance to 120 dB RMS SPL Threshold(m)/Area of Harassment Zone (km²)*
			bearing piles April 2026						
6-34 Year 5	April 1, 2026 – March 31, 2027 Rotary Drilling	CEP-102 Platform Center Portion 163-114	50, 18-inch square precast concrete April 2026	13	0.6/0.000001	0.0/0	0.5/0.000001	0.3/0	1,848/4.38

Notes: *- To determine underwater harassment zones, radial distances from the source were truncated along the shoreline using GIS.
Proxy sources used were unattenuated SPLs.
(a) Injury thresholds are dB SEL_{CUM}, as listed in Table 6-3; (b) Behavioral disturbance thresholds are dB RMS, as listed in Table 6-3; (c) harassment zones calculated using GIS data as determined by transmission loss modeling.
Source: NAVFAC Midlant 2022.
Key: dB = decibels; LF = low-frequency; MF = mid-frequency; HF = high-frequency; m = meter, m² = square meters; PTS = permanent threshold shift; RMS = root mean square; SEL_{CUM} = cumulative sound exposure level.

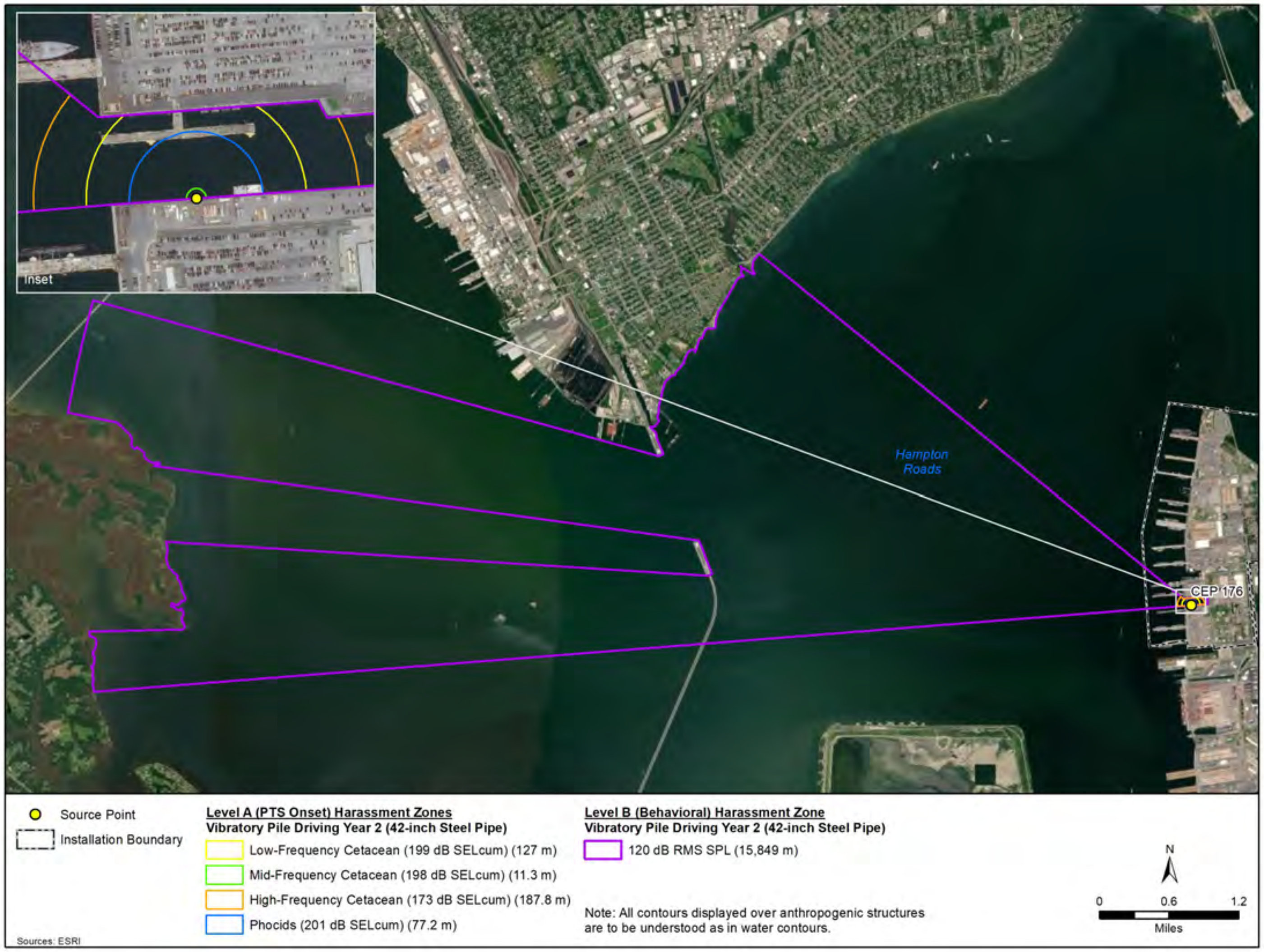

Figure 6-18 Year 2-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Vibratory Pile Driving 42-inch Steel Pipe Piles at CEP-176

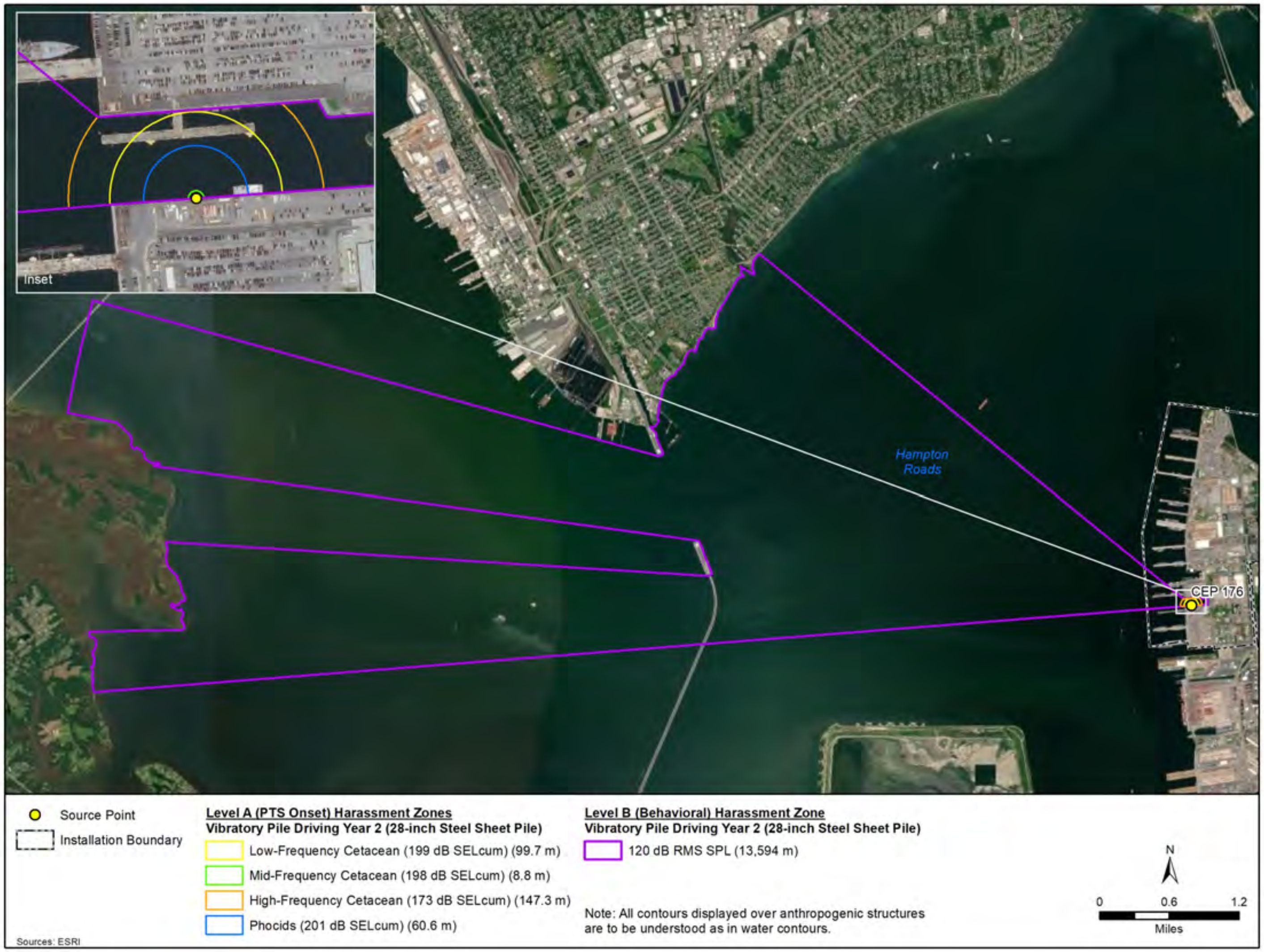

Figure 6-19 Year 2-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Vibratory Pile Driving of 28-inch Steel Sheet Piles at CEP-176 Bulkhead South

Figure 6-20 Year 2-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Vibratory Pile Driving of 13-inch Polymeric Piles at CEP-175 Bulkhead

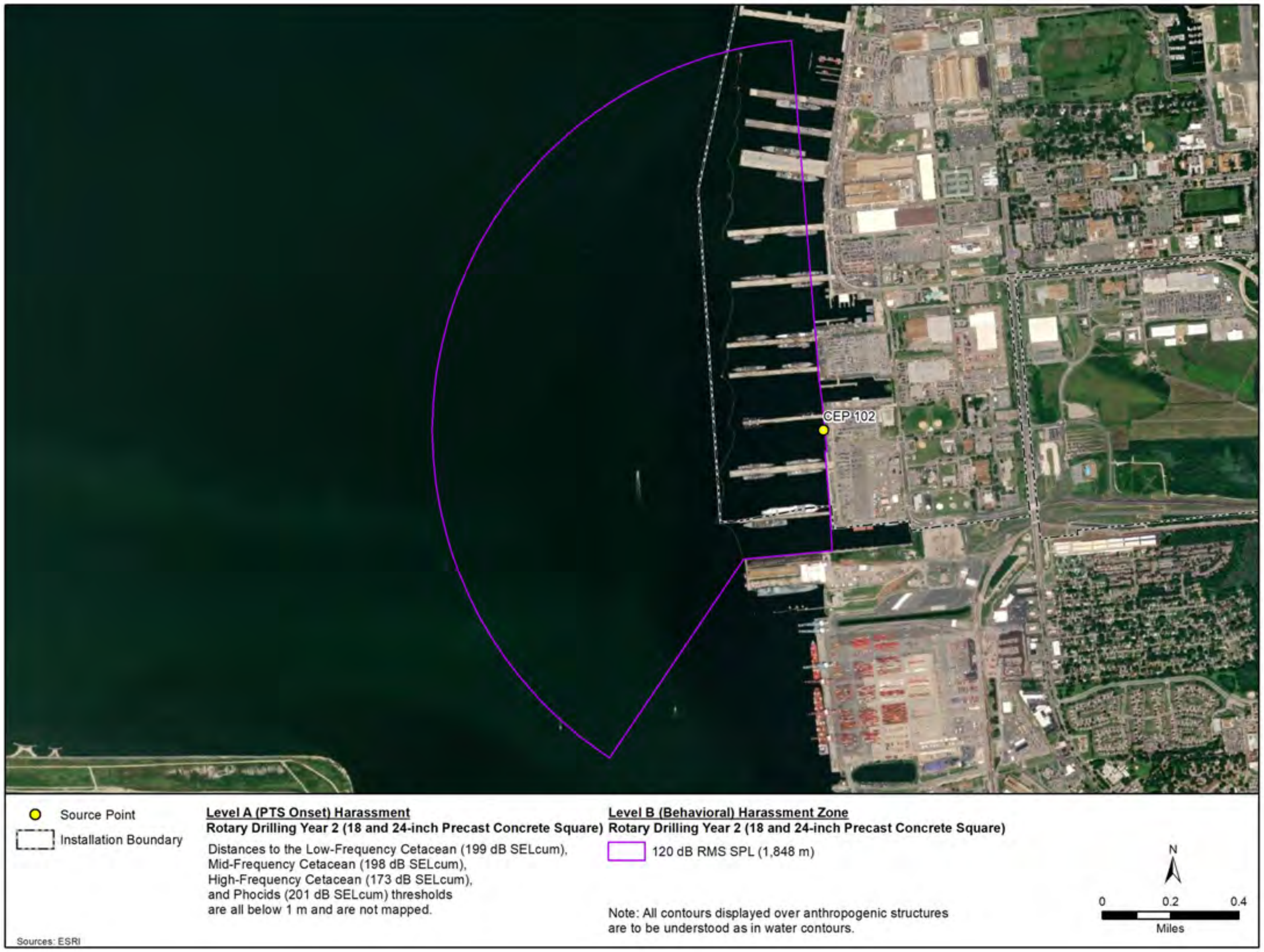

Figure 6-21 Year 2-Maximum Distance to Level B (Behavioral) Harassment Zone from Rotary Drilling for 18-inch and 24-inch Square Precast Concrete Piles at CEP-102 Platform

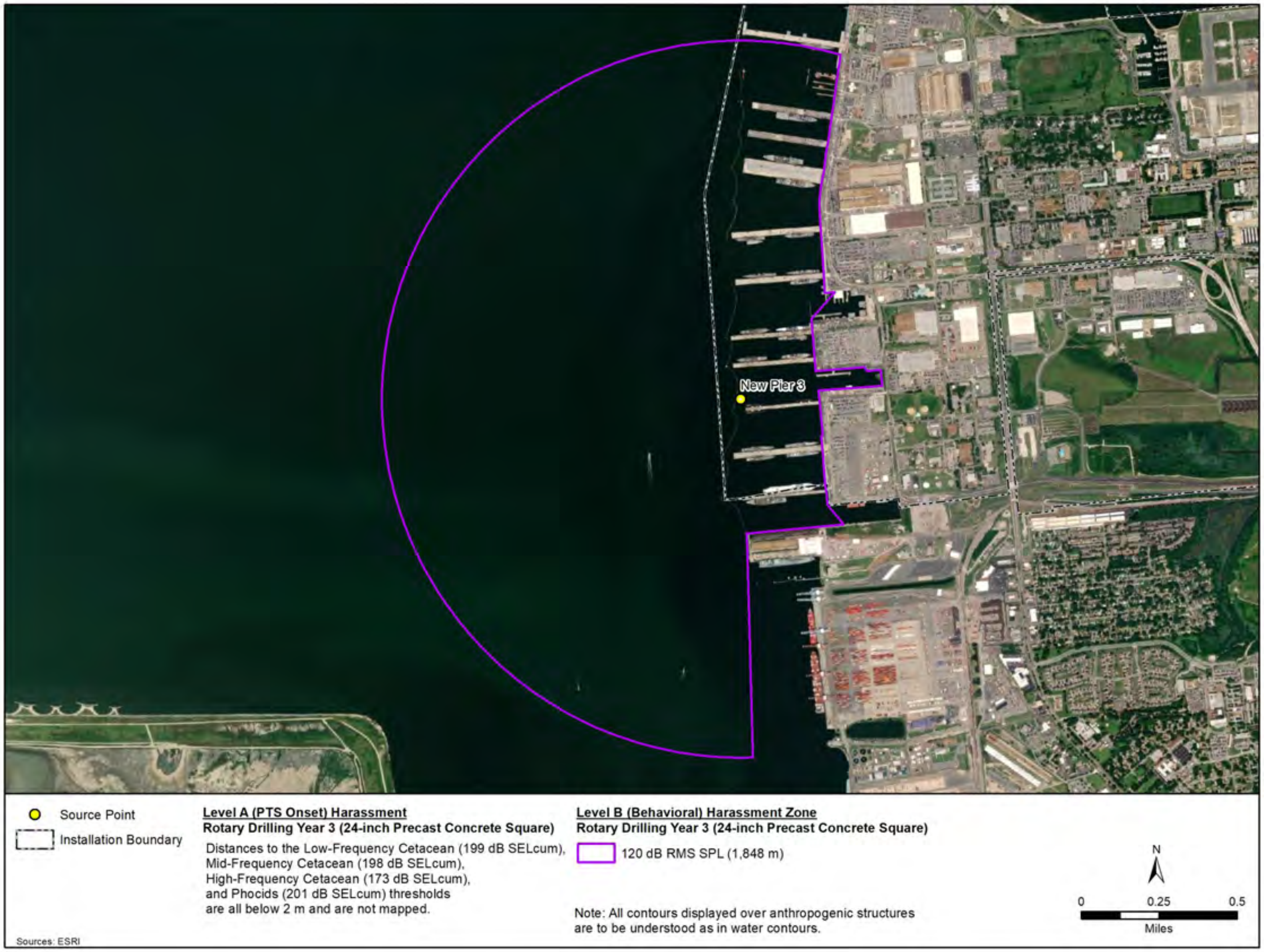

Figure 6-22 Year 3-Maximum Distance to Level B (Behavioral) Harassment Zone from Rotary Drilling for 24-inch Square Precast Concrete Piles at the New Pier 3 Location

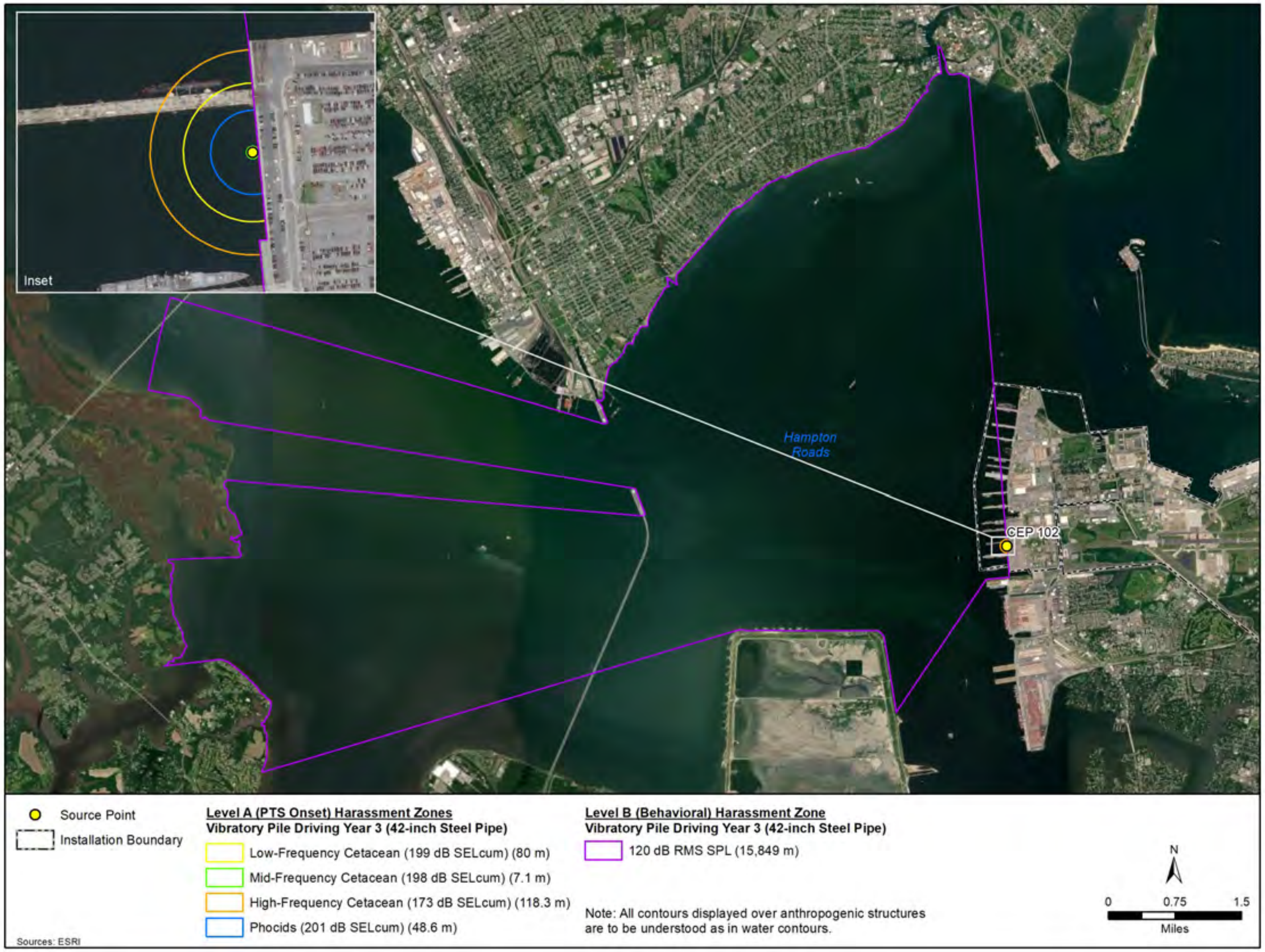

Figure 6-23 Year 3-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Vibratory Pile Driving of 42-inch Steel Pipe Piles at CEP-102 Bulkhead South

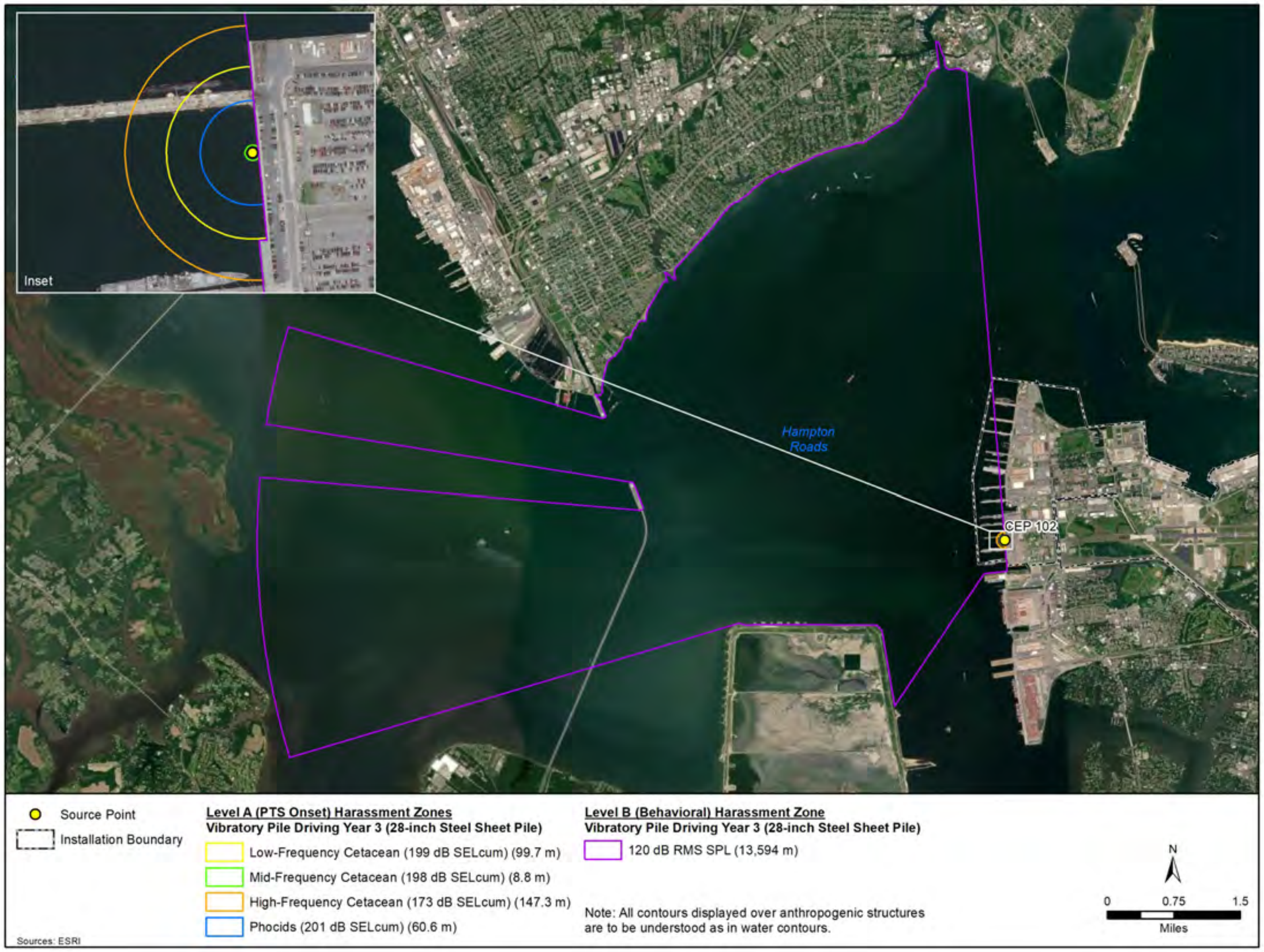

Figure 6-24 Year 3-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Vibratory Pile Driving of 28-inch Steel Sheet Piles at CEP-102 Bulkhead South

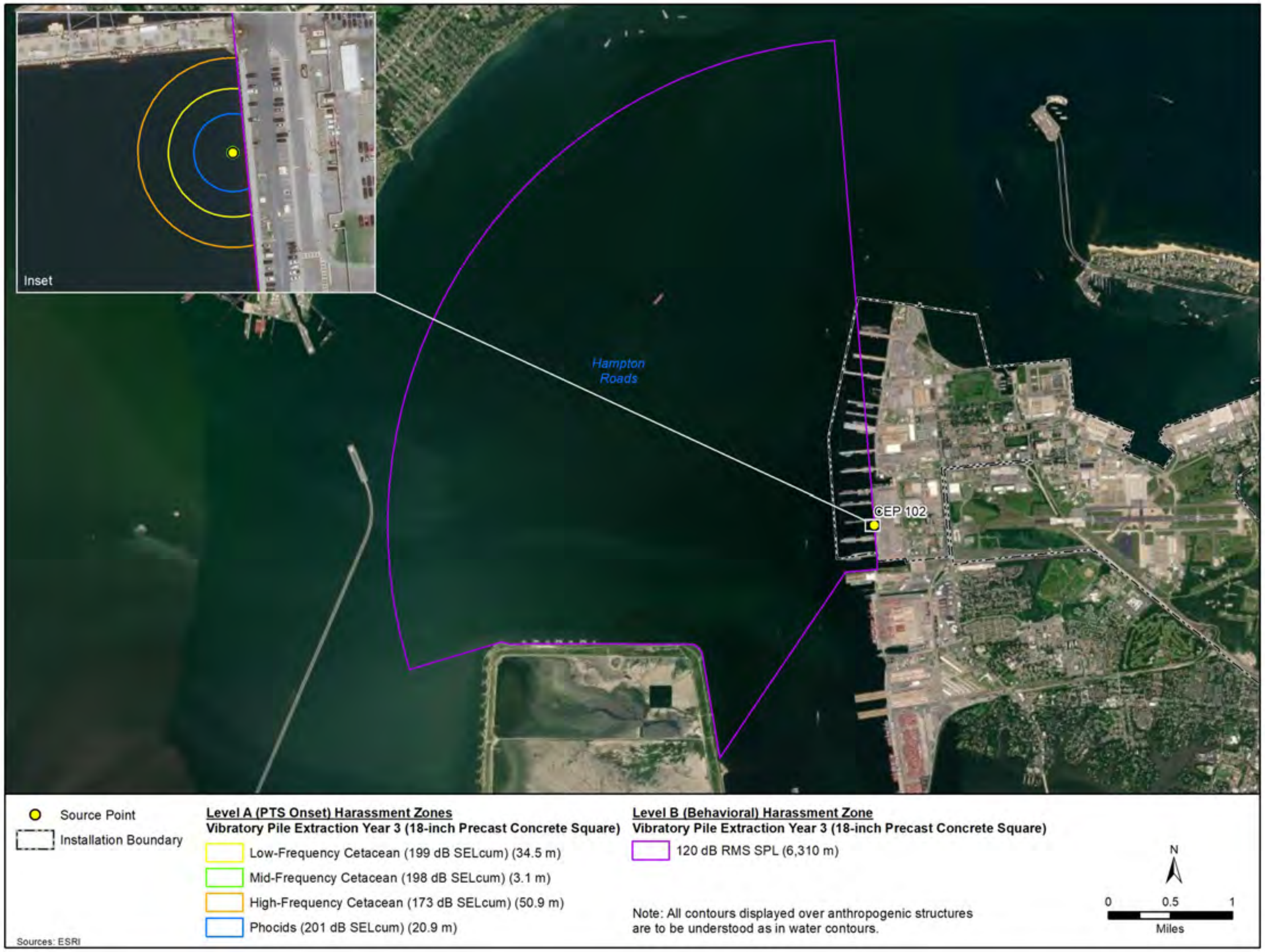

Figure 6-25 Year 3-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Vibratory Extraction of 18-inch Square Precast Concrete Piles at CEP-102 Bulkhead South

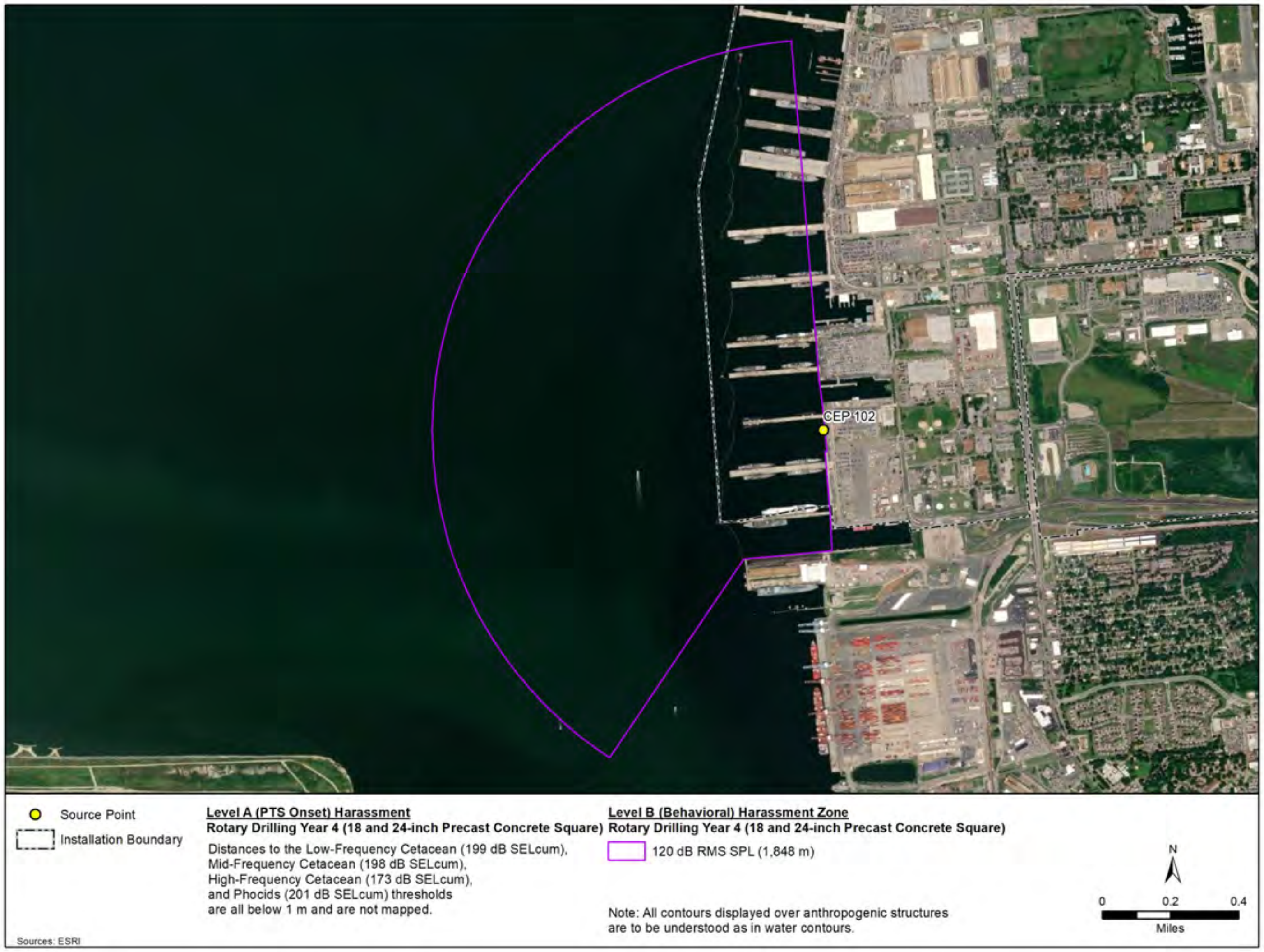

Figure 6-26 Year 4-Maximum Distance to Level B (Behavioral) Harassment Zone from Rotary Drilling for 18-inch and 24-inch Square Precast Concrete Piles at CEP-102 Platform South

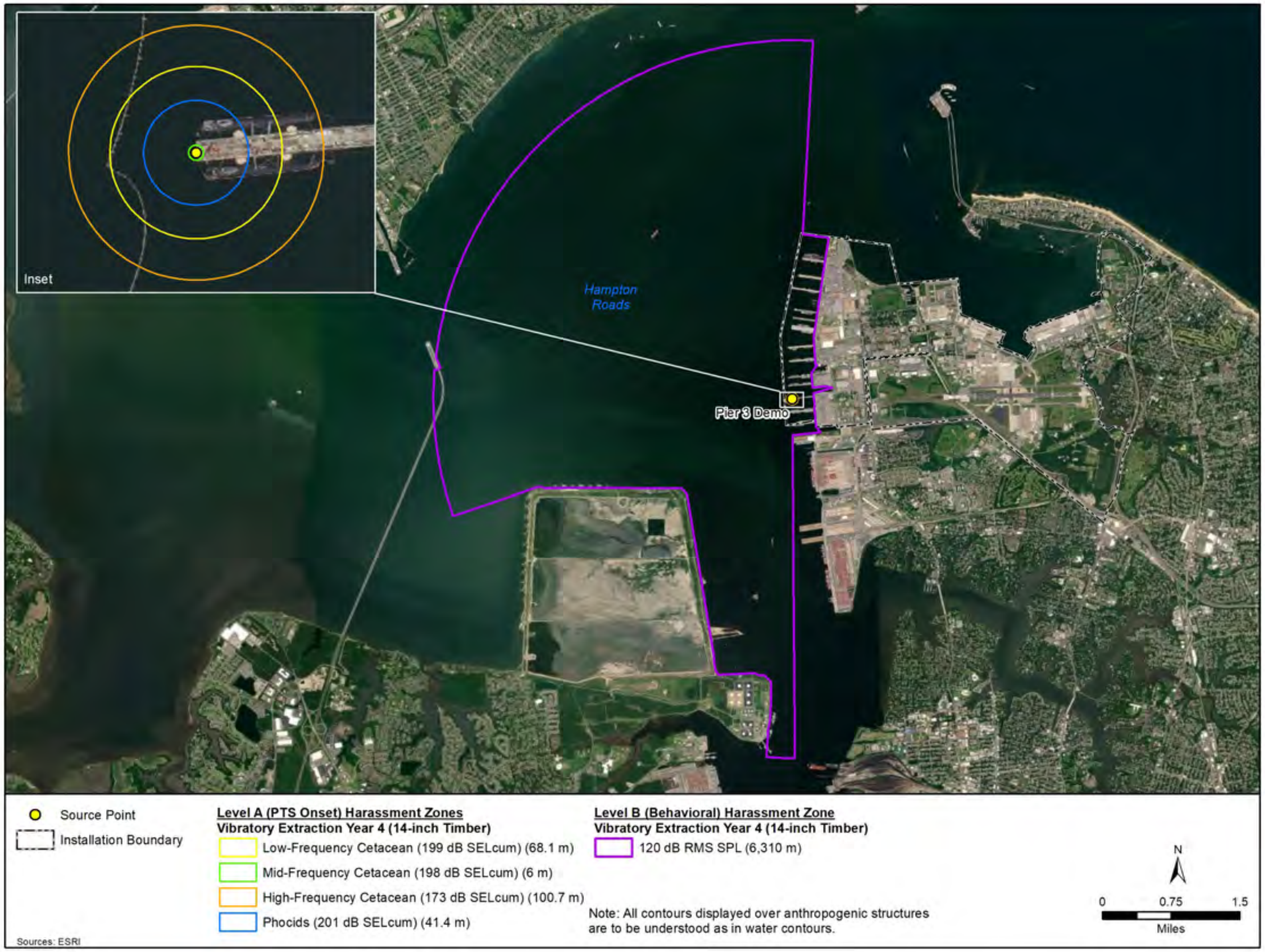

Figure 6-27 Year 4-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Vibratory Extraction of 14-inch Timber Piles at the Existing Pier 3

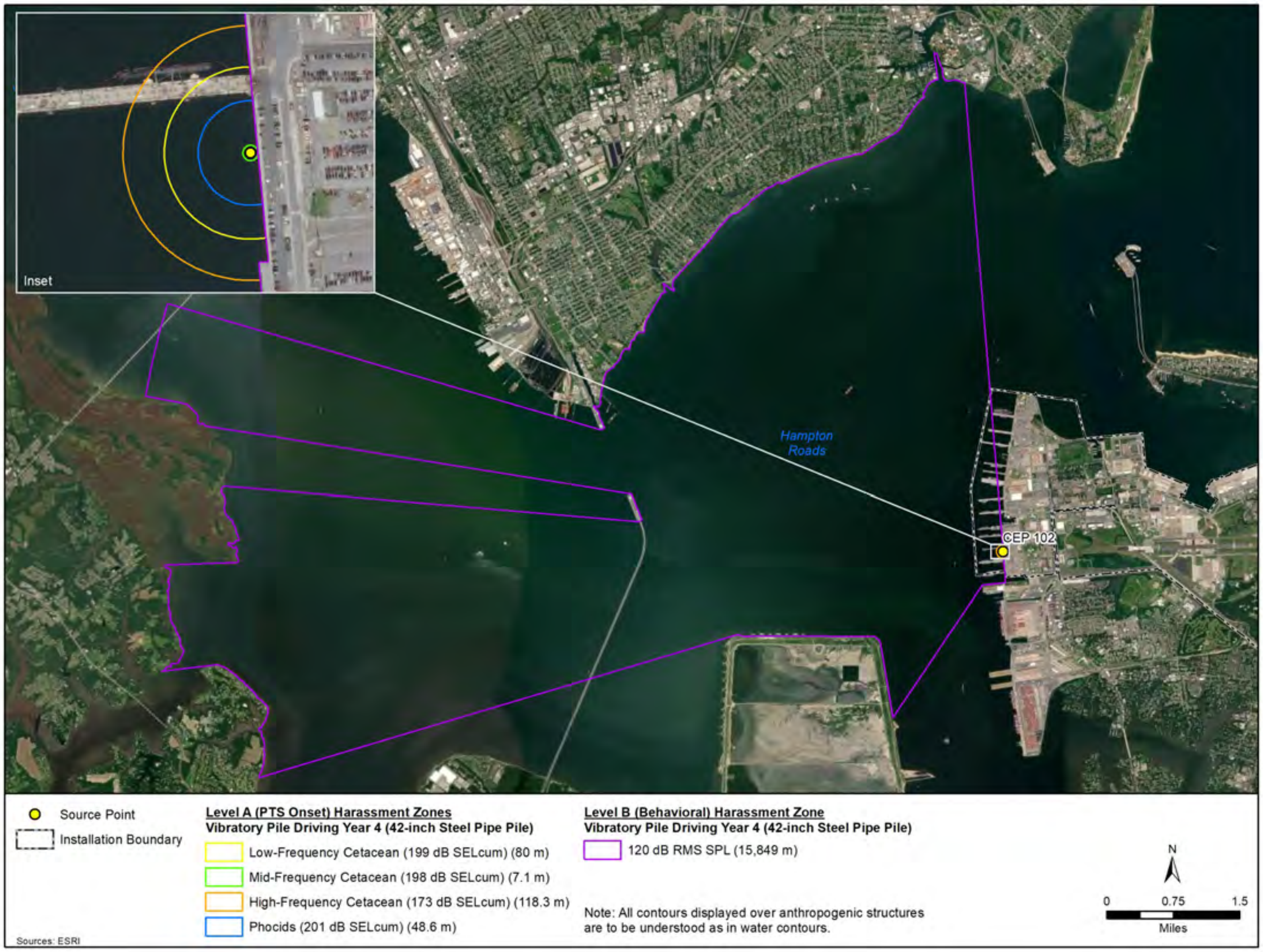

Figure 6-28 Year 4-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Vibratory Pile Driving of 42-inch Steel Pipe Piles at CEP-102 Bulkhead Center

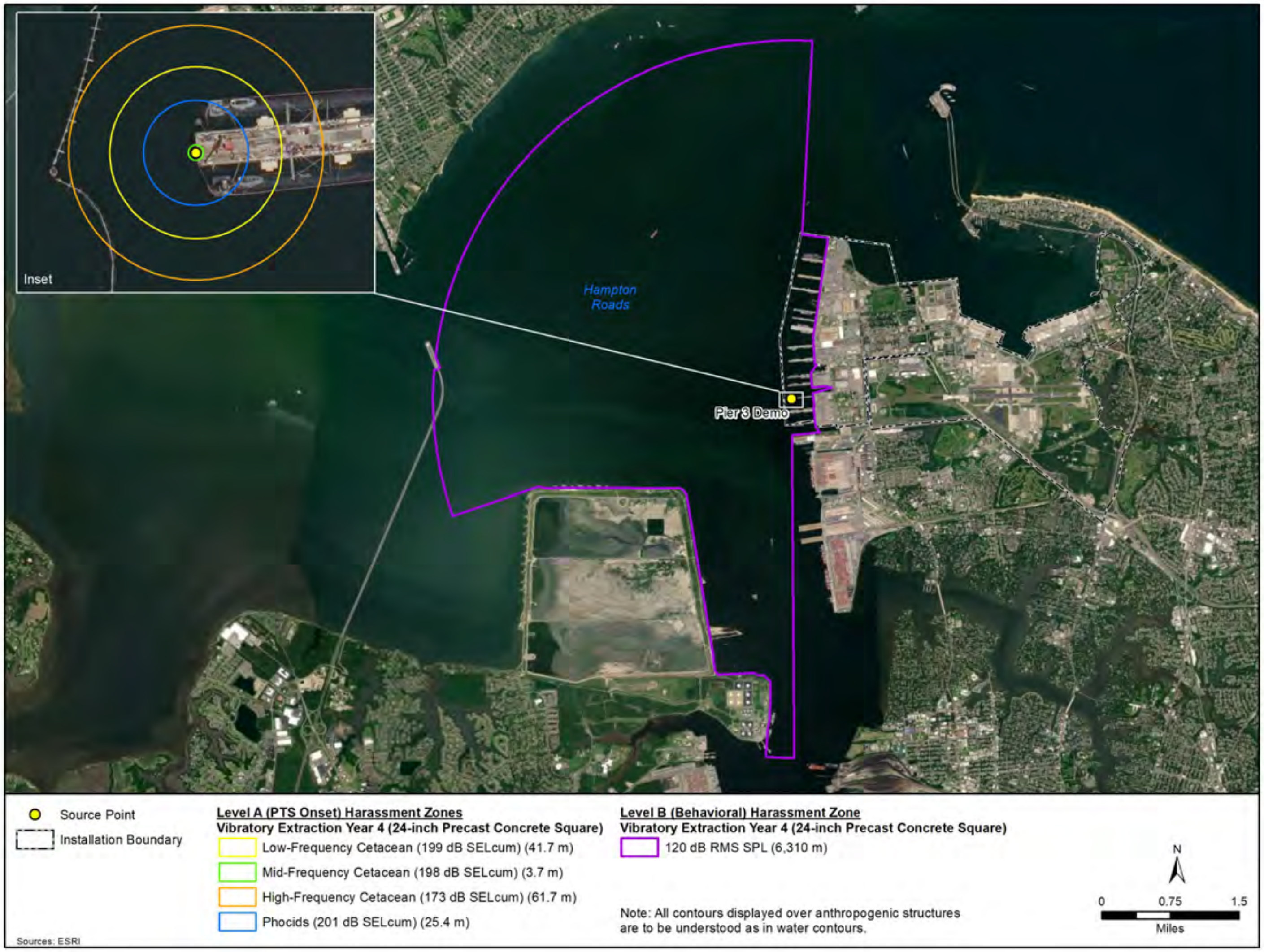

Figure 6-29 Year 4-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Vibratory Extraction of 24-inch Square Precast Concrete Piles at Existing Pier 3

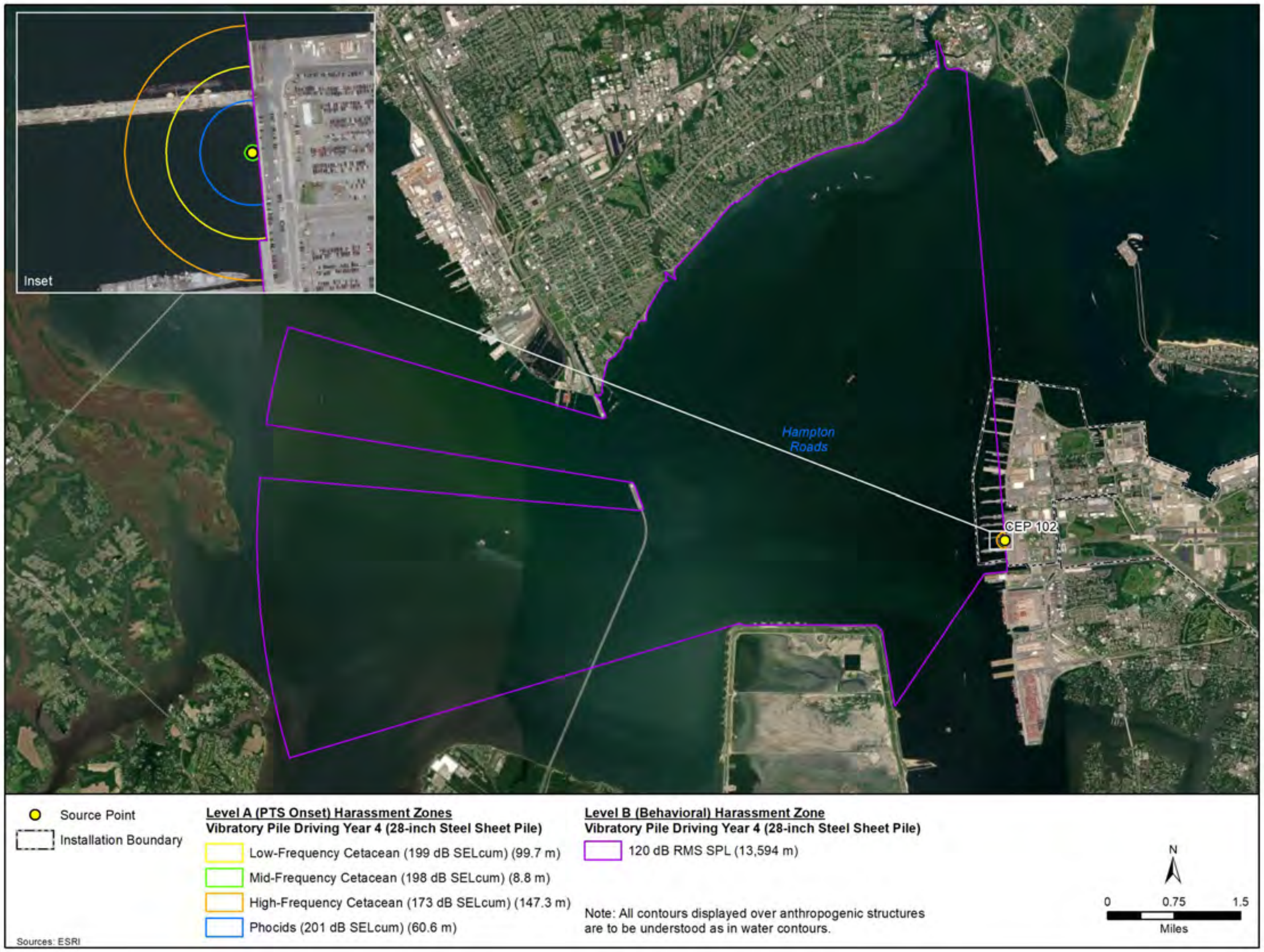

Figure 6-30 Year 4-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zone from Vibratory Pile Driving of 28-inch Steel Sheet Piles at CEP-102 Bulkhead Center

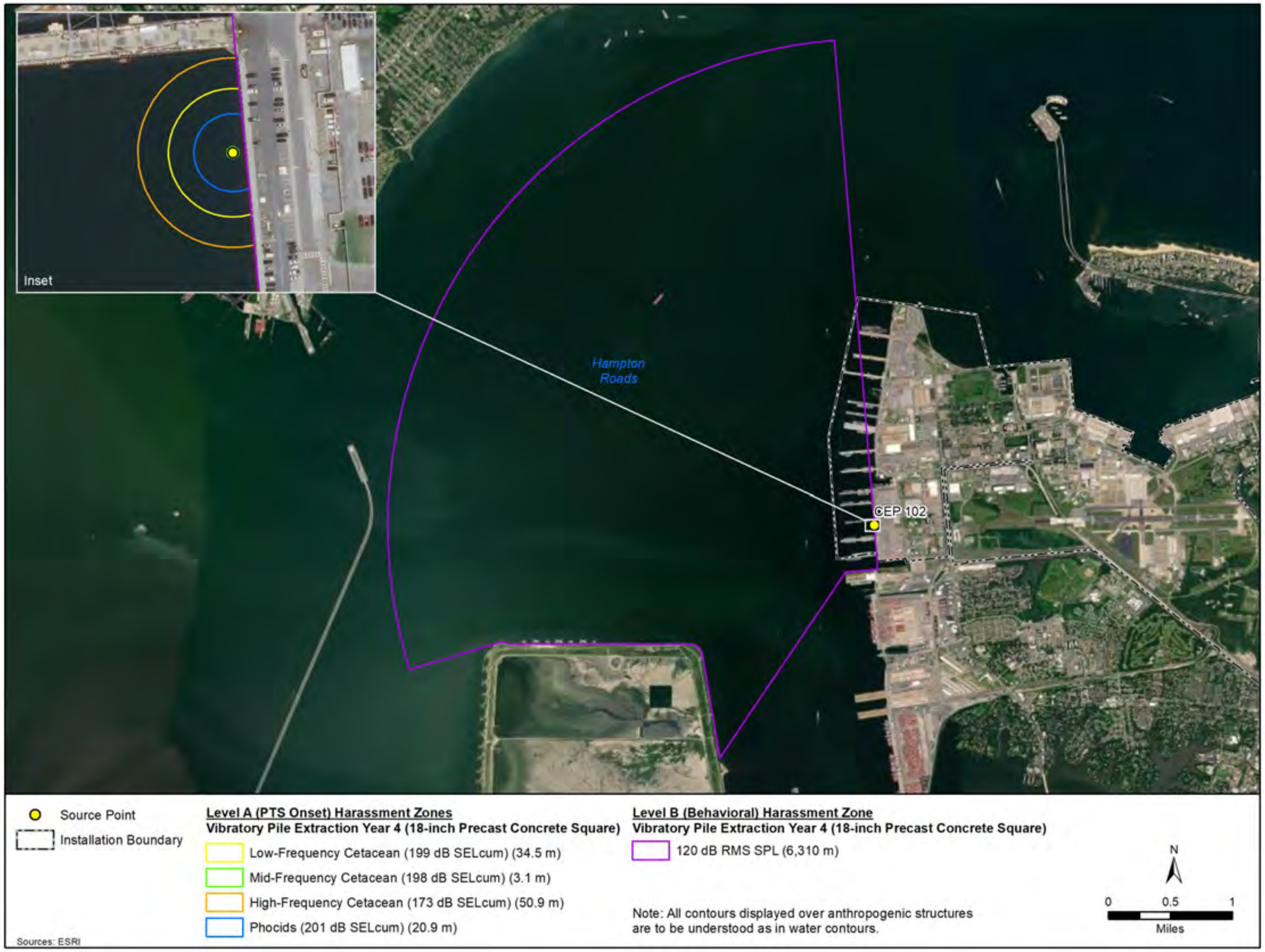

Figure 6-31 Year 4-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Vibratory Extraction of 18-inch Square Precast Concrete Piles at the CEP-102 Bulkhead Center

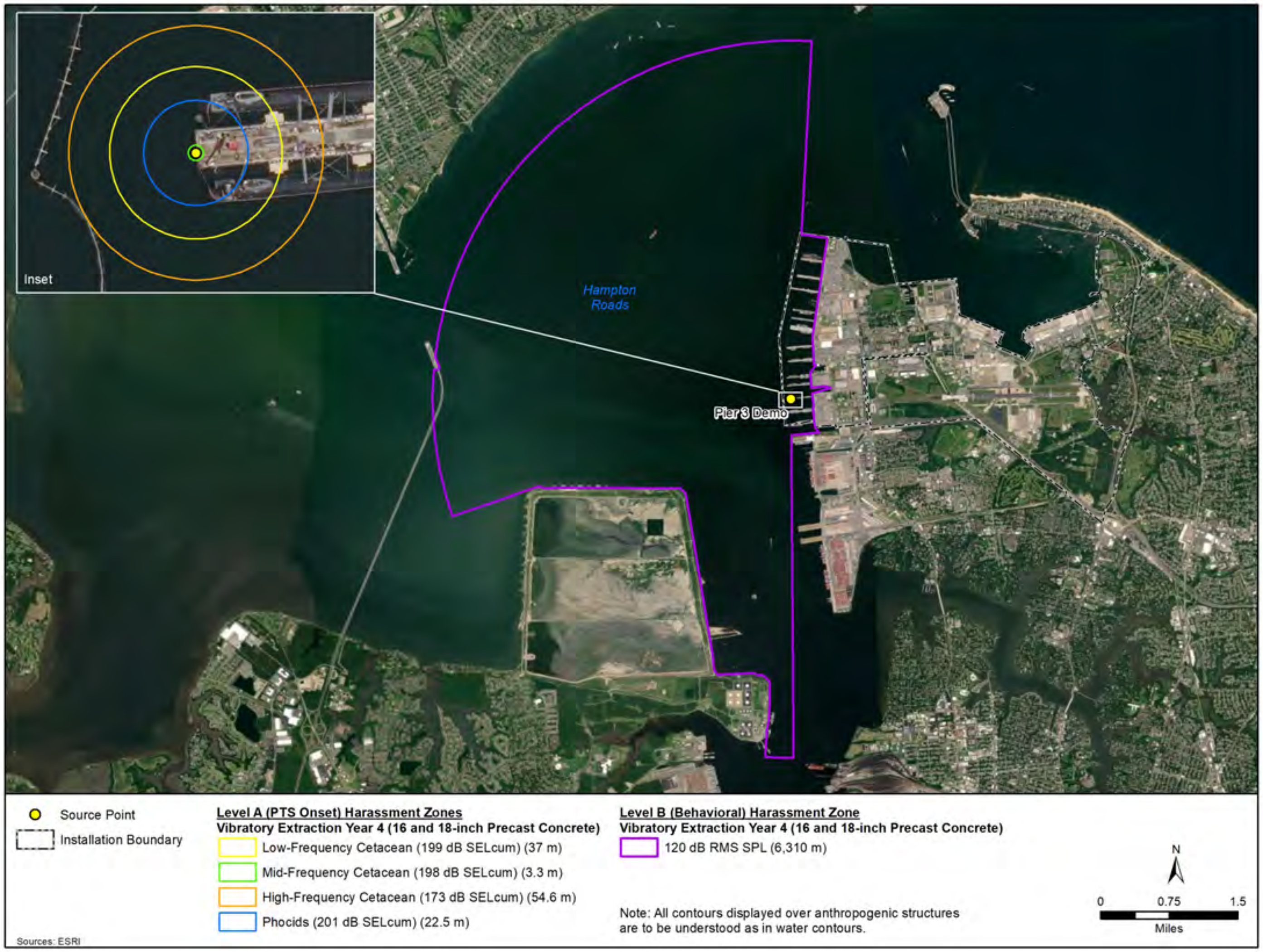

Figure 6-32 Year 4-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Vibratory Extraction of 16- to 18-inch Square Precast Concrete Piles at the Existing Pier 3

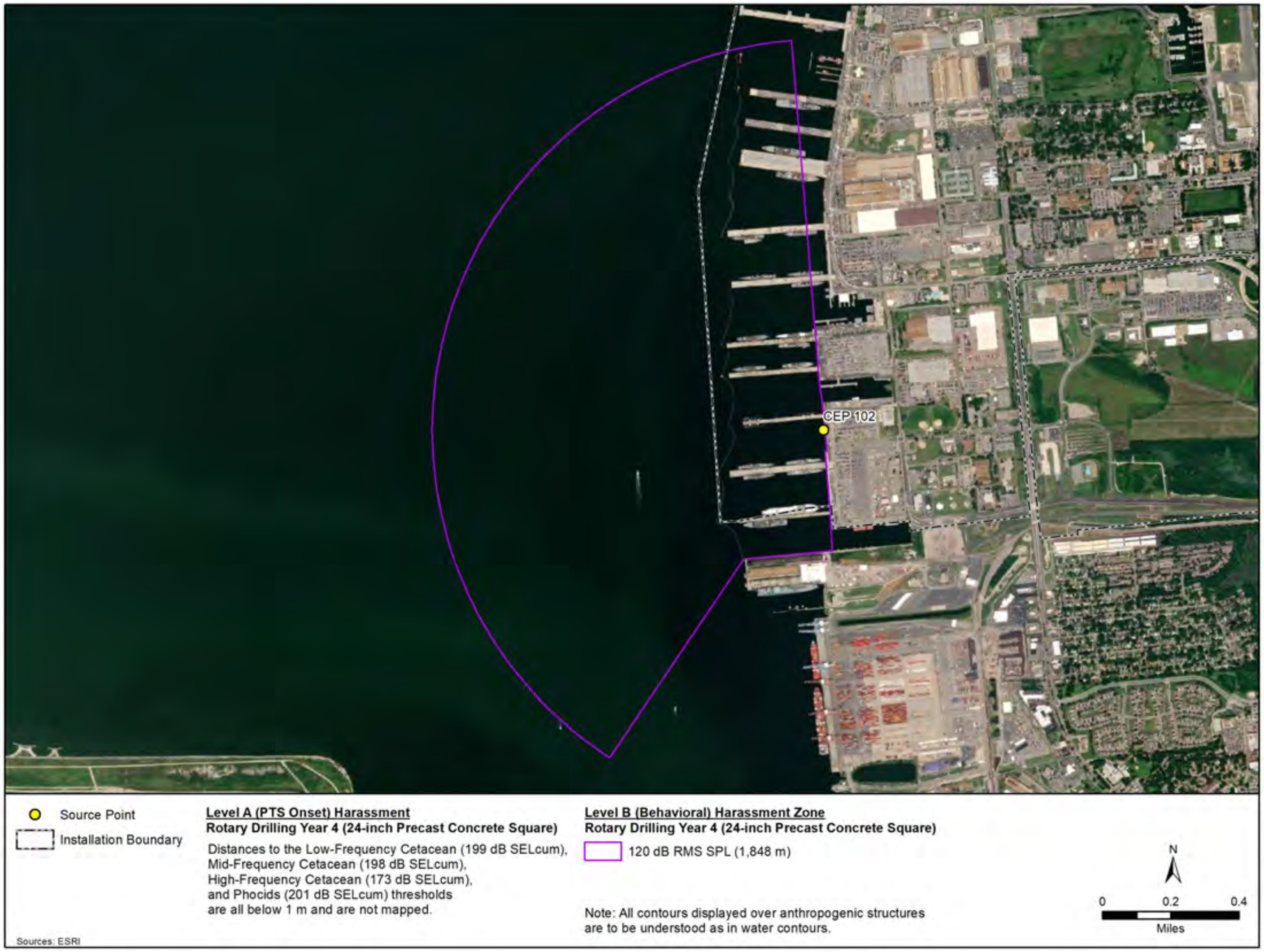

Figure 6-33 Year 4- Maximum Distance to Level B (Behavioral) Harassment Zone from Rotary Drilling for 24-inch Square Precast Concrete Piles at CEP-102 Center Platform

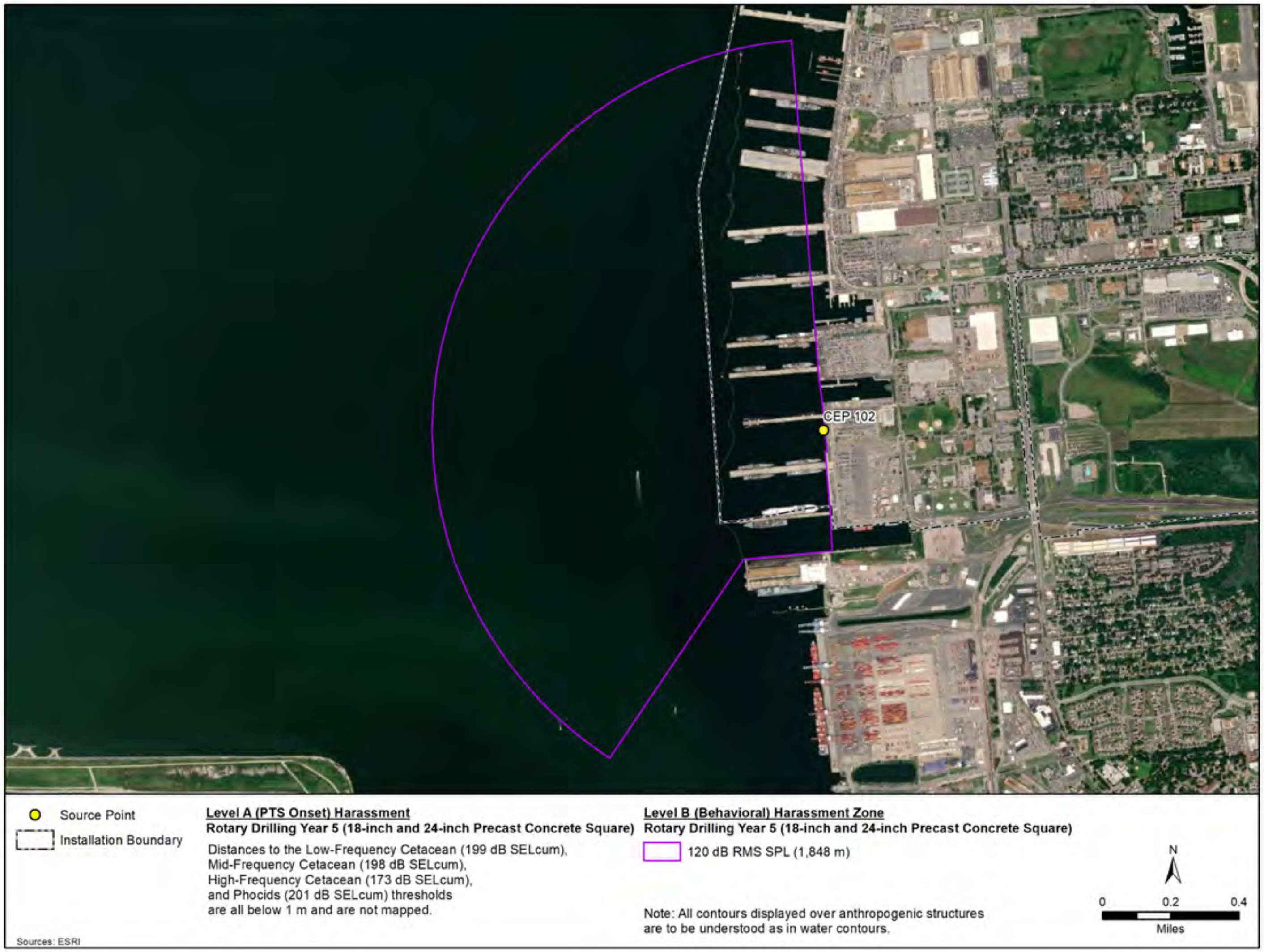

Figure 6-34 Year 5-Maximum Distance to Level B (Behavioral) Harassment Zone from Rotary Drilling for 18-inch and 24-inch Square Precast Concrete Piles at CEP-102 Center Platform

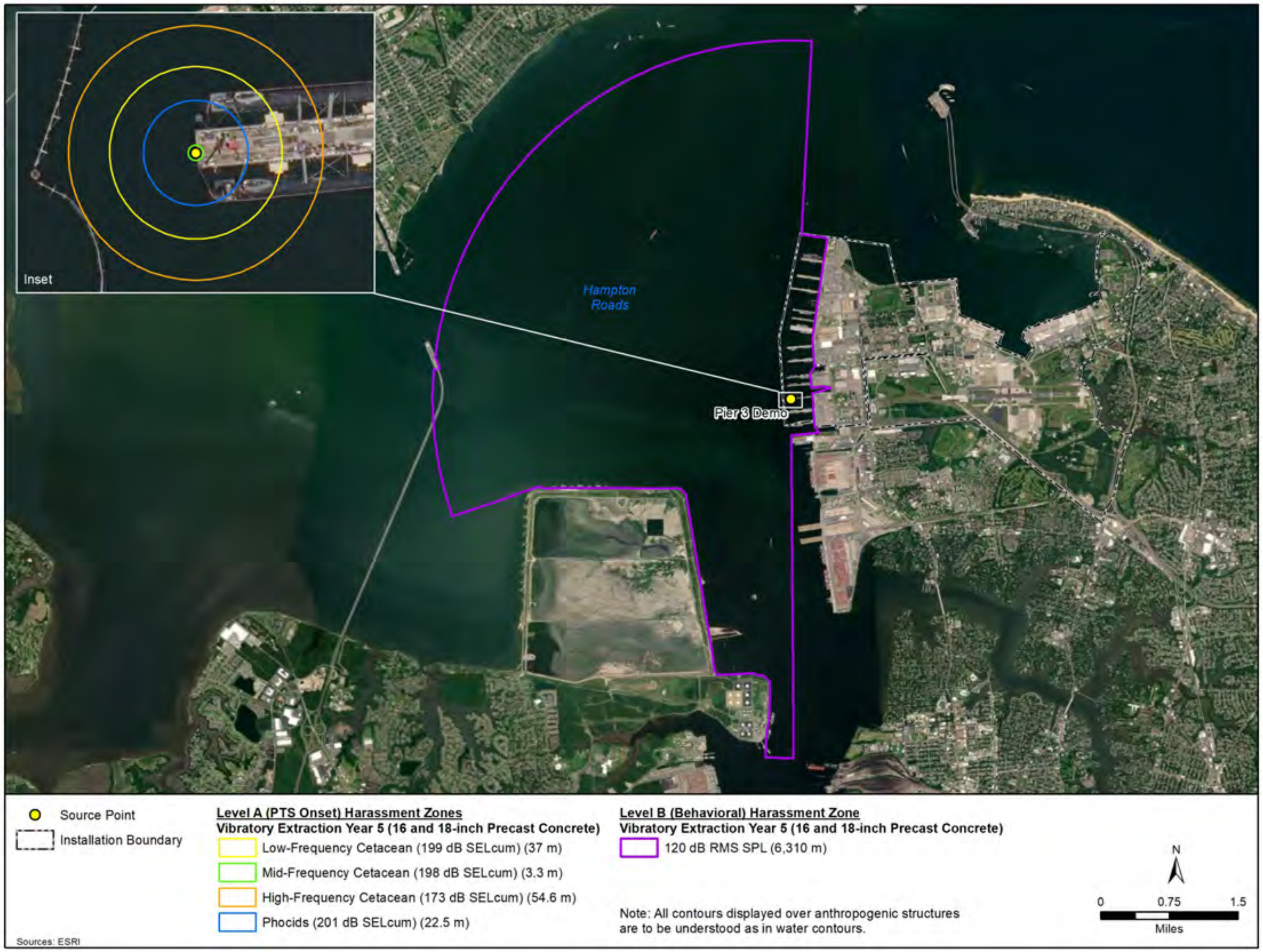

Figure 6-35 Year 5-Maximum Distance to Level B (Behavioral) Harassment Zone from Vibratory Extraction for 16- to 18-inch Square Precast Concrete Piles at Existing Pier 3

The maximum distance to the Level A (PTS onset) during construction would be during impact driving of 28-inch steel sheet piles in Years 2 through Year 4 at CEP-176 (1,782 m for humpback whale; 63 m bottlenose dolphin; 2,123 m for harbor porpoise; and 954 m for pinnipeds).

The furthest extent to the Level B (behavioral) harassment threshold during construction would be a distance of 15,849 m resulting from the vibratory installation of 42-inch steel pipe piles at CEP-176 during Year 2 and CEP-102 during Years 3 and 4.

6.8.2 Concurrent Activities

Simultaneous use of pile drivers, hammers, and drills could result in increased SPLs and harassment zone sizes given the proximity of the structure sites and the rules of decibel addition (Table 6-7).

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. 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, 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

Source: Egger, 2021.
Key: dB = decibel.

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 unpublished).

As shown in Table 1-1, there are anticipated to be scenarios when an impact hammer and vibratory hammer are occurring simultaneously or when two impact hammers may be operating simultaneously. In the situations, 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 Tables 6-5 and 6-6). Simultaneous use of two or more impact hammers does not require source level additions on its own as it is unlikely that two hammers would strike at the same exact instant and thus sound source levels are not adjusted regardless of distance (NMFS, unpublished).

By using the rules of decibel addition method, a revised proxy source for Level A and Level B analysis was determined for the use of the concurrent non-impulsive activity scenarios provided in Table 6-8. The revised proxy value is presented in Table 6-8 and the resulting harassment zones are summarized in Table 6-9 and depicted in Figures 6-36 through 6-47).

Table 6-8 Revised Proxy Values for Simultaneous Use of Non-impulsive Sources

	Structure	*Activity and Proxy*	*New Proxy*
Year 2	CEP-176	Vibratory Install 42-inch steel pipe – 168 dB RMS Vibratory Install 28-inch steel sheets – 167 dB RMS	171 dB RMS
	CEP-176	Two Vibratory Hammers of 42-inch steel pipe – 168 dB RMS	171 dB RMS
	CEP-176 and CEP-102	Vibratory Install 42-inch steel pipe – 168 dB RMS Rotary Drill precast concrete piles – 154 dB RMS	168 dB RMS
	CEP-176 and CEP-175	Vibratory Install of 42-inch steel pipe – 168 dB RMS Vibratory Install of 13-inch polymeric piles - 162	169 dB RMS
Year 3	Pier 3	Two Rotary Drills of precast concrete piles – 154 dB RMS	157 dB RMS
	CEP-102	Vibratory Install 42-inch steel – 168 dB RMS Vibratory Install 28-inch steel sheets – 167 dB RMS	171 dB RMS
Year 4	Existing Pier 3 and CEP-102	Vibratory Extract 14-inch timber – 162 dB RMS Vibratory Install 42-inch steel pipe – 168 dB RMS Vibratory Install 28-inch steel sheet – 167 dB RMS Rotary Drill of Precast concrete piles – 154 dB RMS	171 dB RMS
Year 5	Existing Pier 3 and CEP-102	Vibratory Extract of 16- to 18-inch concrete piles – 162 dB RMS Rotary Drilling concrete bearing piles – 154 dB RMS	163 dB RMs

Key: dB RMS = Decibel Root Mean Square

Table 6-9 Calculated Maximum Distances Corresponding to MMPA Thresholds for Underwater Sound from Non-Impulsive Noise (Vibratory Pile Driving/Extraction or Rotary Drilling)* from CONCURRENT Activities

Figure	*LOA Year/Activity*	*Location*	*Pile Count, Size, Estimated Dates*	*Total Pile Driving Days*	*Level A (PTS Onset) Harassment*				*Level B (Behavioral) Harassment All Species*
					LF Cetaceans	*MF Cetaceans*	*HF Cetaceans*	*Phocids*	
					Maximum Distance to 199 dB SELcum Threshold (m)/Area of Harassment Zone (km²)	*Maximum Distance to 198 dB SELcum Threshold (m)/Area of Harassment Zone (km²)*	*Maximum Distance to 173 dB SELcum Threshold (m)/Area of Harassment Zone (km²)*	*Maximum Distance to 201 dB SELcum Threshold (m)/Area of Harassment Zone (km²)*	*Maximum Distance to 120 dB RMS SPL Threshold(m)/Area of Harassment Zone (km²)*
6-36 Year 2	April 1, 2023 - March 31, 2024 Vibratory Pile Driving	CEP-176 Bulkhead	Install of 42-inch steel pipe and 28-inch steel sheets	18	548.7/0.14	48.6/0.0037	811.2/0.28	333.5/0.070	25,119/49.72
6-37 Year 2	April 1, 2023 - March 31, 2024 Vibratory Pile Driving	CEP-176 Bulkhead	Install of two 42-inch steel pipe piles	13	319.5/0.066	28.3/0.0013	472.4/0.11	194.2/0.038	25,119/49.72
6-38/ 6-39 Year 2	April 1, 2023 - March 31, 2024 Vibratory Pile Driving and Rotary Drilling	CEP-176 and CEP-102	Install of 42-inch steel pipe and 24-inch Square precast concrete	19	166.4/0.045	14.8/0.00053	246.1/0.097	101.2/0.017	15,849/99.00
6-40/6-41 Year 2	April 1, 2023 – March 31, 2024 Vibratory Pile Driving	CEP-176 and CEP-175	Install of 42-inch steel pipe piles and 13-inch polymeric piles	13	254.3/0.068	22.5/0.00079	375.9/0.081	154.5/0.032	18,478/49.36

Table 6-9 Calculated Maximum Distances Corresponding to MMPA Thresholds for Underwater Sound from Non-Impulsive Noise (Vibratory Pile Driving/Extraction or Rotary Drilling)* from CONCURRENT Activities

Figure	*LOA Year/Activity*	*Location*	*Pile Count, Size, Estimated Dates*	*Total Pile Driving Days*	*Level A (PTS Onset) Harassment*				*Level B (Behavioral) Harassment All Species*
					LF Cetaceans	*MF Cetaceans*	*HF Cetaceans*	*Phocids*	
					Maximum Distance to 199 dB SELcum Threshold (m)/Area of Harassment Zone (km²)	*Maximum Distance to 198 dB SELcum Threshold (m)/Area of Harassment Zone (km²)*	*Maximum Distance to 173 dB SELcum Threshold (m)/Area of Harassment Zone (km²)*	*Maximum Distance to 201 dB SELcum Threshold (m)/Area of Harassment Zone (km²)*	*Maximum Distance to 120 dB RMS SPL Threshold(m)/Area of Harassment Zone (km²)*
6-42 Year 3	April 1, 2024 – March 31, 2025 Rotary Drilling	Pier 3	Install of 24-inch Square precast concrete fender piles using two drills	35	1.9/0.000011	0.1/0	1.7/0.000009	1.0/0.000003	2,929/15.10
6-43 Year 3	April 1, 2024 – March 31, 2025 Vibratory Pile Driving	CEP-102 Bulkhead	Install of 42-inch steel pipe and 28-inch steel sheets	5	507.2/0.41	45.0/0.0038	749.9/0.83	308.3/0.15	25,119/103.24

Table 6-9 Calculated Maximum Distances Corresponding to MMPA Thresholds for Underwater Sound from Non-Impulsive Noise (Vibratory Pile Driving/Extraction or Rotary Drilling)* from CONCURRENT Activities

Figure	LOA Year/Activity	Location	Pile Count, Size, Estimated Dates	Total Pile Driving Days	Level A (PTS Onset) Harassment				Level B (Behavioral) Harassment All Species
					LF Cetaceans	MF Cetaceans	HF Cetaceans	Phocids	
					Maximum Distance to 199 dB SELcum Threshold (m)/Area of Harassment Zone (km^2)	Maximum Distance to 198 dB SELcum Threshold (m)/Area of Harassment Zone (km^2)	Maximum Distance to 173 dB SELcum Threshold (m)/Area of Harassment Zone (km^2)	Maximum Distance to 201 dB SELcum Threshold (m)/Area of Harassment Zone (km^2)	Maximum Distance to 120 dB RMS SPL Threshold(m)/Area of Harassment Zone (km^2)
6-44/ 6-45 Year 4	April 1, 2025 – March 31, 2026 Vibratory Extraction, Vibratory Install, and Rotary Drilling	Existing Pier 3 CEP-102 Platform	Extraction of 14-inch timber piles, install of 42-inch steel pipe and 28-inch steel sheets, and rotary drilling of 24-inch Square precast concrete	19	980.5/2.15	86.9/0.024	1,449.6/4.13	596.0/1.00	25,119/115.32

Table 6-9 Calculated Maximum Distances Corresponding to MMPA Thresholds for Underwater Sound from Non-Impulsive Noise (Vibratory Pile Driving/Extraction or Rotary Drilling)* from CONCURRENT Activities

Figure	LOA Year/Activity	Location	Pile Count, Size, Estimated Dates	Total Pile Driving Days	Level A (PTS Onset) Harassment				Level B (Behavioral) Harassment All Species
					LF Cetaceans	MF Cetaceans	HF Cetaceans	Phocids	
					Maximum Distance to 199 dB SELcum Threshold (m)/Area of Harassment Zone (km^2)	Maximum Distance to 198 dB SELcum Threshold (m)/Area of Harassment Zone (km^2)	Maximum Distance to 173 dB SELcum Threshold (m)/Area of Harassment Zone (km^2)	Maximum Distance to 201 dB SELcum Threshold (m)/Area of Harassment Zone (km^2)	Maximum Distance to 120 dB RMS SPL Threshold(m)/Area of Harassment Zone (km^2)
6-46/ 6-47 Year 5	April 1, 2026 – March 31, 2027 Vibratory Extraction and rotary drilling	Existing Pier 3 and CEP-102	Concurrent extraction of 16- and 18-inch Square precast concrete and rotary drilling of 24-inch Square precast concrete	75	77.2/0.019	6.8/0.00015	114.2/0.041	47/0.0069	7,356/63.96

Notes: *- To determine underwater harassment zones, radial distances from the source were truncated along the shoreline using GIS.
Proxy sources used were unattenuated SPLs.
(a) Injury thresholds are dB SEL_{CUM}, as listed in Table 6-3; (b) Behavioral disturbance thresholds are dB RMS, as listed in Table 6-3; (c) Harassment zones calculated using GIS data as determined by transmission loss modeling.
Source: NAVFAC Midlant, 2022.
Key: dB = decibels; LF = low-frequency; MF = mid-frequency; HF = high-frequency; m = meter, m^2 = square meters; PTS = permanent threshold shift; RMS = root mean square; SEL_{CUM} = cumulative sound exposure level.

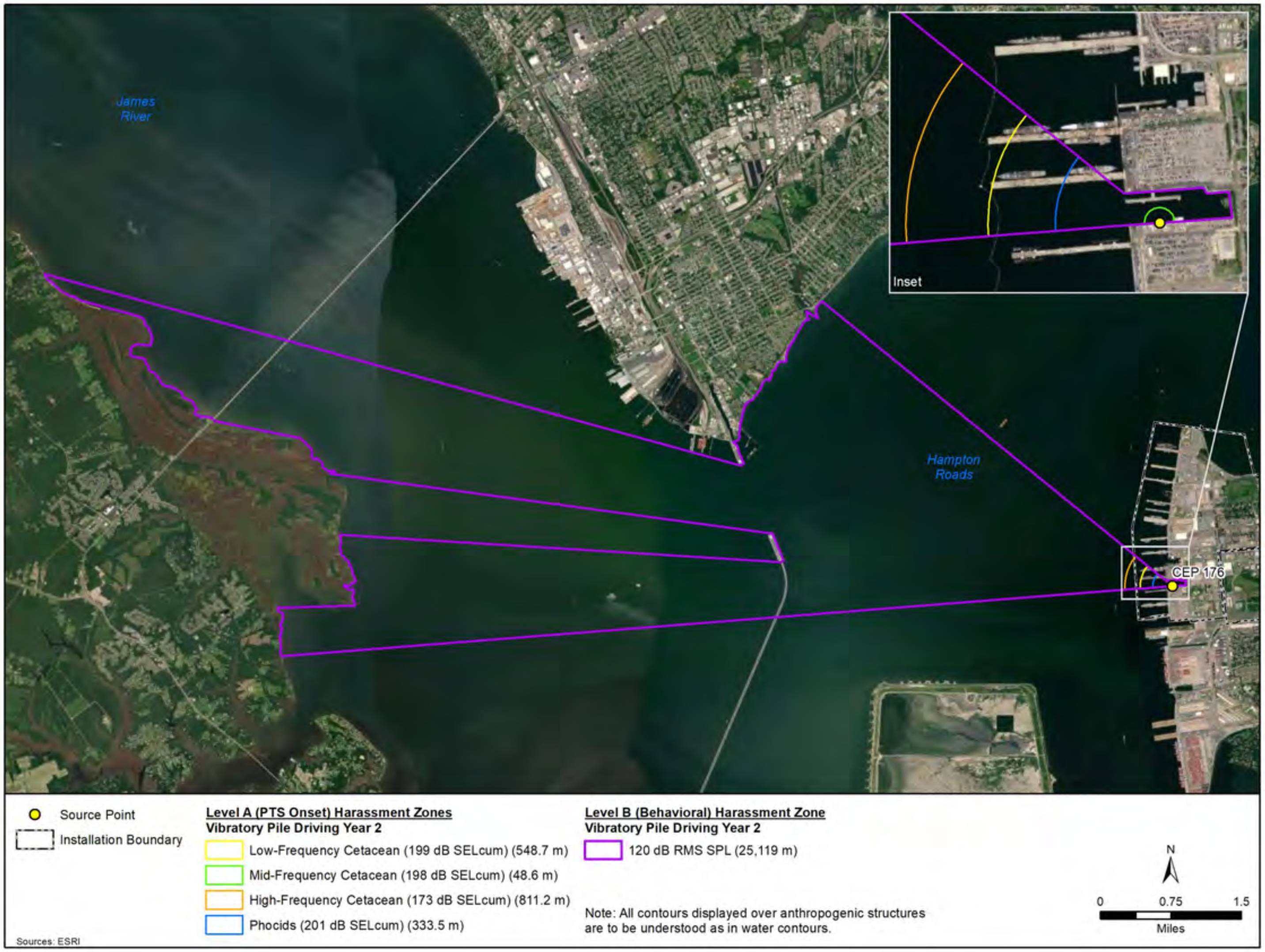

Figure 6-36 Year 2-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Concurrent Vibratory Pile Driving of 42-inch Steel Pipe and 28-inch Steel Sheet Piles at CEP-176 Bulkhead

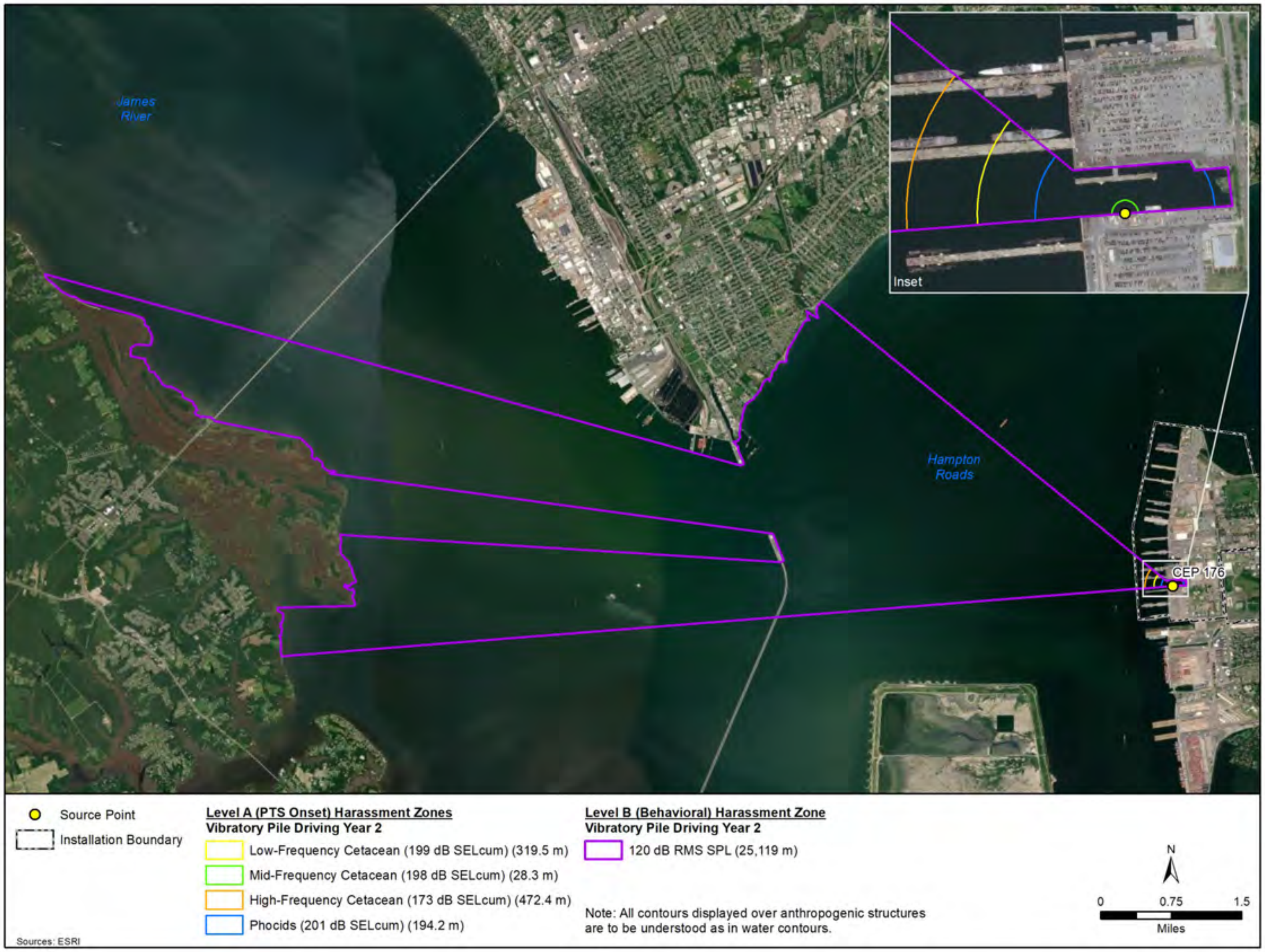

Figure 6-37 Year 2-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Concurrent Vibratory Pile Driving of Two 42-inch Steel Pipe Piles at CEP-176 Bulkhead

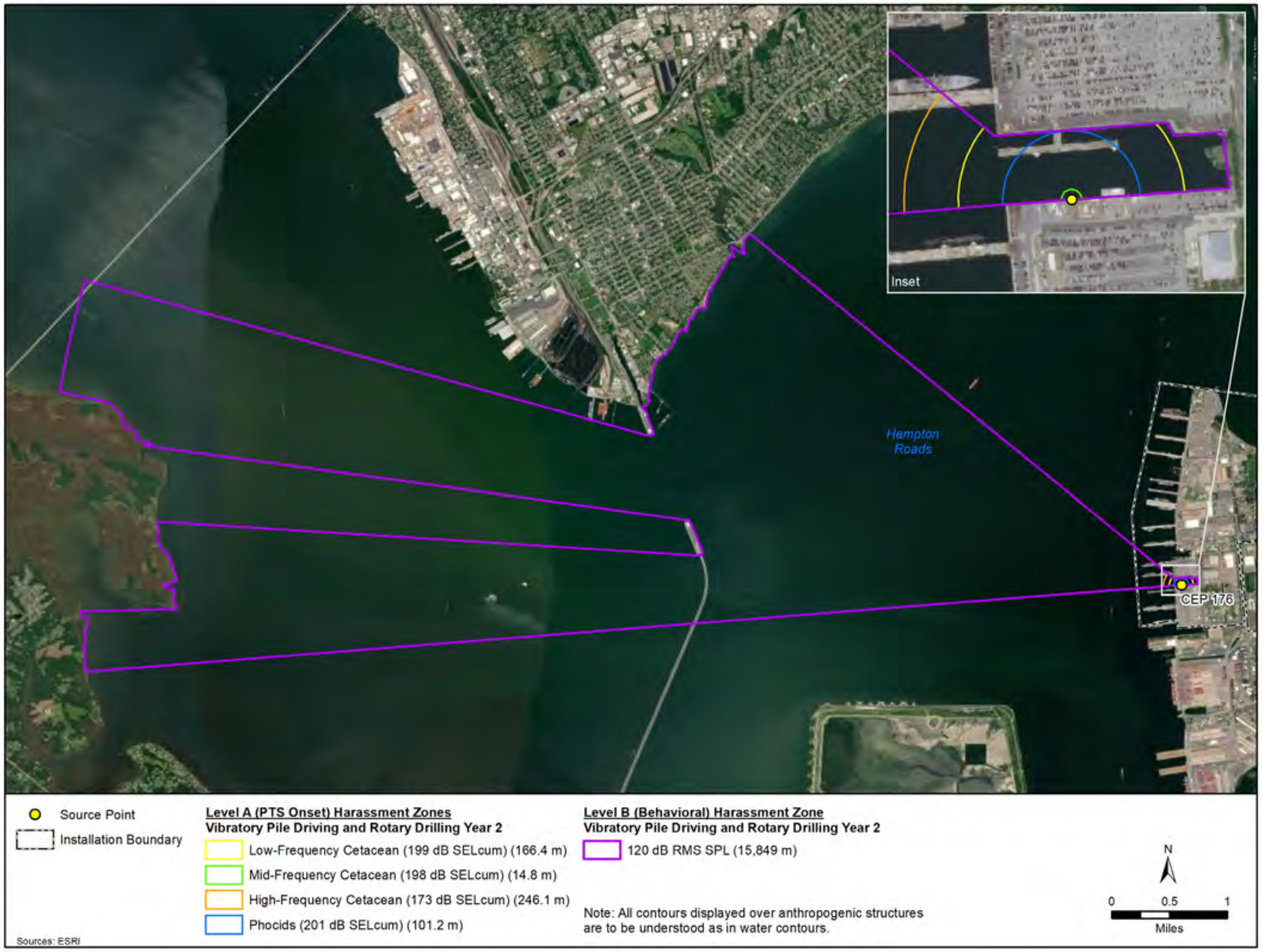

Figure 6-38 Year 2-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Concurrent Vibratory Pile Driving of 42-inch Steel Pipe Piles at CEP-176 and Rotary Drilling of Square Precast Concrete Piles at CEP-102 – Mapped from Notional Pile Location at CEP-176

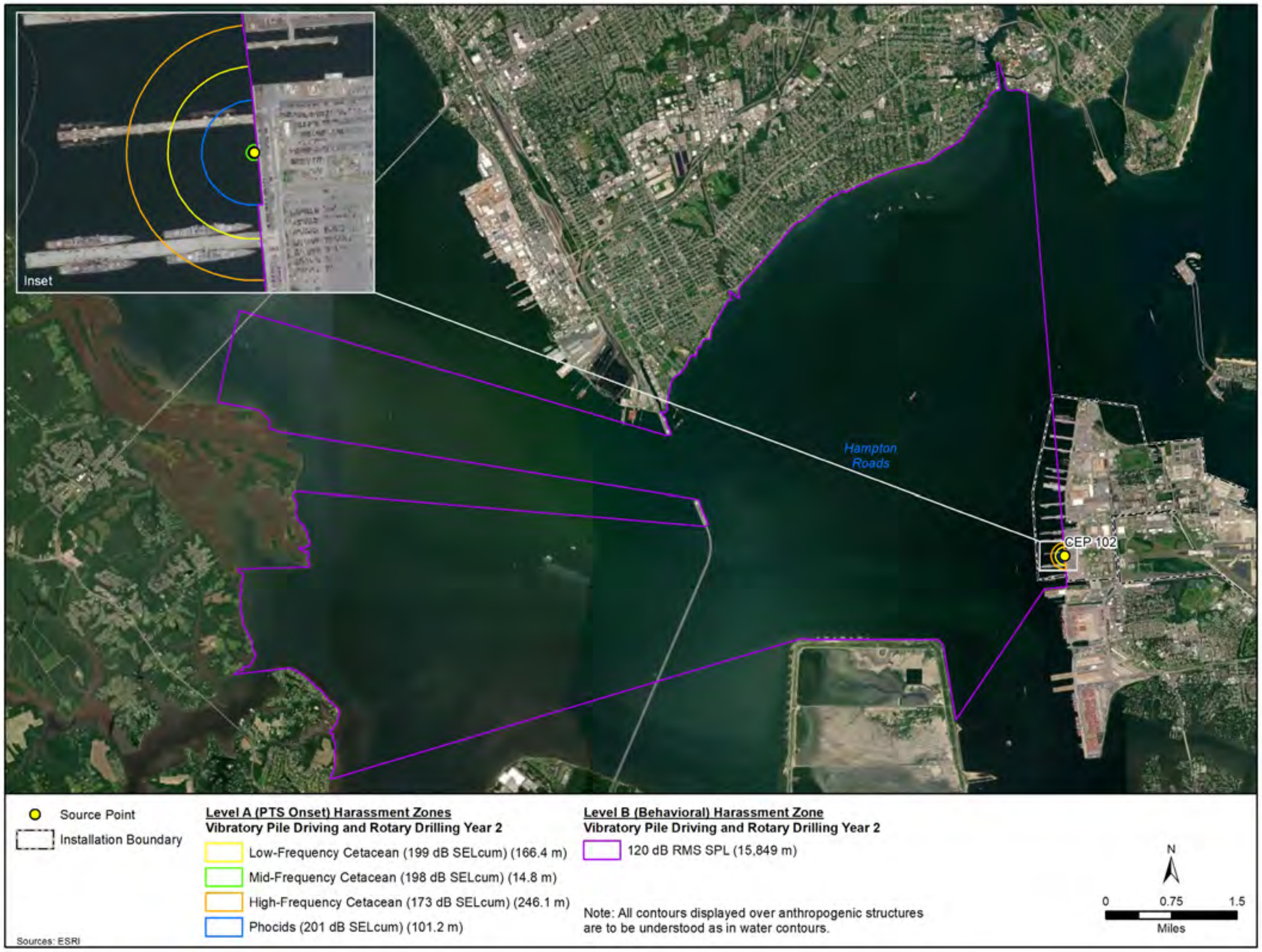

Figure 6-39 Year 2-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Concurrent Vibratory Pile Driving of 42-inch Steel Pipe Piles at CEP-176 and Rotary Drilling of Square Precast Concrete Piles at CEP-102 – Mapped from Notional Pile Location at CEP-102

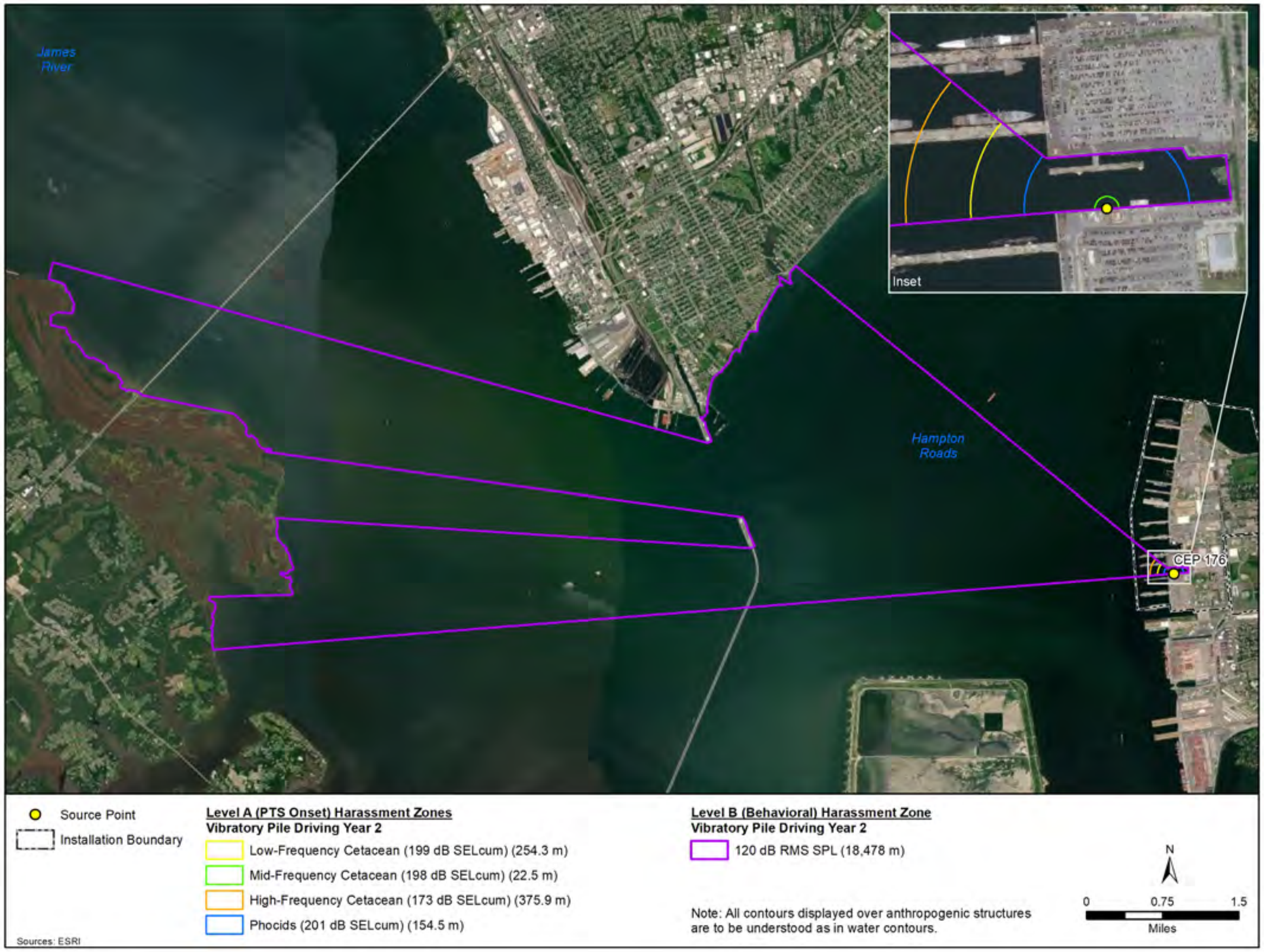

Figure 6-40 Year 2-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Concurrent Vibratory Pile Driving of 42-inch Steel Pipe Piles at CEP-176 and 13-inch Polymeric Piles at CEP-175 – Mapped from Notional Pile Location at CEP-176

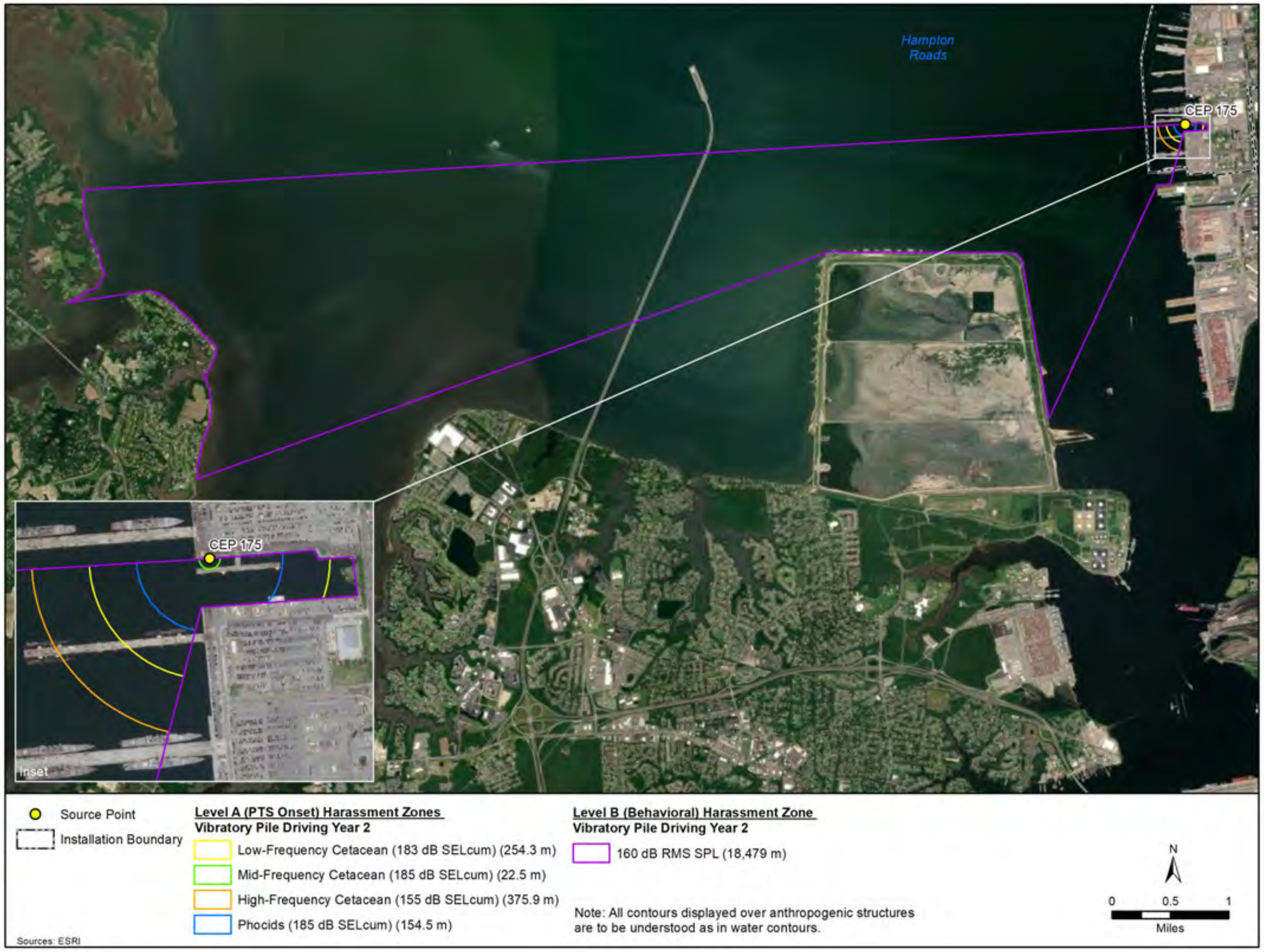

Figure 6-41 Year 2-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Concurrent Vibratory Pile Driving of 42-inch Steel Pipe Piles at CEP-176 and 13-inch Polymeric Piles at CEP-175 – Mapped from Notional Pile Location at CEP-175

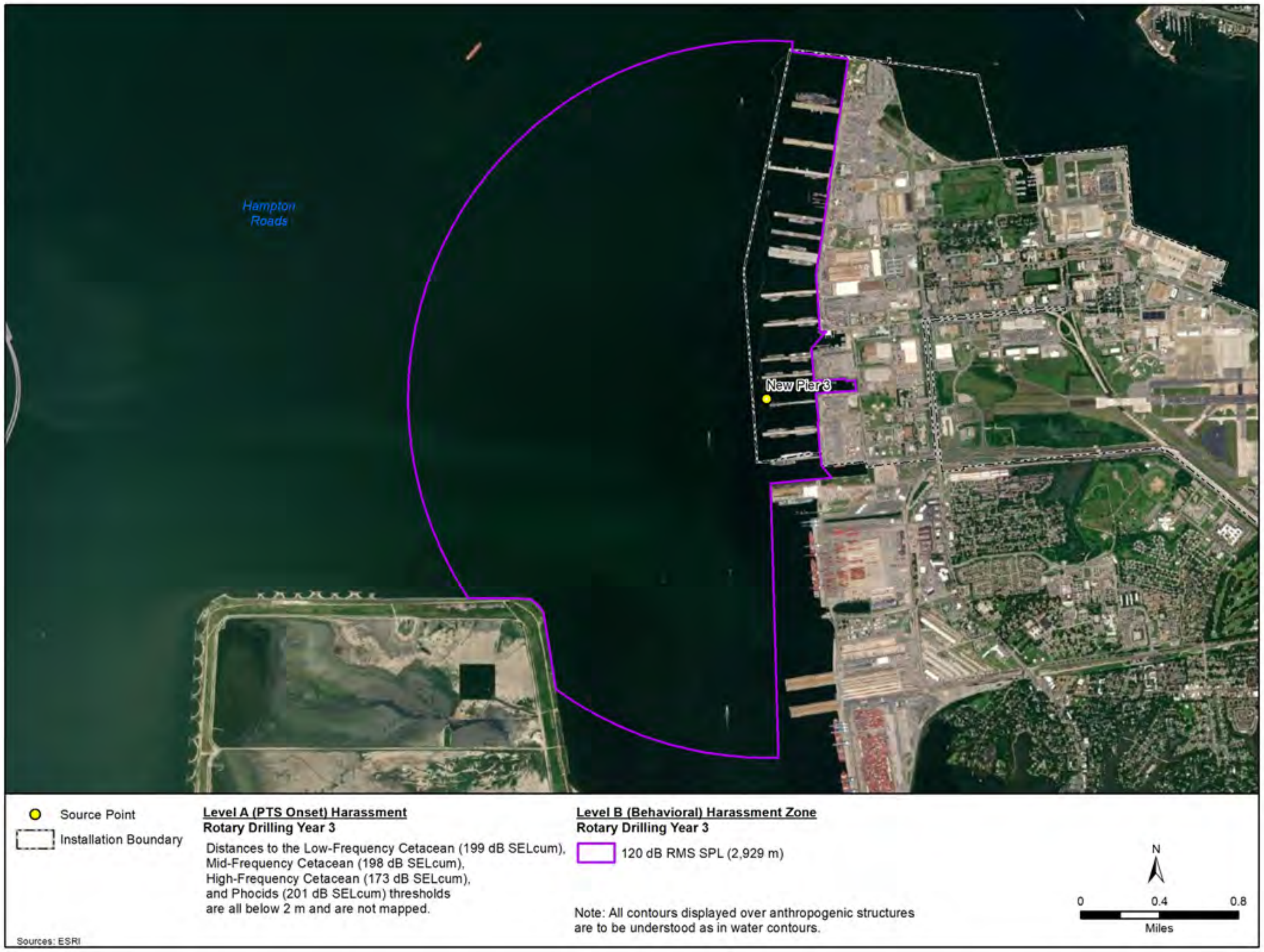

Figure 6-42 Year 3-Maximum Distance to Level B (Behavioral) Harassment Zone from Concurrent Rotary Drilling (Two Drills) of Square Precast Concrete Piles at the New Pier 3

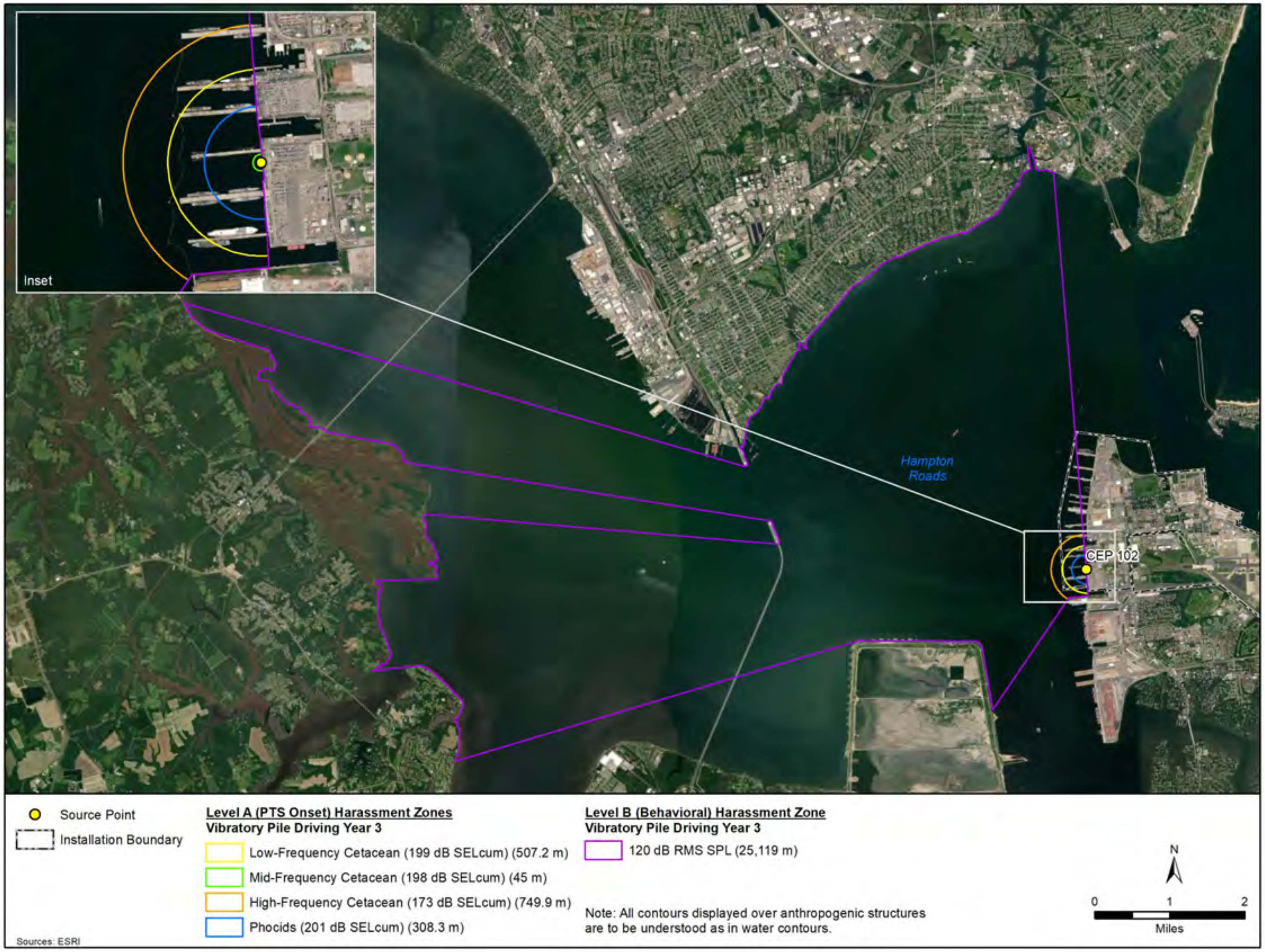

Figure 6-43 Year 3-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Concurrent Vibratory Pile Driving of 42-inch Steel Pipe and 28-inch Steel Sheet Piles CEP-102 Bulkhead

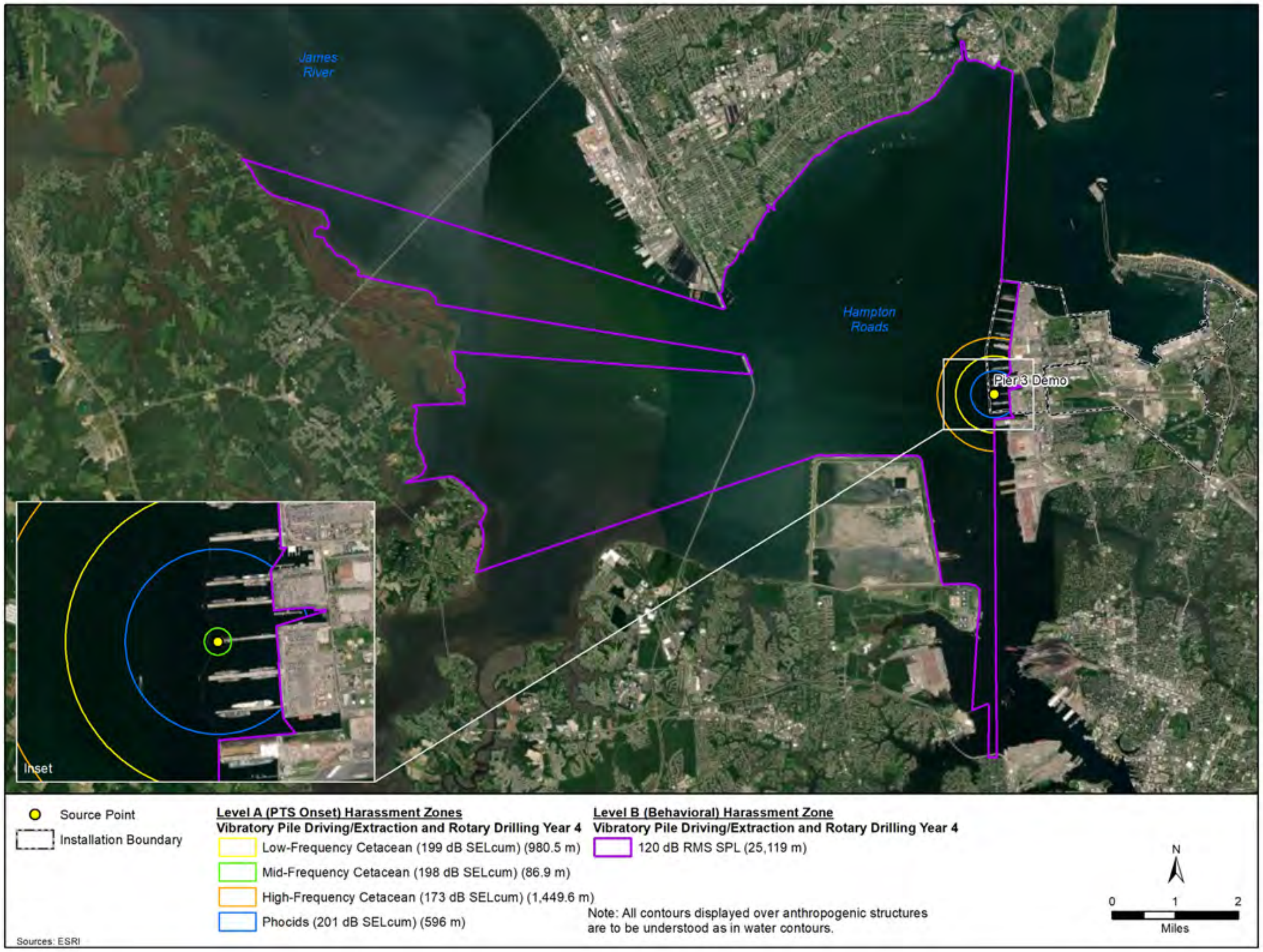

Figure 6-44 Year 4-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Concurrent Vibratory Pile Extraction of 14-inch Timber Piles at the Existing Pier 3 and Vibratory Install of 42-inch steel pipe and 28-inch Steel Sheets, and Rotary Drilling for Square Precast Concrete Piles at CEP-102 – Mapped from Notional Pile Location at Existing Pier 3

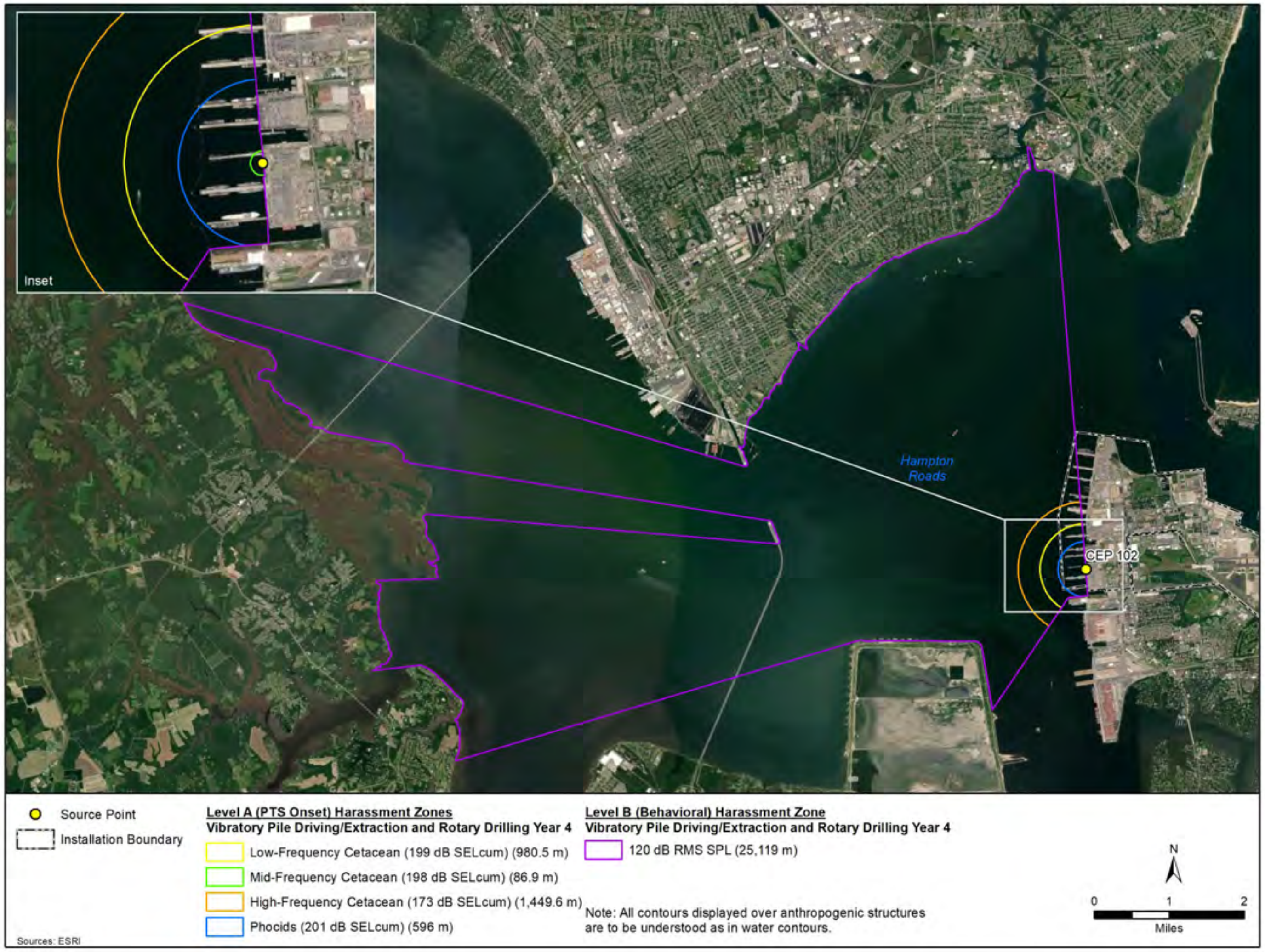

Figure 6-45 Year 4-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Concurrent Vibratory Pile Extraction of 14-inch Timber Piles at the Existing Pier 3 and Vibratory Install of 42-inch steel pipe and 28-inch Steel Sheets, and Rotary Drilling for Square Precast Concrete Piles at CEP-102 – Mapped from Notional Pile Location at CEP-102

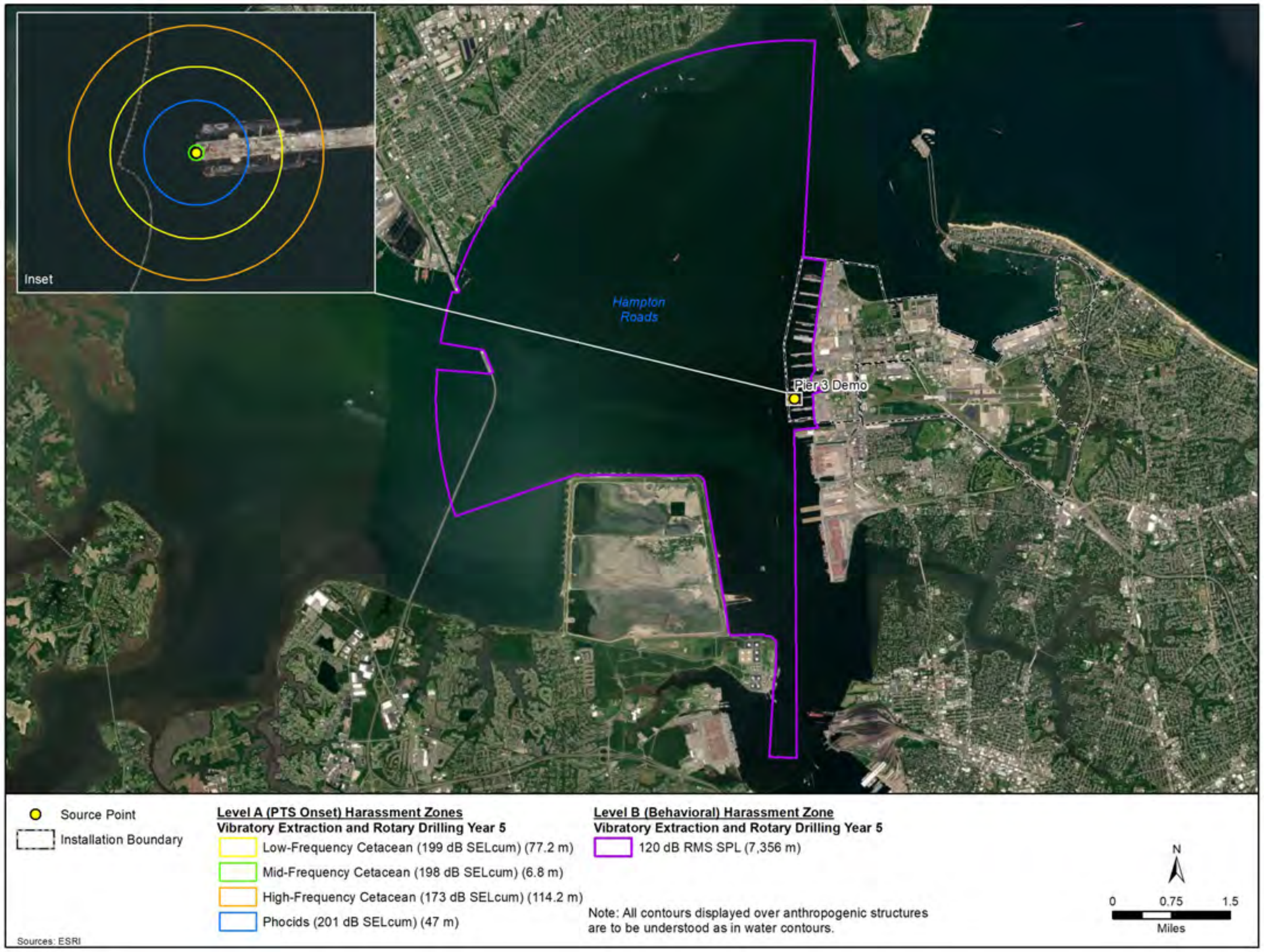

Figure 6-46 Year 5-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Concurrent Vibratory Pile Extraction of 16-to 18-inch Square Precast Concrete Piles at the Existing Pier 3 and Rotary Drilling for Square Precast Concrete Piles at CEP-102 – Mapped from Notional Pile Location at Existing Pier 3

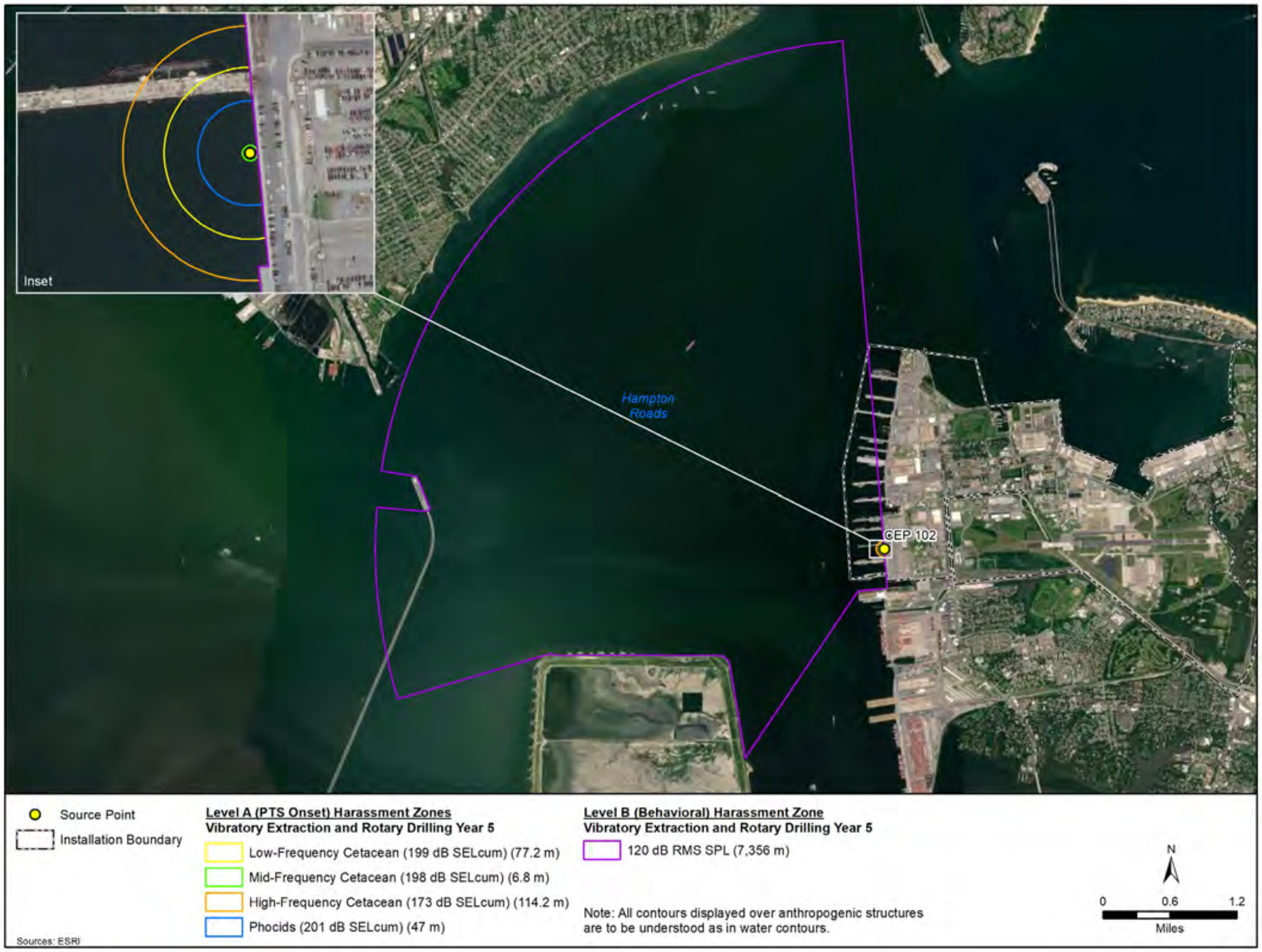

Figure 6-47 Year 5-Maximum Distance to Level A (PTS Onset) and Level B (Behavioral) Harassment Zones from Concurrent Vibratory Pile Extraction of 16-to 18-inch Square Precast Concrete Piles at the Existing Pier 3 and Rotary Drilling for Square Precast Concrete Piles at CEP-102 – Mapped from Notional Pile Location at CEP-102

If any of the concurrent activity scenarios occur, the maximum distance to the Level A (PTS onset) during construction would be during vibratory installation of 42-inch steel pipe and 28-inch steel sheet piles during Year 2 at CEP-176 (549 m for humpback whale; 49 m bottlenose dolphin; 811 m for harbor porpoise; and 334 m for pinnipeds) and during Year 3 at CEP-102 (507 m for humpback whale; 45 m for bottlenose dolphin; 750 m for harbor porpoise; and 308 m for pinnipeds).

The furthest extent to the Level B (behavioral) harassment threshold during construction would be a distance of 25,119 m during the same scenario above at CEP-176 and CEP-102 during Years 2 and 3, respectively.

6.9 Airborne Sound Propagation

Pile driving can generate airborne noise that could potentially result in disturbance to pinnipeds that are hauled out or swimming or resting at the water's surface. There is no threshold for Level A injury for airborne sound for marine mammals. As a result, the Navy analyzed the potential for seals to be exposed to airborne SPLs that could result in Level B behavioral harassment. The airborne noise threshold for behavioral harassment for harbor seals is 90 dB RMS re 20 µPa (unweighted) and is 100 dB RMS re 20 µPa (unweighted) for other pinnipeds (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 (Washington State Department of Transportation [WSDOT], 2019). The water surface is considered a hard site and acts as a reflective surface where it does not provide any attenuation (WSDOT, 2019). There are no known seal haul out sites in the vicinity of the project area. Therefore, it is assumed that areas affected by airborne noise would be smaller than the underwater behavioral threshold zones and a separate analysis of airborne noise and associated takes was not conducted. Seals in the airborne zones would already be exposed within the corresponding Level B underwater zone.

6.10 Estimated Duration of Construction

Pile driving, extraction, and drilling during Years 2-5 of construction for the proposed project will take approximately 513 nonconsecutive days over a period of 4 years, from April 1, 2023 to March 30, 2027. Vibratory and impact pile driving/extraction is assumed to occur on all of those days, with pre-drilling occurring as needed, up to 156 days.

6.11 Basis for Estimating Take by Harassment

The Navy is seeking authorization for the potential taking of humpback whale, common bottlenose dolphin, harbor porpoise, harbor seal, and gray seals near NAVSTA Norfolk as a result of pile driving, extraction, and rotary drilling activities associated with the proposed project. The takes requested are expected to have no more than a minor effect on individual animals and no effect on the populations of these species. Any effects experienced by individual marine mammals are expected to be 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 In-Water Construction Noise

6.12.1 Approach to Estimating Abundance of Marine Mammals Exposed to Noise

Density estimates are available for bottlenose dolphins based on shipboard surveys of the mouth of the Chesapeake Bay and Virginia coast (Engelhaupt et al., 2014; Engelhaupt et al., 2015; Engelhaupt et al., 2016). The Navy has developed a Marine Mammal Species Density Database (Navy, 2017) for the east coast and Atlantic Fleet Training and Testing Study Area, but there are no densities available for the remaining species in the project area. As discussed in Section 3.1 (Marine Mammal Species Likely to be Found within the Activity Area), using a density-based analysis for species that occur intermittently may not adequately account for their unique temporal and spatial distributions in a limited study area[1]. For rare species, historical occurrence and numbers as well as group size were reviewed to develop a realistic estimate of potential exposure to project impacts.

A density-based analysis for bottlenose dolphin uses the following equation to estimate exposure to noise-relative project impacts[2]:

Exposure estimate= (N × harassment zone) × maximum days of pile driving

where

N = seasonal density estimate used for the species; and

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

For the remaining species with no density estimates available for the Chesapeake Bay/Virginia coastline (humpback whale, harbor porpoise, harbor seal, gray seal), the likelihood of occurrence was reviewed based on the information in Section 3 (Marine Mammal Species and Numbers) and Section 4 (Affected Species Status and Distribution) and the potential maximum duration of work days and total work days. The rationale for estimating probable abundance and duration is described for each species in Section 6.13 (Exposure Estimates). Results of the calculations for all potentially affected marine mammal species are described in Section 6.13.

(1) Exposure estimate = Probable abundance during construction × Probable duration

where:

Probable abundance = maximum expected group size, and

Probable duration = probable duration of animal(s) presence at construction sites during in-water work.

6.12.2 Assumptions

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 also exposes them to underwater noise, both natural and

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1 Previously, a density-based exposure analysis was required for these species. The analyses often resulted in zero exposure estimates because of the small size of the affected area and the low densities of most species. Therefore, to obtain IHA coverage for potential exposure to these animals, the Navy would typically augment the requested take by the typical group size of animals. NMFS has subsequently requested that future Navy applications do not use a density estimate for marine mammal species with a low likelihood of occurrence.

2 If exposure is greater than or equal to 0.5 animals, the product is rounded up to a whole number

anthropogenic, essentially 100 percent of the time because their ears are nearly always below the water's surface.

Pinnipeds spend significant amounts of time out of the water during breeding and molting periods, and while resting at haul out sites. In the water, pinnipeds spend varying amounts of time underwater. When not actively diving, pinnipeds at the surface often orient their bodies vertically or horizontally 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.

To assess impacts from underwater sound, the Navy assumed that all cetacean and pinniped species spend 100 percent of their time underwater. This approach is conservative because seals spend a portion of their time hauled out and are therefore expected to be exposed to less sound than is estimated by this approach. Some additional assumptions were used to calculate potential exposures to impact and vibratory pile driving noise for each threshold:

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

- The timeframe for takings would be one potential take per individual, per 24 hours.
- The pile type, size, and installation method that produce the largest harassment zones were used to estimate exposure of marine mammals to noise impacts.
- Exposures to airborne noise were considered included in the larger underwater harassment zones from vibratory driving and, therefore, airborne noise exposures were not calculated for seals because no haul outs occur within the airborne harassment zones for the proposed project.
- Take estimates applied NMFS' suggested methods from the newly published final rule for the taking of marine mammals incidental to U.S. Navy construction at NAVSTA Norfolk (maintenance pile upgrades LOA; 86 FR 24340; NMFS, 2021a and Year 1 IHA for this project [NMFS, 2022]) and from project discussions with NMFS biologists.

6.13 Exposure Estimates

Exposure estimates for each species are discussed in the following sections and presented in Table 6-10 (for non-concurrent activities only). Takes that are estimated due to concurrent pile driving/extracting/drilling activities (see Table 6-8) and discussed in each species section below.

Reporting requirements will provide details of how many actual 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 nearshore waters. When possible and with the available data, this is discussed by species in the sections that follow.

Table 6-10 Underwater Exposure Estimates from Individual Activities by Species and LOA Estimated Construction Year

LOA Construction By Estimated Year	*Species*	*Individual Activities*		*Concurrent Activities*	
		Level A (PTS Onset)	*Level B (Behavioral)*	*Level A (PTS Onset)*	*Level B (Behavioral)*
Year 2 April 2023-March 2024	Humpback whale	0	6	0	2
	Bottlenose dolphin	0	2,619	0	5,609
	Harbor porpoise	2	4	0	1
	Harbor seal	57	949	25	832
	Gray seal	0	1	0	1
Year 3 Apr 2024-March 2025	Humpback whale	0	3	0	1
	Bottlenose dolphin	0	3,061	0	1,440
	Harbor porpoise	0	3	0	1
	Harbor seal	4	309	7	537
	Gray seal	0	0	0	1
Year 4 April 2025-March 2026	Humpback whale	0	7	0	1
	Bottlenose dolphin	0	13,190	0	3,023
	Harbor porpoise	2	5	0	1
	Harbor seal	0	1,809	26	232
	Gray seal	0	2	0	0
5 April 2026-March 2027	Humpback whale	0	2	0	3
	Bottlenose dolphin	0	383	0	6,620
	Harbor porpoise	0	1	0	3
	Harbor seal	0	435	0	1,115
	Gray seal	0	2	0	1

Key: LOA = Letter of Authorization; PTS = permanent threshold shift

6.13.1 Humpback Whale

Humpback whales are seen in the mouth of the Chesapeake Bay and nearshore waters of Virginia during winter and spring months. Most detections during shipboard surveys were of one or two juveniles per sighting. Although two individuals were detected in the vicinity of project activities, there is no evidence that they linger for multiple days. Because no density estimates are available for the species in this area, the Navy estimated two takes for every 60 days of pile driving, based on the potential group size of two animals. The resulting estimate of potential exposures to Level B noise ranges from two to seven individuals per year depending on number of pile driving/extracting days occurring per year (see Table 6-10). Therefore, the Navy is requesting incidental takes of up to six individual whales for Level B harassment due to underwater noise resulting from pile driving/extracting and drilling during Year 2, three takes in Years 3, seven takes in Year 4, and two takes in Year 5. The majority of affected humpback whales would be expected to be juveniles.

To protect humpback whales from injurious noise impacts, the Navy will implement a shutdown if any whales are seen by marine mammal monitors in an injury zone (see Table 5-2). Therefore, no Level A takes are requested for humpback whales.

Table 6-8 presents concurrent pile driving/extracting/drilling scenarios that may occur in Years 2-5. Concurrent activities would reduce production days with simultaneous work occurring. Using the same methods described above, it is estimated that two Level B takes for Year 2, one Level B Take in Years 2 and 3, three Level A Takes in Year 5 and no Level A takes would occur if all concurrent scenarios were to occur.

6.13.2 Bottlenose Dolphin

Bottlenose dolphins are abundant along the Virginia coast and within the Chesapeake Bay and can be seen annually in Virginia from May through October. A density of 1.38 dolphins/km^2 was estimated through review of inshore seasonal densities provided in Engelhaupt et al. (2016) that conducted vessel line-transect surveys near NAVSTA Norfolk and adjacent areas near Virginia Beach, Virginia, from August 2012 through August 2015. This density includes sightings inshore of the Chesapeake Bay from NAVSTA Norfolk west to the Thimble Shoals Bridge, and is the most representative density for the project area (NMFS, 2022). Shipboard surveys of marine mammals in the vicinity of NAVSTA Norfolk and nearshore Virginia coast have provided seasonal densities of bottlenose dolphins. Exposure to Level A and Level B harassment due to pile driving was estimated using the equation in Section 6.11 (Estimating Potential Exposures to Pile Driving Noise), in which the inputs are seasonal density, harassment zone, and maximum number of pile driving days. Based on the proposed activities, no Level A takes are anticipated, and Level B takes were estimated and included in Table 6-11.

Table 6-11 Bottlenose Dolphin Calculated Exposure by Year, Location, and Activity

Estimated Year	*Location*	*Activity*	*Level B Takes*
Year 2	CEP-176 Bulkhead	Impact Install 42-inch Steel pipe	15*
		Vibratory Install 42-inch Steel pipe	1,649
		Impact Install 28-inch steel sheets	54*
		Vibratory Install 28-inch steel sheets	883
	CEP-175 Bulkhead	Impact Install 13-inch polymeric piles	0
		Vibratory Install 13-inch polymeric piles	31
	CEP-102	Impact Install 24-inch concrete	0
		Drilling Install 24-inch concrete	36
	Pier 3	Impact Install 24-in concrete	4
	CEP-102	Impact Install 18-inch concrete	0
		Pre-drilling 18-inch concrete fender piles	12
	Pier 3	Impact Install 24-inch concrete	4
Year 3	Pier 3	Impact Install 24-inch concrete	4*
		Pre-drilling 24-inch concrete piles	622
		Impact install 18-inch steel piles	0
	CEP-102	Impact Install 42-inch Steel pipe	25*
		Vibratory Install 42-inch Steel pipe	1,774
		Impact Install 28-inch steel sheets	44*
		Vibratory Install 28-inch steel sheets	500
		Vibratory Extraction 18-inch concrete	165
Year 4	CEP-102	Impact install 24-inch concrete piles	1*
		Pre-drilling 24-inch concrete piles	121

Table 6-11 Bottlenose Dolphin Calculated Exposure by Year, Location, and Activity

Estimated Year	***Location***	***Activity***	***Level B Takes***
	Existing Pier3	Vibratory Extraction 14-inch timber piles	1,723
	CEP-102	Impact Install 18-inch concrete fender piles	0
		Pre-drilling 18-inch concrete fender piles	42
		Impact Install 42-inch Steel pipe	48*
		Vibratory Install 42-inch Steel pipe	3,412
	Existing Pier 3	Vibratory Extraction 24-inch concrete fender	482
	CEP-102	Impact Install 28-inch steel sheets	88*
		Vibratory Install 28-inch steel sheets	1,001
		Vibratory Extraction 18-inch concrete fender piles	219
Year 4	Existing Pier 3	Vibratory Extraction 16- to 18-inch concrete piles	6,063
	CEP-102	Impact install 24-inch concrete piles	1*
		Pre-drilling 24-inch concrete piles	127
Year 5	Existing Pier 3	Vibratory Extraction 16- to 18-inch concrete fender piles	207
	CEP-102	Impact Install 24-inch concrete bearing piles	1*
		Pre-drilling 24-inch concrete bearing piles	97
		Impact Install 18-inch concrete fender piles	0
		Pre-drilling 18-inch concrete fender piles	79
TOTAL BOTTLENOSE DOLPHIN TAKE ESTIMATE			19,253

Notes: No Level A Takes. Some project elements will use only one method of pile installation (vibratory OR drilling/impact OR impact only). Therefore, takes shown are an over estimate, depending on the installation method.

*Some piles for a few projects are listed twice, due to the contractor choosing the installation method. However, only the method resulting in the most takes was counted in the take totals. In all cases, vibratory driving resulted in the most takes. Numbers with an asterisk indicate calculated takes that were excluded from the totals due to duplication.

Total bottlenose dolphin Level B takes for individual activities (non-concurrent) are estimated at 19,253 total for Years 2 through 5. This accounts for the worst-case construction scenario, from vibratory installation methods. Table 6-11 analyzes takes from all possible methods, but the total subtracts the takes from impact driving when either vibratory or impact could occur. Upon award of the project, the contractor will complete tests to determine which installation method will be most effective and piles would be installed with either impact or vibratory hammers, as indicated in Sections 1 and 2. Resulting takes are likely to be less than the estimate and actual takes of this species will be reported in the annual reports.

The largest injury zone for bottlenose dolphins is 63.4 m resulting from impact driving 28-inch steel sheet piles. This falls within the proposed “shutdown zone” (see mitigation measures in Section 11). Therefore, no Level A takes are requested for bottlenose dolphins.

Table 6-12 presents Level B takes that are estimated to occur if all concurrent pile driving/extracting/drilling scenarios were to occur. Implementation of the shutdown zone would ensure no Level A takes.

Table 6-12 Bottlenose Dolphin Calculated Exposure by Estimated Year and Concurrent Equipment Use Scenario

Estimated Construction Year	*Concurrent Equipment Use Scenario*	*Level B Takes*
Year 2	CEP-176 Bulkhead: Vibratory Install of 42-inch steel pipe and 28-inch Steel Sheets	1,235
	CEP-176 Bulkhead: Vibratory Install of two 42-inch Steel Pipe piles	892
	CEP-176 Bulkhead and CEP-102: Vibratory Install of 42-inch steel pipe and Rotary Drill of 24-inch concrete	2,596
	CEP-176 Bulkhead and CEP-175 Bulkhead: Vibratory Install of 42-inch steel pipe and 13-inch polymeric piles	886
Year 3	I Pier 3: Rotary Drill of two drills for 24-inch concrete	729
	CEP-102 Bulkhead: Vibratory Install of 42-inch steel pipe and 28-inch steel sheets	711
Year 4	Existing Pier 3 and CEP-102: Vibratory Extraction of 14-inch timber and vibratory install of 42-inch steel pipe, 28-inch steel sheets, and rotary drill for 24-inch concrete	3,023
Year 5	Vibratory EXTRACT 16-18-inch concrete piles and rotary drill for concrete piles	6,620

Notes: No Level A Takes.

6.13.3 Harbor Porpoise

Harbor porpoises appear to be rare in the Chesapeake Bay waters in most years, and there is no information about how long, when present, they would linger in the area. For this analysis, it is assumed that any harbor porpoises that occur in the NAVSTA Norfolk vicinity are transiting through the area. Elsewhere in their range they typically occur in groups of 2 to 3 individuals (Carretta et al., 2001; Smultea et al., 2017). Because there are no density estimates for the species in the project area, the Navy conservatively estimated (similar to the methods used in previous IHAs) that there is a porpoise sighting once every 60 days of pile driving/extracting or drilling. Therefore, the assumptions are two individuals per 60 days used for the calculation. Total pile driving days in Year 2 would be 185, Year 3 would have 92 days, Year 4 would have 204 days, and Year 5 would have 32 days. Using the methods and days above for year construction year, the Navy conservatively estimated six total expected takes for Year 2, three total Takes for Year 3, seven total Takes for Year 4, and one total Take in Year 5 (Table 6-10). Per NMFS guidance following their preliminary review of this application, the Navy is requesting incidental takes of up to two (species group size) of the total expected takes per year above for Level A takes and the remaining total expected takes per year for Level B harassment due to underwater noise resulting from vibratory pile driving/extracting/drilling activities. Therefore, Level B Takes requested are four during Year 2, three during Year 3, five during Year 4, and one during Year 5. Animals of any age, sex, or reproductive status could be exposed to elevated underwater noise.

The largest injury zone (Level A exposure) calculated for harbor porpoise is 2,123 m during impact driving of 28-inch diameter steel sheet piles. The Navy will use a 500-meter shutdown zone (previously agreed to with NMFS) for harbor porpoises during impact pile driving of steel and concrete piles (see Table 5-2). This is considered a reasonable area to observe and implement shutdowns for this small and cryptic species while avoiding an impractical number of shutdowns. Due to the cryptic nature of harbor porpoises, it is unlikely that observers would be able to detect every individual entering the injury zone. Per NMFS guidance following their preliminary review of this application described above, the Navy is requesting incidental takes of two Level A Takes in Years 2 and 4 and no Level A takes in Years 3 and 5 Animals of any age, sex, or reproductive status could be exposed to elevated underwater noise.

For concurrent pile driving/extracting/drilling activities presented in Table 6-8, the Navy assumes all scenarios would occur for the sake of being conservative. Per NMFS guidance above, it is estimated that there would be two Level B Takes in Year 2, one Level B Take in Years 3 and 4, three Level B Takes in Year 5 and no Level A Takes of harbor porpoise should all concurrent scenarios occur.

6.13.4 Harbor Seal

Harbor seals regularly haul out on rocks around the portal islands of the CBBT (between approximately 20 and 26 kilometers) from the project area and on mud flats on the nearby southern tip of the Eastern Shore (over 35 kilometers) from the project area (Rees et al., 2016; Jones et al., 2018), and some individuals regularly range into the Chesapeake Bay. Their occurrence is seasonal, from November to April. Although density estimates are not available for this area, haul out survey data can be used to estimate exposure to pile driving noise at the project location. The maximum seal count on a single survey day during 4 survey seasons at CBBT was 45 and during 2 survey seasons at the Eastern Shore haul out site the maximum count was 69 (Rees et al., 2016; Jones et al., 2018). Animals move between haul out sites; therefore, the highest maximum count at the Eastern Shore haul out was used to estimate exposures of harbor seals. Tracking of seven satellite-tagged harbor seals that were captured in the winter at the Eastern Shore haul out site revealed that four seals made trips into the Chesapeake Bay, including one seal that stayed in the bay until it migrated from the area (Ampela et al., 2019). Tracking data indicate that one of these seals entered Hampton Roads Harbor, transited past NAVSTA Norfolk and on to the Warwick River, a minor tributary of James River located approximately 24 kilometers northwest of NAVSTA Norfolk. None of the other seals entered Hampton Roads Harbor. Three tagged seals never entered the Chesapeake Bay. All tagged seals migrated from the area by mid-April. The tagged seals made a total of 56 trips, defined as travel greater than 10 kilometers (km) away from the capture site, while in Virginia waters, of which 36 percent were within the Chesapeake Bay.

Consistent with the approach used in U.S. Navy maintenance pile upgrades LOA at NAVSTA Norfolk (86 FR 24340, NMFS, 2021a) and Year 1 IHA for this Project (NMFS, 2022), the Navy has calculated harbor seal takes based on 13.6 seals per day. Per additional guidance provided by NMFS during a review of this application, 13.6 seals per day was multiplied by the pile driving days within the November 1 to April 30 timeframe when seals are more likely to be present. This entails potential occurrence of harbor seals for 74 days during Year 2, 23 days during Year 3, 133 days during Year 4, and 32 days during Year 5. The 13.6 seals per day was multiplied by occurrence days to get the total takes. Level A takes were calculated based on the number of production days within the November 1 to April 30 timeframe on which the isopleth would exceed the shutdown zone of 200 m (42 days in Year 2; 3 days in Year 3; and 0 days in Year 4 and 5), assuming that approximately 10 percent of harbor seal exposures would be at or above the Level A harassment threshold. Level B takes were calculated by subtracting the Level A takes estimated per year from the total calculated takes (Table 6-13).

Table 6-13 Total Underwater Exposure Estimates for Harbor Seals by LOA Construction Year

Estimated LOA Construction Year	*Level A (PTS Onset)*	*Level B (Behavioral)*
Year 2 April 2023 – March 2024	57	949
Year 3 Apr 2024-March 2025	4	309
Year 4 April 2025-March 2026	0	1809
5 April 2026-March 2027	0	435

Notes: For pile driving activities that only occur in April-May, it was assumed that majority of production occurred in April when seals may be present.

For concurrent pile driving/extracting and drilling activities, a conservative approach was used in that takes were determined based on all scenarios for each year (Table 6-8) would occur. The same methods for calculate takes for Level A and B were used as stated above for individual activities. Therefore, Navy requests 832 Level B and 25 Level A takes in Year 2; 537 Level B and 7 Level A takes in Year 3; 232 Level B and 26 Level A takes in Year 4; and 1,115 Level B and 0 Level A takes in Years 5.

6.13.5 Gray Seal

Very little information is available about the occurrence of gray seals in the Chesapeake Bay and coastal waters. Although the population of the U.S. may be increasing, there are only a few records at known haul out sites in Virginia used by harbor seals, strandings are rare, and they have not been reported in shipboard surveys. Assuming that they may utilize the Chesapeake Bay waters, the Navy conservatively estimates that one gray seal may be exposed to elevated noise levels for every 60 days of vibratory pile driving during the 6-month period when they are most likely to be present. The maximum number of pile driving days where gray seals may be exposed (between November 1 and April 30) were used per estimated year as approach discussed above for harbor seals (Table 6-14). For concurrent pile driving scenarios presented in Table 6-8 and assuming all scenarios occur, it is estimated there would be one Level B take in Years 2,3, and 5 only and no Level A takes for any of the construction years .

Table 6-14 Total Underwater Exposure Estimates for Gray Seals by LOA Construction Year

Estimated LOA Construction Year	*Level A (PTS Onset)*	*Level B (Behavioral)*
Year 2 April 2023 – March 2024	0	1
Year 3 Apr 2024-March 2025	0	0
Year 4 April 2025-March 2026	0	2
5 April 2026-March 2027	0	2

Notes: For pile driving activities that only occur in April-May, it was assumed that majority of production occurred in April when seals may be present.

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 Effects of In-water Construction on Marine Mammals

7.1.1 Potential Effects Resulting from Underwater Noise

Potential impacts to marine species can be caused by 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 sounds on marine mammals. Potential effects from impulsive sound sources can range from Level B effects such as brief behavioral disturbance, tactile perception, and physical discomfort, to Level A impacts, which may include slight injury of the internal organs primarily within air spaces (e.g., lungs, sinuses, ears, and gastrointestinal tract) and the auditory system, and possible death of the animal (Dahl et al., 2015; Finneran, 2015; Kastelein et al., 2016; Kastelein et al., 2018; Ketten, 1995; Navy, 2001; O'Keeffe & Young, 1984; Yelverton et al., 1973).

7.1.1.1 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, and damage the cochlea; it can also cause hemorrhage, and cause leakage of 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 by prolonged exposure to noise. Instances of temporary threshold shifts and/or auditory fatigue are well documented in marine mammal literature as being one of the primary avenues of acoustic impact. Temporary loss of hearing sensitivity has been documented in controlled settings using captive marine mammals exposed to strong sound exposure levels at various frequencies (Finneran, 2015; Finneran et al., 2005; Kastak et al., 1999; Kastelein et al., 2015; Mooney et al., 2009; Ridgway et al., 1997). While injuries to other sensitive organs are possible, they are less likely since pile driving impacts are almost entirely acoustically mediated, versus explosive sounds that also include a shock wave that can result in damage.

7.1.1.2 Behavioral Responses

Behavioral responses to sound can be highly variable. 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, auditory sensitivity, biological and social status (including age and sex), and 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 (National Research Council, 2003; Richardson et al., 1995; Southall et al., 2007; 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 (Finneran et al., 2003; Ridgway et al., 1997). Observed responses of wild marine mammals to loud pulsed sound sources (typically seismic guns or acoustic harassment devices and including pile driving) have been varied, but often consist of avoidance behavior or other behavioral changes suggesting discomfort (Gordon et al., 2004; Morton & Symonds, 2002; Nowacek et al., 2007; Wartzok et al., 2004). 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 153–160 dB RMS range tolerated this noise level and did not seem unwilling to dive. One individual was as close as 63 m from the pile driving.

Responses of harbor seals to impact pile driving at the San Francisco-Oakland Bay Bridge East Span Seismic Safety Project were mixed (California Department of Transportation, 2001; Thorson, 2010; Thorson & Reyff, 2006;). Harbor seals were observed in the water at distances of approximately 400 to 500 m 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. It is likely that seals were transiting through the pile driving area to the haul out site or feeding areas despite pile driving noise. One of these harbor seals was even seen to swim to within 150 m of the pile driving barge during pile driving.

Telemetry studies and modeling of harbor seal usage of offshore wind farm sites in Britain showed significant displacement of harbor seals during periods when impact pile driving was taking place (up to 25 km from the center of the wind farm), but use of the area resumed during breaks in pile driving greater than 2 hours (Russell et al., 2016). Another telemetry study conducted in the Wadden Sea found that reactions to pile driving were diverse. Reactions included altered surfacing or diving behavior and changes in swim direction, including swimming away from the source, heading into shore or traveling perpendicular to the incoming sound, coming to a halt, and slowing descent speed (suggesting a transition from foraging to more horizontal movement). Additionally, seals within 33 km of the pile driving were more likely to swim away (Aarts et al., 2017).

Studies of marine mammal responses to continuous noise, such as vibratory pile driving, are limited. Observations of marine mammals on Naval Base (NAVBASE) Kitsap Bangor during a test pile installation/removal project concluded that pinniped (harbor seal and California sea lion) foraging behaviors decreased slightly during construction periods involving impact and vibratory pile driving, and both pinnipeds and harbor porpoise were more likely to change direction while traveling during construction (HDR Inc., 2012). Pinnipeds were more likely to dive and sink when closer to pile driving activity, and a greater variety of other behaviors were observed with increasing distance from pile driving. Most harbor porpoises were observed swimming or traveling through the project area and no obvious behavioral changes were associated with pile driving. As detailed in Section 6.5, Branstetter et al. (2018) found evidence of altered behavior resulting from vibratory pile driving in bottlenose dolphins (an almost complete cessation of echolocation clicks) only at the highest source level (roughly estimated as 128 dB re 1 µPa); however, the effect on behavior diminished significantly, indicating acclimation.

A total of 3 years of marine mammal monitoring were conducted during vibratory and impact pile driving for the construction of Explosives Handling Wharf-2 at NAVBASE Kitsap Bangor in Washington (Hart Crowser, Inc., 2013, 2014, 2015). Results from monitoring varied slightly year to year, but in general it was found that harbor seals were most frequently observed having no motion to the construction zone during vibratory pile driving, and during impact driving, seals were most frequently observed moving away from the pile. Harbor porpoises were only observed at a greater distance from the construction area than seals, where the predominant behavior during construction (vibratory pile driving) was swimming or traveling through the project area. Harbor porpoise foraging was reported during pre-construction monitoring, but not during pile driving. Marine mammal observers did not detect adverse reactions to these construction activities at NAVBASE Kitsap Bangor that would be consistent with distress, injury, or high speed withdrawal from the area, nor did they report obvious changes in less acute behaviors.

Marine mammal monitoring at the Port of Anchorage marine terminal redevelopment project in Alaska 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). Most marine mammals observed during the two lengthy construction seasons were beluga whales while 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 displacements, 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. Modeling of population-level impacts of pile driving noise for offshore wind farm development suggests that behavioral displacement could lead to reduced reproductive success of displaced female harbor seals during construction years. However, the common pattern at the population-level was short-term reductions in abundance during and immediately after the construction period, followed by recovery with no observable long-term consequences (Thompson et al., 2013).

Marine mammals encountering pile driving operations over a project’s construction timeframe would likely avoid affected areas in which they experience noise-related discomfort, limiting their ability to forage or rest there. As described in the section above, individual responses to pile driving noise are expected to be variable. Some individuals may occupy a project area during pile driving without apparent discomfort, but others may be displaced with undetermined effects. Avoidance of the affected area during pile driving operations would reduce the likelihood of injury impacts, but would also reduce access to foraging areas. Noise-related disturbance may also inhibit some marine mammals from transiting the area. Given the duration of the in-water construction period, there is a potential for displacement of marine mammals from affected areas due to these behavioral disturbances during the in-water construction season. However, in some areas habituation may occur resulting in a decrease in the severity of response. Since pile driving will only occur during daylight hours, marine mammals transiting a project area or foraging or resting in a project area at night will not be affected. Effects of pile driving activities will be experienced by individual marine mammals, but will not cause population-level impacts or affect the continued survival of the species because the effects are temporary, highly localized in a peripheral portion of their range, and likely would affect a small portion of the stock.

7.1.2 Potential Effects Resulting from Airborne Noise

Pinnipeds that occur in the project area could be exposed to airborne sounds associated with pile driving that have the potential to cause behavioral harassment, depending on their distance from pile driving activities. Airborne pile driving noises are expected to have very little impact to cetaceans because most noise from atmospheric sources does not transmit well through the air-water interface (Richardson et al., 1995; Urick, 1972); consequently, cetaceans are not expected to be exposed to airborne sounds that will result in harassment as defined under the MMPA. Airborne noise will primarily be an issue for pinnipeds that are swimming or hauled out within the range of impact as defined by the acoustic criteria discussed in Section 6 (Numbers and Species Exposed). Most likely, airborne sound will cause behavioral responses similar to those discussed above in relation to underwater noise. For instance, anthropogenic sound could cause hauled out pinnipeds to exhibit changes in their normal behavior, such as reduction in vocalizations, or cause them to temporarily abandon their usual or preferred locations and move farther from the noise source. Pinnipeds swimming near pile driving may avoid or withdraw from the area, or may show increased alertness or alarm (e.g., heading out of the water, and looking around). However, studies of ringed seals by Blackwell et al. (2004) and Moulton et al. (2005) indicate a tolerance or lack of response to unweighted airborne sounds as high as 112 dB peak pressure and 96 dB RMS, which suggests that habituation occurred.

California sea lions and harbor seals were present during impact installation and vibratory extraction of piles at NAVBASE Kitsap Bremerton in February 2014 and November 2014 to February 2015 (Northwest Environmental Consulting, 2014, 2015). In February 2014, California sea lions were observed basking on the port security barrier within the underwater behavioral disturbance zone (117 m from the driven pile) and no behavioral harassment takes were documented because they did not enter the water. California sea lions and harbor seals were observed in the water during vibratory driver activity. Marine mammal observers detected 160 individuals during vibratory pile extraction within the 1,600-m vibratory disturbance zone, resulting in exposure to noise levels above the Level B threshold. Marine mammal observers detected 125 individuals during impact pile driving within the 117-m impact disturbance zone, resulting in exposure to noise levels above the Level B threshold. There were no shutdowns of pile driving activity because pinnipeds never entered the injury zones. No visible behaviors indicating a reaction to noise disturbance were observed. Behaviors observed included hauling-out (resting), foraging, milling, and traveling.

Based on these observations, marine mammals in the harassment zones for airborne noise may exhibit temporary behavioral reactions to airborne pile driving noise. These exposures may have a temporary effect on seals, but this level of exposure is very unlikely to result in population-level impacts because the effects are temporary, highly localized, and relatively few harbor and gray seals occur in the project area.

In particular, the closest known haul out sites for seals in the vicinity of NAVSTA Norfolk are the CBBT portal islands (located approximately 20 to 26 km) from the project location and the mud flats on the nearby southern tip of the Eastern Shore (more than 35 km from the project location), which rules out the possibility of behavioral disturbance to hauled out seals due to pile driving noise.

7.2 Conclusions Regarding Impacts on Species or Stocks

Individual marine mammals may be exposed to increased SPL 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 (i.e., swimming speed, foraging habits, etc.) or be temporarily displaced from the area of construction. Any exposures to Level B harassment will likely have only a minor effect on individuals and no effect on the population. The proposed shutdown zone of 150 m from the point of noise generation will help to minimize the number of Level A takes; therefore, the requested Level A takes in the application are likely to be overestimated. Additionally, work would stop if a humpback whale were to enter any Level A harassment zone (see Table 5-2); therefore, there are no Level A takes anticipated for this species. Exposure to Level B behavioral disturbance is possible at the project area, as discussed in Section 6 (Numbers and Species Exposed). However, this level of effect is not anticipated to have any adverse impact to population recruitment, survival, or recovery because the effects are temporary, highly localized in a peripheral portion of their range, and would potentially affect a small portion of the stock. No major feeding or reproductive areas, or pinniped haul out sites would be affected by project activities.

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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 section is not applicable. The project is located at NAVSTA Norfolk, in Norfolk, VA. 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 include increased human activity and noise levels, localized, minor impacts to water quality, and changes in prey availability near the individual project sites. Since the focus of the Proposed Action is pile driving, no habitat loss is expected. The new Pier 3 will be immediately north of the existing Pier 3 and once complete, the current Pier 3 will be demolished. The pier areas are routinely disturbed through prop wash and maintenance dredging and no submerged aquatic vegetation exists. Benthic organisms will be disturbed and lost during construction activities but are expected to recolonize the areas once construction is complete.

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 pile installation and removal activities.

Marine mammals in the Proposed Action area 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) (Bejder et al., 2006; Foote et al., 2004; Mocklin, 2005; Nowacek et al., 2007; Terhune & Verboom, 1999; Watkins, 1986; Würsig et al., 1998). Some dolphin species approach vessels and are observed bow riding or jumping in the wake of vessels (Norris & Prescott, 1961; Ritter, 2002; Shane et al., 1986; Würsig et al., 1998). 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 & Kramer, 2005).

During demolition and construction activities, additional vessels may operate in project areas, but will operate at low speeds within the relatively limited construction zone and access routes during the in-water construction period. The presence of vessels will be temporary and occur at current Navy facilities that have some level of existing 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 will 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 are expected to be negligible.

9.2 Impacts on Prey Base

Pile installation and removal will impact marine habitats used by fish and benthic invertebrate species, which comprise the prey base for marine mammals. Marine habitats used by prey species that occur in the project area include nearshore intertidal and subtidal habitats, including marine vegetation and piles used for structure and cover. The greatest impact to prey species during pile installation will result from behavioral disturbance due to pile driving noise. Secondary impacts include temporary benthic habitat displacement and re-suspension of sediments.

9.2.1 Water Quality

Temporary and localized reduction in-water quality will occur because of in-water construction activities. Most of this effect will occur during the installation and removal of piles when bottom sediments are disturbed. The installation of piles will disturb bottom sediments and may cause a temporary increase in suspended sediment in the project area. Using available information collection from a project in the Hudson River, pile driving activities are anticipated to produce total suspended sediment concentrations of approximately 5.0 to 10.0 milligrams per liter above background levels within approximately 300 ft (91 m) of the pile being driven (NMFS, 2017). This estimate was based on information collected from similar activities conducted in the Hudson River, which has a high percentage of silt and clay in bottom sediments (NYSDEC, 2000). During pile extraction, sediment attached to the pile moves vertically through the water column until gravitational forces cause it to slough off. The small resulting sediment plume is expected to settle out of the water column within a few hours. Studies of the effects of turbid water on fish suggest that concentrations of suspended sediment can reach thousands of milligrams per liter before an acute toxic reaction is expected (Burton, 1993). The total suspended sediment levels expected for pile driving or removal (5.0 to 10.0 milligrams per liter) are below those shown to have adverse effects on fish (580.0 milligrams per liter for the most sensitive species, with 1,000.0 milligrams per liter more typical) and benthic communities (390.0 milligrams per liter [Environmental Protection Agency (EPA), 1986]). Turbidity within the water column has the potential to reduce the level of oxygen in the water and irritate the gills of prey fish species in the construction area. However, turbidity plumes would be temporary and localized, and fish in the construction area would likely move away from the affected areas. Therefore, it is expected that the impacts on fish species from turbidity and therefore on marine mammals, would be minimal and temporary.

Pile extraction and installation may have impacts on benthic invertebrate species primarily associated with disturbance of sediments that may cover or displace some invertebrates. The impacts will be temporary and highly localized, and no habitat will be permanently displaced by construction. Therefore, it is expected that impacts on foraging opportunities for marine mammals due to project activities would be minimal.

9.2.2 Underwater Noise Impacts on Prey Base

Calculated distances to injury thresholds are less than 50 m for fish with and without swim bladders, eggs and larvae. Given the small size of the potentially affected area, the injury zones will be negligible for all life stages of fish, and by extension the impact on marine mammal predators will be negligible. Impact pile driving is likely to exceed the established underwater noise TTS thresholds for fish. TTS zones will be greatest during impact driving of steel pipe piles and steel sheet piles; for example, installation of steel pipe piles will result in a zone of approximately 631 m and installation of steel sheet piles will result in an area of impact of approximately 489 m (Appendix A). Zones for TTS resulting from impact installation of concrete, composite, and timber piles will be much smaller. Given the relatively small size of these zones, adverse impacts on prey availability for marine mammals are negligible and do not rise to the level of MMPA take. Ample foraging opportunities exist in the general area outside of these zones.

9.3 Likelihood of Habitat Restoration

The impacts of the Proposed Action on marine habitats will be temporary and highly localized; therefore, no habitat restoration is planned.

9.4 Summary of Impacts on Marine Mammal Habitat

All marine mammal species using habitat near the proposed project area are primarily transiting the area; no known foraging or haul out areas are located within the 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.

Construction may have permanent and temporary impacts on benthic invertebrate species, another marine mammal prey source. Direct benthic habitat loss would result from the installation of new structures; however, older structures will be removed once the new Pier 3 is completed and to upgrade the other berthing areas. Therefore, the loss of the small amount of habitat would be minor in comparison to the total available benthic habitat in the Hampton Roads area of the Chesapeake Bay. Furthermore, the areas to be permanently impacted are located along NAVSTA Norfolk's waterfront and are regularly disturbed from maintenance dredging and ship movements (e.g., vessel propeller wakes) during waterfront operations. Therefore, impacts of the project are not likely to have adverse effects on marine mammal foraging habitat in the proposed project area.

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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 Action is not expected to have any habitat-related effects that could cause significant or long-term consequences for populations of marine mammals because all activities will be temporary. The Proposed Action will affect marine mammal habitats indirectly through temporary, localized impacts on prey abundance and availability. The most important impacts on marine fish species consumed by marine mammals will result from potential temporary threshold shift effects on fish during pile driving. Temporary threshold shift is a behavioral disturbance that is, by definition, temporary, and any impacts to the marine mammal prey base will cease upon completion of construction. As discussed in Section 9, there will be no permanent loss or modification of 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.

General best management practices (BMPs), mitigation and minimization measures that may be implemented for all in-water repair and replacement activities are presented in the following subsections. These BMPs are routinely used by the Navy during marine structure maintenance, repair, and pile replacement activities. BMPs are intended to avoid and minimize potential environmental impacts. BMPs are included in construction contract plans and specifications for individual projects and become requirements that the contractor must implement.

11.1 General Construction Best Management Practices

- The Navy will adhere to performance conditions imposed as part of the Clean Water Act (CWA), Section 404, Permit and Section 401, Water Quality Certification. No in-water work will be conducted until the CWA authorization process has been completed.
- An Environmental Protection Plan will be prepared prior to the start of construction activities. The plan will identify construction planning elements and recognize spill sources at the sites. The plan will outline BMPs, responsive actions in the event of a spill or release, and notification and reporting procedures. The plan will also outline contractor management elements such as personnel responsibilities, project site security, site inspections, and training.
- No petroleum products, fresh cement, lime, fresh concrete, chemicals, or other toxic or harmful materials will be allowed to enter surface waters.
- Wash water resulting from washdown of equipment or work areas will be contained for proper disposal, and will not be discharged.
- Equipment that enters surface water will be maintained to prevent any visible sheen from petroleum products.
- No oil, fuels, or chemicals will be discharged to surface waters, or onto land where there is a potential for re-entry into surface waters. Fuel hoses, oil drums, oil or fuel transfer valves, fittings, etc., will be checked regularly for leaks. Materials will be maintained and stored properly to prevent spills.
- No cleaning chemicals or solvents will be discharged to ground or surface waters.

11.2 Pile Repair, Removal, and Installation Best Management Practices

11.2.1 General Pile Removal and Replacement

- Removed piles and associated sediments (if any) will typically be contained on a barge. If a barge is not utilized, piles and sediments may be stored in a containment area near the construction sites.
- Piles that break or are already broken below the waterline may be removed by pulling them directly from the sediment with a crane. If this is not possible, piles will be removed with a clamshell bucket. To minimize disturbance to bottom sediments and splintering of piling, the contractor will use the minimum size bucket required to pull out piles based on pile depth and

substrate. The clamshell bucket will be emptied of piling and debris on a contained barge before it is lowered into the water. If the bucket contains only sediment, the bucket will remain closed and be lowered to the mud-line and opened to redeposit the sediment. In some cases (depending on access, location, etc.), piles may be cut below the mud-line.

- Any floating debris generated during removal or installation will be retrieved. Any debris in a containment boom will be removed by the end of the work day or when the boom is removed, whichever occurs first. Retrieved debris will be disposed of at an upland disposal site.
- Whenever activities that generate sawdust, drill tailings, concrete fragments, or wood chips from treated timbers are conducted, tarps or other containment material will be used to prevent debris from entering the water.
- If excavation around piles to be repaired or replaced is necessary, hand tools or a siphon dredge will be used to excavate around piles. If siphon dredges are used, any contaminated sediment must be accounted for as waste and disposed of properly.

11.3 Minimization Measures for Marine Mammals and Other Protected Species

The following mitigation measures will be implemented during pile driving to minimize marine mammal exposure to Level A injurious noise levels generated from impact pile driving and to reduce to the lowest extent practicable exposure to Level A injurious and Level B disturbance noise levels.

11.3.1 Coordination

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

11.3.2 Soft Start

The Navy will utilize a “soft start” procedure to provide a warning and/or give animals in proximity to pile driving the opportunity to leave the area prior to an impact driver operating at full capacity, thereby exposing fewer animals to loud underwater and airborne sounds. The soft start will be accomplished by providing an initial set of strikes from the impact hammer at reduced energy, followed by a 30-second waiting period, then two subsequent sets. The soft start procedure will be used for impact pile driving at the beginning of each day’s in-water pile driving or any time pile driving has ceased for more than 30 minutes.

The reduced energy of an individual hammer cannot be quantified because they vary by individual drivers. Also, the number of strikes will 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.”

11.3.3 Visual Monitoring and Shutdown Procedures

The current Marine Mammal Monitoring Plan submitted to NMFS with the Year 1 IHA application will be updated as needed to reflect the work covered in construction years 2-5 and to reflect changes required based on discussions with NMFS. Revisions will be submitted to NMFS for approval prior to commencement of activities covered in this LOA applications. At a minimum, the plans will include the following:

In order to reduce the potential for Level A (PTS onset) or Level B (behavioral) harassment, the following visual monitoring will be implemented, and shutdown procedures will be put into effect if a marine mammal were to approach a shutdown zone for the activity being conducted. Impacts are expected to be insignificant, and no injury would be expected as monitors will ensure the shutdown zone is clear of mammals before the start of in-water noise generating activities. Proposed monitoring zones are provided in Table 11-1. The minimum monitoring zone is equivalent to the general construction shutdown zone described below.

- For humpback whales, work will stop any time the species is sighted approaching the humpback whale Level A harassment zone. This approach will prevent the need for Level A takes for this species.
- For all impact and vibratory pile driving and drilling, shutdown zones would be as specified in Table 5-2. These shutdown zones will help to reduce injury. They will be monitored at all times as specified in Table 5-2 and work will stop as soon as safely possible if an animal is seen approaching this zones.
- To record takes, the entire Level A (PTS onset) zones beyond the shutdown zones in Table 5-2 and a portion of the Level B (behavioral) harassment zones will be visually monitored. The largest Level A (PTS) onset zone is 2,123 m during the impact pile driving of 28-inch steel sheet piles (see Table 6-5).
- In order to prevent injury from physical interaction with construction equipment, a general construction shutdown zone of 10 m or 33 ft will 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. These activities could include but are not limited to 1) barge positioning, 2) dredging, or 3) pile driving. For some sound-generating activities, the potential for Level A (PTS onset) harassment by acoustic injury extends less than 10 m from the source, and for these activities, the shutdown zone automatically mitigates/minimizes Level A (PTS onset) harassment.
- Visual monitoring will be conducted by experienced personnel with training in marine mammal detection and the ability to describe relevant behaviors that may occur in proximity to in-water construction activities (hereafter PSOs).
- 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 pile driving, the noise producing activity will cease. If such circumstances recur, the Navy will consult with NMFS concerning the potential need for an additional take authorization.
- Pile driving will cease if any marine mammal is detected in or approaching the Level A shutdown zones as described in Table 5-2. If a marine mammal is observed in the Level B (behavioral) harassment zone or the Level A (PTS onset) harassment zone beyond the shutdown zones, but not approaching or entering the shutdown zone, a take will be recorded, and the work will be allowed to proceed without cessation.
- All species that enter either the Level A (PTS onset) harassment or Level B (behavioral) harassment zones will be monitored and documented, with the PSO estimating the amount of time the animal spends within the Level A or Level B zone while pile extraction, driving, or drilling activities are underway.
- In the event of a shutdown, pile driving will 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 will 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 will be monitored for 30 minutes to ensure that the zones are clear of marine mammals.

Pile driving will only commence once observers have declared the shutdown zone clear of marine mammals.

- Monitoring will be conducted by, at a minimum, a two-person PSO team designated by the construction contractor. Given the configuration of the harassment zones, which vary depending on the pile type/size and the pile driver type, it is assumed that two PSOs would be sufficient to monitor the zones for impact drivers, and three to four PSOs would be sufficient to monitor the zones for vibratory drivers. However, additional monitors may be added if warranted by the level of marine mammal activity in the area. PSOs will be placed at the best vantage point(s) practicable (Figure 11-1) to monitor for marine mammals and implement shutdown/delay procedures when applicable by calling for the shutdown by the pile driver operator.
    - Potential PSO Locations can be found on Figure 11-1 and include:
        - Northernmost Jetty
        - Pier 14
        - Pier 8
        - Existing Pier 3
        - Pier 2
        - Pier 1
- The PSOs shall have no other construction-related tasks while conducting monitoring.
- If the shutdown zone is obscured by fog or poor lighting conditions, pile driving will not be initiated until the entire shutdown zone is visible.

11.3.4 Acoustic Measurements

For further detail regarding the acoustic monitoring plan, see Section 13.2.

11.3.5 Mitigation Effectiveness

All observers utilized for mitigation activities will be experienced biologists with training in marine mammal detection and behavior. Due to their specialized training, the Navy expects that visual mitigation will 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. The observers will be positioned in locations which provide the best vantage point(s) for monitoring. Any activity that would result in threshold exceedance at or more than 1,000 meters would require a minimum of three PSOs to effectively monitor the entire ROI. As such, proposed mitigation measures are likely to be very effective.

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

Estimated LOA Year[1]	*Pile type, size, and driving method*	*Level A Shutdown Distance (m) for Humpback Whales[2]*	*Level A Shutdown Distance (m) for Harbor Porpoise*	*Level A Shutdown Distance (m) for all other Species*	*Level B (Behavioral) Harassment Distance (m) All Marine Mammals*
Year 2	Impact Install 42-inch steel pipe piles	1,490	500[3]	200[3]	1,000
	Vibratory Install 42-inch stee pipe piles	140	200	70	2,500
	Impact Install 28-inch steel sheet piles	1,790	500[3]	200[3]	2,500
	Vibratory Install 28-inch steel sheet piles	110	150	80	2,500
	Impact Install 13-inch polymeric piles	20	30	30	30
	Vibratory Install 13-inch polymeric piles	20	30	30	2,500
	Impact Install 24-inch precast concrete bearing piles	260	500[3]	200[3]	117
	Impact Install 18-inch precast concrete fender piles	10	10	10	30
	Pre-drilling	10	10	10	2,500
Year 3	Impact Install 24-inch precast concrete fender piles	40	50	30	120
	Impact Install 18-inch steel piles	700	500[3]	200[3]	30
	Impact Install 42-inch steel pipe piles	1,010	500[3]	200[3]	1,000
	Vibratory Install 42-inch steel pipe piles	90	120	50	2,500
	Impact Install 28-inch steel sheet piles	1,790	500[3]	200[3]	2,500
	Vibratory Install 28-inch steel sheet piles	110	150	70	2,500
	Vibratory Extract 18-inch precast concrete fender piles	40	60	30	2,500
	Pre-drilling	10	10	10	2,500
Year 4	Impact Install 24-inch precast concrete bearing piles	120	150	70	120
	Vibratory Extract 14-inch timber piles	70	110	50	2,500
	Impact Install 18-inch precast concrete fender piles	10	10	10	30
	Impact Install 42-inch steel pipe piles	1,010	500[3]	200[3]	1,000
	Vibratory Install 42-inch steel pipe piles	90	120	50	2,500

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

Estimated LOA Year[1]	*Pile type, size, and driving method*	*Level A Shutdown Distance (m) for Humpback Whales[2]*	*Level A Shutdown Distance (m) for Harbor Porpoise*	*Level A Shutdown Distance (m) for all other Species*	*Level B (Behavioral) Harassment Distance (m) All Marine Mammals*
	Vibratory Extract 24-inch concrete fender piles	50	70	30	2,500
	Impact Install 28-inch steel sheet piles	1,790	500[3]	200[3]	2,500
	Vibratory Install 28-inch steel sheet piles	120	150	70	2,500
	Vibratory Extract 18-inch precast concrete fender piles	40	60	30	2,500
	Vibratory Extract 16- to 18-inch precast concrete bearing piles	40	60	30	2,500
	Pre-drilling	10	10	10	2,500
Year 5	Vibratory Extract 16- to 18-inch precast concrete bearing piles	40	60	30	2,500
	Impact Install 24-inch precast concrete bearing piles	120	150	70	120
	Impact Install 18-inch precast concrete fender piles	10	10	10	30
	Pre-drilling	10	10	10	2,500

Notes:

1. Activities per LOA year are estimated as some activities may shift due to schedules and delays
2. Work will shut down if a humpback whale is sighted in any Level A zone, therefore, there would be no Level A takes of this species.
3. Shut down zones agreed to with NMFS during project discussions.

Key: m = meter

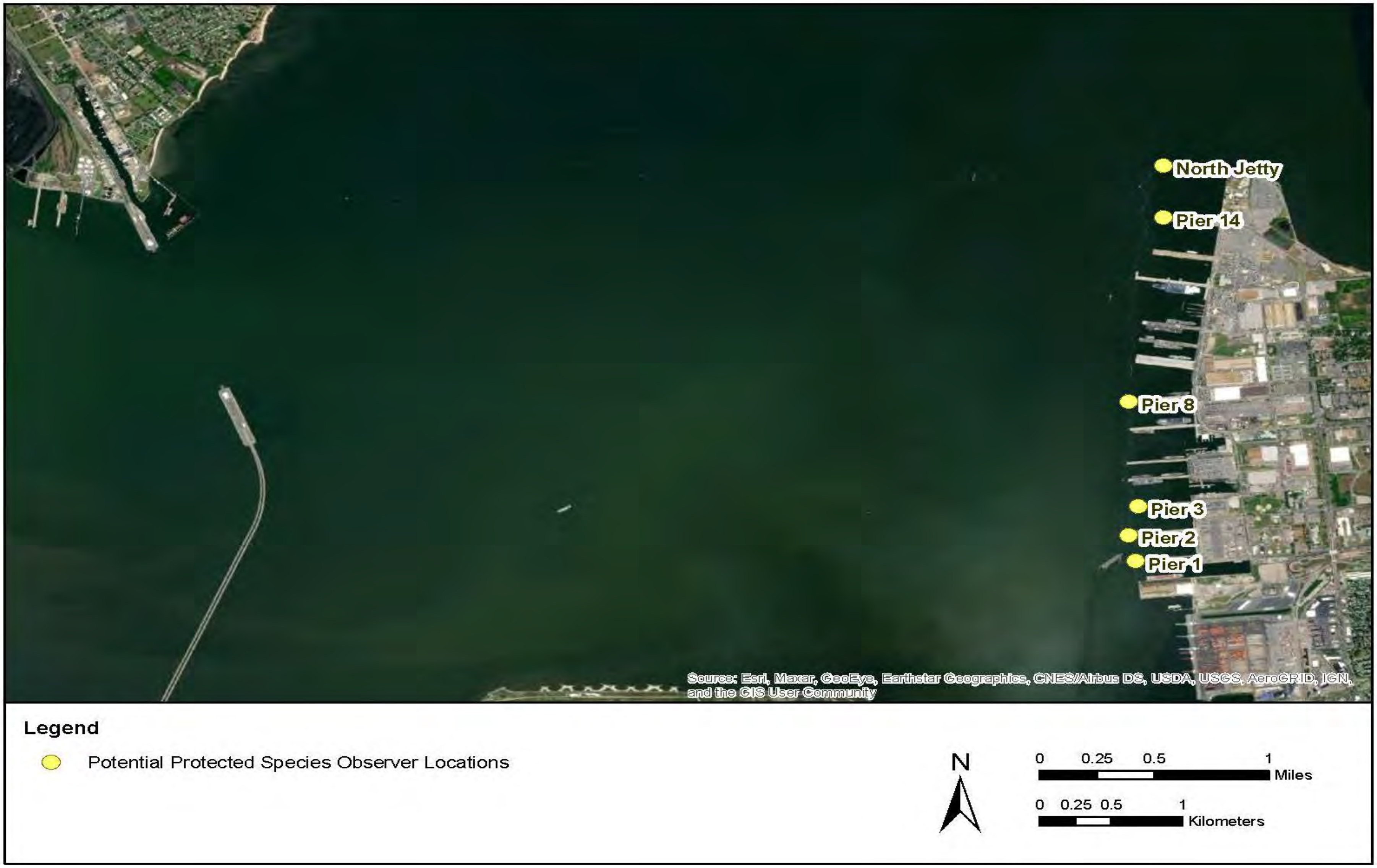

Figure 11-1 Potential PSO Locations

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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 section is not applicable. There is no subsistence use of marine mammal species or stocks in the proposed project area at NAVSTA Norfolk.

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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 would be used to determine the movement and activity of marine mammals near the activity site(s) including migration and other habitat uses, such as feeding.

The Navy intends to complete marine mammal and acoustic 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 will be developed further and submitted to NMFS for approval in advance of the start of construction of the LOA period.

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

13.1 Marine Mammal Monitoring Plan

The current Marine Mammal Monitoring Plan will be updated with the activities covered under this LOA application and submitted to NMFS for approval well in advance of the start of construction of the LOA period. Visual monitoring of the Level A (PTS onset) and Level B (behavioral) disturbance zones would occur (see Table 11-1). If a marine mammal is observed entering the disturbance zone as described in Chapter 11, an exposure would be recorded, and behaviors documented. All observers (PSOs) will be trained in marine mammal identification and behaviors. NMFS requires that the PSOs have no other construction-related tasks while conducting monitoring.

13.1.1 Visual Monitoring

Visual monitoring of the entire Level A shutdown zones will occur for 100 percent of pile driving activities. The disturbance zone will be visually monitored to the extent possible from PSO locations as described in Chapter 11. If a marine mammal is observed entering the disturbance zone, an exposure will be recorded, and behaviors documented. The Navy will use the data collected during monitoring days to calculate total takes for all pile driving days for portions of the disturbance zone that are not visible.

13.1.2 Methods of Monitoring

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

- PSOs will be located on land-based features such as docks, piers, or bridges, in order to properly observe the entire shutdown zone(s).

- There would be a minimum of two PSOs for each pile driving activity. Depending on the size of the zone associated with the type of noise generating activity occurring, site conditions, and the level of marine mammal activity, more may be utilized as necessary.
- PSOs will be located at the best vantage point(s) to observe the zone associated with behavioral impact thresholds.
- During all observation periods, PSOs will use binoculars and the naked eye to search continuously for marine mammals.
- Monitoring distances will be measured with range finders.
- Distances to animals will be based on the best estimate of the PSO, relative to known distances to objects in the vicinity of the PSO.
- Bearing to animals will be determined using a compass.
- In-water activities will be curtailed under conditions of fog or poor visibility that might obscure the presence of a marine mammal within the Level A (PTS onset) shutdown zone.
- Pre-Activity Monitoring: The Level A (PTS onset), shutdown, and Level B (behavioral) disturbance zones will be monitored for 30 minutes prior to in-water construction/demolition activities. If a marine mammal is present within the shutdown zone, the activity will be delayed until the animal(s) leave the shutdown zone. Activity will resume only after the PSO has determined that, through sighting or by waiting approximately 15 minutes, the animal has moved outside the shutdown zone. If a marine mammal is observed approaching the shutdown zone, the PSO who sighted that animal will notify the shutdown PSO of its presence.
- During Activity Monitoring: If a marine mammal is observed entering the disturbance zone, the activity will be completed without cessation, unless the animal enters or approaches the Level A (PTS onset) shutdown zone, at which point all pile driving activities will be halted. If an animal is observed within the shutdown zone during pile driving, then pile driving will be stopped as soon as it is safe to do so. Pile driving can only resume once the animal has left the Level A (PTS onset) shutdown zone of its own volition or has not been re-sighted for a period of 15 minutes.
- Post-Activity Monitoring: Monitoring of the Level A (PTS onset), shutdown, and Level B (behavioral) disturbance zones will continue for 30 minutes following the completion of the activity.

13.1.3 Data Collection

NMFS requires that at a minimum, the following information be collected on the sighting forms:

- Dates and times (begin and end) of all marine mammal monitoring
- Dates and times that pile removal/installation or drilling begins and ends
- Construction activities occurring during each daily observation period, including how many and what type of piles were driven and by what method
- Total duration of driving time for each pile (vibratory) and number of strikes for each pile (impact)
- Weather conditions (e.g., rain, fog, wind speed, percent cloud cover, visibility, etc.)
- Water conditions (e.g., sea state, tidal state [incoming, outgoing, slack, low, and high])
- Species (genus/species, lowest possible taxonomic level, or unidentified), PSO confidence in identification, estimated numbers of animals/group (min/max/best est.), group composition (if there is a mix of species), and, if possible, sex and age class of marine mammals

- Marine mammal behavior patterns observed (feeding, traveling, etc.), including bearing and direction of travel and, if possible, the correlation to SPLs and estimated time spent in the harassment zone, and assessment of behavioral response thought to result from the activity
- Distance from pile removal/installation or drilling activities to marine mammals and distance from the marine mammal to the PSO observation point
- Locations and times of all marine mammal observations
- Other human activity in the area
- Name of PSO and PSO location
- 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)
- Detailed information about any implementation of any mitigation triggered (e.g. shutdowns and delays), a description of specific actions that ensued, and resulting behavior of the animal, if any
- Description of attempts to distinguish between the number of individual animals taken and the number of incidences of take, such as ability to track groups or individuals
- Submit all PSO datasheets and/or raw sighting data (as an appendix to the required report)

The Navy will note in behavioral observations, to the extent practicable, if an animal has remained in the area during construction activities. Therefore, it may be possible to identify if the same animal or different individuals are being taken. The Navy will provide information regarding any mitigation (e.g., shutdowns or delays) in reporting as well.

13.2 Hydroacoustic Monitoring Plan

The Navy will implement in situ acoustic monitoring efforts to measure SPLs from in-water construction activities for pile types and methods that have not been previously collected at NAVSTA Norfolk (Table 13-1). The Navy will collect and evaluate acoustic sound recording levels during pile driving activities. Hydrophones would be placed at locations 33 ft from the noise source and, where the potential for Level A (PTS onset) harassment exists, at a second representative monitoring location that is a distance of 20 times the depth of water at the pile location, to the maximum extent practicable. For the pile driving events acoustically measured, 100 percent of the data will be analyzed.

At a minimum, the methodology includes:

- For underwater recordings, a stationary hydrophone system with the ability to measure SPLs will be placed in accordance with NOAA Fisheries Service's most recent guidance for the collection of source levels.
- Hydroacoustic monitoring will be conducted for 10 percent of each type of activity not previously monitored under the P-381 year 1 IHA. (Table 13-1). Monitoring will occur from the same locations approved by NMFS for P-310 construction activities. The resulting data set will be analyzed to examine and confirm sound pressure levels and rates of transmission loss for each separate in-water construction activity. With NMFS concurrence, these metrics will be used to recalculate the limits of shutdown and Level A (PTS Onset) and Level B (Behavioral) harassment zones. Hydrophones will be placed in the same manner as for P-310 construction activities. Locations of hydroacoustic recordings will be collected via GPS. A depth sounder and/or weighted tape measure will be used to determine the depth of the water. The hydrophone will be attached to a-

weighted nylon cord to maintain a constant depth and distance from the pile/drill/hammer location. The nylon cord or chain will be attached to a float or tied to a static line.

- Each hydrophone (underwater) will be calibrated at the start of each action and will be checked frequently to the applicable standards of the hydrophone manufacturer.
- Environmental data will 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 will supply the acoustics specialist with the substrate composition, hammer/drill model and size, hammer/drill energy settings, depth of the pile being driven or drilling, blows per ft for the piles monitored and any changes to those settings during the monitoring.
- For acoustically monitored construction activities, data from the continuous monitoring locations will be post-processed to obtain the following sound measures:
    - Maximum peak pressure level recorded for all activities, expressed in dB re 1 µPa. This maximum value will originate from the phase of drilling/hammering during which drill/hammer energy was also at maximum (referred to as Level 4).
    - From all activities occurring during the Level 4 phase these additional measures will be made, as appropriate:
        - mean, median, minimum, and maximum RMS pressure level in [dB re 1 µPa]
        - mean duration of a pile strike (based on the 90% energy criterion)
        - number of hammer strikes
        - mean, median, minimum, and maximum single strike SEL in [dB re μPa^2 sec]
    - Cumulative SEL as defined by the mean single strike SEL + 10*log (number of hammer strikes) in [dB re μPa^2 sec].
    - 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 will be 1 Hz, and the spectrum will cover nominal range from 7 Hz to 20 kHz.
  - Finally, the cumulative SEL will 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 sec].

Table 13-1 Hydroacoustic Monitoring Summary

Pile Type[1]	*Count*[2]	*Method of Install/Removal*[2]	*Number Monitored*[2]
18-inch/24-inch concrete	614	Pre-Drilling	5
13-inch Polymeric	9	Vibratory	5
13-inch Polymeric	9	Impact	5
14-inch timber	624	Vibratory Extract	10
16-inch or 18-inch concrete	903	Vibratory Extract	10
18-inch steel pipe	18	Impact	5
18-inch concrete	93	Impact	10
18-inch concrete	62	Vibratory Extract	10
24-inch concrete	1,063	Impact	10
24-inch concrete	72	Vibratory Extract	10
42-inch steel pipe	179	Vibratory	10
42-inch steel pipe	179	Impact	10
28-inch steel sheet	376	Vibratory	10
28-inch steel sheet	376	Impact	10

Notes: 1. Data has previously been collected on the impact driving of 24-inch concrete piles and timber piles at NAVSTA Norfolk; therefore, no additional data collection is proposed for these pile types.
2. Some piles may be either vibratory or pile driving, or a combination of both. Pre-drilling is authorized but may not be utilized if site conditions do not require it. The hydroacoustic report at the end of construction will clarify which installation method was utilized and monitored for each pile type.

13.3 Reporting

Annual draft reports on all monitoring conducted under the issued LOA will be submitted to NMFS within 90 calendar days of the completion of each construction year. A draft comprehensive 5-year summary report must be submitted to NMFS within 90 days of the end of the project. The reports will detail the monitoring protocols, summarize the data recorded during monitoring, and estimate the number of marine mammals that may have been harassed during the period of the report. Final annual and comprehensive summary reports will be prepared and submitted to NMFS within 30 days following receipt of comments on the drafts from NMFS. If no comments are received from NMFS within 30 calendar days of receipt of the draft report, the report shall be considered final. All draft and final monitoring reports will be submitted to PR.ITP.MonitoringReports@noaa.gov as well as to the NMFS biologist who reviews this application.

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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 has funded over $240 million specifically for marine mammal research. More recently, the Navy funded more than $40 million from fiscal year 2019 to 2020. 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 Biology Program. Primary focus of these programs is understanding the effects of sound on marine mammals, including physiological, behavioral, ecological, and population-level effects.

The Office of Naval Research's current Marine Mammals and Biology Program research concentration areas include: (1) monitoring and detection; (2) integrated ecosystem research, including sensing 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.

The Naval Facilities Engineering Systems Command's Living Marine Resources Program aims to improve the best available science regarding the potential impacts to marine species from Navy activities, demonstrate and validate basic research projects that are ready for applied research investment, and broaden the use of or improve the technology and methods available to the U.S. Navy marine species monitoring program. Key investment areas of the Living Marine Resources Program include:

- Data to support risk threshold criteria;
- Data processing and analysis tools;
- Monitoring technology demonstrations;
- Standards and metrics; and
- Emergent topics.

The following marine mammal monitoring activities and contracted studies have been or are currently being conducted by the Navy in the vicinity of NAVSTA Norfolk. To better understand marine mammal presence and habitat use in the region, the Navy has funded and coordinated the following recent major efforts:

- Mid-Atlantic Humpback Whale Monitoring, Virginia Beach, Virginia (Aschettino et al., 2015, 2016, 2017, 2018).
- Seal Tagging and Tracking in Virginia (Ampela et al., 2019).

- Haul out Counts and Photo-Identification of Pinnipeds in Chesapeake Bay and Eastern Shore, Virginia (Jones et al., 2018).
- Haul out Counts and Photo-Identification of Pinnipeds in Chesapeake Bay, Virginia (Rees et al., 2016).
- Occurrence, Distribution, and Density of Marine Mammals Near NAVSTA Norfolk and Virginia Beach (Engelhaupt et al., 2014, 2015, 2016)

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 NMFS from R&D efforts, and current research as previously described.

15 REFERENCES

Aarts et al. (2017). Aarts, G., Brasseur, S., & Kirkwood, R. *Response of grey seals to pile-driving. Wageningen Marine Research report C006/18*. Wageningen Marine Research (University & Research centre).

Ampela et al. (2019). Ampela, K., DeAngelis, M., DiGiovanni Jr., R., & Lockhart, G. *Seal Tagging and Tracking in Virginia, 2017-2018*. Prepared for U.S. Fleet Forces Command. Submitted to Naval Facilities Engineering Command Atlantic, Norfolk, Virginia, under Contract No. N62470-15-8006, Task Order 17F4058, issued to HDR, Inc., Virginia Beach, Virginia. March 2019.

Aschettino et al. (2015). Aschettino, J.M., Engelhaupt, A., & Engelhaupt, D. *Mid-Atlantic Humpback Whale Monitoring, Virginia Beach, VA: Annual Progress Report. Draft Report*. Prepared for U.S. Fleet Forces Command. Submitted to Naval Facilities Engineering Command Atlantic, Norfolk, Virginia, under Contract No. N62470-10-3011, Task Order 054, issued to HDR Inc., Virginia Beach, Virginia. 18 June 2015.

Aschettino et al. (2016). Aschettino, J. M., Engelhaupt, D., Engelhaupt, A., & Richlen., M. *Mid-Atlantic Humpback Whale Monitoring, Virginia Beach, Virginia: 2015/16 Annual Progress Report. Final Report.* Prepared for U.S. Fleet Forces Command. Submitted to Naval Facilities Engineering Command Atlantic, Norfolk, Virginia, under Contract Nos. N62470-10-3011, Task Orders 03 and 54, and N62470-15-8006, Task Order 13, issued to HDR Inc., Virginia Beach, Virgin.

Aschettino et al. (2017). Aschettino, J. M., Engelhaupt, D., Engelhaupt, A., & Richlen, M. *Mid-Atlantic Humpback Whale Monitoring, Virginia Beach, Virginia: 2016/17 Annual Progress Report*. Prepared for U.S. Fleet Forces Command. Submitted to Naval Facilities Engineering Command Atlantic, Norfolk, Virginia, under Contract N62470-15-8006, Task Order 33, issued to HDR, Inc., Virginia Beach, Virginia. August 2017.

Aschettino et al. (2018). Aschettino, J. M., Engelhaupt, D., Engelhaupt, A., Richlen, M., & DiMatteo, A. *Mid-Atlantic Humpback Whale Monitoring, Virginia Beach, Virginia: 2017/18 Annual Progress Report. Final Report*. Prepared for U.S. Fleet Forces Command. Submitted to Naval Facilities Engineering Command Atlantic, Norfolk, Virginia, under Contract N62470-15-8006, Task Order 17F4013, issued to HDR, Inc., Virginia Beach, Virginia. June 2018.

Aschettino et al. (2019). Aschettino, J.M., D. Engelhaupt, A. Engelhaupt, M. Richlen, & M. Cotter. *Mid-Atlantic Humpback Whale Monitoring, Virginia Beach, Virginia: 2018/19 Annual Progress Report.* Prepared for U.S. Fleet Forces Command. Submitted to Naval Facilities Engineering Command Atlantic, Norfolk, Virginia, under Contract N62470-15-8006, Task Order 19F4005, issued to HDR, Inc., Virginia Beach, Virginia. July 2019.

Aschettino et al. (2020a). Aschettino, J.M., D. Engelhaupt, A. Engelhaupt, M. Richlen, & M. Cotter. *Mid-Atlantic Humpback Whale Monitoring, Virginia Beach, Virginia: 2019/20 Annual Progress Report.* Prepared for U.S. Fleet Forces Command. Submitted to Naval Facilities Engineering Command Atlantic, Norfolk, Virginia, under Contract N62470-15-8006, Task Order 20F4011, issued to HDR, Inc., Virginia Beach, Virginia. May 2020.

Aschettino et al. (2020b). Aschettino, J.M., D. Engelhaupt, A. Engelhaupt, A. DiMatteo, T. Pusser, M.F. Richlen, & J.T. Bell. Satellite Telemetry Reveals Spatial Overlap between Vessel High-Traffic Areas and Humpback Whales (Megaptera novaeangliae) Near the Mouth of the Chesapeake Bay. Front. Mar. Sci. 7:121. Doi: 10.3389/fmars.2020.00121.

Aschettino et al. (2021). Aschettino, J.M., D. Engelhaupt, A. Engelhaupt, M. Cotter, & M. Richlen. *Mid-Atlantic Humpback Whale Monitoring, Virginia Beach, Virginia: 2019/20 Annual Progress Report.* Prepared for U.S. Fleet Forces Command. Submitted to Naval Facilities Engineering Command Atlantic, Norfolk, Virginia, under Contract N62470-15-8006, Task Order 20F4011, issued to HDR, Inc., Virginia Beach, Virginia. May 2021.

Au, W. (1993). *The Sonar of Dolphins.* New York: Springer-Verlag.

Baird, R. W. (2001). Status of harbour seals, Phoca vitulina, in Canada. *The Canadian Field-Naturalist*, 663-675.

Barco, S., & Swingle, W. (2014). Marine Mammal Species Likely to be Encountered in the Stranding Data. VAQF Scientific Report #2014-07a. Prepared for the Virginia Department of Mines, Minerals and Energy.

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

Bejder et al. (2006). Bejder, L., Samuels, A.L., Whitehead, H.; Gales, N.G., Barbara, J.M., Connor, R.T., Heithaus, M., Watson-Capps, J.J., Flaherty, C., & Krützen, M. Decline in relative abundance of bottlenose dolphins exposed to long-term disturbance. *Conservation Biology*, 1791–1798.

Bettridge et al. (2015). Bettridge, Shannon, Baker, C. Scott, Barlow, Jay, Clapham, Phillip J., Ford, Michael, Gouveia, David, Mattila, David K., Richard M. Pace, III, Rosel, Patricia E., Silber, Gregory K., & Wade, Paul R. *Status review of the humpback whale (Megaptera novaeangliae) under the Endangered Species Act. NOAA-TM-NMFS-SWFSC-540*.

Blackwell et al. (2004). Blackwell, S.B., Lawson, J.W., & Williams, M.T. Tolerance by ringed seals (Phoca hispida) to impact pipe-driving and construction sounds at an oil production island. *The Journal of the Acoustical Society of America*, 2346–2357.

Blackwell, S. B., & Greene, C. R. (2002). *Acoustic measurements in Cook Inlet, Alaska during August 2001.* Prepared by Greeneridge Sciences, Inc., Aptos, CA and Santa Barbara, CA. Prepared for National Marine Fisheries Service Protected Resources Division, Anchorage, AK.

Branstetter et al. (2018). Branstetter, B.K., Bowman, V.F., Houser, D.S., Tormey, M., Banks, P., Finneran, J.J; & Jenkins, K. Effects of vibratory pile driver noise on echolocation and vigilance in bottlenose dolphins (Tursiops truncatus). *Journal of the Acoustical Society of America*, 429–439.

Brumm, H., & Slabbekoorn, H. (2005). Acoustic Communication in Noise. In P. J. Slater, C. T. Snowdon, T. J. Roper, H. J. Brockmann, & M. Naguib, *Advances in the Study of Behavior* (pp. 151-209). Academic Press.

Brumm, H., & Zollinger, S. A. (2011). The evolution of the Lombard effect: 100 years of psychoacoustic research. *Behaviour*, 1173-1198.

Burns, J. J. (2008). Harbor seal and spotted seal Phoca vitulina and P. largha. In W. Perrin, B. Wursig, & J. Thewissen, *Encyclopedia of Marine Mammals (Second Edition)* (pp. 533-542). Cambridge: Academic Press.

Burton, W. (1993). Effects of bucket dredging on water quality in the Delaware River and the potential for effects on fisheries resources. Columbia: Versar.

Calambokidis et al. (2001). Calambokidis, J., Steiger, G.H, Straley, J.M, Herman, L.M., Cerchio, S., Salden, D.R.,...Quinn II, T.J. Movements and population structure of humpback whales in the North Pacific. *Marine Mammal Science*, 769-794.

California Department of Transportation. (2001). San Francisco - Oakland Bay Bridge East Span seismic safety project. Pile installation demonstration project: marine mammal impact assessment. California Department of Transportation.

Caltrans. (2015). *Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish.* Sacramento, CA: California Department of Transportation Division of Environmental Analysis. (CTHWANP-RT-15-306.01.01). Retrieved from http://www.dot.ca.gov/hq/env/bio/files/bio_tech_guidance_hydroacoustic_effects_110215.pdf.

Caltrans. (2020). *Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish*. Retrieved from https://dot.ca.gov/-/media/dot-media/programs/environmental-analysis/documents/env/hydroacoustic-manual.pdf.

Cammen et al. (2018). Cammen, K. M., Schultz, T.F., Bowen, W. Don, Hammill, M.O., Puryear, W.B., Runstadler, J., Wenzel, F.W., Wood, S.A., & Kinnison, M. Genomic signatures of population bottleneck and recovery in Northwest Atlantic pinnipeds. *Ecology and Evolution*, 6599-6614.

Carretta et al. (2001). Carretta, J.V., Taylor, B.L., & Chivers, S.J. Abundance and depth distribution of harbor porpoise Phocoena phocoena) in northern California determined from a 1995 ship survey. *Fisheries Bulletin*, 99:29-39.

Cetacean and Turtle Assessment Program. (1982). A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf. Final Report #AA551-CT8-48. Washington, DC: Bureau of Land Management.

CH2M. (2018). Final Sampling and Analysis Plan Sediment Sampling to Support Fiscal Year 2019 to Fiscal Year 2021 Maintenance Dredging. Prepared for Department of the Navy, Naval Facilities Engineering Command Mid-Atlantic.

City and Borough of Sitka Department of Public Works (Sitka). 2017. Request for an Incidental Harassment Authorization City and Borough of Sitka Gary Paxton Industrial Park Multipurpose Dock Project Sawmill Cove, Sitka, Alaska. Prepared by: Solstice Alaska Consulting, Inc., Anchorage, Alaska for City and Borough of Sitka Department of Public Works Sitka, Alaska.

Clapham, P. (2000). The humpback whale: seasonal feeding and breeding in a baleen whale. In M. J., *Cetacean societies: Field studies of dolphins and whales* (pp. 173-196). Chicago: University of Chicago.

Clapham, P.J. & Mattila, D.K. (1990). Humpback whale songs as indicators of migration routes. *Marine Mammal Science*, 155-160.

Corcoran, K. (2021). Email from Kim Corcoran (NMFS) to Jessica Bassi and Ron Carmichael. Sent October 19, 2021.

Costidis et al. (2019). Costidis, A.M., Swingle, W.M., Barco, S.G., Bates, E.B., Mallette, S.D., Rose, S.A., & Epple, A.L. *Virginia Sea Turtle and Marine Mammal Stranding Network 2018 Grant Report*. Virginia Beach, VA: Final Report to the Virginia Coastal Zone Management Program, NOAA CZM Grant NA17NOS4190152, Task 49. VAQF Scientific Report 2019-01.

Craig, A., & Herman, L. (2000). Habitat preferences of female humpback whales Megaptera novaeangliae in the Hawaiian Islands are associated with reproductive status. *Marine Ecology Progress Series*, 209-216.

Curry, B., & Smith., J. (1997). Phylogeographic structure of the bottlenose dolphin (Tursiops truncatus): stock identification and implications for management. In A. Dizon, S. Chivers, & W. Perrin, *Molecular genetics of marine mammals. Spec. Publ. 3* (pp. 327-247). Society for Marine Mammalogy.

Dahl et al. (2015). Dahl, Peter H., Jong, Christ A. F. de, & Popper, Arthur N. The Underwater Sound Field from Impact Pile Driving and Its Potential Effects on Marine Life. *Acoustics Today*, 18-25.

Dazey et al. (2012). Assessment of Underwater Anthropogenic Noise Associated with Construction Activities in Bechers Bay, Santa Rosa Island, California. Journal of Environmental Protection, 2012, 3, 1286-1294.

DeHart, P. (2002). The distribution and abundance of harbor seals (Phoca vitulina concolor) in the Woods Hole region. (Unpublished thesis). Boston: Boston University.

Department for Environment, Food and Rural Affairs. (2003). Preliminary investigation of the sensitivity of fish to sound generated by aggregate dredging and marine construction. (Project AE0914 Final Report). London.

DiGiovanni et al. (2011). DiGiovanni, R.A., S.A., Wood, G.T., Waring, A., Chaillet, & Josephson., E. Trends in harbor and gray seal counts and habitat use at southern New England and Long Island index sites. *Poster presented at the Society for Marine Mammalogy, Tampa, Florida USA, October 2011.*

DiGiovanni et al. (2018). DiGiovanni Jr., R.A.; DePerte, A.; Winslow, H.; Durham, K. Gray seals (Halichoerus grypus) and Harbor Seals (Phoca vitulina) in the endless winter. *Northwest Atlantic Seal Research Consortium Meeting.* New Bedford.

Dolphin, W. F. (2000). Electrophysiological measures of auditory processing in odontocetes. In W. Au, A. Popper, & R. R. Fay, *Hearing by Whales and Dolphins.* New York: Springer-Verlag.

Duffield, D. (1986). Investigation of genetic variability in stocks of the bottlenose dolphin (Tursiops truncatus). Final report to the NMFS/SEFSC, Contract No. NA83-GA-00036.

Duffield et al. (1983). Duffield, D.A., Ridgway, S.H., & Cornell, L.H. Hematology distinguishes coastal and offshore forms of dolphins (Tursiops). *Canadian Journal of Zoology*, 930-933.

Egger, Stephanie. (2021). NMFS Fishery Biologist. Personal Communication to Jessica Bassi NAVFAC MIDLANT Natural Resources Specialist. October 21.

Engelhaupt et al. (2014). Engelhaupt, A., Richlen, M., Jefferson, T.A., & Engelhaupt, D. Occurrence, Distribution, and Density of Marine Mammals Near Naval Station Norfolk & Virginia Beach, VA: Annual Progress Report. Prepared for U.S. Fleet Forces Command. Submitted to Naval Facilities Engineering Command (NAVFAC) Atlantic, Norfolk, Virginia, under Contract No. N62470-10-3011, Task Orders 031 and 043, issued to HDR Inc., Norfolk, Virginia. 22 July 2014.

Engelhaupt et al. (2015). Engelhaupt, A., Aschettino, J., Jefferson, T.A., Richlen, M., & Engelhaupt, D. Occurrence, Distribution, and Density of Marine Mammals Near Naval Station Norfolk & Virginia Beach, VA: Annual Progress Report. Final Report. Prepared for U.S. Fleet Forces Command. Submitted to Naval Facilities Engineering Command Atlantic, Norfolk, Virginia, under Contract No. N62470- 10-3011, Task Orders 031 and 043, issued to HDR Inc., Virginia Beach, Virginia. 07 August 2015.

Engelhaupt et al. (2016). Engelhaupt, A., Aschettino, J., Jefferson, T.A., Engelhaupt, D., & Richlen, M. Occurrence, Distribution, and Density of Marine Mammals Near Naval Station Norfolk and Virginia Beach, Virginia: 2016 Final Report. Prepared for U.S. Fleet Forces Command. Submitted to Naval Facilities Engineering Command Atlantic, Norfolk, Virginia, under Contract No. N62470-10- 3011, Task Orders 03 and 043, issued to HDR Inc., Virginia Beach, Virginia. 12 October 2016.

EPA. (1986). *Quality Criteria for Water. EPA 440/5-86-001.* U.S. Environmental Protection Agency.

Ersts, P. J., & Rosenbaum, H. C. (2003). Habitat preference reflects social organization of humpback whales (Megaptera novaeangliae) on a wintering ground. *Journal of Zoology, 260*(4), 337-345.

Finneran, J. J. (2015). Noise-induced hearing loss in marine mammals: A review of temporary threshold shift studies from 1996 to 2015. *Journal of the Acoustical Society of America*, 1702–1726.

Finneran et al. (2003). Finneran, J., Dear, R., Carder, D. A., & Ridgway, S. H. Auditory and behavioral responses of California sea lions (Zalophus californianus) to single underwater impulses from an arc-gap transducer. *The Journal of the Acoustical Society of America*, 1667-1677.

Finneran et al. (2005). Finneran, J. J., Carder, D. A., Schlundt, C. E., & Ridgway, S. H. Temporary threshold shift in bottlenose dolphins (Tursiops truncatus) exposed to mid-frequency tones. *The Journal of the Acoustical Society of America*, 2696–2705.

Foote et al. (2004). Foote, A. D., Osborne, R. W., & Hoelzel, A. R. Environment: whale-call response to masking boat noise. *Nature*, 428(6986), 910.

Galli et al. (2003). Galli, L., Hurlbutt, B., Jewett, W., Morton, W., Schuster, S., & Van Hilsen, Z. *Source-level noise in Haro Strait: relevance to orca whales*. Colorado Springs, CO: Colorado College.

Garrison et al. (2017). Garrison, L.P., Barry, K., & Hoggard, W. *The abundance of coastal morphotype bottlenose dolphins on the U.S. east coast: 2002-2016*. Miami, FL: Southeast Fisheries Science Center, Protected Resources and Biodiversity Division.

Gaskin, D. (1992). Status of the harbour porpoise, Phocoena phocoena, in Canada. *Canadian Field-Naturalist*, 36-54.

Gilbert, J. R., & Guldager, N. (1998). *Status of Harbor and Gray Seal Populations in Northern New England.* Woods Hole: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center.

Gordon et al. (2004). Gordon, J., Gillespie, D., Potter, J., Frantzis, A., Simmonds, M. P., Swift, R., & Thompson, D. A review of the effects of seismic surveys on marine mammals. *Marine Technology Society Journal*, 16-34.

Graham et al. (2017). Graham, I.M., Pirotta, E., Merchant, N.D., Farcas, A., Barton, T.R., Cheney, B., Hastie, G.D., & Thompson, P.M. Responses of bottlenose dolphins and harbor porpoises to impact and vibration piling noise during harbor construction. *Ecosphere*, 8(5):e01793. 10.1002/ecs2.1793.

Hall, A., & Thompson, D. (2009). Gray seal, Halichoerus grypus. In W. Perrin, B. Wursig, & J. Thewissen, *Encyclopedia of Marine Mammals (2nd ed.)* (pp. 500-503). Cambridge: Academic Press.

Hamazaki, T. (2002). Spatiotemporal prediction models of cetacean habitats in the mid-western North Atlantic Ocean (from Cape Harteras, North Carolina, USA. to Nova Scotia, Canada). *Marine Mammal Science*, 920-939.

Hammill et al. (1998). Hammill, M.O., Stenson, G.B., Myers, R.A., & Stobo, W.T. Pup production and population trends of the grey seal (Halichoerus grypus) in the Gulf of St. Lawrence. *Canadian Journal of Fisheries and Aquatic Sciences*, 423-430.

Harris, C. (1998). Handbook of acoustical measurements and noise control. (3rd ed.). McGraw Hill.

Hart Crowser, Inc. (2013). Naval Base Kitsap-Bangor Explosives Handling Wharf 2 Year 1 Marine Mammal Monitoring Report (2012–2013). Bangor: Prepared for Naval Facilities Engineering Northwest.

Hart Crowser, Inc. (2014). Naval Base Kitsap-Bangor Explosives Handling Wharf 2 Year 2 Marine Mammal Monitoring Report (2013–2014). Bangor: Prepared for Naval Facilities Engineering Northwest.

Hart Crowser, Inc. (2015). Naval Base Kitsap-Bangor Explosives Handling Wharf 2 Year 3 Marine Mammal Monitoring Report (2014–2015). Silverdale: Prepared for Naval Facilities Engineering Northwes.

Hayes et al. (2017). Hayes, S.A, Josephson, E., Maze-Foley, K., & Rosel, P.E. US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments -- 2016. NOAA Tech Memo NMFS NE.

HDR Inc. (2012). Naval Base Kitsap at Bangor Test Pile Program, Bangor, Washington. Final Marine Mammal Monitoring Report. Silveredale: Prepared for Naval Facilities Engineering Northwest.

Hemilä et al. (2006). Hemilä, S., Nummela, S., Berta, A., & Reuter, T. High-frequency hearing in phocid and otariid pinnipeds: An interpretation based on inertial and cochlear constraints. *The Journal of the Acoustical Society of America*, 3463-3466.

Hersh, S., & Duffield, D. (1990). Distinction between northwest Atlantic offshore and coastal bottlenose dolphins based on hemoglobin profile and morphometry. In S. Leatherwood, & R. Reeves, *The bottlenose dolphin.* (pp. 129-139). San Diego: Academic Press.

Hoffman, J. F. (1980). *Investigation into Deep-Draft Vessel Berthing Problems at Selected U.S. Naval Facilities.* Office for Naval Research and Naval Facilities Engineering Command.

Holt et al. (2011). Holt, M.M., Noren, D.P., & Emmons, C.K. Effects of noise levels and call types on the source levels of killer whale calls. *The Journal of the Acoustical Society of America*, 3100-3106.

Holt, M. (2008). Sound exposure and Southern Resident killer whales (Orcinus orca): A review of current knowledge and data gaps. NOAA Tech. Memo. NMFS NWFSC-89. U.S. Department of Commerce.

Hotchkin, C., & Parks, S. (2013). The Lombard effect and other noise-induced vocal modifications: insight from mammalian communication systems. *Biological Reviews*, 809-824.

ICF Jones and Stokes and Illingworth and Rodkin. (2012). Final Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish. Appendix I Compendium of Pile Driving Sound Data. October.

Illingworth and Rodkin. (2017). Pile Driving Noise Measurements at Atlantic Fleet Naval Installations: 28 May 2013–28 April 2016.

Jacobs, S., & Terhune, J. (2000). Harbor seal (Phoca vitulina) numbers along the New Brunswick coast of the Bay of Fundy in autumn in relation to aquaculture. *Northeastern Naturalist*, 289-296.

Jefferson et al. (2015). Jefferson, T.A., Webber, M.A., & Pitman, R.L. *Marine mammals of the world: a comprehensive guide to their identification. 2nd ed.* London: Academic Press.

Johnston et al. (2015). Johnston, David W.; Frungillo, Jaime,...Read, Andrew J. Trends in Stranding and By-Catch Rates of Gray and Harbor Seals along the Northeastern Coast of the United States: Evidence of Divergence in the Abundance of Two Sympatric Phocid Species? *PLoS ONE*, 10(7): e0131660.

Jones et al. (2018). Jones, D.V., Rees, D.R., & Bartlett, B.A. Haul-out Counts and Photo-Identification of Pinnipeds in Chesapeake Bay and Eastern Shore, Virginia: 2017/2018 Annual Progress Report. Final Report. Prepared for U.S. Fleet Forces Command, Norfolk, Virginia. 21 December 2018.

Jones, D.V. & Rees, D.R. (2021). Haul-out Coutns and Photo-Identification of Pinnipeds in Chesapeake Bay and Eastern Shore, Virginia: 2019/2020 Annual Progress Report. Prepared for U.S. Fleet Forces Command, Norfolk, Virginia. February 2021.

Kastak et al. (1999). Kastak, D., Schusterman, R. J., Southall, B. L., & Reichmuth, C. J. Underwater temporary threshold shift induced by octave-band noise in three species of pinniped. *The Journal of the Acoustical Society of America*, 1142-1148.

Kastelein et al. (2015). Kastelein, R.A., Gransier, R., Marijt, M.A., & Hoek, L. Hearing frequency thresholds of harbor porpoises (Phocoena phocoena) temporarily affected by played back offshore pile driving sounds. *The Journal of the Acoustical Society of America*, 556–564.

Kastelein et al. (2016). Kastelein, R. A., Helder-Hoek, L., Covi, J., & Gransier, R. Pile driving playback sounds and temporary threshold shift in harbor porpoises (Phocoena phocoena): Effect of exposure duration. *The Journal of the Acoustical Society of America, 139*(5), 2842-2851.

Kastelein et al. (2018). Kastelein, R. A., Helder-Hoek, L., Kommeren, A., Covi, J., & Gransier, R. Effect of pile-driving sounds on harbor seal (Phoca vitulina) hearing. *The Journal of the Acoustical Society of America, 143*(6), 3583-3594.

Katona et al. (1993). Katona, S.K., Rough, V., & Richardson, D.T. *Field Guide to Whales, Porpoises, and Seals from Cape Cod to Newfoundland (Fourth ed.)*. Washington, DC: Smithsonian Institution Press.

Kenney, M. K. (1994). Harbor seal population trends and habitat use in Maine. (Unpublished master's thesis). Orono: University of Maine.

Kenney, R. D. (1990). Bottlenose dolphins off the northeastern United States. In S. Leatherwood, & R. Reeves, *The bottlenose dolphin* (pp. 369-386). San Diego: Academic Press.

Kenney, R. D. (2019). *Marine Mammals of Rhode Island, Part 5, Harbor Seal*. Retrieved from Rhode Island Natural History Survey: http://rinhs.org/uncategorized/marine-mammals-of-rhode-island-part-5-harbor-seal/. August 5.

Kenney, Robert D. & Winn, Howard E. (1986). Cetacean High-Use Habitats of the Northeast United States Continental Shelf. *Fishery Bulletin*, 345-357.

Ketten, D. R. (1995). Estimates of blast injury and acoustic trauma zones for marine mammals from underwater explosions. In R. A. Kastelein, J. A. Thomas, & P. E. Nachtigall, *Sensory systems of aquatic mammals* (pp. 391-407). Woerden: De Spil Publishers.

Ketten, D. R. (2000). Cetacean ears. In W. L. Au, A. Popper, & R. Fay, *Hearing by whales and dolphins* (pp. 43-108). New York: Springer-Verlag.

Ketten, D. R. (2004). Marine mammal auditory systems: a summary of audiometric and anatomical data and implications for underwater acoustic impacts. *Polarforschung*, 79-92.

LaBrecque et al. (2015). LaBrecque, E.; Curtice, C.; Harrison, J.; Van Parijs, S.M.; & Halpin, P.N. Biologically Important Areas for cetaceans within U.S. waters – East coast region. In S. V. Parijs, C. Curtice, & M. Ferguson, *Biologically Important Areas for cetaceans within U.S. waters. Aquatic Mammals (Special Issue)* (pp. 17-29).

Lesage, V., & Hammill, M. (2001). The status of the grey seal, Halichoerus grypus, in the Northwest Atlantic. *Canadian Field-Naturalist*, 653-662.

Malme et al. (1984). Malme, C. I., Miles, P. R., Clark, C. W., Tyack, P. L., & Bird, J. E. Investigations of the Potential Effects of Underwater Noise from Petroleum Industry Activities on Migrating Gray Whale Behavior. Phase II, January 1984 Migration. Anchorage: Prepared by Bolt, Beranek, and Newman, Cambridge, MA. Prepared for United States Minerals Management Service, Alaska, OCS Office.

Malme et al. (1988). Malme, C. I., Wursig, B., Bird, J. E., & Tyack, P. L. Observations of feeding gray whale responses to controlled industrial noise exposure. In W. M. Sackinger, M. O. Jefferies, J. L. Imm, & S. D. Treacy, *Port and Ocean Engineering Under Arctic Conditions (Vol. II)* (pp. 55-73). Fairbanks: University of Alaska.

Matzner, S., & Jones, M. E. (2011). Measuring coastal boating noise to assess potential impacts on marine life. *Sea Technology*, 41-44.

McKenna, M. F. (2011). Blue whale response to underwater noise from commercial ships. University of California, San Diego.

Mead, J., & Potter, C. (1995). Recognizing two populations for the bottlenose dolphin (Tursiops truncatus) off the Atlantic coast of North America: morphologic and ecologic considerations. *International Biological Research Institute Reports*, 31-43.

Mocklin, J. (2005). Final report: Research and monitoring needs relevant to decisions regarding increasing seasonal use days for cruise ships in Glacier Bay. Appendix C: Potential impacts of cruise ships on the marine mammals of Glacier Bay. Glacier Bay Vessel Management Science Advisory Board.

Mooney et al. (2009). Mooney, T. A., Nachtigall, P. E., Breese, M., Vlachos, S., & Au, W. W. Predicting temporary threshold shifts in a bottlenose dolphin (Tursiops truncatus): The effects of noise level and duration. *The Journal of the Acoustical Society of America*, 1816-1826.

Morton, A. B., & Symonds, H. K. (2002). Displacement of Orcinus orca (L.) by high amplitude sound in British Columbia, Canada. *ICES Journal of Marine Science*, 71-80.

Moulton et al. (2005). Moulton, V. D., Richardson, W. J., Elliott, R. E., McDonald, T. L., Nations, C., & Williams, M. T. Effects of an offshore oil development on local abundance and distribution of ringed seals (Phoca hispida) of the Alaskan Beaufort Sea. *Marine Mammal Science*, 217–242.

Nachtigall et al. (2007). Nachtigall, P. E., Mooney, T. A., Taylor, K. A., & Yuen, M. M. L. Hearing and Auditory Evoked Potential Methods Applied to Odontocete Cetaceans. *Aquatic Mammals*, 6-13.

National Research Council. (2003). *Ocean noise and marine mammals.* Washington, DC: The National Academies Press.

National Research Council. (2005). Marine Mammal Populations and Ocean Noise: Determining When Noise Causes Biologically Significant Effects. Washington, DC: The National Academies Press.

NAVFAC Mid-Atlantic. (2022). Data for In-Water Construction Activities, June 2022 through April 2026 for Construction of Pier 3 t Naval Station Norfolk.

NAVFAC SW (Naval Facilities Engineering Systems Command Southwest). (2020). Compendium of Underwater and Airborne Sound Data During Pile Installations and In-water Demolition Activities in San Diego Bay, California. October 2020. Prepared by Tierra Data, Inc.

Navy. (2001). Shock trial of the WINSTON S. CHURCHILL (DDG 81): Final Environmental Impact Statement. Department of the Navy.

Navy. (2015). Proxy Soruce Sound Levels and Potential Bubble Curtain Attenuation for Acoustic Modeling of Nearshore Marine Pile Driving a Navy Installations in Puget Sound. Naval Facilities Engineering Command Northwest.

Navy. (2017). U.S. Navy Marine Species Density Database Phase III for the Atlantic Fleet Training and Testing Study Area. NAVFAC Atlantic Final Technical Report. Norfolk: Naval Facilities Engineering Command Atlantic.

Nemeth, E., & Brumm, H. (2010). Birds and anthropogenic noise: are urban songs adaptive? *American Naturalist*, 465-475.

NMFS. (2017). *Turbidity Table*. Retrieved August 7, 2017, from NOAA Fisheries, Greater Atlantic Region (National Marine Fisheries Service): https://www.greateratlantic.fisheries.noaa.gov/protected/section7/guidance/consultation/turbiditytablenew.html. National Oceanic and Atmospheric Administration Fisheries.

NMFS. (2018a). TM 245 US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2017 (Second Edition). NOAA Tech Memo NMFS NE-245.

NMFS. (2018b). 2018 Revision to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts. NOAA Technical Memorandum NMFS-OPR-59.

NMFS. (2019a). US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2018. NOAA Technical Memorandum NMFS-NE-258.

NMFS. (2021a). Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to U.S. Navy Construction at Naval Station Norfolk in Norfolk, Virginia. Federal Register 50 CFR 218. Pages 24340-24359. May 6, 2021.

NMFS. (2022). Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to Replacement of Pier 3 at Naval Station Norfolk in Norfolk, Virginia. Notice of Proposed incidental harassment authorization. Federal Register Vol 87, No.17, 3976-4001. January 26.

NMFS. Unpublished. Guidance for Simultaneous Sources. Provided by Jessica Bassi, NAVFAC Midlant, August 2021

Norris, K., & Prescott, J. (1961). Observations on Pacific cetaceans of Californian and Mexican waters. *University of California Publications in Zoology*, 291-402.

Northwest Environmental Consulting. (2014). *Replace Fendering System, Pier 6, PSNS & IMF Marine Mammal Monitoring.* Gig Harbor: Prepared for Watts Constructors, LLC.

Northwest Environmental Consulting. (2015). *Naval Base Bremerton Pier 6 Pile Replacement – Marine Mammal Monitoring.* Gig Harbor: Prepared for Watts Constructors, LLC.

Nowacek et al. (2007). Nowacek, D. P., Thorne, L. H., Johnston, D. W., & Tyack, P. L. Responses of cetaceans to anthropogenic noise. *Mammal Review*, 81-115.

NYSDEC. (2000). *Hudson River Sediment and Biological Survey.* New York State Department of Environmental Conservation.

O'Keeffe, D. J., & Young, G. A. (1984). *Handbook on the environmental effects of underwater explosions. (NSWC TR 83-240).* Dahlgren, VA and Silver Spring, MD: Naval Surface Weapons Center.

Payne et al. (1990). Payne, P. Michael, Wiley, David N., Young, Sharon B., Pittman, Sharon, Clapham, Phillip J., & Jossi, Jack W. Recent Fluctuations in the Abundance of Baleen Whales in the Southern Gulf of Maine in Relation to Changes in Selected Prey. *Fishery Bulletin*, 687-696.

Prescott, R. (1982). Harbor seals: Mysterious lords of the winter beach. *Cape Cod Life*, 24-29.

Read, A. (1999). Harbor porpoise, Phocoena phocoena (Linnaeus, 1758). In S. H. Ridgway, & R. Harrison, *Handbook of Marine Mammals* (pp. 323-355). San Diego: Academic Press.

Reeder, D. M., & Kramer, K. M. (2005). Stress in free-ranging mammals: integrating physiology, ecology, and natural history. *Journal of Mammalogy*, 225-235.

Rees et al. (2016). Rees, D.R., Jones, D.V., & Bartlett, B.A. Haul-out Counts and Photo-Identification of Pinnipeds in Chesapeake Bay, Virginia: 2015/16 Annual Progress Report. Final Report. Norfolk: Prepared for U.S. Fleet Forces Command.

Reeves et al. (1992). Reeves, R.R., Stewart, B.S., & Leatherwood, S. *The Sierra Club Handbook of Seals and Sirenians*. San Francisco: Sierra Club Books.

Reine, K. J., & Dickerson, C. (2014). Characterization of underwater sounds produced by a hydraulic cutterhead dredge during maintenance dredging in the Stockton Deepwater Shipping Channel, California. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

Richardson et al. (1995). Richardson, W.J., Greene, Jr., C. R., Malme, C.I., & Thomson, D.H. *Marine Mammals and Noise*. San Diego: Academic Press.

Ridgway et al. (1997). Ridgway, S. H., Carter, D. A., Smith, R. R., Kamolnick, T., Schlundt, C. E., & Elsberry, W. R. Behavioral responses and temporary shift in masked hearing threshold of bottlenose dolphins, Tursiops truncatus, to 1-second tones of 141 to 201 dB re 1 µPa. (Technical Report 1751). San Diego: Naval Command, Control and Ocean Surveillance Center, RDT&E Division.

Ritter, F. (2002). Behavioural observations of rough-toothed dolphins (Steno bredanensis) off La Gomera, Canary Islands (1995–2000), with special reference to their interactions with humans. *Aquatic Mammals*, 46-59.

Rosel et al. (1999). Rosel, P.E., France, S.C., Wang, J.Y., & Kocher, T.D. Genetic structure of harbor porpoise Phocoena phocoena populations in the northwest Atlantic based on mitochondrial and nuclear markers. *Molecular Ecology*, S41-54.

Rosenfeld et al. (1988). Rosenfeld, M., George, M., Terhune, J.M. Evidence of autumnal harbour seal, Phoca vitulina, movement from Canada to the United States. *Canadian Field-Naturalist*, 527-529.

Russell et al. (2016). Russell, D. J., Hastie, G. D., Thompson, D., Janik, V. M., Hammond, P. S., Scott-Hayward, L. A., Matthiopoulos, J., Jones, E. L., & McConnell, B. J. Avoidance of wind farms by harbour seals is limited to pile driving activities. *Journal of Applied Ecology*, 53(6), 1642-1652.

Schneider, D., & Payne, P. M. (1983). Factors Affecting Haul-Out of Harbor Seals at a Site in Southeastern Massachusetts. *Journal of Mammalogy*, 518-520.

Schusterman, R. (1981). Behavioral Capabilities of Seals and Sea Lions: A Review of Their Hearing, Visual, Learning and Diving Skills. *The Psychological Record*, 125-143.

Scott, M., & Chivers, S. (1990). Distribution and herd structure of bottlenose dolphins in the eastern tropical Pacific Ocean. In S.Leatherwood, & R. R. Reeves, *The Bottlenose Dolphin* (pp. 387-402). Cambridge: Academic Press.

Sebastianutto et al. (2011). Sebastianutto, L., Picciulin, M., Costantini, M., & Ferrero, E. A. How boat noise affects an ecologically crucial behaviour: the case of territoriality in Gobius cruentatus (Gobiidae). *Environmental Biology of Fishes*, 207-215.

Shane et al. (1986). Shane, S. H., Wells, R. S., & Würsig, B. Ecology, behavior and social organization of the bottlenose dolphin: A review. *Marine Mammal Science*, 34-63.

Smultea et al. (2017). Smultea, M. A., Lomac-MacNair, K., Campbell, G., Courbis, S., & Jefferson, T. A. *Final Report Aerial Surveys of Marine Mammals Conducted in the Inland Puget Sound Waters of Washington, Summer 2013–Winter 2016*. Preston, WA: Smultea Environmental Sciences, LLC. Prepared for Naval Facilities Engineering Command Pacific, Silverdale, WA.

Smultea, M. A. (1994). Segregation by humpback whale (Megaptera novaeangliae) cows with a calf in coastal habitat near the island of Hawaii. *Canadian Journal of Zoology*, 805-811.

Southall et al. (2007). Southall, B., Bowles, A., Ellison, W., Finneran, J., Gentry, R., Greene, C. Jr., Kastak, D., Ketten, D., Miller, J., Nachtigall, P., Richardson, W., Thomas, J., Tyack, P. Marine mammal noise exposure criteria: Initial scientific recommendations. *Aquatic Mammals*, 411-521.

Southall et al. (2019). Southall, B.L., Finneran, J.J., Reichmuth, C., P.E. Nachtigall, D.R. Ketten, A.E. Bowles, W.T. Ellison, D.P. Nowacek, and P.L. Tyack. Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects. Aquatic Mammals 45(2), 125-232, DOI 10.1578/AM.45.2.2019.125.

Stevick et al. (2003). Stevick, P.T.; Allen, J.; Clapham, P. J.; Friday, N.; Katona, S. K.; Larsen, F.; Lien, J.; Mattila, D.K.,...Hammond, P.S. North Atlantic humpback whale abundance and rate of increase four decades after protection from whaling. *Marine Ecology Progress Series*, 263-273.

Stevick et al. (2006). Stevick, P.T., Allen, J., Clapham, P. J., Katona, S.K., Larsen, F., Lien, J., Mattila, D.K., Palsbøll, P.J., Sears, R.,...Hammond, P.S. Population spatial structuring on the feeding grounds in North Atlantic humpback whales (Megaptera novaeangliae). *Journal of Zoology*, 244 –255.

Straley, J. (1990). Fall and winter occurrence of humpback whales (Megaptera novaeangliae) in southeastern Alaska. *Reports of the International Whaling Commission*, 319-323.

Swingle et al. (2014). Swingle, W. M., Lynott, M. C., Bates, E. B., D'Eri, L.R., Lockhart, G.G., Phillips, K.M., & Thomas, M.D. *Virginia Sea Turtle and Marine Mammal Stranding Network 2013 Grant Report. Final Report to the Virginia Coastal Zone Management Program, NOAA CZM Grant #NA11NOS4190122, Task 49. VAQF Scientific Report 2013-01*. Virginia Beach.

Swingle et al. (2015). Swingle, W. M., Lynott, M.C., Bates, E.B., Lockhar, G.G., Phillips, K.M., Rodrique, K.R., Rose, S.A., & Williams, K.M. *Virginia Sea Turtle and Marine Mammal Stranding Network 2014 Grant Report. Final Report to the Virginia Coastal Zone Management Program, NOAA CZM Grant #NA13NOS4190135, Task 49. VAQF Scientific Report 2015-01*.

Swingle et al. (2016). Swingle, W.M., Barco, S.G., Bates, E.B., Lockhart, G.G., Phillips, K.M., Rodrique, K.R., Rose, S.A., & Williams, K.M. *Virginia Sea Turtle and Marine Mammal Stranding Network 2015 Grant Report Final Report to the Virginia Coastal Zone Management Program, NOAA CZM Grant #NA14NOS4190141, Task 49. VAQF Scientific Report 2016-01.*

Swingle et al. (2017). Swingle, W.M., Barco, S.G., Costidis, A.M., Bates, E.B., Mallette, S.D., Phillips, K.M., Rose, S.A., & Williams, K.M. *Virginia Sea Turtle and Marine Mammal Stranding Network 2016 Grant Report. Final Report to the Virginia Coastal Zone Management Program, NOAA CZM Grant #NA15NOS4190164, Task 49. VAQF Scientific Report 2017-01*. Virginia Beach.

Swingle et al. (2018). Swingle, W.M., Barco, S.G., Costidis, A.M., Bates, E.B., Mallette, S.D., Rose, S.A., & Epple, A.L. Virginia Sea Turtle and Marine Mammal Stranding Network 2017 Grant Report. Final Report to the Virginia Coastal Zone Management Program, NOAA CZM Grant NA16NOS4190171, Task 49. VAQF Scientific Report 2018-01. Virginia Beach.

Terhune, J. M., & Verboom, W. C. (1999). Right whales and ship noise. *Marine Mammal Science*, 256-258.

Tetra Tech, Inc. (2016). *Nearshore Surveys at Naval Station Norfolk (NSN), Final Report.* Norfolk, VA: Naval Facilities Engineering Command Mid-Atlantic.

Thompson et al. (2013). Thompson, P. M., Hastie, G. D., Nedwell, J., Barham, R. Brookes, K. L., Cordes, L. S., Bailey, H., & McLean, N. Framework for assessing impacts of pile-driving noise from offshore wind farm construction on a harbour seal population. *Environmental Impact Assessment Review*, 43, 73-85.

Thorson, P. (2010). San Francisco-Oakland Bay Bridge east span seismic safety project marine mammal monitoring for the self-anchored suspension temporary towers, June 2008-May 2009. California Department of Transportation.

Thorson, P., & Reyff, J. (2006). San Francisco-Oakland Bay bridge east span seismic safety project marine mammals and acoustic monitoring for the marine foundations at piers E2 and T1. California Department of Transportation.

Urick, R. J. (1972). Noise signature of an aircraft in level flight over a hydrophone in the sea. *The Journal of the Acoustical Society of America*, 939-999.

Urick, R. J. (1983). *Principles of Underwater Sound. 3rd Edition.* New York: McGraw-Hill.

USACE and Port of Virginia. (2017). Elizabeth River and Southern Branch Improvements Draft General Reevaluation Report and Environmental Assessment. Norfolk VA: USACE Norfolk District.

USACE and Port of Virginia. (2018). Norfolk Harbor Navigation Improvements General Reevaluation Report and Environmental Assessment. U.S. Army Corps of Engineers.

Viada et al. (2008). Viada, S. T., Hammer, R. M., Racca, R., Hannay, D., Thompson, M. J., Balcom, B. J., & Phillips, N.W. Review of potential impacts to sea turtles from underwater explosive removal of offshore structures. *Environmental Impact Assessment Review*, 267-285.

Ward, W. D. (1997). Effects of high intensity sound. In M. J. Crocker, *Encyclopedia of acoustics, (Volume III)* (pp. 1497-1507). New York: John Wiley & Sons.

Waring et al. (2004). Waring, G.T., Pace, R.M., Quintal, J.M., Fairfield, C.P., & Maze-Foley, K. *U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments–2003 (NOAA Technical Memorandum NMFS-NE-182)*. Woods Hole: U.S. Department of Commerce, National Marine Fisheries Service.

Waring et al. (2015). Waring, G. T., Josephson, E., Maze-Foley, K., & Rosel, P.E. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments -- 2014. NOAA Tech. Memo. NMFS-NE-231.

Waring et al. (2016). Waring, Gordon T., Josephson, Elizabeth, Maze-Foley, Katherine, & Rosel, Patricia E. US Atlantic and Gulf of Mexico marine mammal stock assessments - 2015. NOAA technical memorandum NMFS-NE; 238.

Wartzok et al. (2004). Wartzok, D., Popper, A. N., Gordon, J., & Merrill, J. Factors affecting the responses of marine mammals to acoustic disturbance. *Marine Technology Society Journal*, 6-15.

Wartzok, D. & Ketten, D.R. (1999). Marine Mammal Sensory Systems. In J. Reynolds III, & S. Rommel, *Biology of Marine Mammals* (pp. 117-175). Washington, DC: Smithsonian Institute Press.

Watkins, W. A. (1986). Whale reactions to human activities in Cape Cod waters. *Marine Mammal Science*, 251-262.

Watts, P., & Gaskin, D. (1985). Habitat index analysis of the harbor porpoise (Phocoena phocoena) in the southern coastal Bay of Fundy, Canada. *Journal of Mammalogy*, 733-744.

Wells et al. (1999). Wells, R.S., Rhinehart, H.L., Cunningham, P., Whaley, J., Baran, M., Koberna, C., & Costa, D.P. Long distance offshore movements of bottlenose dolphins. *Marine Mammal Science*, 1098-1114.

Wells, R., & Scott, M. (2008). Bottlenose Dolphin, Tursiops truncatus, Common Bottlenose Dolphin. In W. B., T. J.G.M., & K. K.M., *Encyclopedia of Marine Mammals Second Edition* (pp. 249-255). London: Academic Press.

Westgate et al. (1998). Westgate, A.J., Read, A.J., Cox, T.M., Schofield, T.D.; Whitaker, B.R., & Anderson, K.E. Monitoring a rehabilitated harbor porpoise using satellite telemetry. *Marine Mammal Science*, 599-604.

Whitehead, H. (1982). Populations of humpback whales in the northwest Atlantic. *Reports of the International Whaling Commission*, 345-353.

Whitman, A., & Payne, P. (1990). Age of harbour seals, Phoca vitulina concolor, wintering in southern New England. *Canadian Field-Naturalist*, 579-582.

Whitt et al. (2015). Whitt, A.D., Powell, J.A., Richardson, A.G., & Bosyk., J.R. Abundance and distribution of marine mammals in nearshore waters off New Jersey, US. *Journal of Cetacean Research and Management*, 45-59.

Wilson, S. C. (1978). *Social organization and behavior of harbor seals, Phoca vitulina concolor, in Maine. (MMC-76/10).* Prepared by Office of Zoological Research, National Zoological Park, Smithsonian Institution, Washington, DC. Prepared for U.S. Marine Mammal Commission, Washington, DC.

Wingfield et al. (2017). Wingfield, JE, O'Brien, M, Lyubchich, V, Roberts, J.J., Halpin, P.N., Rice, A.N., & Bailey, H. Year-round spatiotemporal distribution of harbor porpoises within and around the Maryland wind energy area. *PLoS ONE*, 12(5): e0176653.

WSDOT. (2019). Biological Assessment Preparation for Transportation Projects – Advanced Training Manual Chapter 7.0 Construction Noise Impact Assessment. (Version-1-2019). Olympia: Washington State Department of Transportation.

Würsig et al. (1998). Würsig, B., Lynn, S. K., Jefferson, T. A., & Mullin, K. D. Behaviour of cetaceans in the northern Gulf of Mexico relative to survey ships and aircraft. *Aquatic Mammals*, 41-50.

Yelverton et al. (1973). Yelverton, J. T., Richmond, D. R., Fletcher, E. R., & Jones, R. K. *Safe distances from underwater explosions for mammals and birds*. Albuquerque: Lovelace Foundation.

Appendix A

NMFS Acoustic Worksheets

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USER SPREADSHEET INTRODUCTION

VERSION: 2.2 (2020)

Companion* User Spreadsheet to:

National Marine Fisheries Service (NMFS): 2018 Revision to: Technical Guidance For Assessing the Effects of Anthropogenic Noise on Marine Mammal Hearing: Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts (Version 2.0)

2018 Revised Technical Guidance web page

***For more information on the optional methodology provided within this User Spreadsheet, see Appendix D of Technical Guidance (2018)**

DISCLAIMER: NMFS has provided this spreadsheet as an optional tool to provide estimated effect distances (i.e., isopleths) where PTS onset thresholds may be exceeded. Results provided by this spreadsheet do not represent the entirety of the comprehensive effects analysis, but rather serve as one tool to help evaluate the effects of a proposed action on marine mammal hearing and make findings required by NOAA's various statutes. Input values are the responsibility of the individual user.

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.

INSTRUCTIONS

STEP 1: Determine what spreadsheet is appropriate for activity

HOW TO DETERMINE WHICH TAB TO USE

1) Is the sound source NON-IMPULSIVE or IMPULSIVE? (If it is unclear which category describes your source, consult NOAA)
- a) NON-IMPULSIVE (e.g., drilling, vibratory pile driving, tactical sonar): Go to Question 2
- b) IMPULSIVE (e.g., explosives, impact pile driving, DTH pile driving, seismic): Go to Question 5

2) Is the NON-IMPULSIVE sound source STATIONARY or MOBILE?
- a) STATIONARY: Go to Question 3
- b) MOBILE: Go to Question 4

3) Is the NON-IMPULSIVE, STATIONARY source CONTINUOUS or INTERMITTENT[1]?
- a) CONTINUOUS: Use Tab A* — RED
- *If source is vibratory pile driving: Use Tab A.1 — BRICK
- b) INTERMITTENT: Use Tab B — YELLOW

[1] A key distinction between continuous and intermittent sound sources is that intermittent sounds have a more regular (predictable) pattern of bursts of sounds and silent periods (i.e., duty cycle), which continuous sounds do not.

4) Is the NON-IMPULSIVE, MOBILE source CONTINUOUS or INTERMITTENT?
- a) CONTINUOUS: Use Tab C ("safe distance" methodology from Sivle et al. 2014) — BLUE
- b) INTERMITTENT: Use Tab D ("safe distance" methodology from Sivle et al. 2014) — ORANGE

5) Is the IMPULSIVE sound source STATIONARY or MOBILE?
- a) STATIONARY: Use Tab E* — GREEN
- *If source is impact pile driving: Use Tab E.1 — EVRGRN
- *If source is DTH pile driving/installation: Use Tab E.2 — TEAL
- b) MOBILE: Use Tab F ("safe distance" methodology from Sivle et al. 2014) — PURPLE

STEP 2: Within the appropriate tab, fill-in: **SAGE CELLS** specific to the activity
- a) Please provide information used to support values in provided in sage boxes (e.g., surrogate data, direct measurements, etc.)
- b) If information is unavailable to fill-out one or more of the sage boxes, please consult NMFS

STEP 3: Estimated PTS isopleths (meter) will be provided in: **SKY BLUE CELLS** by marine mammal hearing group

STEP 4: When using this spreadsheet to estimate marine mammal takes, please provide a copy of completed tab used to estimate isopleths

ASSUMPTIONS & ADDITIONAL INFORMATION

1) Marine mammals remain stationary during activity
2) Currently, recovery between intermittent sounds is not considered regardless of time between sounds (i.e., all sounds within the accumulation period are counted)

Suggested (Default*) Weighting Factor Adjustments (WFA) for Broadband Sources:

Source	WFA	Example Supporting Sources
Seismic airguns	1 kHz	Breitzke et al. 2008; Tashmukhambetov et al. 2008; Tolstoy et al. 2009
Impact pile driving hammers	2 kHz	Blackwell 2005; Reinhall and Dahl 2011
Vibratory pile driving hammers	2.5 kHz	Blackwell 2005; Dahl et al. 2015
DTH pile driving/installation	2 kHz	Denes et al. 2016; Denes et al. 2019; Reyff and Heyvaert 2019
Drill vessels/platforms	2 kHz	Greene 1987; Blackwell et al. 2004; Blackwell and Greene 2006

* NMFS acknowledges default WFAs are likely conservative

Marine Mammal Hearing Group
Low-frequency (LF) cetaceans: baleen whales
Mid-frequency (MF) cetaceans: dolphins, toothed whales, beaked whales, bottlenose whales
High-frequency (HF) cetaceans: true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* & *L. australis*
Phocid pinnipeds (PW): true seals
Otariid pinnipeds (OW): sea lions and fur seals

Based on NMFS 2018 Revised Technical Guidance

Literature Cited

Blackwell, S.B. 2005. Underwater Measurements of Pile Driving Sounds during the Port MacKenzie Dock Modifications, 13-16 August 2004. Juneau, Alaska: Federal Highway Administration.

Blackwell, S.B., C.R. Greene, Jr., and W.J. Richardson. 2004. Drilling and operational sounds from an oil production island in the ice-covered Beaufort Sea. Journal of the Acoustical Society of America 116: 3199-3211.

Blackwell, S.B., and C.R. Green, Jr. 2006. Sounds from an oil production island in the Beaufort Sea in summer: Characteristics and contribution of vessels. Journal of the Acoustical Society of America 119: 182-196.

Breitzke, M., O. Boebel, S. El Naggar, W. Jokat, and B. Werner. 2008 Broad-band calibration of marine seismic sources used by R/V Polarstern for academic research in polar regions. Geophysical Journal International 174: 505-524.

Dahl, P.H., D.R. Dall'Osto, and D.M. Farrell. 2015. The underwater sound field from vibratory pile driving. Journal of the Acoustical Society of America 137: 3544–3554.

Denes, S. L., G.J. Warner, M.E. Austin, and A.O. MacGillivray. 2016. Hydroacoustic Pile Driving Noise Study – Comprehensive Report. Document 001285, Version 2.0. Technical report by JASCO Applied Sciences for Alaska Department of Transportation & Public Facilities. Anchorage, AK: JASCO Applied Sciences.

Denes, S., J. Vallarta, and D. Zeddies 2019. Sound Source Characterization of Down-the-Hole Hammering: Thimble Shoal, Virginia. Document 001888, Version 1.0. Technical report by JASCO Applied Sciences for Chesapeake Tunnel Joint Venture. Silver Spring, MD: JASCO Applied Sciences.

Greene, R. 1987. Characteristics of oil industry dredge and drilling sounds in the Beaufort Sea. Journal of the Acoustical Society of America 82: 1315-1324.

Madsen, P.T. 2005. Marine mammals and noise: Problems with root mean square sound pressure levels for transients. Journal of the Acoustical Society of America 117:3952–3957.

Reinhall, P.G., and P.H. Dahl. 2011. Underwater Mach wave radiation from impact pile driving: Theory and observation. Journal of the Acoustical Society of America 130: 1209–1216.

Reyff, J., and C. Heyvaert. 2019. White Pass & Yukon Railroad Mooring Dolphin Installation: Pile Driving and Drilling Sound Source Verification. Cotati, CA: Illingworth & Rodkin, Inc.

Sivle, L.D., P.H. Kvadsheim, and M.A. Ainslie. 2014. Potential for population-level disturbance by active sonar in herring. ICES Journal of Marine Science 72: 558-567.

Tashmukhambetov, A.M., G.E. Ioup, J.W. Ioup, N.A. Sidorovskaia, and J.J. Newcomb. 2008. Three-dimensional seismic array characterization study: Experiment and modeling. Journal of the Acoustical Society of America 123:4094–4108.

Tolstoy, M., J. Diebold, L. Doermann, S. Nooner, S.C. Webb, D.R. Bohnenstiehl, T.J. Crone, and R.C. Holmes. 2009. Broadband calibration of the R/V Marcus G. Langseth four-string seismic sources. Geochemistry Geophysics Geosystems 10: 1-15.

Technical questions or suggestion on User Spreadsheet: Please contact Amy Scholik-Schlomer (amy.scholik@noaa.gov)

UPDATES (will be posted when change results in the need to recalculate an isopleth; other non-substantive changes may be made periodically but will not result in a version number change)

Original Version	Updated Version	Change	Date posted
1.0	1.1	Sheet A, error with formula for phocid pinniped	Aug. 22, 2016
1.1	2.0	Corresponds to 2.0 version of Revised Technical Guidance (2018). Added sheet specific to vibratory pile driving and explosives and added capabilities to calculate peak sound pressure level isopleths for impulsive sources	July 2018
2.0	2.1	Updated version based on comments from 2018 public comment period. Added Tab for DTH	July 2020
2.0	2.2	Updated version based on comments from 2018 public comment period (late) on seismic surveys from IAGC	December 2020

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 2: Construction of CEP-176 Bulkhead, Install 103 bearing piles (42-inch diamter steel pipe)-April 2023 to May 2023 (26 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 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)	**215.6**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	177
Number of strikes per pile	1800
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)	213
Distance of $L_{p,0\text{-}pk}$ measurement (meters)	10
$L_{p,0\text{-}pk}$ Source level	228.0

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)	**1,482.4**	**52.7**	**1,765.7**	**793.3**	**57.8**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**4.0**	**NA**	**54.1**	**4.6**	**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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 2: Construction of CEP-176 Bulkhead, Install 221 bearing piles (28-inch steel sheets)- April 2023 to May 2023 (16 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 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)	**216.8**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	181
Number of strikes per pile	270
Number of piles per day	14
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)	211
Distance of $L_{p,0\text{-}pk}$ measurement (meters)	10
$L_{p,0\text{-}pk}$ Source level	226.0

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)	**1,782.6**	**63.4**	**2,123.4**	**954.0**	**69.5**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**2.9**	**NA**	**39.8**	**3.4**	**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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 2: Construction of CEP-175 Bulkhead, Install 9 piles (13-inch polymeric)-April 2023 to May 2023 (2 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 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)	**186.5**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	153
Number of strikes per pile	450
Number of piles per day	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)	**17.1**	**0.6**	**20.4**	**9.2**	**0.7**
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.

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

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 2: Construction of CEP-102 Platform Phase 2 Portion 113-108, Install 11 bearing piles (24-inch concrete square)- May 2023 (6 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 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)	**199.0**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	163
Number of strikes per pile	2000
Number of piles per day	2
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)	189
Distance of $L_{p,0\text{-}pk}$ measurement (meters)	10
$L_{p,0\text{-}pk}$ Source level	204.0

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)	**116.8**	**4.2**	**139.1**	**62.5**	**4.6**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**NA**	**NA**	**1.4**	**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

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 2: Construction of Pier 3, Install 280 bearing piles (24-inch concrete square)- May 2023 to September 2023 (70 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 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)	**204.1**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\text{single strike}}$) specified at "x" meters (Cell B32)	163
Number of strikes per pile	3200
Number of piles per day	4
Transmission loss coefficient	15
Distance of single strike SEL_{ss} ($L_{E,p,\text{single strike}}$) measurement (meters)	10

PK

$L_{p,0\text{-pk}}$ specified at "x" meters (Cell G29)	189
Distance of $L_{p,0\text{-pk}}$ measurement (meters)	10
$L_{p,0\text{-pk}}$ Source level	204.0

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)	**253.6**	**9.0**	**302.1**	**135.7**	**9.9**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**NA**	**NA**	**1.4**	**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[Δ] (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)	

[Δ]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

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 2: Construction of CEP-102 Platform Phase 2 Portion 113-108, Install 6 fender piles (18-inch concrete square)- July 2023 (2 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 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)	**180.8**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	154
Number of strikes per pile	120
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)	185
Distance of $L_{p,0\text{-}pk}$ measurement (meters)	10
$L_{p,0\text{-}pk}$ Source level	200.0

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)	**7.1**	**0.3**	**8.5**	**3.8**	**0.3**
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.

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

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 2: Construction of Pier 3, Install 250 bearing piles (24-inch concrete square)- July 2023 to November 2023 (63 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 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)	**204.1**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	163
Number of strikes per pile	3200
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)	189
Distance of $L_{p,0\text{-}pk}$ measurement (meters)	10
$L_{p,0\text{-}pk}$ Source level	204.0

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)	**253.6**	**9.0**	**302.1**	**135.7**	**9.9**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**NA**	**NA**	**1.4**	**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

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 3: Construction of Pier 3, Install 409 fender piles (24-inch concrete square)- July 2024 to October 2024 (69 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 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)	**191.6**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	163
Number of strikes per pile	120
Number of piles per day	6
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)	189
Distance of $L_{p,0\text{-}pk}$ measurement (meters)	10
$L_{p,0\text{-}pk}$ Source level	204.0

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)	**37.2**	**1.3**	**44.4**	**19.9**	**1.5**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**NA**	**NA**	**1.4**	**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

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 3: Construction of Pier 3, Install 18 fender piles (18-inch steel pipe)- July 2024 to November 2024 (3 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 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)	**210.3**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	176
Number of strikes per pile	450
Number of piles per day	6
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)	208
Distance of $L_{p,0\text{-}pk}$ measurement (meters)	10
$L_{p,0\text{-}pk}$ Source level	223.0

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)	**661.2**	**23.5**	**787.6**	**353.8**	**25.8**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**1.8**	**NA**	**25.1**	**2.2**	**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

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 3: Construction of CEP-102 Bulkhead South Portion 188-163, Install 26 bearing piles (42-inch steel pipe)- December 2024 to January 2025 (13 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 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)	**213.0**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\text{single strike}}$) specified at "x" meters (Cell B32)	177
Number of strikes per pile	2000
Number of piles per day	2
Transmission loss coefficient	15
Distance of single strike SEL_{ss} ($L_{E,p,\text{single strike}}$) measurement (meters)	10

PK

$L_{p,0\text{-pk}}$ specified at "x" meters (Cell G29)	213
Distance of $L_{p,0\text{-pk}}$ measurement (meters)	10
$L_{p,0\text{-pk}}$ Source level	228.0

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)	1,001.8	35.6	1,193.3	536.1	39.0
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	4.0	NA	54.1	4.6	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

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 3: Construction of CEP-102 Bulkhead South Portion 188-163, Install 53 sheet piles (28-inch steel sheets)- January 2025 (4 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 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)	**216.8**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	181
Number of strikes per pile	270
Number of piles per day	14
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)	211
Distance of $L_{p,0\text{-}pk}$ measurement (meters)	10
$L_{p,0\text{-}pk}$ Source level	226.0

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)	**1,782.6**	**63.4**	**2,123.4**	**954.0**	**69.5**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**2.9**	**NA**	**39.8**	**3.4**	**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

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 4: Construction of CEP-102 Platform South Portion 188-163, Install 40 bearing piles (24 inch concrete square)- April 2025 to May 2025 (20 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 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)	**199.0**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	163
Number of strikes per pile	2000
Number of piles per day	2
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)	189
Distance of $L_{p,0\text{-}pk}$ measurement (meters)	10
$L_{p,0\text{-}pk}$ Source level	204.0

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)	**116.8**	**4.2**	**139.1**	**62.5**	**4.6**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**NA**	**NA**	**1.4**	**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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 4: Construction of CEP-102 Platform South Portion 188-163, Install 25 fender piles (18-inch concrete square)- September 2025 (7 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 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)	**180.8**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	154
Number of strikes per pile	120
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)	185
Distance of $L_{p,0\text{-}pk}$ measurement (meters)	10
$L_{p,0\text{-}pk}$ Source level	200.0

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)	**7.1**	**0.3**	**8.5**	**3.8**	**0.3**
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[Δ] (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)	

[Δ]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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 4: Construction of CEP-102 Bulkhead Center Portion 163-114, Install 50 bearing piles (42-inch steel pipe)- September 2025 to October 2025 (25 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 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)	**213.0**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	177
Number of strikes per pile	2000
Number of piles per day	2
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)	213
Distance of $L_{p,0\text{-}pk}$ measurement (meters)	10
$L_{p,0\text{-}pk}$ Source level	228.0

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)	**1,001.8**	**35.6**	**1,193.3**	**536.1**	**39.0**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**4.0**	**NA**	**54.1**	**4.6**	**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

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 4: Construction of CEP-102 Bulkhead Center Portion 163-114, Install 102 sheet piles (28-inch steel sheets)- October 2025 (8 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 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)	**216.8**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	181
Number of strikes per pile	270
Number of piles per day	14
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)	211
Distance of $L_{p,0\text{-}pk}$ measurement (meters)	10
$L_{p,0\text{-}pk}$ Source level	226.0

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)	**1,782.6**	**63.4**	**2,123.4**	**954.0**	**69.5**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**2.9**	**NA**	**39.8**	**3.4**	**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

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 4: Construction of CEP-102 Platform Center Portion 163-114, Install 41 bearing piles (24-inch precast concrete square)-February 2026 to March 2026 (21 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 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)	**199.0**

SEL$_{cum}$

Single Strike SEL$_{ss}$ ($L_{E,p,\text{single strike}}$) specified at "x" meters (Cell B32)	163
Number of strikes per pile	2000
Number of piles per day	2
Transmission loss coefficient	15
Distance of single strike SEL$_{ss}$ ($L_{E,p,\text{single strike}}$) measurement (meters)	10

PK

$L_{p,0\text{-pk}}$ specified at "x" meters (Cell G29)	189
Distance of $L_{p,0\text{-pk}}$ measurement (meters)	10
$L_{p,0\text{-pk}}$ Source level	204.0

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)	**116.8**	**4.2**	**139.1**	**62.5**	**4.6**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**NA**	**NA**	**1.4**	**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$^{\Delta}$ (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)	

$^{\Delta}$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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 5: Construction of CEP-102 Platform Center Portion 163-114, Install 32 bearing piles (24-inch precast concrete square)-April 2026 (16 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 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)	**199.0**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	163
Number of strikes per pile	2000
Number of piles per day	2
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)	189
Distance of $L_{p,0\text{-}pk}$ measurement (meters)	10
$L_{p,0\text{-}pk}$ Source level	204.0

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)	**116.8**	**4.2**	**139.1**	**62.5**	**4.6**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**NA**	**NA**	**1.4**	**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

	Action Proponent Provided Information
	NMFS Provided Information (Technical Guidance)
	Resultant Isopleth

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 5: Construction of CEP-102 Platform Center Portion 163-114, Install 50 fender piles (18-inch precast concrete square)- April 2026 (13 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 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)	**180.8**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	154
Number of strikes per pile	120
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)	185
Distance of $L_{p,0\text{-}pk}$ measurement (meters)	10
$L_{p,0\text{-}pk}$ Source level	200.0

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)	**7.1**	**0.3**	**8.5**	**3.8**	**0.3**
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.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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 2: Construction of CEP-176 Bulkhead, Install 103 bearing piles (42-inch steel pipe)- April 2023 to May 2023 (26 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 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 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)	168
Number of piles within 24-h period	4
Duration to drive a single pile (minutes)	240
Duration of Sound Production within 24-h period (seconds)	57600
10 Log (duration of sound production	47.60
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)	**127.0**	**11.3**	**187.8**	**77.2**	**5.4**

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 2: Construction of CEP-176 Bulkhead, Install 221 sheet piles (28-inch steel sheet)- April 2023 to May 2023 (16 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 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 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)	167
Number of piles within 24-h period	14
Duration to drive a single pile (minutes)	60
Duration of Sound Production within 24-h period (seconds)	50400
10 Log (duration of sound production	47.02
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)	**99.7**	**8.8**	**147.3**	**60.6**	**4.3**

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 2: Construction of CEP-175 Bulkhead, Install 9 piles (13-inch polymeric)- April 2023 to May 2023 (2 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 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 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)	162
Number of piles within 24-h period	5
Duration to drive a single pile (minutes)	30
Duration of Sound Production within 24-h period (seconds)	9000
10 Log (duration of sound production	39.54
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)	**14.7**	**1.3**	**21.7**	**8.9**	**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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 2: CONCURRENT install of 42-inch steel pipe and 28-inch steel pipe for a total of 18 days (103 42-inch bearing piles + 221 28-inch sheet pils = 324/18 piles per day (4/day + 14/day))

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 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)	171
Number of piles within 24-h period	18
Duration to drive a single pile (minutes)	240
Duration of Sound Production within 24-h period (seconds)	259200
10 Log (duration of sound production	54.14
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)	**548.7**	**48.6**	**811.2**	**333.5**	**23.4**

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 2: CONCURRENT install of two 42-inch steel pipe for a total of 13 days or (103 piles/8 piles per day).

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 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)	171
Number of piles within 24-h period	8
Duration to drive a single pile (minutes)	240
Duration of Sound Production within 24-h period (seconds)	115200
10 Log (duration of sound production	50.61
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)	**319.5**	**28.3**	**472.4**	**194.2**	**13.6**

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 2: CONCURRENT vibratory install of 42-inch steel pipe piles at CEP-176 and rotary drilling of 24-inch precast concrete bearing piles at a total of 6/day for a total of 19 days or (103 42-inch piles + 11 24-inch precast concrete piles = 114 piles/6 = 19 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 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 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)	168
Number of piles within 24-h period	6
Duration to drive a single pile (minutes)	240
Duration of Sound Production within 24-h period (seconds)	86400
10 Log (duration of sound production)	49.37
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)	**166.4**	**14.8**	**246.1**	**101.2**	**7.1**

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 2: CONCURRENT vibratory install of 42-inch steel pipe piles at CEP-176 and vibratory install of 13-inch polymerica piles at a total of 9/day for a total of 28 days or (103, 42-inch piles + 9, 13-inch polymeric piles = 112 piles/9 = 13 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 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 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)	169
Number of piles within 24-h period	9
Duration to drive a single pile (minutes)	240
Duration of Sound Production within 24-h period (seconds)	129600
10 Log (duration of sound production	51.13
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)	**254.3**	**22.5**	**375.9**	**154.5**	**10.8**

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: 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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 2: Construction of CEP-102 Platform Phase 2 Portion 113-108, Install 11 bearing piles (24-inch concrete square)- May 2023 (6 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 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 modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

Source Level (L_{rms})	154
Duration of Sound Production (hours) within 24-h period	6
Duration of Sound Production (seconds)	21600
10 Log (duration of sound production)	43.34
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)	**0.8**	**0.0**	**0.7**	**0.4**	**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: 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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 2: Construction of CEP-102 Platform Phase 2 Portion 113-108, Install 6 fender piles (18-inch concrete square)- July 2023 (2 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 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 modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

Source Level (L_{rms})	154
Duration of Sound Production (hours) within 24-h period	4
Duration of Sound Production (seconds)	14400
10 Log (duration of sound production)	41.58
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)	**0.6**	**0.0**	**0.5**	**0.3**	**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: 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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 3: Construction of Pier 3, Install 409 fender piles (24-inch concrete square)- June 2024 to October 2024 (69 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 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 modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

Source Level (L_{rms})	154
Duration of Sound Production (hours) within 24-h period	12
Duration of Sound Production (seconds)	43200
10 Log (duration of sound production)	46.35
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)	**1.2**	**0.1**	**1.1**	**0.7**	**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: 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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 3: Concurrent install 409 fender piles (24-inch concrete square) using two rotary drills- Increased install from 6 per day to 12 per day. 409 piles/12 = 35 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 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 modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

Source Level (L_{rms})	157
Duration of Sound Production (hours) within 24-h period	12
Duration of Sound Production (seconds)	43200
10 Log (duration of sound production)	46.35
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)	**1.9**	**0.1**	**1.7**	**1.0**	**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)†	**-0.01**	**-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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 3: CONCURRENT install of 42-inch steel pipe and 28-inch steel pipe for a total of 5 days (26 42-inch bearing piles + 53 28-inch sheet pils = 79/16 piles per day (2/day + 14/day))

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 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)	171
Number of piles within 24-h period	16
Duration to drive a single pile (minutes)	240
Duration of Sound Production within 24-h period (seconds)	230400
10 Log (duration of sound production	53.62
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)	**507.2**	**45.0**	**749.9**	**308.3**	**21.6**

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 3: Construction of CEP-102 Bulkhead South Portion 188-163, Install 26 bearing piles (42-inch steel pipe)- December 2024 to January 2025 (13 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 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 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)	168
Number of piles within 24-h period	2
Duration to drive a single pile (minutes)	240
Duration of Sound Production within 24-h period (seconds)	28800
10 Log (duration of sound production	44.59
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)	**80.0**	**7.1**	**118.3**	**48.6**	**3.4**

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 3: Construction of CEP-102 Bulkhead South Portion 188-163, Install 53 sheet piles (28-inch steel pipe)-January 2025 (4 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 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 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)	167
Number of piles within 24-h period	14
Duration to drive a single pile (minutes)	60
Duration of Sound Production within 24-h period (seconds)	50400
10 Log (duration of sound production	47.02
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)	**99.7**	**8.8**	**147.3**	**60.6**	**4.3**

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 3: EXTRACT of CEP-102 Bulkhead South Portion 188-163, EXTRACT 26 fender piles (18-inch precast concrete square)-February 2025 (3 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 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 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)	162
Number of piles within 24-h period	9
Duration to drive a single pile (minutes)	60
Duration of Sound Production within 24-h period (seconds)	32400
10 Log (duration of sound production	45.11
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)	**34.5**	**3.1**	**50.9**	**20.9**	**1.5**

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: 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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 4: Construction of CEP-102 Platform South Portion 188-163, Install 40 bearing piles (24-inch concrete square)- April 2025 to May 2025 (20 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 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 modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

Source Level (L_{rms})	154
Duration of Sound Production (hours) within 24-h period	6
Duration of Sound Production (seconds)	21600
10 Log (duration of sound production)	43.34
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)	**0.8**	**0.0**	**0.7**	**0.4**	**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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 4: EXTRACT of Existing Pier 3, EXTRACT 624 fender piles (14-inch timber)-August 2025 to September 2025 (25 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 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 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)	162
Number of piles within 24-h period	25
Duration to drive a single pile (minutes)	60
Duration of Sound Production within 24-h period (seconds)	90000
10 Log (duration of sound production	49.54
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)	**68.1**	**6.0**	**100.7**	**41.4**	**2.9**

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 4: Concurrent vibratory EXTRACT of 14-inch timber piles (624) at Existing Pier 3, Vibratory extract 16/18-inch concrete (873), vibratory install of 42-inch steel pipe(50) and 28-inch steel sheets (102), and rotary drilling of precast concrete piles (40). 624 + 873

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 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)	171
Number of piles within 24-h period	53
Duration to drive a single pile (minutes)	240
Duration of Sound Production within 24-h period (seconds)	763200
10 Log (duration of sound production	58.83
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)	**1,127.1**	**99.9**	**1,666.4**	**685.1**	**48.1**

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: 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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 4: Construction of CEP-102 Platform South Portion 188-163, Install 25 fender piles (18-inch concrete square)- September 2025 (7 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 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 modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

Source Level (L_{rms})	154
Duration of Sound Production (hours) within 24-h period	4
Duration of Sound Production (seconds)	14400
10 Log (duration of sound production)	41.58
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)	**0.6**	**0.0**	**0.5**	**0.3**	**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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 4: Construction of CEP-102 Bulkhead South Portion 163-114, Install 50 bearing piles (42-inch steel pipe)- September 2025 to October 2025 (25 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 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 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)	168
Number of piles within 24-h period	2
Duration to drive a single pile (minutes)	240
Duration of Sound Production within 24-h period (seconds)	28800
10 Log (duration of sound production	44.59
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)	**80.0**	**7.1**	**118.3**	**48.6**	**3.4**

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 4: EXTRACT of Existing Pier 3, EXTRACT 72 fender piles (24-inch precast concrete square)- September 2025 to October 2025 (7 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 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 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)	162
Number of piles within 24-h period	12
Duration to drive a single pile (minutes)	60
Duration of Sound Production within 24-h period (seconds)	43200
10 Log (duration of sound production	46.35
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)	**41.7**	**3.7**	**61.7**	**25.4**	**1.8**

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 4: Construction of CEP-102 Bulkhead Center Portion 163-114, Install 102 sheet piles (28-inch steel sheet)- October 2025 (8 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 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 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)	167
Number of piles within 24-h period	14
Duration to drive a single pile (minutes)	60
Duration of Sound Production within 24-h period (seconds)	50400
10 Log (duration of sound production	47.02
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)	**99.7**	**8.8**	**147.3**	**60.6**	**4.3**

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 4: EXTRACT of CEP-102 Bulkhead Center Portion 163-114, EXTRACT 36 fender piles (18-inch precast concrete square)- November 2025 (4 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 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 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)	162
Number of piles within 24-h period	9
Duration to drive a single pile (minutes)	60
Duration of Sound Production within 24-h period (seconds)	32400
10 Log (duration of sound production	45.11
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)	**34.5**	**3.1**	**50.9**	**20.9**	**1.5**

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 4: EXTRACT of Existing Pier 3, EXTRACT 873 bearing piles (16- to 18-inch precast concrete)- November 2025 to March 2026 (88 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 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 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)	162
Number of piles within 24-h period	10
Duration to drive a single pile (minutes)	60
Duration of Sound Production within 24-h period (seconds)	36000
10 Log (duration of sound production	45.56
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)	**37.0**	**3.3**	**54.6**	**22.5**	**1.6**

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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 5: Concurrent vibratory extract 16 and 18-inch concrete piles (30) and rotary driling 24-inch precast piles (32). 30 +32 = 62 total piles at 10/day + 2/day = 12/day. 62 piles/12 per day = 5.16 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 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 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	12
Duration to drive a single pile (minutes)	120
Duration of Sound Production within 24-h period (seconds)	86400
10 Log (duration of sound production	49.37
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)	**77.2**	**6.8**	**114.2**	**47.0**	**3.3**

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: 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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 4: Construction of CEP-102 Center Platform Portion 163-114, Install 41 bearing piles (24-inch concrete square)- February 2026 to March 2026 (21 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 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 modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

Source Level (L_{rms})	154
Duration of Sound Production (hours) within 24-h period	6
Duration of Sound Production (seconds)	21600
10 Log (duration of sound production)	43.34
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)	**0.8**	**0.0**	**0.7**	**0.4**	**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: 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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 5: Construction of CEP-102 Center Platform Portion 163-114, Install 32 bearing piles (24-inch concrete square)- April 2026 (16 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 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 modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

Source Level (L_{rms})	154
Duration of Sound Production (hours) within 24-h period	6
Duration of Sound Production (seconds)	21600
10 Log (duration of sound production)	43.34
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)	**0.8**	**0.0**	**0.7**	**0.4**	**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: 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	P-095 Replace Submarine Pier 3
PROJECT/SOURCE INFORMATION	YR 5: Construction of CEP-102 Center Platform Portion 163-114, Install 50 bearing piles (18-inch concrete square)- April 2026 (13 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 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 modification.

STEP 3: SOURCE-SPECIFIC INFORMATION

Source Level (L_{rms})	154
Duration of Sound Production (hours) within 24-h period	4
Duration of Sound Production (seconds)	14400
10 Log (duration of sound production)	41.58
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)	**0.6**	**0.0**	**0.5**	**0.3**	**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.

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

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Appendix B

Marine Mammal Observation Forms

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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* Name and Location	Visibility Info (e.g. wind, glare, swell)	Construction Activity (Including Number and Type of Piles)	Species	Distance to Animal (from Observer) and Closest Point of Approach to the Activity	# of Animals Group Size (min/max/best) # of Calves	Animal Movement Relative to Pile Driving Equipment/ Time in Harassment Zone	Behavior Change/ Response to Activity/ Shutdown Info
Start Monitoring – End Monitoring Soft Start – Vibratory – Impact Sighting – Delay – Shutdown	: :					m	/ / ___ calves	toward or away parallel none Time in Harassment Zone:	
Start Monitoring – End Monitoring Soft Start – Vibratory – Impact Sighting – Delay – Shutdown	: :					m	/ / ___ calves	toward or away parallel none Behavior Code: ________	
Start Monitoring – End Monitoring Soft Start – Vibratory – Impact Sighting – Delay – Shutdown	: :					m	/ / ___ calves	toward or away parallel none Behavior Code: ________	
Start Monitoring – End Monitoring Soft Start – Vibratory – Impact Sighting – Delay – Shutdown	: :					m	/ / ___ 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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Appendix C

Marine Mammal Monitoring Plan

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