INCIDENTAL HARASSMENT AUTHORIZATION APPLICATION FOR THE NAVY'S PIER 6 REPLACEMENT PROJECT AT NAVAL BASE SAN DIEGO

October 1, 2021 THROUGH September 30, 2022

Submitted to:

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

Prepared by:

Naval Facilities Engineering Systems Command

For:

Naval Base San Diego

November 2020

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ACRONYMS AND ABBREVIATIONS

°C	Celsius
Caltrans	California Department of Transportation
CFR	Code of Federal Regulations
CTR	California Toxic Rule
cy	cubic yards
dB	decibel
ESA	Endangered Species Act
ESTCP	Environmental Security Technology Certification Program
°F	Fahrenheit
ft	foot/feet
Hz	hertz
IHA	Incidental Harassment Authorization
in	inch(es)
kHz	kilohertz
km	kilometer(s)
l	liter
lbs	pounds
lf	linear ft
LMR	Living Marine Resources
m	meter(s)
min	minute(s)
MLLW	mean lower low water
MMPA	Marine Mammal Protection Act
NAVFAC	Naval Facilities Engineering Systems Command (SW = Southwest)
Navy	U.S. Department of the Navy
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	National Marine Fisheries Service
NRSW	Navy Region Southwest
ONR	Office of Naval Research
Pa	Pascal
POSD	Port of San Diego
ppm	parts per million
PSO	protected species observer
PTS	permanent threshold shift
R&D	research and development
RMS	root mean square
s	second(s)
SEL	sound exposure level
SERDP	Strategic Environmental Research and Development Program
sf	square ft
SPAWAR	Space and Naval Warfare Systems Command
SPL	sound pressure level
TL	transmission loss
TTS	temporary threshold shift
re 1 µPa	referenced to 1 micropascal
U.S.	United States
USACE	U.S. Army Corps of Engineers
ZOI	Zone of Influence

EXECUTIVE SUMMARY

In accordance with the Marine Mammal Protection Act (MMPA) of 1972, as amended, the U.S. Navy (Navy) is applying for an Incidental Harassment Authorization (IHA) for activities associated with the Pier 6 Replacement Project in the south-central part of San Diego Bay at Naval Base San Diego (NBSD). For this IHA application, the Navy determined that underwater noise from pile removal during demolition of the existing pier and pile installation during construction of the new pier have the potential to result in incidental harassment under the MMPA. This IHA application is intended to cover 12 months of pile removal and installation activity during fiscal year 2022. A subsequent Continuation IHA application will be submitted for any remaining in-water demolition and construction activities that are necessary to complete the project that extend beyond the planned 12-month construction period.

One species of marine mammal has a reasonable likelihood of occurrence during the project's timeline and could thereby be exposed to sound pressure levels (SPLs) and sound exposure levels (SELs) associated with vibratory and impulsive pile demolition and installation activities: the California sea lion (*Zalophus californianus*).

Pier 6 is functionally obsolete and operationally constrained given its inadequate utilities capacity, load restrictions, and inadequate deck size to support current and projected ship berthing operations. It is also structurally deteriorated with concrete spalling in many locations, cracked and broken concrete curbs, and exposed sections of corroded steel. The replacement of Pier 6 is needed to provide adequate ship berthing infrastructure to support modern Navy ships and ultimately, Fleet readiness as part of the Navy's overall mission to maintain, train, and equip combat-ready Naval forces. Unless replaced, Pier 6's structural integrity will continue to deteriorate and pose unsafe working conditions, especially during berthing operations.

The existing Pier is 18 meters (m; 60 feet [ft]) wide by 420 m (1,377 ft) long and would be demolished prior to the construction of the new pier. Following an initial hazardous materials survey and any necessary abatement, workers would disconnect, clean, and safe-out all utilities and then remove all electrical and mechanical equipment from the pier. All piles (totaling approximately 2,000 structural, fender, and other piles) would be removed, one pile at a time, at a rate of up to 8 piles per day; this analysis assumes the maximum rate of removal over 250 working days. The existing piles are predominantly 20-inch square concrete piles.

Workers would initially attempt to extract the piles out by securing the piles above the water line and applying upwards pressure to the pile (dead-pull). Workers may also use the dead-pull method with pile jetting (where an external high-pressure water jet is used to loosen the sediment around the pile). A vibratory hammer may also be used to loosen the piles prior to removal. If the piles could not be pulled out by these methods, workers would place a hydraulic cutter over each pile and lower it to the mudline. Diver assistance may or may not be required during this specific pile removal activity. An underwater hydraulic saw operated by a diver may also be used to remove piles. Once the piles are cut, a crane would remove the pile and set it onto a barge for transport to a concrete processing yard (at NBSD or offsite). Ultimately, the contractor will use one of the above described methods depending on which method proves to be most efficient method to remove the pile. Throughout the demolition effort, material floats and collection bins would capture demolition debris before it enters the water. Workers in support boats would gather any floating debris for recycling or disposal, as appropriate.

Following demolition of the existing pier, the Navy would construct a conventional concrete single-deck berthing pier measuring 37 m (120 ft) wide by 457 m (1,500-ft) long. The total surface area of Pier 6 would increase from approximately 0.8 hectare (ha; 1.9 acres) to approximately 1.7 ha (4.1 acres), an increase of approximately 0.9 ha (2.2 acres).

On average, workers would install approximately 5-9 piles each day, one pile at a time. At an average daily rate of 7 piles per day, it would take workers approximately 138 working days to install all of the piles. It is anticipated that some overlap would occur between demolition and installation with 138 installation days occurring concurrently with pile removal over a total of 250 working days.

In addition, approximately 15 additional structural test piles would be installed at the beginning of construction and are included. Some or all of the structural test piles would likely be left in place as a permanent part of the project or be removed.

The total length of the piles would range from approximately 26 m (85 ft) (fender piles) to 34 m (110 ft) (structural piles); the length of the portion of the piles in the water column would range from approximately 3 to 9 m (10 to 30 ft), depending on pile type, location, and tide. The use of concrete and fiberglass rather than creosote-treated wood pilings would be consistent with Navy policy and would be preferable because, unlike creosote-treated wood pilings, the new piles would not be a potential source of polycyclic aromatic hydrocarbons to the bay.

Workers would construct the pier deck on-site with rebar-reinforced concrete. Pre-stressed concrete (structural) piles with cast-in-place concrete pile caps would support the concrete deck structure. All pile and deck construction for Pier 6 would follow current seismic standards and would be strong enough to support a 140-metric ton (154-US ton) crane. The design would position the pier deck above the predicted high tides and tidal surges to ensure that sea water would not damage the deck or pier utilities network. All construction material deliveries would be via truck.

In this IHA application, the Navy has used site-specific acoustic models (Dall'Osto and Dahl 2019), the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NOAA Fisheries) Technical Guidance, NOAA Fisheries User Spreadsheet, and simple practical spreading loss models (NOAA Fisheries 2018a, 2020a) to identify the Level A (injury) and Level B (behavior) zones of influence (ZOIs) that would result from pile removal and installation, as outlined in Section 6 (Table ES-1). Recently proposed changes to the criteria and thresholds (Southall et al. 2019) have not been formally adopted as of the date of this application and are not used here. Empirically measured source levels from similar pile removal events as reported in the literature (California Department of Transportation [Caltrans] 2015; Naval Facilities Engineering Command [NAVFAC] Atlantic 2017; NAVFAC SW 2020) were used to estimate sound source levels for this project. Source levels for pile driving are typically measured at 10 m (33 ft) from the pile in order to standardize sound measurement data. For pile driving and removal activities, underwater sound transmission loss is estimated using the site-specific model developed for the Navy by Dall'Osto and Dahl (2019). Transmission loss from other sound-generating activities has been modeled using “practical spreading loss,” which assumes a loss of 4.5 decibels (dB) with each doubling of distance. Ambient underwater sound levels for the project area (Dahl and Dall'Osto 2019) are used as appropriate in the analysis.

Transect surveys have very infrequently encountered marine mammals south of the Coronado Bridge, and very few surveys have extended as far south as the project area because of the scarcity of marine mammals in this part of the Bay. There are no known haulout locations in the project area, although there are structures, such as buoys, that could be used. A single survey in February 2010 (Sorensen and Swope 2010), however, recorded two California sea lions swimming off of NBSD. More recently, monitoring efforts for a quaywall repair project at the northern end of NBSD in late 2019 and early 2020 recorded California sea lions observations at an average of 0.69 animals per monitoring day (Chollas Creek Quaywall Repairs, unpublished data). Given that there is a lack of density data in the project area, an accepted observation protocol is to assume that for every California sea lion observed there is one more unseen because California sea lions tend to travel in groups of two or more (Melin et al 2018). This is the basis for a conservative estimate of four California sea lions per day within the potential acoustic ZOIs for the project.

Table ES-1. Noise Model Used to Calculate Level A and B ZOI by Extraction / Installation Method by Pile Type

Installation / Extraction Method	***Pile Type***
Dall'Osto and Dahl Model (2019)	
Vibratory extraction	12-inch timber-plastic piles
	20-inch and 24-inch concrete piles
	16-inch I-shaped steel piles
Pile Installation	20-inch and 24-inch concrete piles
NOAA Fisheries User Spreadsheet (2020)/Simple Practical Spreading Loss Model (15LOGR)	
High-pressure water jetting	Removal of 20-inch square concrete piles
Underwater hydraulic chainsaw	Cutting all types of piles
Small pile clipper	Clipping 12-inch timber and plastic piles
Large pile clipper	Clipping 20-inch square concrete

Potential exposures that would constitute takes under the MMPA are calculated in Section 6, and based on this analysis, no mortality or serious injuries are anticipated. A "Physical Interaction Shutdown Zone" of 10 m (33 ft) would be implemented to halt activities that could pose a risk of non-hearing injury when a marine mammal is within 10 m (33 ft) of the activity. No project related activities are expected to have a Level A acoustic ZOI beyond the 10-m (33-ft) "Physical Interaction Shutdown Zone." Further, a buffer of 10 m (33 ft) would be added to that required 10-m (33-ft) Level A injury prevention (shutdown) zone resulting in a 20-m (66 ft) monitored shutdown zone. This would further reduce the likelihood of Level A harassment (minor injury due to the onset of a permanent threshold shift [PTS]), which could only occur if an animal were to remain well inside of 10 m (33 ft) for a prolonged period. Previously established thresholds and the aforementioned site-specific modeling (Dall'Osto and Dahl 2019) and practical spreading loss model are used to determine the extent of the Level B ZOI for these activities.

The proposed action will include specific acoustic monitoring of pile removal activities not previously validated by repetitive field measurements and analysis, as well as continued observational monitoring of marine mammal occurrences within established ZOIs.

Pursuant to the MMPA Section 101(a)(5)(D)[1], the Navy submits this application to the NOAA Fisheries for an IHA for the incidental, but not intentional, taking of 1,000 California sea lions during pile removal and installation activities as part of the Pier 6 Replacement Project, for the 12-month period beginning October 1, 2021. The anticipated take of California sea lions would be in the form of non-lethal, temporary harassment behavioral disturbance and is expected to have a negligible impact on the species.

[1] 16 U.S.C. § 1371(a)(5); 50 CFR Part 216, Subpart I.

In addition, the taking would not have an unmitigable adverse impact on the availability of these species for subsistence use. If in-water activities do not occur within the year anticipated, a request for a Renewal will be submitted and received by NOAA Fisheries no later than 60 days prior to the expiration of this IHA. The Renewal request will include an explanation that the activities to be conducted under the requested Renewal are identical to the activities analyzed under the initial IHA, are a subset of the activities, or include changes so minor that the changes do not affect the previous analyses, mitigation and monitoring requirements, or take estimates (with the exception of reducing the type or amount of take because only a subset of the initially analyzed activities remain to be completed under the Renewal). The Renewal request will also include a preliminary monitoring report showing the results of the required monitoring to date and an explanation showing that the monitoring results do not indicate impacts of a scale or nature not previously analyzed or authorized.

Regulations governing the issuance of incidental take under certain circumstances are codified at 50 Code of Federal Regulations (CFR) Part 216, Subpart I (Sections 216.101 – 216.108). Section 216.104 sets out 14 specific items that must be addressed in requests for take pursuant to Section 101 (a) (5) (D) of the MMPA. These 14 items are addressed in Sections 1 through 14 of this IHA application.

1 DESCRIPTION OF ACTIVITIES

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

1.1 Introduction

Pursuant to the Marine Mammal Protection Act (MMPA) Section 101(a)(5)(D), the United States Navy (Navy) submits this application to National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NOAA Fisheries) for an Incidental Harassment Authorization (IHA) for the incidental taking of marine mammal species during pile removal and installation activities associated with the proposed replacement of Pier 6 at Naval Base San Diego (NBSD) (Figure 1-1). This application is intended to cover the in-water demolition and installation activities that may result in takes of marine mammals between October 1, 2021 and September 30, 2022, inclusive. 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 addressed in Sections 1 through 14 of this IHA. If in-water activities do not occur within the year anticipated, a request for renewal will be submitted and received by NOAA Fisheries no later than 60 days prior to the expiration of this IHA. The renewal request will include an explanation that the activities to be conducted under the requested Renewal are identical to the activities analyzed under the initial IHA, are a subset of the activities, or include changes so minor that the changes do not affect the previous analyses, mitigation and monitoring requirements, or take estimates (with the exception of reducing the type or amount of take because only a subset of the initially analyzed activities remain to be completed under the Renewal). The renewal request will also include a preliminary monitoring report showing the results of the required monitoring to date and an explanation showing that the monitoring results do not indicate impacts of a scale or nature not previously analyzed or authorized.

1.2 Proposed Action

NBSD is a major port for Navy ships assigned to the Pacific Fleet and is the major West Coast logistics base for surface forces of the Navy, dependent activities, and other commands. Activities at NBSD include Continuous Maintenance Availabilities and loading supplies for fleet vessels. NBSD contains 12 piers (including a mole pier), two channels, and various quay walls that extend along approximately 5.6 miles of shoreline (Figure 1-2). Surface ships, support vessels, and barges receive various ship support services, such as supplies and minor repair or maintenance, when berthed at NBSD.

Constructed by the Navy in 1945, Pier 6 is 18 meters (m; 60 feet [ft]) wide and 420 m (1,377 ft) long and begins at the intersection of West Vesta and Brinser Streets. Pier 6 is functionally obsolete and operationally constrained given its inadequate utilities capacity, load restrictions, and inadequate deck size (at only 18 m [60 ft] wide) to support current and projected ship berthing operations. It is also structurally deteriorated with concrete spalling in many locations, cracked and broken concrete curbs, and exposed sections of corroded steel. A 2015 Load Capacity Analysis Report (NAVFAC SW 2015) cited Pier 6's overall condition as poor and in need of replacement. Due to Pier 6's limited width, utilities deficiencies, and other infrastructure support limitations, only dock landing ships, guided-missile frigates, and older amphibious transfer dock ships can berth at Pier 6.

Pier 6's deficiencies include the following:

- Width:
  - The limited width of Pier 6 restricts the amount and type of ship maintenance and large-load ship storing that can occur.
  - There is inadequate space for trash containers; when a container is on the pier, no traffic can pass.
  - Trucks and mobile truck cranes must travel on the center 5 m (17 ft) of the pier only.
  - There is no adequate fire lane on Pier 6.
- Structural:
  - Pier 6 is not compliant with current structural or seismic criteria (i.e., Department of Defense [DoD] Unified Facilities Criteria [DoD 2017]).
  - Concrete is spalling in many locations above and below deck, at pile caps, and at the top of concrete bearing piles.
  - There are cracked and broken concrete curbs on the deck edges in many areas; exposed sections of corroded steel reinforcement create unsafe working conditions to personnel, especially during berthing operations.
  - Maximum load limits restrict 35-ton crane and forklift use to limited areas.
  - By 2023, the Navy will prohibit all crane operations on Pier 6 due to the concrete deck's projected inability to structurally support the load of a crane.
- Utility Services:
  - Electrical, potable water, sanitary sewer, compressed air, and steam utilities on the pier are all in poor condition and/or inadequate to meet demands.
  - There is no oily waste system on Pier 6 due to the narrowness of Pier 6 and its load restrictions.

The Proposed Action is needed to provide adequate ship berthing infrastructure to support modern Navy ships and ultimately, Fleet readiness as part of the Navy's overall mission to maintain, train, and equip combat-ready Naval forces. Unless the Navy replaces structurally deteriorating and operationally constrained piers such as Pier 6, NBSD will not be able to properly support berthing of homeported ships. Unless replaced, Pier 6's structural integrity will continue to deteriorate and pose unsafe working conditions, especially during berthing operations.

No new ship homeporting actions are specifically planned as a part of the Proposed Action. Port loading at NBSD is coordinated between the Commander Navy Region Southwest Port Operations Shore Infrastructure Plan (Commander Navy Region Southwest 2010) and the Chief of Naval Operations Notional Strategic Laydown Plan. Ship berthing and pier operations (including pier maintenance) are included in these two plans and any potential operational impacts at Pier 6, both in water and on land, were analyzed as a part of the plan adoption process. Therefore, ship berthing operations associated with the Proposed Action are not addressed in this IHA. While Pier 6 is being demolished and replaced, existing berthing operations would be temporarily re-distributed to the other NBSD piers.

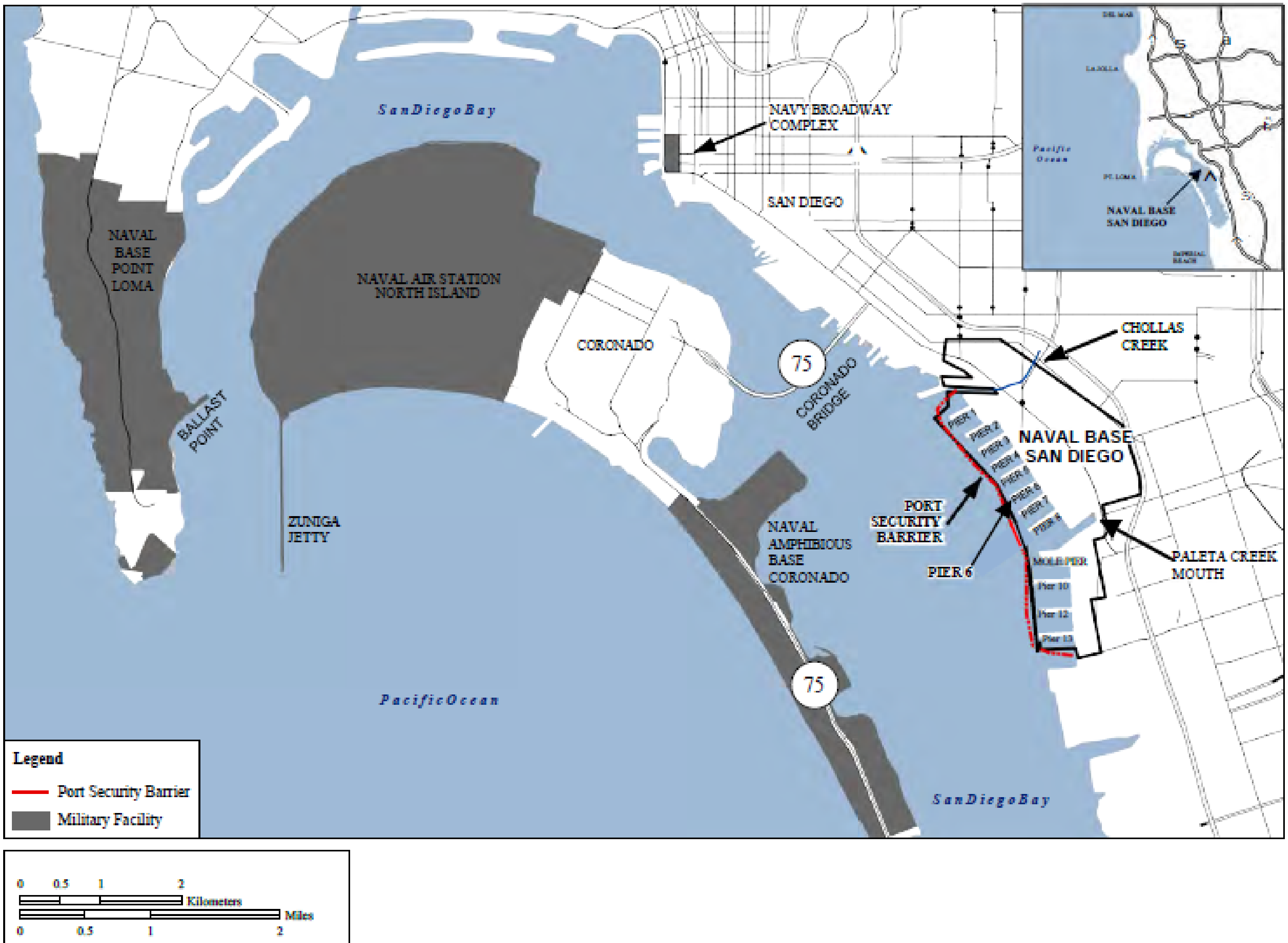

Figure 1-1 Regional Location of Naval Base San Diego

Figure 1-2
Pier 6 Location at Naval Base San Diego

1.3 Description of Activities

Figure 1-3 presents a typical cross-section of the existing pier. The Navy would demolish Pier 6 over a period of approximately 12 months generally in the following manner:

- Following an initial hazardous materials survey and any necessary abatement, workers would disconnect, clean, and safe-out all utilities and then remove all electrical and mechanical equipment from the pier.
- All piles (totaling approximately 2,000 structural, fender, and other piles) would be removed (NAVFAC SW 2019a). Workers would remove approximately 8 piles per day, one pile at a time (Moffatt and Nichol 2019). The existing piles are predominantly 20-inch square concrete piles (NAVFAC SW 2019b).

Workers would initially attempt to extract the piles out by securing the piles above the water line and applying upwards pressure to the pile (dead-pull). Workers may also use the dead-pull method with pile jetting (where an external high-pressure water jet is used to loosen the sediment around the pile). A vibratory hammer may also be used to loosen the piles prior to removal. If the piles could not be pulled out by these methods, workers would place a hydraulic cutter over each pile and lower it to the mudline. Diver assistance may or may not be required during this specific pile removal activity. An underwater hydraulic saw operated by a diver may also be used to remove piles. Once the piles are cut, a crane would remove the pile and set it onto a barge for transport to a concrete processing yard (at NBSD or offsite). Ultimately, the contractor will use one of the above described methods depending on which method proves to be most efficient method to remove the pile. Throughout the demolition effort, material floats and collection bins would capture demolition debris before it enters the water. Workers in support boats would gather any floating debris for recycling or disposal, as appropriate.

The pier deck would be sawcut and removed in large sections using a floating derrick crane before the crane would place the sections on a barge. Workers would also remove portions of the quaywall pile cap to allow for extension of new utility services to the pier. Support craft would tow the barges loaded with concrete deck sections and piles to a concreate processing yard (at NBSD or offsite) to process the material. Trucks would haul concrete to an off-site recycler for processing in compliance with recycling facility requirements. Workers would separate steel from concrete for recycling. Trucks would then transport unrecyclable materials to a permitted landfill. Throughout the demolition effort, material floats and collection bins would capture demolition debris before it enters the water. Workers in support boats would gather any floating debris for recycling or disposal, as appropriate.

The new Pier 6 would be a conventional concrete single-deck berthing pier measuring 37 m (120 ft) wide by 457 m (1,500 ft) long and would wholly replace the old Pier 6. The total surface area of Pier 6 would increase from approximately 0.8 hectare (ha; 1.9 acres) to approximately 1.6 ha (4.1 acres), an increase of approximately 0.9 ha (2.2 acres).

On average, workers would install approximately 5-9 piles each day, one pile at a time. At an average daily rate of 7 piles per day, it would take workers approximately 138 working days to install all of the piles. It is anticipated that some overlap would occur between demolition and installation with the 138 installation days occurring concurrently with 250 working days for demolition, for a total of 250 working days.

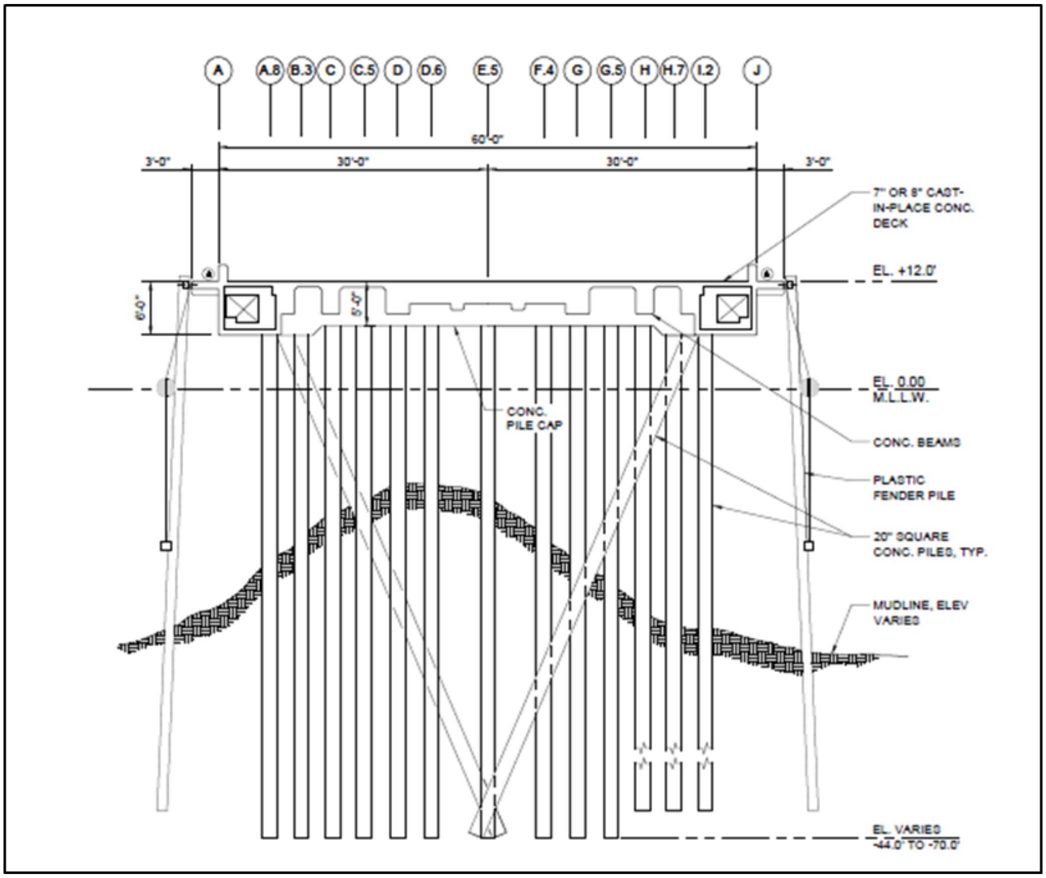

Figure 1-3 Existing Cross-Section of Pier 6 (typical)

In addition, approximately 15 additional test piles would be installed at the beginning of construction. Some or all of the structural test piles would likely be left in place as a permanent part of the project or be removed.

The total length of the piles would range from approximately 26 m (85 ft) (fender piles) to 34 m (110 ft) (structural piles); the length of the portion of the piles in the water column would range from approximately 3 to 9 m (10 to 30 ft), depending on pile type, location, and tide. The use of concrete and fiberglass rather than creosote-treated wood pilings would be consistent with Navy policy and would be preferable because, unlike creosote-treated wood pilings, the new piles would not be a potential source of polycyclic aromatic hydrocarbons to the bay.

Workers would construct the pier deck on-site with rebar-reinforced concrete. Pre-stressed concrete (structural) piles with cast-in-place concrete pile caps would support the concrete deck structure. All pile and deck construction for Pier 6 would follow current seismic standards and would be strong enough to support a 140-metric ton (154-US ton) crane. The design would position the pier deck above the predicted high tides and tidal surges to ensure that sea water would not damage the deck or pier utilities network. All construction material deliveries would be via truck. Because construction of the new pier deck would occur above the water line, it is not included in this analysis of in-water noise impacts to marine mammals.

1.4 Best Management Practices, Mitigation, and Minimization Measures

Section 11 describes the general Best Management Practices (BMPs), mitigation, and minimization measures that may be implemented for all in-water activities. BMPs are routinely used by the Navy during pile installation activities to avoid and minimize potential environmental impacts. Additional minimization measures have been added to protect marine mammals. These measures include vibratory removal of piles where possible, noise attenuation and performance measures for impact pile driving, and marine mammal monitoring as described in Section 11.

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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

For this analysis, it is assumed that the removal of all 2,000 piles (predominantly 20-inch square concrete structural piles) would be removed within a 12-month period. Accordingly, it is estimated that 8 piles would be removed (pulled or cut) per day over the course of 250 workdays of in-water demolition activities. The new pier would require the installation no more than 966 concrete and fiberglass piles at a rate of 7 piles per day over the course of 138 days.

It is anticipated that overlap between demolition and installation activities would occur over the 250-day project period (Table 2-1). Pile removal would begin on day 1 and progress at a rate of 8 piles per day, for an expected 250 days of pile removal. Pile installation is anticipated to begin after removal of one third of the piles, or approximately 83 days of pile removal, at a rate of 7 piles per day for an expected 138 days of pill installation. Pile installation is expected to periodically occur alongside ongoing pile removal activities over 138 days of the remaining 167 project days of pile removal. Because pile installation cannot continue where demolition activities are incomplete, there would be 29 days (167 days – 138 days of pile installation) where only pile removal would occur after pile installation has started. Demolition and installation activities would end on day 250. In summary, the 250-day project period would include 112 days of pile removal-only activities and 138 days of concurrent pile removal and installation activities.

Table 2-1. Activity Summary, Pile Driving and Demolition, Pier 6 Replacement Project.

Method	Pile Type	Number of Piles	Piles/ Day	Total Estimated Days
Demolition Existing Pier				
Vibratory Extraction High-pressure Water Jetting Hydraulic Pile Clipper Hydraulic Chainsaw	24-inch square pre-cast concrete, 20-inch square pre-stressed/pre-cast concrete piles	1,833	**8**	**250**
	12-inch composite (timber-plastic) piles	149		
Vibratory Extraction	16-inch I-shaped steel piles	16		
	Total	**1,998**		
Construction New Pier				
Impact Pile Driving	24-inch octagonal concrete structural test piles	15	**7**	**138**
	24-inch octagonal concrete structural piles	513		
	24-inch square concrete fender system test piles	4		
	24-inch square concrete primary fender piles	204		
	20-inch square concrete pile for load-out ramp cradle	4		
	16-inch fiberglass secondary and corner fender piles	226		
High-pressure Water Jetting	20- and 24-inch concrete piles	Within Above Counts		
	Total	**966**		

Note: high-pressure water jetting may be used to assist pile installation/extraction and a hydraulic cutter may be used to clip piles at the mudline.

2.2 Project Area Description

San Diego Bay is a narrow, crescent-shaped natural embayment oriented northwest-southeast with an approximate length of 24 kilometers (km; 15 miles) and a total area of roughly 4,450 ha (11,000 acres) (Port of San Diego [POSD] 2007). The width of the bay ranges from 0.3 km to 5.8 km (0.2 to 3.6 miles), and depths range from 23 m (74 ft) mean lower low water (MLLW) near the tip of Ballast Point (refer to Figure 1-2) to less than 1.2 m (4 ft) at the southern end (Merkel & Associates, Inc. 2009). About half of the bay is less than 4.6 m (15 ft) deep and most of it is less than 15 m (50 ft) deep (Merkel & Associates, Inc. 2009).

2.2.1 Bathymetric Setting

The northern and central portions of San Diego Bay have been shaped by historical dredging and filling to support large ship navigation and shoreline development; only the southernmost portion of the bay retains its natural shallow bathymetry (Merkel & Associates Inc. 2009). The bathymetry and bedform of the bay are defined by a main navigation channel that steps up to shallower dredged depths toward the sides and south end of the bay (Merkel & Associates, Inc. 2009). U.S. Army Corps of Engineers (USACE) dredges the main navigation channel in San Diego Bay to maintain a depth of -14.3 m (-47 ft) MLLW and is responsible for providing safe transit for private, commercial, and military vessels within the bay (NOAA 2010). Outside of the navigation channel, the bay floor consists of platforms at depths that vary slightly (Merkel & Associates, Inc. 2009). Within the Central Bay, typical depths range from -11 m to -12 m (-35 to -38 ft) MLLW to support large ship turning and anchorage (Merkel & Associates, Inc. 2009). Small vessel marinas are typically dredged to depths of 4.6 m (-15 ft) MLLW (Merkel & Associates, Inc. 2009). Water depth at Pier 6 ranges from 6 to 8 m (20.5 to 26 ft).

2.2.2 Circulation, Tides, Temperature, and Salinity

Circulation within San Diego Bay is affected by its crescent shape and narrow bay mouth, tides, and seasonal salinity and temperature variations (POSD 2007). San Diego Bay can be divided into four regions based on circulation characteristics:

- The North Bay – Marine Region extends from the bay mouth to the area offshore downtown San Diego. Tidal action has the greatest influence on circulation in this area, where bay water is exchanged with sea water over a period of two to three days (POSD 2007).
- The North-Central Bay – Thermal Region runs from the North Bay to Glorietta Bay (south of Coronado Island). In the Thermal Region, currents are mainly driven by surface heating. Incoming tides bring cold ocean water from deeper areas, which is then replaced with warm bay surface water when the tide recedes. These tidal processes lead to strong vertical mixing (POSD 2007).
- The South-Central Seasonally Hypersaline Region (i.e., with higher salt content than seawater) occurs between Glorietta Bay and Sweetwater Marsh. Here, variations in salinity due to warm-weather evaporation at the surface separate the water into upper and lower zones driven by density differences (POSD 2007).
- The South Bay Estuarine Region, located south of Sweetwater Marsh, receives occasional freshwater inflows from the Otay and Sweetwater Rivers. Residence time of bay water in the estuarine region may be greater than 1 month (POSD 2007). Common salinity values for the bay range from 33.3 to 35.5 practical salinity units for the bay mouth and the south bay, respectively (Chadwick et al. 1999).

San Diego Bay has mixed diurnal/semi-diurnal tides, with the semi-diurnal component being dominant (Largier 1995). The interaction between these two types of tides is such that the higher high tide occurs before the lower low tide, creating the strongest currents on the large ebb tide (Largier 1995). The tidal range (difference between MLLW and mean highest high water) is approximately 1.7 m (5.5 ft) (Largier 1995). In general, tidal currents are strongest near the bay mouth, with maximum velocities of 0.5 to 1.0 m per second (1.6 to 3.3 feet per second) (Largier 1995). Tidal current direction generally follows the center of the channel (Chadwick et al. 1999). Residence time for water in San Diego Bay increases from approximately 5 to 20 days in mid-bay to over 40 days in the South Bay (Chadwick et al. 1999). During an average tidal cycle, approximately 13 percent of the water in the San Diego Bay mixes with ocean water and then moves back into the bay (POSD 2007). The complete exchange of all the water in the San Diego Bay can take between 10 and 100 days, depending on the amplitude of the tidal cycle (POSD 2007). Tidal flushing and mixing are important in maintaining water quality within San Diego Bay. The tidally induced currents regulate salinity, moderate water temperature, and disperse pollutants (POSD 2007). Water temperature in San Diego Bay ranges from 59.1 to 78.9 degrees Fahrenheit (°F). This range can be attributed to thermoclines exhibited in deeper industrial/port waters, which are typical of this geographic region (Amec Foster Wheeler Environment & Infrastructure, Inc. 2016).

Temperature and density gradients, both with depth and along a longitudinal cross-section of the bay, drive tidal exchange of bay and ocean water beginning in the spring and continuing into fall. The seasonal thermal cycle has an amplitude of about 8 to 9 degrees Celsius (° C; 14 to 16 degrees Fahrenheit [° F]). Maximum water temperatures occur in July and August, and minimums in January and February. In the winter, thermal gradients are absent, with cooler air temperatures and higher winds causing the bay to be nearly isothermal. During 1993 surveys, the warmest temperature was 84.7° F (29.3° C) in south bay, and the coolest temperature, 15.1 ° C (59.2° F), was just north of the Coronado Bridge in January. The average surface temperature is estimated to be 17.4° C (63.3° F). Maximum vertical temperature gradients of about 0.5° C/m (0.3° F/ft) occur during the summer. Typical longitudinal temperature range is about 7 to 10° C (45 to 50° F) (about 0.3 to 0.5° C/km) over the length of the bay during the summer. Temperature inversions also occur diurnally due to night cooling.

Salinities of the project area resemble those of the nearby open ocean, i.e. 32.8 to 33 parts per thousand (Tierra Data, Inc. 2012).

2.2.3 Water Quality

Water quality is commonly assessed by measuring dissolved nutrients, dissolved oxygen, pH, turbidity, chlorophyll *a* (a measure of the amount of phytoplankton present in San Diego Bay), and coliform bacteria (Chadwick et al. 1999). Measured values for dissolved nutrients in the bay such as phosphate and silicates range from 0.9 to 4 parts per million (ppm) for silicon and 0.02 to 0.3 ppm phosphorus in the winter, to 0.3 to 1.3 ppm for silicates and 0.2 ppm phosphorus in the summer (Chadwick et al. 1999). This variation is the result of inflow of these nutrients with winter runoff, and uptake by phytoplankton growth in the summer (Chadwick et al. 1999). Dissolved oxygen levels range from approximately 4 milliliters per liter (mL/L) during the summer to 8 mL/L during the winter (Chadwick et al. 1999). These oxygen levels are typically at or near atmospheric equilibrium levels. The pH of seawater in San Diego Bay is relatively uniform, ranging from approximately 7.9 to 8.1 throughout the bay and the year (Chadwick et al. 1999).

Surface water chemistry is analyzed by the Regional Harbor Monitoring Program using primary and secondary indicators, including total and dissolved levels of copper (primary), and total and dissolved zinc and nickel (secondary). Copper concentrations in San Diego Bay show improvement in comparison with a historical baseline, and average copper concentrations do not exceed the California Toxics Rule (CTR) threshold of 5.8 micrograms per liter (µg/L) total and 4.8 µg/L dissolved. Less than 20 percent of measurements throughout the bay still exceed the CTR threshold. Both total and dissolved zinc and nickel concentrations are well below CTR threshold values used for the Regional Harbor Monitoring Program. All other dissolved and total metals have concentrations below their respective acute and chronic CTR thresholds (Amec Foster Wheeler Environment & Infrastructure, Inc. 2016). Polycyclic aromatic hydrocarbon concentrations are also below their respective CTR threshold values (Amec Foster Wheeler Environment & Infrastructure, Inc. 2016).

Turbidity is a measure of water clarity or murkiness and can be caused by suspended sediments transported in runoff or increased algal/bacterial growth (Tierra Data, Inc. 2010). Turbidity can also be created by natural and manmade resuspension of bottom sediments. Increased turbidity reduces the amount of light available for plant growth underwater, so it can affect the ability of San Diego Bay to support living organisms (Tierra Data, Inc. 2010). Turbidity in San Diego Bay varies, depending on the tides, seasons, and location within the bay (Tierra Data, Inc. 2010).

Chlorophyll *a* ranges from 0.2 to 25 µg/L (Chadwick et al. 1999). The highest values were measured in the South Bay in winter, when runoff carries high levels of nutrients into the South Bay. In summer, chlorophyll *a* levels return to background levels of 1 to 2 µg/L. These chlorophyll *a* levels are generally much higher than those found in the adjacent open ocean. Before 1964, when untreated sewage was still being discharged into the San Diego Bay, bacterial counts (fecal coliform) were as high as 82 milliliters in the South Bay (Chadwick et al. 1999). Since these discharges ended, bacterial counts typically remain below 10 milliliters except during some winter storms. These levels are below federal limits for water contact, implying that the San Diego Bay is generally safe for recreational use (Chadwick et al. 1999).

Current sources of pollution to San Diego Bay include underground dewatering, industries on the bay and upstream, marinas and anchorages, U.S. Naval activities, materials used for underwater hull cleaning and vessel antifouling paints, and urban runoff (Chadwick et al. 1999). Additional pollution sources include creosote-treated wood pier pilings, which are a source of polycyclic aromatic hydrocarbons, stormwater runoff from land used for industrial, commercial, and transportation purposes, bilge water discharge, and oil spills (Chadwick et al. 1999). Changes in Navy procedures since the mid-1990s have included replacing approximately half of the pier pilings with plastic, concrete, or untreated wood, and implementing the Bilge Oily Waste Treatment System for treatment of construction and repair wastewater.

Overall, the levels of contamination in the water and sediment in San Diego Bay appear to be lower now than in previous decades, including levels of some metals and polycyclic aromatic hydrocarbons (POSD 2007). However, copper concentrations remain routinely higher than federal and state limits for dissolved copper (POSD 2007).

2.2.4 Substrates and Habitats

Sediments in San Diego Bay are relatively sandy (NAVFAC SW and POSD 2013) as tidal currents tend to keep the finer silt and clay fractions in suspension, except in harbors and elsewhere in the lee of structures where water movement is diminished. Much of the shoreline consists of riprap and manmade structures as can be seen in aerial views. The predominant habitats of the project area are moderately deep (3.7 to 6.0 m [12 to 20 ft] below MLLW) and deep (>6 m [20 ft] below MLLW) subtidal and artificial hard substrates. Over-water structures (the existing piers) provide substrates for the growth of algae and invertebrates off the bottom and support more abundant fish populations than occur in the adjacent deep water habitat. Eelgrass is not present within the project area.

2.2.5 Vessel Traffic and Ambient Underwater Soundscape

As illustrated by Table 2-2 below, San Diego Bay is heavily used by commercial, recreational, and military vessels, with an average of 80,691 vessel movements (in or out of the bay) per year. This equates to about 221 vessel transits per day, a majority of which are presumed to occur during daylight hours. The number of transits does not include recreational boaters that use San Diego Bay, estimated to number 200,000 (San Diego Harbor Safety Committee 2020).

Acoustic monitoring of ship noise in Glacier Bay, Alaska (Kipple and Gabriele 2007), found that sound source levels from a variety of vessel types and sizes was typically within the range of 157-180 decibels (dB) referenced to 1 microPascal (re 1 μPa) at 1m. Ship noise was characterized by a broad frequency range (roughly 0.1 to 35 kilohertz [kHz]), with peak noise at higher frequency for smaller vessels. Similar broad-spectrum (10 Hz to >1 kHz) noise has been reported for a variety of categories of ships (NRC 2003). Within southern California, in the Santa Barbara Channel, large cargo ships at transit speeds range from 177 to 188 dB re 1 μPa (McKenna 2011).Ship noise in San Diego Bay thus has the potential to obscure underwater sound that would otherwise emanate from the project site to locations farther up the bay or offshore through the mouth.

In February 2019, data were collected over a three-day period at two locations on NBSD, with one location approximately 200 m (656 ft) south of the end of Pier 13 (at the far southern end of NBSD), and the second location approximately 20 m (66 ft) off the end of Pier 6 (closer to the northern end of NBSD). The ambient noise levels varied at these locations, with median L_{50} levels of 121 dB re 1 μPa and 131 dB re 1 μPa at the Pier 13 and Pier 6 locations, respectively (Dahl and Dall'Osto 2019). The L_{50} values represent a statistical descriptor of the sound level exceeded for 50% of the time measurement period. Because this data was collected over a relatively short time period, and during one season, an average of the two L_{50} values was used to describe ambient noise values in the south-central San Diego Bay, knowing that some of the time ambient noise levels may be higher or lower than 126 dB re 1 μPa (Dahl and Dall'Osto 2019). Furthermore, because ambient noise levels at the Pier 6 monitoring location were louder than 126 dB re 1 μPa, this is considered as a conservative estimate of the ambient levels around the project area. Therefore, while the Level B threshold criteria for non-impulsive noise is 120 dB re 1 μPa, noise from non-impulsive sources associated with the Pier 6 project is assumed to become indistinguishable from background noise as it diminishes to 126 dB re 1 μPa with distance from the source.

Table 2-2. Port of San Diego Average Annual Vessel Traffic

VESSEL TYPE	VESSEL MOVEMENTS (Total Calls by Vessel Type)		
	Subtotal by Vessel Type		*Total*
	Cargo	*Others*	
Total Annual Movements for All Vessel Types			**80,691**
Deep Draft Commercial Vessel (Cargo plus Cruise)[1]			
Cargo Ships (largest vessel: 1,000’ length,106’ beam, 41’draft)	197		197
Barge	5		
Bulk	5		
Container Ships	52		
General Cargo	90		
Roll On/Roll Off	45		
Cruise Ships (largest vessel: 1,000’ length, 106' beam, 34’ draft)		100	100
Excursion Ships[2] (largest vessel: 222’ length, 57’ beam, 6’ draft)		68,000	68,000
Commercial Sportfishing[2] (average vessel size: 123’ length, 32’ berth, 13’ draft)		10,094	10,094
Military[1] (largest vessel: 1,115’ length, 252’beam (flight deck), 39’ draft)		2,300	2,300

Note: Tug traffic was not included in the above statistics since inner harbor tug movements alone exceed 7,000 for a typical year.

Source: San Diego Harbor Safety Committee (2009)
San Diego Harbor Safety Committee (2020)

3 MARINE MAMMAL SPECIES AND NUMBERS

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

The most frequently observed marine mammal in San Diego Bay is the California sea lion (*Zalophus californianus*), which often rests on buoys and other structures and occurs throughout the North to North-Central Bay. Other species include coastal bottlenose dolphin (*Tursiops truncatus*), which is regularly seen in the North Bay; harbor seal (*Phoca vitulina*), which frequently enters the North Bay; and common dolphins (*Delphinus* spp.), which are rare visitors in the North Bay. California gray whales (*Eschrichtius robustus*) are also occasionally sighted near the mouth of San Diego Bay during their winter migration (NAVFAC SW and POSD 2013).

The project action area for marine mammals is determined by the limits of potential effects, which in this case are defined by acoustic zones of influence (ZOIs) (see Section 6.6). Because sound transmission is impeded by natural and manmade barriers on the shore, the project's acoustic ZOIs are primarily concentrated south of the Coronado Bridge (see Section 6.6).

Based on many years of observations and Navy-funded surveys in San Diego Bay, marine mammals are often observed in the north and north-central San Diego Bay (Merkel & Associates, Inc. 2008; Sorensen and Swope 2010; Graham and Saunders 2014; Tierra Data, Inc. 2016; NAVFAC SW 2020). For instance, during five years of monitoring efforts associated with the Naval Base Point Loma Fuel Pier Replacement project in north San Diego Bay, of the 21,643 marine mammals observed, 19,091 (88.2%) were of California sea lions (NAVFAC SW 2020). However, relative this project area, only one dedicated line transect survey (Sorensen and Swope 2010) surveyed an area south of the Coronado Bridge. During the Sorensen and Swope (2010) survey, two sightings of one California sea lion each were reported in the water adjacent to NBSD. More recently in 2019 and 2020 during marine mammal monitoring for a project adjacent to Pier 1 (approximately 1.4 km [0.87 mile] to the north of Pier 6), California sea lions were the only pinniped observed (n=8) during 12 days of observations (Chollas Creek Quaywall Repairs, unpublished data). Given that the best available science for the project area indicates that California sea lions are the most likely species to occur in the project area, only impacts to the California sea lion are evaluated in this IHA. If other marine mammal species are observed, procedures identified in Chapter13 and in the Monitoring Plan will be implemented which will stop all in-water pile demolition and/or installation activities if a non-IHA marine mammal enters the Level B ZOI.

3.1 Species Descriptions and Abundances

3.1.1 California Sea Lion

3.1.1.1 Species Description

The California sea lion is now considered to be a full species, separated from the Galapagos sea lion (*Z. wollebaeki*) and the extinct Japanese sea lion (*Z. japonicus*) (Carretta et al. 2019). The breeding areas of the California sea lion are on the Channel Islands, western Baja California, and the Gulf of California. Mitochondrial DNA analysis of California sea lions has identified five genetically distinct geographic populations: (1) Pacific Temperate, (2) Pacific Subtropical, (3) Southern Gulf of California, (4) Central Gulf of California and (5) Northern Gulf of California. The Pacific Temperate population makes up the U.S. stock and includes rookeries within U.S. waters and the Coronado Islands just south of the U.S.-Mexico border.

The California sea lion is sexually dimorphic. Males may reach 453 kilograms (kg; 1,000 pounds) and 2.4 m (8 ft) in length; females grow to 136 kg (300 pounds) and 1.8 m (6 ft) in length. Their color ranges from chocolate brown in males to a lighter, golden brown in females. At around 5 years of age, males develop a bony bump on top of the skull called a sagittal crest. The crest is visible in the “dog-like” profile of male California sea lion heads, and hair around the crest gets lighter with age (NOAA Fisheries 2019).

3.1.1.2 Population Abundance

The entire population cannot be counted because all age and sex classes are never ashore at the same time. In lieu of counting all California sea lions, pups are counted when all are ashore, in July during the breeding season, and the number of births is estimated from pup counts (Carretta et al. 2019). The size of the population is then estimated from the number of births and the proportion of pups in the population. Based on these censuses, the U.S. stock has generally increased from the early 1900s, to the most recent estimate of 257,606, with a minimum estimate of 233,515 (Carretta et al. 2019). There are indications that the California sea lion may have reached or is approaching carrying capacity, although more data are needed to confirm that leveling in growth persists (Carretta et al. 2019).

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.

The California sea lion is the only marine mammal expected to occur within the project area and may potentially be affected by project activities. The stock status, distribution, and site-specific occurrence of California sea lions is described below.

4.1 California Sea Lion, U.S. Stock

4.1.1 Status and Management

California sea lions are protected under the MMPA and are not listed under the Endangered Species Act (ESA). The NOAA Fisheries has defined one stock for California sea lions (U.S. Stock), with five genetically distinct geographic populations: Pacific Temperate, Pacific Subtropical, Southern Gulf of California, Central Gulf of California, and Northern Gulf of California. The Pacific Temperate population includes rookeries within U.S. waters and the Coronado Islands just south of the United States-Mexico border. Animals from the Pacific Temperate population range north into Canadian waters, and movement of animals between U.S. waters and Baja California waters has been documented (Carretta et al. 2019). The U.S. stock is not considered strategic or depleted under the MMPA.

4.1.2 Distribution

More than 95% of the U.S. Stock breeds and gives birth to pups on San Miguel, San Nicolas, and Santa Barbara islands. Some movement has been documented between the U.S. Stock and Western Baja California, Mexico Stock, but rookeries in the United States are widely separated from the major rookeries of western Baja California. Smaller numbers of pups are born on San Clemente Island, the Farallon Islands, and Año Nuevo Island (Lowry et al. 1991). The California sea lion is by far the most commonly sighted pinniped species at sea or on land in the vicinity of San Diego Bay. In California waters, California sea lions represented 97 percent (381 of 393) of identified pinniped sightings at sea during the 1998–1999 NOAA Fisheries surveys (Carretta et al. 2000). They were sighted during all seasons and in all areas with survey coverage from nearshore to offshore areas (Carretta et al. 2000). California sea lions while potentially present at-sea, are most commonly seen hauled-out on piers and buoys within and leading into San Diego Bay, (Merkel & Associates, Inc. 2008). In a study of California sea lion reaction to human activity, Holcomb et al. (2009) showed that in general California sea lions are rather resilient to human disturbance.

The distribution and habitat use of California sea lions varies with the sex of the animals and their reproductive phase. Adult males haul-out on land to defend territories and breed from mid-to-late May until late July. Individual males remain on territories for 27 to 45 days without going to sea to feed. During August and September, after the mating season, the adult males migrate northward to feeding areas as far away as Washington (Puget Sound) and British Columbia (Lowry et al. 1991). They remain there until spring (March through May), when they migrate back to the breeding colonies. Thus, adult males are present in offshore areas only briefly as they move to and from rookeries. Distribution of immature California sea lions is less well known, but some make northward migrations that are shorter in length than the migrations of adult males (Huber 1991). However, most immature California sea lions are presumed to remain near the rookeries for most of the year. Adult females remain near the rookeries throughout the year. Most births occur from mid-June to mid-July (peak in late June).

Survey data from 1975 to 1978 were analyzed to describe the seasonal shifts in the offshore distribution of California sea lions near the Channel Islands (Bonnell and Ford 1987). The seasonal changes in the center of distribution were attributed to changes in the distribution of the prey species. If California sea lion distribution is determined primarily by prey abundance as influenced by variations in local, seasonal, and interannual oceanographic variation, these same areas might not be the center of California sea lion distribution every year. Melin et al. (2008) showed that foraging female California sea lions showed significant variability in individual foraging behavior and foraged further offshore and at deeper depths during El Niño years as compared to non-El Niño years.

There are limited published at-sea density estimates for pinnipeds within southern California. At-sea densities likely decrease during warm-water months because females spend more time ashore to give birth and attend their pups. Radio-tagged female California sea lions at San Miguel Island spent approximately 70% of their time at sea during the nonbreeding season (cold-water months) and pups spent an average of 67% of their time ashore during their mother's absence (Melin and DeLong 2000). Different age classes of California sea lions are found in the San Diego region throughout the year (Lowry et al. 1991). Although adult male California sea lions feed in areas north of San Diego, animals of all other ages and sexes spend most, but not all, of their time feeding at sea during winter. During warm-water months, a high proportion of the adult males and females are hauled-out at terrestrial sites during much of the period.

The geographic distribution of California sea lions includes a breeding range from Baja California to southern California. During the summer, California sea lions breed on islands from the Gulf of California to the Channel Islands and seldom travel more than about 50 km (31 miles) from the islands (Bonnell et al. 1983). The primary rookeries are located on the California Channel Islands of San Miguel, San Nicolas, Santa Barbara, and San Clemente (Le Boeuf and Bonnell 1980; Bonnell and Dailey 1993). Their distribution shifts to the northwest in fall and to the southeast during winter and spring, probably in response to changes in prey availability (Bonnell and Ford 1987). In the nonbreeding season, adult and subadult males, and juvenile males and females (McHuron et al. 2018) migrate northward along the coast to central and northern California, Oregon, Washington, and Vancouver Island in British Columbia, and return south in the spring.

4.1.3 Site-Specific Occurrence

In San Diego Bay, in general, California sea lions regularly occur on rocks, buoys and other structures, and especially on bait barges, although numbers vary greatly. As discussed in Chapter 3, California sea lion occurrence in the project area is expected to be rare based on sighting of only two individuals in the water off of NBSD during one 2010 survey (Sorensen and Swope 2010).

4.1.4 Behavior and Ecology

Sexual maturity occurs at around 4 to 5 years of age for California sea lions, and the pupping and mating season begins in May and continues through July (Heath 2002). California sea lions are gregarious during the breeding season and social on land during other times. California sea lions' food consists of squid, octopus, and a variety of fishes. While no studies have occurred of their diet in the bay, studies of food sources have been done in other California coastal areas (Antonelis et al. 1990; Lowry et al. 1990; Melin et al. 1993; Hanni and Long 1995; Henry et al. 1995). Fish species found in the bay that California sea lions most likely feed on include spiny dogfish, jack mackerel, Pacific herring, Pacific sardine, and northern anchovy. They also eat octopus and leopard shark (NAVFAC SW and POSD 2013).

California sea lions show a high tolerance for human activity (Holcomb et al. 2009), modify their foraging in response to spatial and temporal variations in the availability of different prey species (Lowry et al. 1991), and make opportunistic use of almost any available structures as haulouts (NAVFAC SW and POSD 2013).

California sea lions seek a variety of structures, such as rocks, piers, and buoys and low-profile docks for hauling out. These behaviors can be destructive to structures due to the weight of the animal and fouling. If California sea lions find an easy food source at tourist spots or fishing piers, their presence can become a nuisance at certain areas in the bay as they have at marinas in Monterey and San Francisco Bay (Leet et al. 1992). Marina operators and commercial and sport fishermen tend to consider them a major nuisance, leading to some human-caused mortality.

4.1.5 Acoustics

On land, California sea lions make incessant, raucous barking sounds with most of the energy at less than 2 kHz (Schusterman et al. 1967). Males vary both the number and rhythm of their barks depending on the social context; the barks appear to control the movements and other behavior patterns of nearby conspecifics (Schusterman 1977). Females produce barks, squeals, belches, and growls in the frequency range of 0.25 to 5 kHz, while pups make bleating sounds at 0.25 to 6 kHz. California sea lions produce two types of underwater sounds: clicks (or short-duration sound pulses) and barks (Schusterman et al. 1966, 1967, Schusterman and Baillet 1969), both of which have most of their energy below 4 kHz (Schusterman et al. 1967). The functional hearing range for California sea lions on land is 50 Hz to 75 kHz (Schusterman 1981) and in-water is 60 Hz to 39 kHz (NOAA Fisheries 2018a).

5 HARASSMENT 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.

Under Section 101 (a)(5)(D) of the MMPA, the Navy requests an IHA for the take of a small numbers of California sea lions, by Level B behavioral harassment only, incidental to the replacement of Pier 6 at Naval Base San Diego. The Navy requests an IHA for proposed activities that will be conducted between October 1, 2021 and September 30, 2022.

Except with respect to certain activities not pertinent here, the MMPA defines ''harassment'' as: any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment] (50 CFR, Part 216, Subpart A, Section 216.3-Definitions). The proposed activities are not anticipated to result in any Level A harassment due to anticipated small ZOIs generated from pile driving and extracting activities and implementation of marine mammal monitoring and a 10-m (33-ft) Physical Interaction Shutdown Zone with an additional 10-m (33-ft) buffered shutdown area.

5.1 Method of Incidental Taking

This authorization request considers noise from impact pile driving, pile removal, and high pressure water jetting. These activities were deemed as the only activities that have the potential to disturb or displace marine mammals or produce a temporary shift in their hearing ability (temporary threshold shift [TTS]) resulting in Level B harassment, as defined above. The project has the potential to produce a permanent shift in the ability of California sea lions to hear from impact pile driving resulting in Level A harassment. However, Level A zones will be fully monitored to avoid take. To further reduce the likelihood of Level A takes, a buffered shutdown zone out to 20 m (66 ft) would be implemented to halt activities that could potentially injure a marine mammal that is near in-water Project-related activities. All pile driving will either be delayed from starting, or halted if any marine mammals approach the buffered shutdown zone (20 m [66 ft]) which would include all distances calculated for the Level A zone. No Level A take is anticipated with implementation of this buffered shutdown zone. The Proposed Action is not anticipated to affect the prey base or significantly affect other habitat features of California sea lions that would meet the definition of take.

Table 5-1 Number of Takes Requested per Species (Level B Harassments)

Species	*Number of Level B Takes Requested*
California sea lion	1,000

6 NUMBERS AND SPECIES EXPOSED

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

6.1 Introduction

In-water pile installation and removal will temporarily increase the local underwater noise environment in the vicinity of the project. Pile driving can also generate airborne noise that could potentially result in disturbance to marine mammals (pinnipeds) that are hauled out; however, due to the absence of haulouts in the project area, the potential for acoustic harassment by airborne noise is considered negligible and is not analyzed.

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

Sound sources associated with pile removal and/or installation are not expected to result in Level A exposures of marine mammals as defined under the MMPA, with all Level A ZOIs smaller than 10 m (33 ft; see Table 6-5 and Appendix A). Protocols identified in Chapter 13 and the Marine Mammal Monitoring Plan, are expected to stop all in-water sound producing activities prior to potential exposure to Level A thresholds. However, the noise-related impacts discussed in this application may result in Level B harassment. The methods for estimating the number and types of exposures are summarized below.

The following methods were used to determine exposure of California sea lions:

- Estimating the area of impact where noise levels exceed acoustic thresholds for marine mammals (Sections 6.3)
- Evaluating the potential presence of California sea lions based on historical occurrence or density or by site-specific survey as outlined in (Section 6.7)
- Estimating potential harassment exposures by multiplying the density or site-specific abundance, as applicable, of California sea lions calculated in the area by their probable duration during construction (Section 6.8)

These three methods are discussed in the sections that follow.

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. Ambient noise levels in south-central San Diego Bay were measured at between 121 and 131 dB (Dahl and Dall'Osta 2019), depending on location, with an average L_{50} value of 126 dB. 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.

The sounds produced by in-water demolition and construction activities fall into two sound types: impulsive and non-impulsive (defined below). Impact pile driving produces impulsive sounds, while all other equipment used to install or extract piles produces non-impulsive sounds. The distinction between these two general sound types is important because their potential to cause physical effects differs, particularly with regard to hearing (Ward, 1997).

Impulsive sounds (e.g., explosions, seismic air gun pulses, and impact pile driving), which are referred to as pulsed sounds by Southall et al. (2007, 2019), are brief, broadband, atonal transients (Harris, 1998) and occur either as isolated events or are 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). 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 and extraction (Southall et al., 2007, 2019). In some environments, the duration of both impulsive and non-impulsive sounds can be extended due to reverberations.

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 meter	Richardson et al., 1995; DEFRA 2003; Reine et al., 2014
Small vessels	860–8,000	141–175 dB RMS re: 1 µPa at 1 meter	Galli et al., 2003; Matzner & Jones 2011; Sebastianutto et al., 2011
Large ship	20–1,000	157–188 dB re: 1 µPa^{2}sec SEL at 1 meter	McKenna 2011; Kipple and Gabriele 2007
Tug docking gravel barge	200–1,000	149 dB at 100 meters	Blackwell and Greene 2002

Key: dB = decibel; Hz = Hertz; RMS = root mean square; sec = second; SEL = sound exposure level
dB re 1 µPa @ 1 m = decibels (dB) referenced to (re) 1 micro (µ) Pascal (Pa) at 1 meter

6.3 Sound Exposure Criteria and Thresholds

Under the MMPA, the NOAA Fisheries has defined levels of harassment for marine mammals. Level A harassment is defined as "any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild." Level B harassment is defined as "any act of pursuit, torment, or annoyance which 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."

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. Currently, the NOAA Fisheries uses underwater sound exposure thresholds to determine when an activity could result in impacts to a marine mammal defined as Level A (injury) or Level B (disturbance including behavioral and TTS) harassment (NOAA Fisheries 2018a). The NOAA Fisheries has developed acoustic threshold levels for determining the onset of permanent threshold shift (PTS) in marine mammals in response to underwater impulsive and non-impulsive sound sources (Table 6-2). The criteria use cumulative sound exposure level (SEL) metrics (dB SEL_{CUM}) and peak pressure (dB PEAK) rather than the previously used dB root mean square (RMS) metric. The NOAA Fisheries equates the onset of PTS, which is a form of auditory injury, with Level A harassment under the MMPA, and with "harm" under the ESA. Level B harassment occurs when marine mammals are exposed to impulsive underwater sounds above 160 dB RMS re 1 µPa, such as from impact pile driving, and to non-impulsive underwater sounds above 120 dB RMS re 1 µPa, such as from vibratory pile driving (NOAA Fisheries 2005) (Table 6-2). The onset of TTS is a form of Level B harassment under the MMPA and a form of "harassment" under the ESA. All forms of harassment, either auditory or behavioral, constitute "incidental take" under these statutes.

Table 6-2 Injury and Disturbance Threshold Criteria for Underwater and Airborne Noise

Marine Mammals	*Underwater Non-impulsive Noise (non-impulsive sounds) (re 1 µPa)*		*Underwater 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*
Otariidae (sea lions)	219 dB SEL_{CUM}	120 dB RMS	232 dB Peak[2] 203 dB SEL_{CUM}[3]	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]Flat weighted or unweighted peak sound pressure within the generalized hearing range.

[3]Cumulative sound exposure level over 24 hours.

Abbreviations: µPa = microPascal; dB = decibel; PTS = permanent threshold shift; RMS = root mean square; SEL = sound exposure level;

6.4 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 no research or data supporting a response by pinnipeds or odontocetes to non-impulsive sounds from vibratory pile driving as low as the 120 dB threshold. Southall et al. (2007) reviewed studies conducted to document the behavioral responses of harbor seals and northern elephant seals to non-impulsive sounds under various conditions. They 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. While the Level B threshold criteria for non-impulsive noise is 120 re 1 µPa, noise from non-impulsive sources associated with the Pier 6 project is assumed to become indistinguishable from background noise as it diminishes to 126 dB re 1 µPa with distance from the source (Dahl and Dall'Osto 2019). This value is used as a local baseline ambient noise value for all noise sources, including demolition and construction activities.

6.5 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 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 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) and the acoustic environment at the time of signaling may both influence the call source level (Holt et al., 2011), which directly affects the chances that a signal will be masked (Nemeth & Brumm, 2010). Miksis-Olds & Tyack (2009) showed that manatees modified vocalizations differently during increased noise, depending on whether or not a calf was present.

Masking noise from anthropogenic sources could cause behavioral changes if the masking 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 Hz to 1.5 kHz, which is likely to overlap with 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.

Based on the frequency overlap between noise produced by both vibratory and impact pile driving (10 Hz to 1.5 kHz), animals that remain in a project area during pile driving may be vulnerable to masking for the duration of pile driving (typically 2 hours or less, intermittently over the course of a day depending on site and project). Energy levels of vibratory pile driving are less than half that of impact pile driving; therefore, the potential for masking noise would be limited to a smaller radius around a pile. The likelihood that vibratory pile driving would mask relevant acoustic signals for marine mammals is negligible. In addition, most marine mammal species that may be subject to masking are transitory within the project area. Possible behavioral reactions to vocalization masking include changes to vocal behavior (including cessation of calling), habitat abandonment (short- or long-term), and modifications to the acoustic structure of vocalizations (which may help signalers compensate for masking) (Brumm & Slabbekoorn, 2005; Brumm & Zollinger, 2011). Given the relatively high source levels for most marine mammal vocalizations, the Navy has estimated that masking events would occur concurrently within the zones of behavioral harassment estimated for vibratory and impact pile removal and installation (see Section 6.6.2, Underwater Noise from Pile Driving and Extraction) and are therefore taken into account in the exposure analysis.

6.6 Modeling Potential Noise Impacts from Pile Driving and Extracting

In this IHA application, the Navy has used site-specific acoustic models (Dall'Osto and Dahl 2019), the NOAA Fisheries Technical Guidance, NOAA Fisheries User Spreadsheet, and simple practical spreading loss models (NOAA Fisheries 2018a, 2020a) to identify the Level A (injury) and Level B (behavior) ZOIs that would result from pile removal and installation, as outlined in Section 6 (Table 6-3).

Table 6-3 Noise Model Used to Calculate Level A and B ZOI by Extraction / Installation Method by Pile Type

Installation / Extraction Method	*Pile Type*
Dall'Osto and Dahl Model (2019)	
Vibratory extraction	12-inch timber-plastic piles
	20-inch and 24-inch concrete piles
	16-inch I-shaped steel piles
Pile Installation	20-inch and 24-inch concrete piles
NOAA Fisheries User Spreadsheet (2020)/Simple Practical Spreading Loss Model (15LOGR)	
High-pressure water jetting	Removal of 20- and 24-inch square concrete piles
Underwater hydraulic chainsaw	Cutting all types of piles
Small pile clipper	Clipping 12-inch timber and plastic piles
Large pile clipper	Clipping 20- and 24-inch square concrete
Two large pile clippers	Simultaneously clipping two 20- or 24-inch concrete piles

6.6.1 Underwater Sound Propagation

Pile removal will generate underwater noise that potentially could result in disturbance to California sea lions swimming by the project area. Anticipated sound propagation during impact and vibratory pile driving and extraction was assessed using acoustic models developed for south-central San Diego Bay (Dall'Osto and Dahl 2019). The models take into account local environmental conditions (bathymetry, sediment type, seasonal water temperatures) and the physiography of the bay. Separate models were developed for concrete, plastic (applied to fiberglass, timber-plastic), and steel piles, and in-water demolition activities using other equipment (underwater hydraulic pile clippers, underwater chainsaw, and high-pressure water jetting).

Distances to the Otariid Level A acoustic threshold was based on SEL_{cum} (SEL x 10 Log[number of strikes or duration per 24 hours]) given that the anticipated peak values at 10-m (33-ft) during pile driving or removal are below injury thresholds[2]. Construction assumptions include 600 strikes per pile, 10-minute duration for all non-impulsive sources except water jetting (20-minutes), and 8 piles removed, and 7 piles installed per day. For the south-central Bay acoustic models, specific weighting factors were applied to adjust SEL_{cum} for the Otariid functional hearing group (-23.6 dB for concrete piles, -16.1 dB for composite piles). For all in-water construction and demolition activities, the distances to PTS onset (Level A) are modeled to be less than 10-m (33-ft) from the source pile (Dall'Osto and Dahl 2019). The models were also used to determine the distance to the Level B acoustic thresholds for continuous and intermittent noise sources.

Calculated distances to in-water Otarriid disturbance (Level B) and corresponding areas within the ZOIs are based on the average underwater noise level (126 dB) within the project area (Dahl and Dall'Osto

[2] Source levels for pile driving are typically measured at 10 m (33 ft) from the pile in order to standardize sound measurement data.

2019). ZOIs for impact and vibratory driving or extraction based on the south-central Bay acoustic models indicate that sound propagation is substantially influenced by local bathymetry, with the steep slope of the navigation channel limiting sound transmission across the bay (Figures 6-1, 6-2, 6-3, and 6-4). Closer to land, adjacent piers are expected to influence sound transmission, but the rate of reduction is uncertain. For instance, in Figure 6-1, the orange shaded area represents areas of uncertain sound propagation, while the unshaded area represents areas with unimpeded transmission loss. Therefore, ZOIs were calculated separately for the open water and areas influenced by piers.

6.6.2 Underwater Noise from Pile Driving and Extraction

The intensity of pile driving, or removal, sound is greatly influenced by factors such as the type of pile, the type of equipment, and the physical environment in which the activity takes place. To determine reasonable SPLs from pile removal, activities with similar properties to the proposed project were evaluated. Table 6-4 presents representative source sound levels at a distance of 10 m (33 ft) from the pile for demolition activities. Table 6-5 present both installation and demolition values including actual sound source data (i.e. PEAK, RMS, SPL) of those same size piles.

Source levels associated with non-impulsive sources, including use of a vibratory driver/extractor to loosen 20-inch square concrete, 16-inch steel piles, and 12-inch timber-plastic piles, high-pressure water jetting to loosen concrete piles, diver use of a hydraulic chainsaw to cut piles at the mudline, and the use of small and large pile clippers for the removal of 12-inch timber-plastic piles and 20-inch square concrete piles, respectively, are shown in Table 6-5. Data from the most similar activities reported in the Acoustic Compendium for San Diego Bay (NAVFAC SW 2020) or by Caltrans (2015) have been used as proxies for the proposed activities at Pier 6. For these purposes, the maximum RMS SPL is the only relevant criterion; peak SPLs and SELs for these types of sources would only exceed thresholds less than 1 m (3.3 ft) from the source.

Pile installation and/or extraction may take place concurrently as pier demolition progresses shoreward ahead of pile installation for pier construction, where multiple piles are extracted, installed or both during the workday. If pile installation via impact pile driving and pile extraction activities occur at the same time, the largest Level B ZOI (see Table 6-5) would be monitored for potential Level B "take." The Level A ZOIs are not anticipated to change and would remain less than 10 m (33 ft). If multiple pile extraction techniques are used at the same time, Level A and B ZOIs would use additive dB levels to determine the Level A/B ZOIs by adding between 1 to 3 dB to the higher of the two source levels. Per a methodology modified from the U.S. Department of Transportation (USDOT; 1995), Washington State Department of Transportation (WSDOT; 2020), and NOAA Fisheries (2020b), between 1 dB (where there is 4 to 8 dB difference between the two sources) to 3 dB (where sources are the same or there is less than 1 dB difference) would be added to the larger of the two source values. For instance if a large pile clipper (source level: 161 dB RMS) and small pile clipper (source level: 154 dB) were in use simultaneously, then 1 dB would be added to the greater large pile clipper source value, based on the 7 dB difference between the two, resulting in a combined source level of 162 dB and the Level B ZOIs would be based on this source level. In order to depict the largest possible ZOI, and consequentially greatest impact scenario, the Level B ZOI for the simultaneous use of two large pile clippers (additive source level of 164 dB RMS) is included in Tables 6-4 and 6-5 and depicted in Figure 6-4.

Table 6-4 Underwater Noise Source Levels Modeled for Non-Impulsive Sources for Demolition Activities

Method	*Pile Type and Size Measured*	*Used as Proxy Source Level for Pier 6 Piles*	*RMS SPL[1] (dB re 1 µPa)*
Vibratory extraction	Timber piles	12-inch timber-plastic piles	152[2]
	24-inch steel sheet	20-inch and 24-inch concrete piles	160[3]
		16-inch I-shaped steel piles	
High-pressure water jetting	24x30-inch concrete	Removal of 20-inch square concrete piles	158[4]
Underwater hydraulic chainsaw	16-inch concrete square piles	Cutting all types of piles	150[4, 5]
Small pile clipper	13-inch polycarbonate	Clipping 12-inch timber and plastic piles	154[4]
Large pile clipper	24-inch square concrete	Clipping 20- and 24-inch square concrete piles	161[4]
Two large pile clippers	24-inch square concrete	Simultaneously clipping 20- and 24-inch square concrete piles	164[4, 6]

Sources: Dahl 2019, Caltrans 2015, NAVFAC SW 2020

Notes:

1 All SPLs are unattenuated

2 Proxy source level for vibratory timber pile extraction from Greenbusch 2018

3 Proxy source level from Caltrans 2015

4 Proxy source level from NAVFAC SW 2020

5 NAVFAC SW (2020) reports a value of 147 dB RMS at 17 m for hydraulic chainsaw. While NAVFAC SW (2020) shows a higher TL factor of 27.3 at the NBPL Fuel Pier in the northern portion of San Diego Bay, given the differing environments of the northern and southern portions of San Diego Bay, a TL value of 15 is used here to arrive at the 150 dB RMS source value for the hydraulic chainsaw.

6 Additive source level for simultaneous use of two large pile clippers (161 dB RMS + 3 dB addition)

Abbreviations:

dB re 1 µPa = decibels referenced to a pressure of 1 microPascal (measures underwater SPL)

RMS = root mean square

For the analyses that follow, the TL model described above was used to calculate the expected noise propagation from pile removal, using the proxy source levels identified in Table 6-4. Distances to Level A (onset PTS) thresholds, based on cumulative SEL, have been calculated as shown in Appendix A using the NOAA Fisheries User Spreadsheets (NOAA Fisheries 2020a; Dahl and Dall'Osto 2019). Non-impulsive noise sources are assumed to operate for 20 minutes per pile (water jetting or underwater chainsaw) or 10 minutes per pile (other sources). Based on the average ambient sound level of 126 dB near Pier 6 (Dahl and Dall'Osto 2019), the Level B threshold distance is determined by the point at which sound from the project source diminishes to 126 dB.

The calculated radial distances to thresholds and corresponding areas within the ZOIs are summarized in Table 6-5. Figure 6-1 shows graphically the extent of the ZOIs associated with noise propagation from concrete pile driving and extraction, while Figure 6-2 shows the ZOIs associated with timber-plastic and fiberglass pile driving and extraction, Figure 6-3 shows the ZOI for steel pile extraction, and Figure 6-4 depicts ZOIs associated with high-pressure water jetting and pile cutting activities. ZOIs that extend less than the Physical Interaction Shutdown Zone (10 m) from the source, including all of the Level A distances, are not shown because the shutdown procedure (when a marine mammal could approach to within 20 m [66 ft]) would prevent any exposures.

Table 6-5 Calculated Distance(s) to Underwater Noise Thresholds and ZOIs within the Thresholds from Pile Driving and Removal

Activity Description/ Source Sound Levels at 10-m (33-ft)	*Minor Injury (PTS Onset) Level A[4]*		*Behavioral Disturbance Level B [5, 6]*	
	Radial Distance (m)	*ZOI Area (km^2)*	*Maximum Radial or Length x Width Distance (m)*	*Total ZOI Area (km^2) (Open Water / Around Piers)*
Demolition Activities				
Vibratory extraction 20-inch and 24-inch concrete[1], 160 RMS	<10	<0.001	6,990 x 1,173	5.35 (4.06 / 1.29)
Vibratory extraction 12-inch timber-plastic[1], 152 RMS	<10	<0.001	2,167 x 1,055	2.11 (1.49 / 0.62)
Vibratory extraction 16-inch I-shaped steel pile[1], 160 RMS	<10	<0.001	7,140 x 1,595	6.43 (5.15 / 1.28)
Water jetting installation/ extraction[3], 158 RMS	<10	<0.001	1,359	3.6 (2.8 / 0.8)
Large hydraulic pile clipper, concrete[3], 161 RMS	<10	<0.001	2,154	7.7 (6.5 / 1.2)
Two large hydraulic pile clippers, concrete[3], 164 RMS	<10	<0.001	3,415	15.37 (13.85 / 1.52)
Small hydraulic pile clipper, timber-plastic[3], 154 RMS	<10	<0.001	736	1.4 (1.0 / 0.4)
Underwater hydraulic chain saw[3], 150 RMS	<10	<0.001	398	0.48 (0.4 / 0.08)
Installation Activities				
Impact driving 20 and 24-inch concrete[1,2], 188 Peak, 176 RMS, 166 SEL	<10	<0.001	192	0.10 (0.10 / NA)
Impact driving 16-inch fiberglass[1,2], 166 Peak, 153 RMS, 144 SEL	<10	<0.001	<10	<0.001

Notes:

1 Distances to Level A and B thresholds were calculated for impact pile driving and vibratory or extraction using acoustic models developed for south-central San Diego Bay (Dall'Osto and Dahl 2019 and Caltrans 2015). The distances to the Level A SEL_{cum} threshold are adjusted for the representative frequency range of Otariid functional hearing group. The Level B ZOIs for impact pile installation and vibratory pile extraction are based on the 160 dB threshold and distance to ambient levels (126 dB), respectively.

2 Impact driving values as reported in Dall'Osto and Dahl 2019

3 For pile installation/extraction activities using other equipment (water jetting, pile clippers, chain saw), the 2020 NOAA Fisheries User Spreadsheet was used to calculate distances to the Level A SEL_{cum} threshold and practical spreading loss model was used to calculate distances to Level B thresholds. Weighting Factor Adjustments of 2 kHz for impact pile driving and 2.5 kHz for non-impulsive sounds, and the representative frequency range for Otariid functional hearing group were used (NOAA Fisheries, 2020).

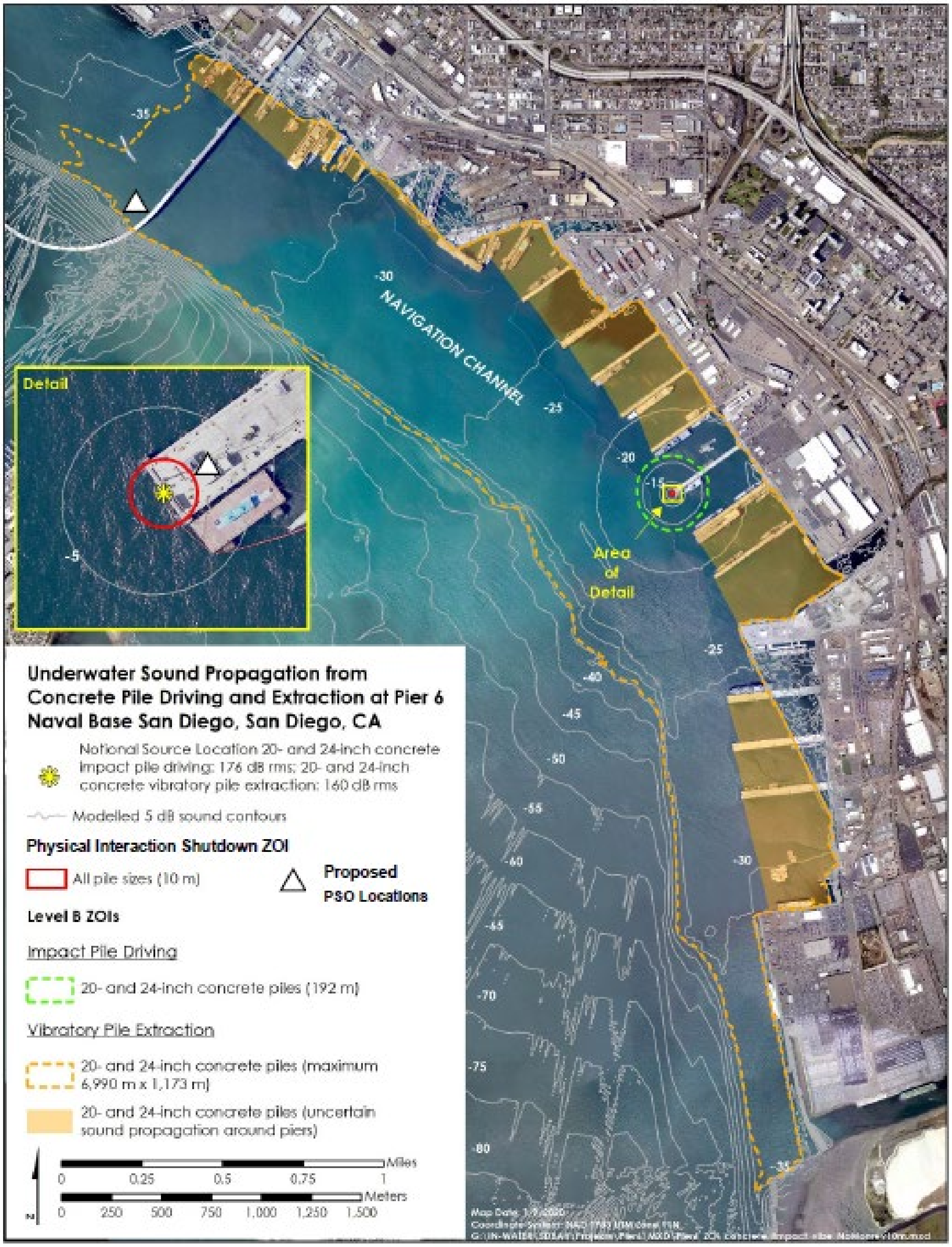
4 Assumes 600 strikes per pile, 10-minute duration for all non-impulsive sounds except for high-pressure water jetting (20-minute), and 7 piles installed and 8 piles removed per day.

5 The Level B ZOIs were calculated to the average ambient underwater noise value of 126 dB re 1 µPa within the project area (Dahl and Dall'Osto 2019).

6 Level B ZOI areas were calculated separately for open water versus areas around piers where the structure's influence on sound propagation is uncertain; slight variations between these estimated values and those presented in other documentation result from rounding at the hundredths level.

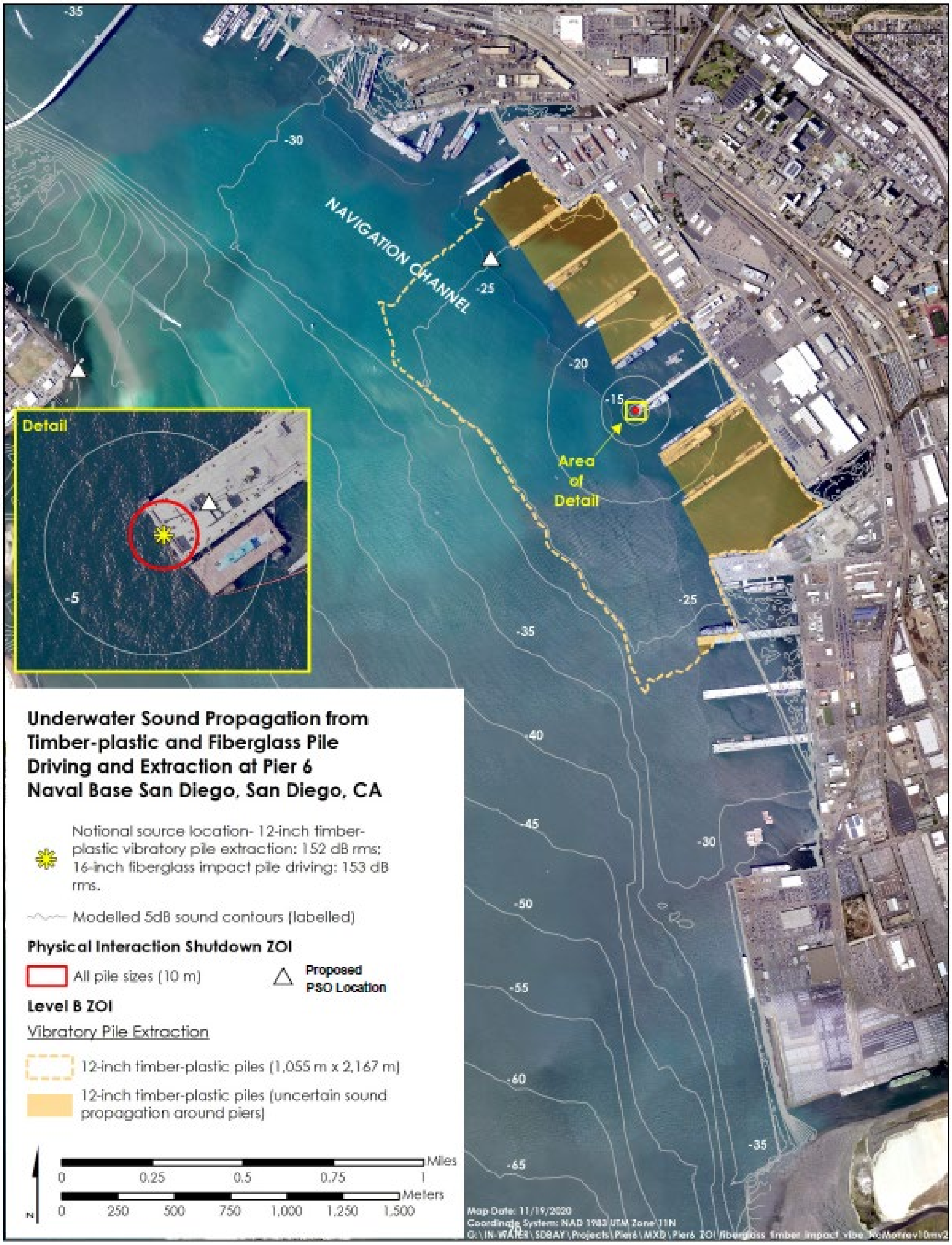
Abbreviations:

dB re 1 µPa = decibels referenced to a pressure of 1 microPascal; km^2 = square kilometers; m = meters;
N/A = not applicable because the ZOI is contained within the shutdown zone (less than 10-m [33-ft] from source);
PTS = permanent threshold shift; RMS = root mean square; SEL = sound exposure level; and
ZOI = Zone of Influence (area encompassed within acoustic threshold boundary).



Note: Additional Representative PSO Location at Naval Amphibious Base Coronado (obscured by insert here)

Figure 6-1 Underwater Sound Propagation from Concrete Pile Driving and Extraction and Proposed Monitor Locations at Pier 6



Note: Impact Driving of Fiberglass Piles is not expected to result in Level A or B acoustic harassment; a 20-m buffered (66-ft) shutdown zone will be monitored to avoid injury from physical interaction with operating in-water equipment.

Figure 6-2 Underwater Sound Propagation from Timber-Plastic and Fiberglass Pile Driving and Extraction and Proposed Monitor Locations at Pier 6

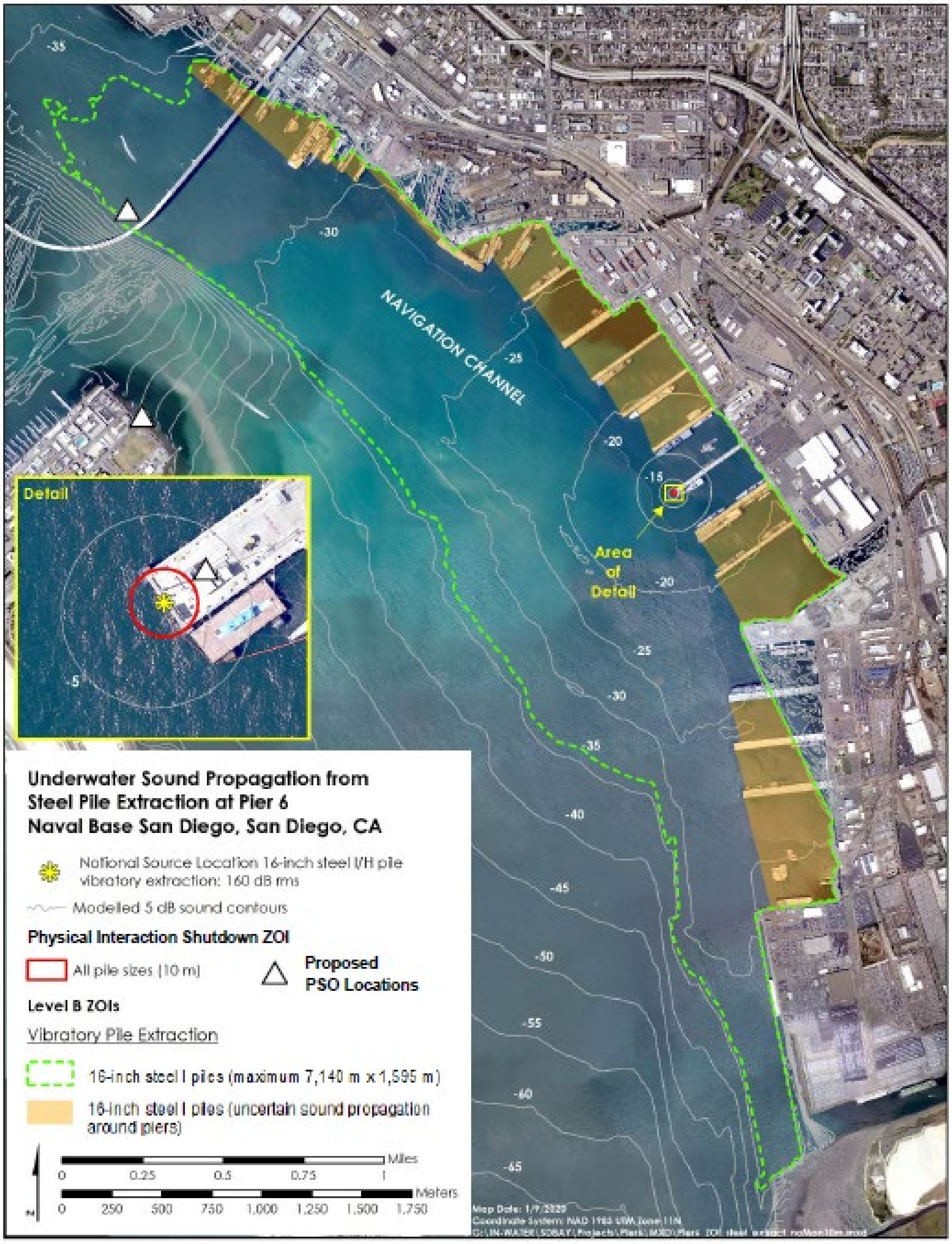


Figure 6-3 Underwater Sound Propagation from Steel Pile Extraction and Proposed Monitor Locations at Pier 6

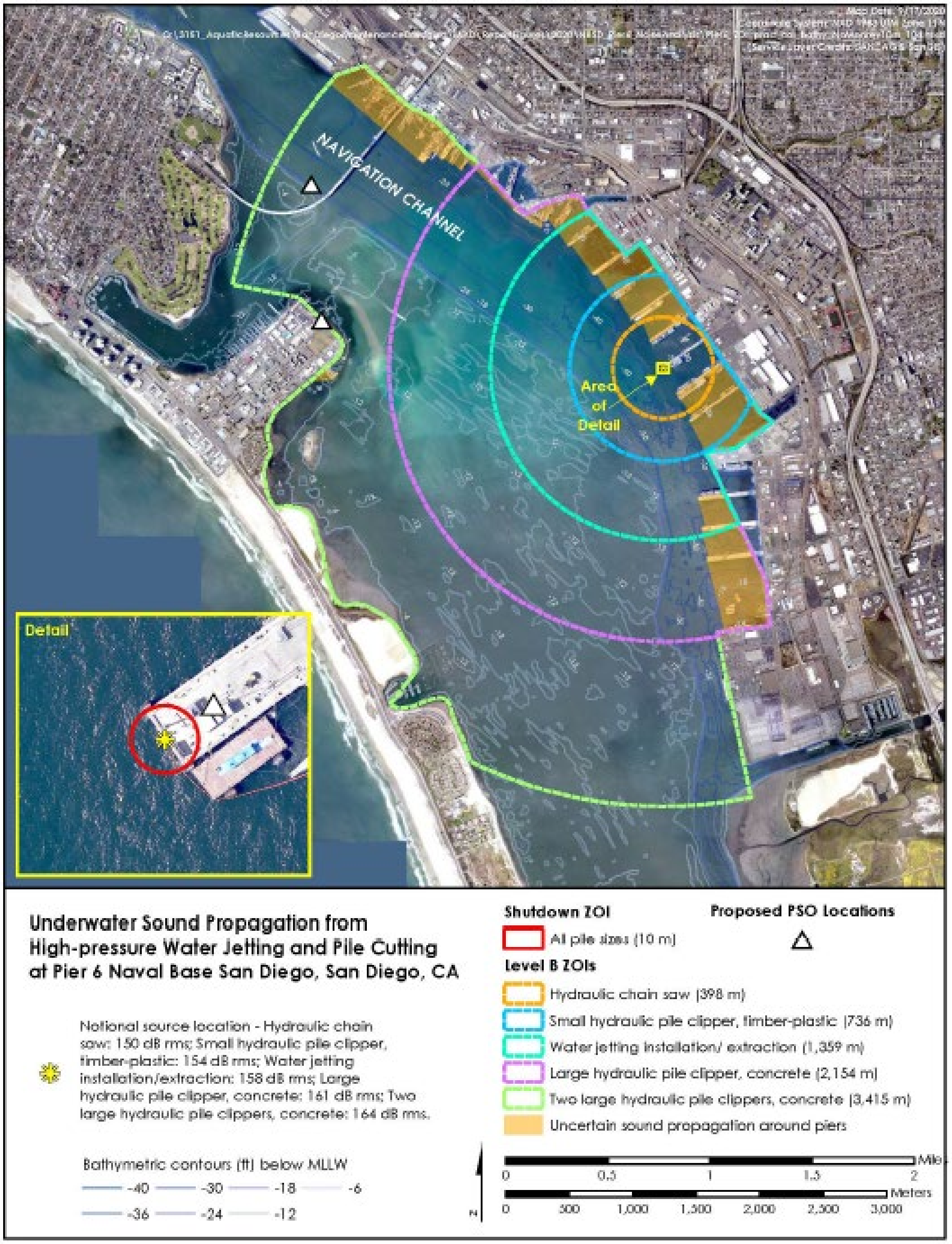


Figure 6-4 Underwater Sound Propagation from High-Pressure Water Jetting and Pile Cutting and Proposed Monitor Locations at Pier 6

6.7 Basis for Estimating Take by Harassment

The U.S. Navy is seeking authorization for the potential taking of small numbers of California sea lions in the project area as a result o f pile removal and installation associated with the replacement of Pier 6. California sea lions are present in San Diego Bay year-round, but as previously discussed, they are considered to be rare south of the Coronado Bridge (Sorensen and Swope 2010). The takes requested are expected to have no more than a minor effect on individual animals and no effect on the California sea lion population in general. Any effects experienced by individual marine mammals are anticipated to be limited to short-term disturbance of normal behavior or temporary displacement of animals near the source of the noise.

Level A (PTS onset) takes, as well as risks of physical injury, would not occur due to the small threshold distances (Table 6-5) and implementation of the 20-m (66-ft) buffered shutdown zone.

Potential Level B takes would occur throughout pile installation or removal activities if California sea lions are present within the ZOIs (Table 6-5, Figures 6-1, 6-2, 6-3, and 6-4). There are no known haul-outs in the project area, although there are structures, such as buoys, that could be used as haul-outs. California sea lions observed in the area would likely be swimming and/or foraging. As such, potential takes by disturbance will have a negligible short-term effect on individual California sea lions and would not result in population-level impacts.

6.8 Description of Take Calculation and Exposure Estimates

California sea lions are primarily observed north of the Coronado Bridge (Merkel and Associates, Inc. 2008; Sorensen and Swope 2010; Graham and Saunders 2014;) and sightings rates in the project area would be expected to be low based on Sorenson and Swope (2010), and more recent monitoring efforts in late 2019 and early 2020 for a quaywall repair project at the northern end of NBSD (Chollas Creek Quaywall Repairs, unpublished data). The more recent data recorded California sea lions observations at an average of 0.69 animals per monitoring day as observed from a restricted observation location set at the base of two pier with limited visibility (Chollas Creek Quaywall Repairs, unpublished data). Further, the nearby MGBW Floating Dry Dock project assumed 2 California sea lions per day would be in that project area which is further south in San Diego Bay and consequentially more distant from greater concentrations of California sea lions in the northern part of the Bay than the Pier 6 site. These data, and assumptions for other approved projects, were used to provide a rough approximation of the potential for California sea lion presence in the project area. Further, given the general lack of density data in the project area, an accepted observation protocol is to assume that for every California sea lion observed there is one more unseen because California sea lions tend to travel in groups of two or more (Melin et al. 2018). We have, therefore, used the conservative assumption that four California sea lions would be present within the project Level B ZOIs for every day of the 250-workday construction and demolition period.

Pile installation and/or extraction may take place concurrently as pier demolition progresses shoreward ahead of pile installation for pier construction, where multiple piles are extracted, installed or both during the workday. The following assumptions were used to calculate potential exposures to impact pile driving and vibratory extraction noise for each threshold:

- Each animal can be "taken" via Level B harassment once every 24 hours.
- 4 California sea lions have the potential to occur within the project ZOIs per day.

  Exposure Estimate = (250 workdays x 4 California sea lions))

  = 1,000 California sea lions

The estimate of four California sea lions per day within the project area is considered as a conservative estimate of potential presence in the project area based on the two California sea lions observed during the dedicated 2010 survey (Sorenson and Swope 2010), as well as during the recent monitoring efforts (Chollas Creek Quaywall Repairs, unpublished data). Therefore, a conservative assumption of four California sea lions is appropriate for the location and the scale of the project; hence, the estimate of 1,000 takes is a reasonable estimate of the maximum number of takes that would occur.

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 Pile Driving on Marine Mammals

7.1.1 Potential Effects Resulting from Underwater Noise

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

Potential impacts on marine species are expected to be the result of physiological responses to both the type and strength of the acoustic signature (Viada et al., 2008). Behavioral impacts may also occur, though the type and severity of these effects are more difficult to define due to limited studies addressing the behavioral effects of impulsive as well as non-impulsive sounds on marine mammals. Potential effects can range from brief acoustic effects such as behavioral disturbance, tactile perception, physical discomfort, slight injury of the internal organs and temporary to permanent impairment of the auditory system to death of the animal (Yelverton et al., 1973; O'Keefe and Young, 1984; Ketten, 1995; Navy, 2001; Dahl et al., 2015; Finneran 2015; Kastelein et al., 2016, 2018).

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, damage the cochlea, cause hemorrhage, and leak cerebrospinal fluid into the middle ear (Ketten 2004). Sub-lethal impacts also include hearing loss, which is caused by exposure to perceptible sounds. Moderate injury implies partial hearing loss. Permanent hearing loss (also called PTS) can occur when the hair cells of the ear are damaged by a very loud event, as well as prolonged exposure to noise. Instances of TTS and/or auditory fatigue are well documented in marine mammal literature as being one of the primary avenues of acoustic impact. TTS has been documented in controlled settings using captive marine mammals exposed to strong SELs at various frequencies (Ridgway et al., 1997; Kastak et al. 1999; Finneran et al. 2005; Finneran et al. 2015). While injuries to other sensitive organs are possible, they are less likely since pile driving impacts are almost entirely acoustically mediated. Based on the mitigation measures outlined in Chapter 11 and the conservative modeling assumptions discussed in Chapter 6, California sea lions may be present, but would be expected in very low numbers. Therefore, California sea lions that are present during construction may experience auditory effects, but will not cause population-level impacts or affect the continued survival of the species.

7.1.1.2 Behavioral Responses

Behavioral responses to sound are highly variable and context-specific. For each potential behavioral change, the magnitude of the change ultimately determines the severity of the response. A number of factors may influence an animal's response to noise, including its previous experience, its auditory sensitivity, its biological and social status (including age and sex), and its behavioral state and activity at the time of exposure. Habituation occurs when an animal's response to a stimulus wanes with repeated exposure, usually in the absence of unpleasant associated events (Wartzok et al., 2004). Animals are most likely to habituate to sounds that are predictable and unvarying. The opposite process is sensitization, when an unpleasant experience leads to subsequent responses, often in the form of avoidance, at a lower level of exposure.

Behavioral state or differences in individual tolerance levels may affect the type of response as well. For example, animals that are resting may show greater behavioral change in response to disturbing noise levels than animals that are highly motivated to remain in an area for feeding (Richardson et al., 1995; NRC, 2003; Wartzok et al., 2004). Indicators of disturbance may include sudden changes in the animal's behavior or avoidance of the affected area. A marine mammal may show signs that it is startled by the noise and/or it may swim away from the sound source and avoid the area. Increased swimming speed, increased surfacing time, and cessation of foraging in the affected area would indicate disturbance or discomfort. Pinnipeds may increase their haul-out time, possibly to avoid in-water disturbance.

Controlled experiments with captive marine mammals showed pronounced behavioral reactions, including avoidance of loud sound sources (Ridgway et al., 1997; Finneran et al., 2003) and an increase in the respiration rate of harbor porpoises (*Phocoena phocoena*) (Kastelein et al., 2013). Observed responses of wild marine mammals to loud pulsed sound sources (typically including seismic guns or acoustic harassment devices and pile driving) have been varied, but these responses often consist of avoidance behavior or other behavioral changes that suggest discomfort (Morton & Symonds 2002; also see reviews in Gordon et al., 2004; Wartzok et al., 2004; and Nowacek et al., 2007). Some studies of acoustic harassment and acoustic deterrence devices have found habituation in resident populations of seals and harbor porpoises (see the review in Southall et al., 2007). Blackwell et al. (2004) found that ringed seals (*Phoca hispida*) exposed to underwater pile-driving sounds in the 153 to 160 dB RMS range tolerated this noise level and did not seem unwilling to dive and did not react strongly to pile-driving activities. Responses of two pinniped species to impact pile driving at the San Francisco-Oakland Bay Bridge East Span Seismic Safety Project were mixed (Caltrans, 2001). Harbor seals were observed in the water at distances of approximately 400 to 500 m (1,312 to 1,640 ft) from the pile-driving activity and exhibited no alarm responses, although several showed alert reactions. None of the seals appeared to remain in the area, although they may have been transiting to the haulout site or feeding areas. One of these harbor seals was even seen to swim to within 150 m (492 ft) of the pile-driving barge during pile driving. Several California sea lions, however, were observed at distances of 500 to 1,000 m (1,640 to 3,280 ft) swimming rapidly and porpoising away from pile-driving activities. Both harbor seals and California sea lions continued feeding on dense schools of herring that occasionally occurred during pile driving (Caltrans, 2001). Observations at other construction sites (for example, the Navy's Point Loma fuel pier project) indicated that California sea lions typically did not respond behaviorally to pile driving (NAVFAC SW, 2014;

Navy 2016). The reasons for these differences are not known and probably reflect the context of construction activities and the previous experiences of the animals.

Observations of marine mammals on Naval Base Kitsap at Bangor during the Test Pile Program 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, 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.

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.

Marine mammals encountering pile-driving operations over a project's construction time frame 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 vary. 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. The ZOI is only a small portion of foraging habitat utilized in San Diego Bay in general. Noise-related disturbance may also inhibit some marine mammals from transiting the area. 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 the response. Since pile driving/removal activities will only occur during daylight hours, California sea lions swimming, foraging, or resting in a project area at night will not be affected. Effects of pile-driving activities will be experienced by individual California sea lions but will not cause population-level impacts or affect the continued survival of the species.

7.2 Conclusions Regarding Impacts to Species or Stocks

Individual California sea lions may be exposed to SPLs during pile driving and extraction operations at NBSD may result in Level B Behavioral harassment. Any California sea lions which are taken (harassed), may change their normal behavior patterns (i.e., swimming speed, foraging habits, etc.) or be temporarily displaced from the area of construction. Any takes would likely have only a minor effect on individuals and no effect on the population. The sound generated from vibratory pile extraction is non-pulsed (e.g., continuous) which is not known to cause injury to marine mammals. Mitigation is likely to avoid most potential adverse underwater impacts to California sea lions from impact pile driving. Nevertheless, some level of impact is unavoidable. The expected level of unavoidable impact (defined as an acoustic or harassment "take") is described in Section 6. This level of effect is not anticipated to have any detectable adverse impact to the California sea lion population recruitment, survival, or recovery.

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8 IMPACT ON SUBSISTENCE USE

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

Potential impacts resulting from the Proposed Action will be limited to individuals of California sea lions located in NBSD ZOI that have no subsistence requirements. Therefore, no impacts on the availability of species or stocks for subsistence use are considered.

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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.

The proposed activities at NBSD are expected to have little if any effect on the distribution of California sea lions within the project area. Only small numbers of California sea lions are expected to be present during construction and there are no haulout structures within the project area. Therefore, the main impact issue associated with the proposed activity will be temporarily elevated noise levels and the associated direct effects on California sea lions, as discussed in Sections 6 and 7. The most likely impact to habitat will occur from pile driving effects on likely California sea lion prey (i.e., fish) and minor impacts to the immediate substrate during the removal of piles.

9.1 Pile Removal and Installation Effects on Potential Prey (Fish)

The current IHA application addresses non-impulsive and impulsive sounds associated with the machinery used to extract and install piles. Fish react to sounds which are especially strong and/or intermittent low-frequency sounds. Short duration and sharp sounds can cause overt or subtle changes in fish behavior and local distribution. Hastings and Popper (2005) and Popper and Hastings (2009) identified several studies that suggest fish may relocate to avoid certain areas of noise energy. Additional studies have documented effects of pile driving (or other types of continuous sounds) on fish, although several are based on studies in support of large, multiyear bridge construction projects (Scholik and Yan 2001, 2002, Govoni et al. 2003, Hawkins 2005, Hastings 1990, 2007, Popper et al. 2006, Popper and Hastings 2009). Sound pulses at received levels of 160 dB re 1 μPa may cause subtle changes in fish behavior. SPLs of 180 dB may cause noticeable changes in behavior (Chapman and Hawkins 1969; Pearson et al. 1992; Skalski et al. 1992). SPLs of sufficient strength have been known to cause injury to fish and fish mortality (Caltrans 2001; Longmuir and Lively 2001). Additionally, studies of fish response to pile driving for Pacific sardine and northern anchovy found that fish exhibited immediate startle response to individual strikes at 50 m (164 ft) but returned to “normal” pre-strike behavior following the conclusion of pile driving and no evidence of injury to fish as a result of pile driving (NAVFAC SW 2014, Appendix C). The most likely impact to fish from pile removal and installation activities at the Project Area would be temporary behavioral avoidance of the immediate area. The duration of fish avoidance of this area after pile driving or removal stops is unknown, but a rapid return to normal recruitment, distribution and behavior is anticipated. In general, impacts to marine mammal prey species are expected to be minor and temporary.

Thresholds for fish mortality, injury, and temporary threshold shift from pile driving are shown in Table 9-1. These are the thresholds used in the *Hawaii-Southern California Training and Testing Final EIS/OEIS* (Navy 2018) and represent best available science (Popper et al. 2014). Use of a threshold dB value for behavioral responses is not supported, although a threshold of 150 dB has been used (Caltrans 2015). The likelihood of behavioral responses is qualitatively considered to be high within tens of meters, intermediate within hundreds of meters, and low at thousands of meters (Popper et al. 2014).

Table 9-1. Sound Exposure Criteria for Mortality, Injury, and TTS for Fish

Fish Hearing Group	Onset of Mortality		Onset of Injury		TTS
	SEL_{cum}	SPL_{peak}	SEL_{cum}	SPL_{peak}	SEL_{cum}
Fishes without a swim bladder	> 219	> 213	> 216	> 213	NC
Fishes with a swim bladder not involved in hearing	210	> 207	203	203	> 186
Fishes with a swim bladder involved in hearing	207	>207	203	> 207	186
Fishes with a swim bladder and high-frequency hearing	207	> 207	203	> 203	186

Source: Navy 2018

For impact pile driving, SEL_{cum} at the 10-m (33-ft) source distance is calculated as:

$$SEL_{cum} = \text{Single-strike SEL} + 10 \log10 \text{ (number of strikes per day)}$$

For 20 and 24- inch concrete piles the SEL_{cum} is 202.28 (refer to Table 6-5 for 166 SEL and assumed 600 strikes per pile and 7 piles installed per day)"

$$SEL_{cum} = 166 + 10 \log10 \text{ (600 strikes/pile x 7 piles/day)} = 202.2$$

which is below both mortality and injury thresholds for all fish groups. Relatively small portions of the project area would be affected, and the effects on EFH would be temporary, limited to the duration of sound-generating activities and would not exceed any mortality or injury thresholds.

Source levels associated with non-impulsive sources, including use of a vibratory driver/extractor to loosen 20-inch square concrete and 12-inch timber-plastic piles, high-pressure water jetting to loosen concrete piles, diver use of a hydraulic chainsaw to cut piles at the mudline, and the use of small and large pile clippers for the removal of 12-inch timber-plastic piles and 20-inch square concrete piles, respectively, at 10 m (33 ft) from the source are shown in Table 6-5. Data from the most similar activities reported in the Acoustic Compendium for San Diego Bay (NAVFAC SW 2020) or by Caltrans (2015) have been used as proxies for the proposed activities at Pier 6. For these purposes, the maximum RMS SPL for each activity type is the only relevant criterion; peak SPLs and SELs for these types of sources would not exceed California sea lion prey fish injury or mortality thresholds.

9.2 Pile Removal and Installation Effects on Potential Foraging Habitat

The area likely impacted by the Pier 6 Replacement Project is relatively small compared to the available habitat in San Diego Bay. The Navy's marine mammal surveys have documented small numbers of California sea lions within the project area and the affected area is used little, if at all, as foraging habitat. As a result, the removal and replacement of pilings, substrate disturbance, and high levels of activity at the project site would be inconsequential in terms of effects on marine mammal foraging.

Turbidity is expected to increase in the short-term during pile installation and removal. The size and shape of the turbidity plume from pile driving and removal are difficult to quantify because of variability in naturally occurring conditions, such as wind and currents. Consequently, it is difficult to predict the specific areas that may be influenced by the plume. Pile driving and removal activities are likely to increase turbidity in the immediate vicinity, for example when high-pressure water jetting is used. Turbidity monitoring during jetting to remove caissons for the Fuel Pier Replacement Project revealed relatively minor if any changes, with only localized decreases in water clarity that dissipated within 11 minutes or less (NAVFAC SW 2017). Pile removal and installation at the project site when jetting is employed would likely have similar effects, resulting relatively minor (local to the pile being worked on) and temporary negative effects on the water quality.

Eelgrass is not present with the project footprint. The nearest eelgrass beds are approximately 1.9 km northwest of Pier 6 on the west side of the Bay. Therefore, no impacts to eelgrass that provides habitat for California sea lion prey would be affected.

9.3 Summary of Impacts to Marine Mammal Habitat

Given that the project area and the affected area have limited use as foraging habitat for California sea lions, the removal and replacement of pilings, substrate disturbance, and high levels of activity at the project site would be inconsequential in terms of effects on marine mammal foraging. Therefore, pile driving / removal is not likely to have a permanent, adverse effect on California sea lion foraging habitat in the Project Area.

10 IMPACTS TO MARINE MAMMALS FROM LOSS OR MODIFICATION OF HABITAT

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

The proposed activities at NBSD are not expected to have any habitat-related effects that could cause significant or long-term consequences for individual California sea lions or the population. As previously discussed, California sea lions do not occur in large numbers nor are they expected to use the project area as frequent foraging habitat. Based on the discussions in Section 9, there will be no impacts to California sea lions resulting from loss or modification of marine mammal habitat.

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11 MEANS OF EFFECTING THE LEAST PRACTICABLE ADVERSE IMPACTS – MITIGATION MEASURES

The availability and feasibility (economic and technological) of equipment, methods, and manner of conducting such activity or other means of effecting the least practicable adverse impact upon the affected species or stocks, their habitat, and on their availability for subsistence uses, paying particular attention to rookeries, mating grounds, and areas of similar significance.

The exposures outlined in Section 6 represent the maximum expected number of marine mammals that could be exposed to acoustic sources reaching Level B harassment levels. The Navy proposes to employ a number of mitigation measures, discussed below, in an effort to minimize the number of marine mammals potentially affected.

11.1 Mitigation for Pile Driving and Removal Activities

11.1.1 Proposed Measures

1. Time Restriction - In-water pile driving and removal activities will only be conducted when sufficient light is available for visual observations (generally 30 minutes after sunrise and up to 45 minutes before sunset).
2. General Vessel & Machinery Stoppage - For in-water construction, heavy machinery activities other than pile driving (e.g., use of barge-mounted excavators, or dredging), if a marine mammal comes within 10 m (33 ft), the activity must cease operations and reduce vessel speed to the minimum level required to maintain steerage and safe working conditions.
3. Pre-Construction Briefing - Prior to the start of all in-water pile installation or extraction activities, briefings will be conducted for construction supervisors and crews and the monitoring team and when new personnel join the work, in order to explain responsibilities, communication procedures, the marine mammal protocol, and operational procedures.
4. Establishment of Level A and Level B Harassment ZOIs During Pile Driving and Removal
    a. During all pile driving and removal activities, regardless of predicted SPLs, a buffered shutdown area of 10 m (33 ft) will be added to the required 10-m (33 ft) Level A injury prevention Physical Interaction Shutdown Zone. Since California sea lions are fast-swimming, this is appropriate to reduce the likelihood of injury to marine mammal species due to physical interaction with construction equipment during in-water activities. If an animal enters the buffered shutdown zone, pile driving or extraction would be stopped until the individual(s) has left the zone of its own volition, or not been sighted for 15 min.
    b. To the maximum extent possible, Level A/B harassment ZOIs will be monitored throughout the time required to drive or extract a pile. Based on the small size of the Level A ZOIs (<10 m [33 ft], but with a 20 m [60 ft] monitoring area), the whole of the Level A ZOI will be monitored during pile extraction and/or installation. Because many of the Level B ZOIs (depending on the activity, see Table 6-5) are outside of the visual range of the PSOs, an extrapolation of take will be calculated based on the assumption that for every animal observed inside of the Level B ZOI, there is one animal that is inside of the ZOI, but outside of the visual range of the PSO. If a marine mammal is observed entering the Level B ZOI, an exposure would be recorded and behaviors documented. Work would continue without cessation, unless the animal approaches or enters the buffered shutdown zone, at which point pile driving or extraction shall be halted.

5. Visual Monitoring

    a. Pile Installation and Extraction: Monitoring will be conducted for a 20 m (66 ft) buffered shutdown zone and within the Level B ZOI before, during, and after pile installation and removal activities. The Level B ZOI may be adjusted based on acoustic monitoring results, subject to NOAA Fisheries concurrence. Monitoring will take place from 30 min prior to initiation through 30 min post-completion of installation or removal activities.

    b. Monitoring will be conducted by qualified protected species observers (PSOs). All PSOs would be trained in marine mammal identification and behaviors, and have experience conducting marine mammal monitoring or surveys. Trained PSOs will be placed at the best vantage point(s) practicable (e.g., from a small boat, the pile driving barge, on shore, or any other suitable location) to monitor for marine mammals and implement shutdown/delay procedures, when applicable, by notifying the hammer operator of a need for a shutdown of construction. Up to four PSOs will be deployed on land or vessel with a clear view of the shutdown zone and ZOIs.

    c. Up to four PSOs at up to three locations (including two PSOs on a captained vessel) will be deployed with a clear view of the shutdown zone and ZOIs. The number of PSOs may vary depending on the pile installation or removal activity and applicable size of the ZOI(s).

    d. Prior to the start of pile installation activity, the buffered shutdown zones will be monitored for 30 min to ensure that they are clear of marine mammals. Pile driving will only commence once observers have declared the buffered shutdown zones clear of marine mammals; Animals will be allowed to remain in the Level B ZOI and their behavior will be monitored and documented.

    d. If a marine mammal approaches/enters the buffered shutdown zone during the course of pile installation or extraction operations, pile driving will be halted and delayed until either the animal has voluntarily left and been visually confirmed beyond the shutdown zone, or 15 min have passed without a re-detection of the animal(s) from the last observation time.

    e. If a marine mammal species not covered in this IHA enters the Level B harassment zone, all pile driving or extraction activities shall be halted until the animal(s) has been observed to have left the Level B ZOI, or has not been observed for at least one hour. NOAA Fisheries will be notified immediately with the species, and precautions made during the encounter. Pile installation or extraction will be allowed to proceed if the above measures are fulfilled for non-IHA species.

    f. In the unlikely event of conditions that prevent the visual detection of marine mammals, such as heavy fog, activities, prevent the visual detection of marine mammals within the buffered shutdown zone, in-water construction of demolition activities have been initiated, and conditions deteriorate so that the buffered shutdown zone is not completely visible, activities will be delayed until the full buffered shutdown zone is once again visible.

    g. If the take of a marine mammal species approaches the take limits specified in the IHA, NOAA Fisheries will be notified, and appropriate steps will be discussed.

6. Acoustic Measurements – Acoustic measurements will be used to empirically validate sound source levels. For further detail regarding our acoustic monitoring plan see Section 13.

7. Soft Start - The use of impact pile driving soft-start procedures are believed to provide additional protection to marine mammals by providing a warning and/or giving marine mammals a chance to leave the area prior to the hammer operating at full capacity. The soft start procedure is described below:

    Soft start requires contractors to provide an initial set of strikes at reduced energy, followed by a thirty-second waiting period, then two subsequent reduced energy strike sets. A soft start 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 thirty minutes or longer.*

8. Daylight Construction – In-water pile installation and removal work will occur only during daylight hours that allow for sighting of marine protected species within all project area and defined monitoring zones.

11.1.2 Measures Considered but not Proposed

Silt curtains were considered but rejected as a mitigation measure for turbidity because 1) the sediments of the project site are sandy and will settle out rapidly when disturbed; 2) fines that do remain suspended would be rapidly dispersed by tidal currents; and 3) tidal currents would tend to collapse the silt curtains and make them ineffective. Additionally, the use of bubble curtains was evaluated during the previous Naval Base Point Loma Fuel Pier project (completed in 2018) and were eliminated from consideration for that project and, by extension, this project given the dynamic tidal cycle in San Diego Bay.

11.2 Mitigation Effectiveness

All PSOs 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. Visual detection conditions in San Diego Bay are generally excellent. By its orientation, the bay is sheltered from large swells and infrequently experiences strong winds; winds are less than 17 knots 98% of the time between November and April (San Diego Bay Harbor Safety Committee 2009). Fog is anticipated on 10-20% of the days, typically in late night and early morning hours (San Diego Bay Harbor Safety Committee 2009) and could occasionally limit visibility for marine mammal monitoring. However, observers will be positioned in locations which provide the best vantage point(s) for monitoring, such as on nearby piers or on a small boat, and the shutdown and buffer zones cover relatively small and accessible areas of the bay. As such, proposed mitigation measures are likely to be very effective.

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12 MINIMIZATION OF ADVERSE EFFECTS ON SUBSISTENCE USE

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.

There is no subsistence use of marine mammal species or stocks in the project area.

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13 MONITORING AND REPORTING MEASURES

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

13.1 Monitoring Plan

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 IHA. A marine mammal monitoring plan will be developed further and submitted to NOAA Fisheries for approval well in advance of the start of construction during the IHA period. The monitoring plan includes the following components: acoustic measurements and visual observations.

13.1.1 Acoustic Measurements

For each distinct pile type, size, and method of installation or removal, the sound source level (SEL, peak and RMS SPL) will be measured at a 10-m (33-ft) distance at mid-depth. Measurements will be taken throughout the installation/removal of a single pile of each type, size, and method. Acoustic measurements also will be taken at the estimated limits of the Level B ZOIs for each type of pile. The acoustic data will be analyzed to verify, and if appropriate, to make adjustments to ZOI boundaries initially estimated using the models described above in Section 6.6. During pile installation monitoring specifically, the acoustician will obtain pertinent information from the construction contractor for the piles being driven during the acoustic monitoring (e.g., substrate composition, hammer model and size, hammer energy settings and any changes to those settings, depth of the pile being driven, and blows per foot) to support transmission loss calculations. Prior to any changes to the transmission loss calculations or monitoring methodology, NOAA Fisheries will be contacted to discuss the proposed changes. Monitoring methods from the IHA Monitoring Plan will be followed.

13.1.1.1 Methods of Monitoring

- Hydroacoustic monitoring stations will be located at source and at appropriate distances away from the in-water construction activities to confirm monitoring zone Level A and B ZOI distances and sound transmission loss.
- All underwater sound monitoring systems will deploy hydrophones at mid-water depth (as determined by direct measurement or vessel-based depth finder).
- The hydrophone will be deployed so as to maximize its distance from flat surfaces or structures that may produce excessive reflections.
- During all vessel-based recordings, the vessel will be anchored and the engine off.
- GPS coordinates will be recorded for all acoustic monitoring locations.

- Sound level meter will be set to applicable source sound type, impulsive or non-impulsive, depending on pile driving or extraction method. Recordings will be made for the duration of each individual pile driving or extraction activity.
- Data will be reported on electronic tablet or hardcopy data sheets.
  - Field data collection will include, but not be limited to: date, AT initials, general weather information (wind, waves, temperature), boat/ship traffic in area, pile number, hydrophone location, hydrophone depth, water depth, start/end time of activity, type of activity, and field-collected acoustic metrics.
  - The monitoring coordinator will supply the AT with the start and stop times for the activity, hammer model and size, hammer energy settings, blow counts, and any changes to those settings during the piles being monitored.
- Conduct pile driving sound source verification for the following types and sizes of piles.
  - At least five piles each during impact installation of the following pile sizes and types: 24-inch concrete octagonal piles, 16-inch fiberglass piles.
  - At least five piles each during vibratory extraction of 20-inch concrete piles and 12-inch timber-plastic piles.
  - At least three piles each during water jetting assisted pile installation and pile extraction.
  - At least three piles each during pile clipping and pile cutting with a chainsaw, as applicable.
- For impact pile driving source level measurements, reports will include: pulse duration and mean, median, and maximum sound levels (dB re: 1 µPa); cumulative sound exposure level (SEL_{cum});peak sound pressure level (SPL_{peak}), and single-strike sound exposure level ($SEL_{s\text{-}s}$).
- For vibratory pile driving/removal, water jetting, clipping and chainsaw cutting, source level measurements, reports will include: mean, median, and maximum source levels (dB re: 1 µPa); root mean square sound pressure level (SPL_{rms}); and cumulative sound exposure level (SEL_{cum}).
- Number of strikes (impact) or duration (vibratory or other non-impulsive sources) per pile measures, one-third octave band spectrum and power spectral density plot.
- Empirically determine the Level B harassment distance by extrapolating from in-situ measurements of received SPLs at several points between 10 m and 500 m (33 ft and 1,640 ft) from the source. It is recommended that, at a minimum, measurements be taken at 10, 50, 250 and 500 m (33, 164, 820, and 1,640 ft) from the source, and that the best fit regression equation be used to estimate the Level B harassment distance. Alternatively, the Level B harassment distance can be determined by direct measurements to locate the distance where the received levels reach the ambient noise level (126 dB) (Dahl and Dall'Osto 2019).

13.1.2 Visual Marine Mammal Observations

The Navy will collect sightings data and behavioral responses to construction for marine mammal species observed in the region of activity during the period of construction. All observers will be trained in marine mammal identification and behaviors.

13.1.2.1 Methods of Monitoring

The Navy will monitor the Level A (shutdown) and Level B ZOIs before, during, and after pile driving or extraction activities. Based on NOAA Fisheries requirements, the Marine Mammal Monitoring Plan would include the following procedures:

- Monitoring will be conducted during daylight hours. If lighting conditions do not allow PSOs to observe the buffered Level A ZOI effectively, in-water construction or demolition activities will not be allowed to start (or continue) until conditions improve.
- For each type of construction with in-water activities (removal of existing piles, installation of new piles), PSOs will be placed at the best vantage point(s) practicable (e.g., from a small boat, construction barges, on shore).
- Up to four PSOs at up to three location (including two PSOs on a captained vessel) will conduct the marine protected species monitoring depending on the activity and size of monitoring zones. When there are two or more PSOs, all will be in radio communication with each other to enhance tracking of marine mammals that may be moving through the area and to minimize duplicate observation records of the same animal by different PSOs (i.e., a re-sighting);
- One land-/barge-based PSO ("Command" position) will be stationed with clear view of the buffered shutdown and physical interaction shutdown zone(s) and will be responsible for the collection of pile driving/extraction start and stop times, identification of all marine protected species in the vicinity of the pile being installed or removed, and notifying the contractor if construction or demolition must be delayed or stopped due to the presence of a marine protected species within the shutdown zones.
- For activities with monitoring zones beyond the visual range of the PSO/Command position, additional monitoring locations or the use of a vessel with captain and up to three other PSOs (depending on width of the monitoring zones) will conduct monitoring. During pre-activity monitoring, the vessel will start from south of the Project area (where potential marine mammal occurrence is lowest) and proceed to the north. Data will be collected on any marine protected species observed within the monitoring zones in accordance with monitoring and data collection procedures. When the vessel arrives near the northern boundary of the ZOI, it will set up station so the PSO(s) are best situated to detect any marine mammals that may approach from the north.
- Monitoring will be conducted before, during, and after pile driving/removal activities. Pile driving activities include the time to remove a single pile or series of piles, as long as the time elapsed between use of the pile driving equipment is no more than 30 minutes.
- During all observation periods, the PSOs will use binoculars and/or the naked eye to search continuously for marine protected;
- A 20-m (66-ft) buffered shutdown zone will be established around all in-water construction and demolition activities to avoid the potential for physical or Level A acoustic injury of marine protected species.
- If a marine protected species enters the buffered shutdown zone, all pile driving or removal activities at that location must be halted. The animal(s) must be allowed to remain in the shutdown zone (i.e., must leave of their own volition) and their behavior must be monitored and documented. Work will

be allowed to restart once the animal has been observed either leaving the shutdown area, or 15 minutes has elapsed since the last observation without re-detection of the animal.

- Results of all marine protected species observations during pre-activity, during activity, and post-activity monitoring will be recorded on electronic tablet or hardcopy datasheets.
- If an injured, sick, or dead marine mammal is observed, procedures outlined in Section 4.0 will be followed.

Pre-, during, and post-activity visual survey protocols are further described below.

- Pre-Activity Monitoring:
  - Visual surveys will occur for at least 30 minutes prior to the start of construction.
  - If a marine mammal is present within the 20-m (66-ft buffered shutdown zone), in-water activities will be delayed until either the animal has voluntarily left and been visually confirmed beyond the shutdown zone, or 15 minutes as elapsed since the last observation time without a re-detection of the animal.
  - The buffered shutdown zone may only be declared clear, and pile driving or demolition started, when the entire buffered shutdown zone is visible (i.e., when not obscured by poor light, rain, fog, etc.). If the buffered shutdown zone is obscured by fog or poor lighting conditions, activity at the location will not be initiated until the buffered shutdown zone is visible.
  - If marine mammals are present within the Level B Behavioral Harassment Monitoring Zone, in-water construction or demolition will not need to be delayed.
- During Activity Monitoring:
  - If a marine protected species approaches, or appears to be approaching, the 20-m (66-ft) buffered shutdown zone, the PSO who first observed the animal will alert the PSO/"Command," who will notify the construction crew of the animal's current status; in-water activities will be allowed to continue while the animal remains outside the buffered shutdown zone.
  - If the marine protected species enters the 20-m (66-ft) buffered shutdown zone, a shutdown will be called by the PSO/"Command." As the animal enters the shutdown zone, all pile operations will be stopped and the animal(s) will be continually tracked. Once a shutdown has been initiated, all in-water activities that generate potentially impactful noise will be delayed until the animal has voluntarily left the shutdown zone and has been visually confirmed beyond the shutdown zone, or 15 minutes have passed without re-detection of the animal (i.e., the zone is deemed clear of marine protected species). The PSO/"Command" will inform the construction contractor that activities can re-commence.
  - If shutdown and/or clearance procedures would result in an imminent concern for human safety, then the activity will be allowed to continue until the safety concern is addressed. During that timeframe the animal will be continuously monitored, and the Navy point of contact will be notified and consulted prior to re-initiation of project-related activities.
  - Shutdown shall occur if a species, for which authorization has not been granted, or for which the authorized numbers of takes have been met, approaches or is observed within the Level B ZOI. The monitoring coordinator or lead PSO shall notify the Navy point of contact, who will then contact NOAA Fisheries immediately. For non-IHA species, pile installation/removal will

be allowed to proceed if the animal(s) is observed to leave the Level B ZOI, or if one hour has lapsed since the last observation.

- The number, species, and locations of all marine mammals observed will be documented using an electronic tablet or hardcopy datasheets in compliance with NOAA Fisheries reporting requirements.
- If a marine mammal is observed entering the Level B monitoring zones, the pile segment being worked on will be completed without cessation, unless the animal enters or approaches the buffered shutdown zone. Regardless of location within the Level B monitoring zone, an initial behavior and the location of the animal(s) will be logged. Behaviors will be continually logged until the animal is either passed off to another PSO, the animal is no longer visible, or it has left the Level B monitoring zone.
- Due to the size of the larger Level B ZOIs, some animals may enter the ZOIs unseen by the PSOs. For these cases, the number of California sea lions observed during active pile driving or extraction by the PSOs inside of the Level B ZOI will also be counted as unobserved animals inside of the ZOI, effectively doubling take on any given day. These unobserved animals will be considered as “estimated” takes, as opposed to “observed” takes reported by the PSOs. For any regular or final reporting, the “estimated” and “observed” take will be added together to genera a total take for the reporting period.

- Post-Activity Monitoring:
  - Monitoring of all zones will continue for 30 minutes following completion of pile driving/extraction. These surveys will record all marine mammal observations following the same procedures as identified for the pre-construction monitoring time period, and will focus on observing and reporting unusual or abnormal behaviors.

- Concurrent Action
  - There is a possibility that an overlap of in-water construction or construction and demolition activities could occur. If construction and/or demolition activities were to occur simultaneously, then two PSO/“Command” positions would be in place. These positions would act independently and would have the ability to shutdown proximate construction or demolition if a marine protected species entered the buffered shutdown zone under their observation. Sightings of marine protected species at one location that are moving towards the other location will be communicated among the PSOs, to increase the awareness of an incoming potential sighting.
  - In the event that water jetting and pile driving or extraction occur at the same time or simultaneous use of multiple pile clippers, the action will be monitored as one sound source. The buffered shutdown or the Level B ZOI associated with the louder of the two actions or additive Level B ZOI will be monitored for species presence as appropriate.

13.1.2.2 Data Collection

NOAA Fisheries requires that at a minimum, the following information be collected by PSOs:

- Date and time that pile driving or removal begins or ends;
- Construction activities occurring during each observation period;
- Weather parameters (e.g., wind, temperature, percent cloud cover, and visibility);

- Tide stage and sea state (The Beaufort Sea State Scale will be used to determine sea-state);
- 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;
- Locations of all PSOs; and
- Other human activity in the area.

The required fields will be incorporated into an electronic tablet form or hardcopy datasheets that will be used by the PSOs (example provided in Appendix A). Data collection forms shall be submitted to the Navy point of contact for review within a mutually agreeable timeframe prior to the start of construction.

To the extent practicable, the PSOs will also record behavioral observations that may make it possible to determine if the same or different individuals are being “taken” as a result of Project activities over the course of a day.

In addition, the PSOs will document any occurrences of green sea turtles within the designated monitoring zones. Sighting information for green sea turtles will include all data that was collected for marine mammals (e.g., distance, bearing, and number of individuals). All measures identified in the applicable ESA consultation documents will be incorporated into monitoring protocols.

The PSOs will monitor the applicable ZOIs before, during, and after all pile driving and demolition activities, except for dead-pull pile removal, which will be monitored within the buffered shutdown zone only to avoid the potential for physical interaction with operating equipment.

13.2 Reporting

A draft report would be submitted to NOAA Fisheries within 90 calendar days of the completion of marine mammal and acoustic monitoring or 60 days prior to the issuance of any subsequent IHA for this project. A final report would be prepared and submitted to the NOAA Fisheries within 30 days following resolution of comments on the draft report from NOAA Fisheries.

The marine mammal report shall contain informational elements including, but not limited to:

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

- Description of any marine mammal behavior patterns during observation, including direction of travel and estimated speed time spent within the Level A and Leve B harassment zones while the source was active.
- Number of individuals of each species (differentiated by month as appropriate) detected within the monitoring zone, and estimates of number of marine mammals taken, by species (a correction factor may be applied to total take numbers, as appropriate).
- Detailed information about any implementation of any mitigation triggered (e.g., shutdowns and delays), a description of specific actions that ensued, and resulting behavior of the animal, if any.
- Description of attempts to distinguish between the number of individual animals taken and the number of incidences of take, such as ability to track groups or individuals.
- Submit all PSO datasheets and/or raw sighting data (in a separate file from the Final Report referenced immediately above).

The acoustic monitoring report must, at minimum, include the following:

- Hydrophone equipment and methods: recording device, sampling rate, distance (m) from the pile where recordings were made; depth of recording device(s).
- Type of pile being driven, substrate type, method of driving during recordings, and if a sound attenuation device was used.
- For impact pile driving and/or down the hole drilling: Pulse duration and mean, median, and maximum sound levels (dB re 1 µPa): cumulative sound exposure level (SEL_{cum}), peak sound pressure level (SPL_{peak}); and single strike sound exposure levels (SELs-s).
- For vibratory driving/removal: Mean, median, and maximum sound levels (dB re 1 µPa); RMS sound pressure levels (SPL_{RMS}); cumulative sound exposure level (SEL_{cum}).
- Number of strikes (impact) or duration (vibratory) per pile measures; one-third octave band spectrum and power spectral density plot.

14 RESEARCH

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

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

To manage some of the Navy's marine mammal research programmatic elements, OPNAV N45 developed in 2011 a new Living Marine Resources (LMR) Research and Development Program (http://www.lmr.navy.mil/). The goal of the LMR Research and Development Program is to identify and fill knowledge gaps and to demonstrate, validate, and integrate new processes and technologies to minimize potential effects to marine mammals and other marine resources. Key elements of the LMR program include:

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

Other National Department of Defense Funded Initiative - Strategic Environmental Research and Development Program (SERDP) and Environmental Security Technology Certification Program (ESTCP) are the Department of Defense's environmental research programs, harnessing the latest science and technology to improve environmental performance, reduce costs, and enhance and sustain mission capabilities. The Programs respond to environmental technology requirements that are common to all of the military Services, complementing the Services' research programs. SERDP and ESTCP promote partnerships and collaboration among academia, industry, the military Services, and other Federal agencies. They are independent programs managed from a joint office to coordinate the full spectrum of efforts, from basic and applied research to field demonstration and validation.

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Appendix A
Pier 6 PTS CALCULATIONS – NOAA Fisheries

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

VERSION 2.1: 2020

KEY

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

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	NBSD Pier 6 Replacement Project - Vibratory extraction of timber-plastic piles
PROJECT/SOURCE INFORMATION	Vibratory extraction of 12-inch timber-plastic piles assumed to occur 10 minutes at time for up to 8 piles per day or 80 minutes per day

Please include any assumptions

PROJECT CONTACT	Todd McConchie todd.c.mcconchie@navy.mil

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)	152
Number of piles within 24-h period	8
Duration to drive a single pile (minutes)	10
Duration of Sound Production within 24-h period (seconds)	4800
10 Log (duration of sound production)	36.81
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)	**2.1**	**0.2**	**3.1**	**1.3**	**0.1**

WEIGHTING FUNCTION CALCULATIONS

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

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

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

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

VERSION 2.1: 2020

KEY

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

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	NBSD Pier 6 Replacement Project - Vibratory extraction of concrete and steel piles
PROJECT/SOURCE INFORMATION	Vibratory extraction of 20-inch and 24-inch concrete piles and 16-inch I-shaped steel piles assumed tooccur 10 minutes at time for up to 8 piles per day or 80 minutes perday

Please include any assumptions

PROJECT CONTACT	Todd McConchie todd.c.mcconchie@navy.mil

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)	160
Number of piles within 24-h period	8
Duration to drive a single pile (minutes)	10
Duration of Sound Production within 24-h period (seconds)	4800
10 Log (duration of sound production)	36.81
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)	**7.1**	**0.6**	**10.5**	**4.3**	**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 2.1: 2020

KEY

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

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	NBSD Pier 6 Replacement Project - Water Jetting - Pile Installation & Extraction
PROJECT/SOURCE INFORMATION	Water jetting assumed to occur 20 minutes at a time for up to 8 piles per day or 160 minutes per day for removal of 24-inch pre-cast concrete or 20-inch square pre-stressed/pre-cast concrete piles
Please include any assumptions	
PROJECT CONTACT	Todd McConchie todd.c.mcconchie@navy.mil

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	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 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})	158
Duration of Sound Production (hours) within 24-h period	2.7
Duration of Sound Production (seconds)	9720
10 Log (duration of sound production)	39.88
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**	**0.1**	**1.2**	**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)†	**-0.05**	**-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 2.1: 2020

KEY

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

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	NBSD Pier 6 Replacement Project - Hydraulic Chainsaw
PROJECT/SOURCE INFORMATION	Underwater Chainsaw assumed to occur 10 minutes at time for up to 8 piles per day or 80 minutes per day for extraction of all pile types
Please include any assumptions	
PROJECT CONTACT	Todd McConchie todd.c.mcconchie@navy.mil

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	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 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})	150
Duration of Sound Production (hours) within 24-h period	1.33
Duration of Sound Production (seconds)	4788
10 Log (duration of sound production)	36.80
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)	**0.2**	**0.0**	**0.2**	**0.1**	**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)†	**-0.05**	**-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 2.1: 2020

KEY

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

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	NBSD Pier 6 Replacement Project - Small Hydraulic Pile Clipper
PROJECT/SOURCE INFORMATION	Small hydraulic pile clipper assumed to occur 10 minutes at a time for up to 8 piles per day or 80 minutes per day for removal of 12-inch composite (timber-plastic) piles
Please include any assumptions	
PROJECT CONTACT	Todd McConchie todd.c.mcconchie@navy.mil

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	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 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	1.33
Duration of Sound Production (seconds)	4788
10 Log (duration of sound production)	36.80
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)	**0.3**	**0.0**	**0.4**	**0.2**	**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)†	**-0.05**	**-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 2.1: 2020

KEY

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

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	NBSD Pier 6 Replacement Project - Large Hydraulic Pile Clipper
PROJECT/SOURCE INFORMATION	Large hydraulic pile clipper assumed to be used 10 minutes at a time for up to 8 piles per day or 80 minutes per day for removal of 24-inch square pre-cast concreteor 20-inch square pre-stressed/pre-cast concrete piles
Please include any assumptions	
PROJECT CONTACT	Todd McConchie todd.c.mcconchie@navy.mil

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	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 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})	161
Duration of Sound Production (hours) within 24-h period	1.33
Duration of Sound Production (seconds)	4788
10 Log (duration of sound production)	36.80
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**	**0.1**	**1.2**	**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)†	**-0.05**	**-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 2.1: 2020

KEY

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

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	NBSD Pier 6 Replacement Project - Large Hydraulic Pile Clipper
PROJECT/SOURCE INFORMATION	Two large hydraulic pile clippers assumed to be used 10 minutes at a time for up to 8 piles per day or 80 minutes per day for removal of 24-inch square pre-cast concreteor 20-inch square pre-stressed/pre-cast concrete piles
Please include any assumptions	
PROJECT CONTACT	Todd McConchie todd.c.mcconchie@navy.mil

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	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 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})	164
Duration of Sound Production (hours) within 24-h period	1.33
Duration of Sound Production (seconds)	4788
10 Log (duration of sound production)	36.80
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)	1.3	0.1	1.9	0.8	0.1

WEIGHTING FUNCTION CALCULATIONS

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

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

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

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

VERSION 2.1: 2020

KEY

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

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	NBSD Pier 6 Replacement Project - Concrete
PROJECT/SOURCE INFORMATION	Concrete pile driving assumed to require 600 strikes at 166 dB SEL and 7 piles i2-- or 24-inch nstalled per day.
Please include any assumptions	
PROJECT CONTACT	Todd McConchie todd.c.mcconchie@navy.mil

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)	**202.2**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	166
Number of strikes per pile	600
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

$L_{p,0-pk}$ specified at "x" meters (Cell G29)	188
Distance of $L_{p,0-pk}$ measurement (meters)	10
$L_{p,0-pk}$ Source level	203.0

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)	**191.2**	**6.8**	**227.8**	**102.3**	**7.5**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**NA**	**NA**	**1.2**	**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)	176
Number of piles per day	7
Strike (pulse) Duration^ (seconds)	0.01
Number of strikes per pile	600
Duration of Sound Production (seconds)	42
10 Log (duration of sound production)	16.23
Transmission loss coefficient	15
Distance of sound pressure level (L_{rms}) measurement (meters)	10

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

PK

$L_{p,0-pk}$ specified at "x" meters (Cell G47)	188
Distance of $L_{p,0-pk}$ measurement (meters)	10
$L_{p,0-pk}$ Source level	203.0

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)	**41.2**	**1.5**	**49.1**	**22.0**	**1.6**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**NA**	**NA**	**1.2**	**NA**	**NA**

"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 2.1: 2020

KEY

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

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	NBSD Pier 6 Replacement Project - Fiberglass
PROJECT/SOURCE INFORMATION	Concrete pile driving assumed to require 600 strikes at 144 dB SEL and 7 16-inch piles installed per day.
Please include any assumptions	
PROJECT CONTACT	Todd McConchie todd.c.mcconchie@navy.mil

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)	**180.2**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	144
Number of strikes per pile	600
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)	166
Distance of $L_{p,0\text{-}pk}$ measurement (meters)	10
$L_{p,0\text{-}pk}$ Source level	181.0

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)	**6.5**	**0.2**	**7.8**	**3.5**	**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)	153
Number of piles per day	7
Strike (pulse) Duration[^] (seconds)	0.01
Number of strikes per pile	600
Duration of Sound Production (seconds)	42
10 Log (duration of sound production)	16.23
Transmission loss coefficient	15
Distance of sound pressure level (L_{rms}) measurement (meters)	10

[^] 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)	166
Distance of $L_{p,0\text{-}pk}$ measurement (meters)	10
$L_{p,0\text{-}pk}$ Source level	181.0

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)	**1.2**	**0.0**	**1.4**	**0.6**	**0.0**
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.

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.

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