National Marine Fisheries Service
Office of Protected Resources

Marine Mammal
Incidental Harassment Authorization Application

Piers 39 to 43½ Sediment Remediation Project, Remedial Response Areas A and B
San Francisco, San Francisco County, California

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ACRONYMS AND ABBREVIATIONS

AMM	Avoidance and Minimization Measure
Applicant	Pacific Gas and Electric Company
CAS	California Academy of Sciences
d	day
dB	decibel
ESA	Federal Endangered Species Act
ft	feet
FS	Feasibility Study
h	hour
HF cetacean	high-frequency cetacean
Hz	hertz
IC	institutional control
IHA	Incidental Harassment Authorization
in	inch
I&R	Illingworth and Rodkin, Inc.
kHz	kilohertz
km	kilometer
LF cetacean	low-frequency cetacean
MF cetacean	mid-frequency cetacean
MHF	Material Handling Facility
mi	mile
min	minute
MMSZ	marine mammal shutdown zone
MMMP	Marine Mammal Monitoring Plan
MMO	Marine Mammal Observer
MMPA	Marine Mammal Protection Act
MZ	monitoring zone
NMFS	National Marine Fisheries Service

NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
OPR	Office of Protected Resources
OULs	Operational Use Limits
Peak	peak pressure
PG&E	Pacific Gas and Electric Company
Project	Piers 39 to 43½ Sediment Remediation Project
PTS	permanent threshold shift
re 1µPa	reference 1 micro-Pascal
RAL	Remedial Action Level
RAO	remedial action objective
RAP	Remedial Action Plan
RMS	root mean square
RWF	Red and White Fleet
sec	second
SEL	sound exposure level
SELcum	cumulative sound exposure level
SPL	sound pressure level
SWQMP	Surface Water Quality Monitoring Plan
TMMC	The Marine Mammal Center
TTS	temporary threshold shift
U.S.	United States
YBI	Yerba Buena Island

SUMMARY

Pacific Gas and Electric Company (PG&E) submits this request for an Incidental Harassment Authorization (IHA) for a portion (Remedial Response Areas A and B) of the Piers 39 to 43½ Sediment Remediation Project (the Project).

LOCATION

The sediment remediation area encompasses Pier 39, both the Pier 39 East and West Basins, defined by existing breakwaters, and the intertidal and subtidal areas between Pier 39 and Pier 45 along the margin of San Francisco Bay (Bay) located in San Francisco, California (Figure 1. Project Area Vicinity Map). The sediment remediation area is divided into the following five remedial response areas (Figure 2. Remedial Response Areas and Remediation Action):

- Remedial Response Area A – Pier 43½ offshore area and western limit of the remedial response areas to the east of Pier 45;
- Remedial Response Area B – Pier 43 offshore area which includes two subareas (B1 and B2);
- Remedial Response Area C – Pier 41½ offshore area (Area C2) and the area under Pier 41½ (Area C1);
- Remedial Response Area D – Pier 39 West Basin; and
- Remedial Response Area E – Pier 39 East Basin and eastern limit of the remedial response areas.

Remediation is proposed to occur in phases, over a 5- to 7-year period. Construction would proceed from west to east. If the planned start dates and sequencing are maintained, the recommended remedial alternative would be completed in 2029.

AUTHORIZATION REQUEST

The Applicant requests an IHA to allow for sediment remediation activities within Remedial Response Areas A and B. Some activities associated with sediment remediation have the potential to generate underwater sound that may result in Level B harassment of marine mammals present in the project area during project implementation. These hydroacoustic sources would include the following:

- Hydroacoustic Data Collection Test Piles: Impact hammer installation, and vibratory removal, of up to 10, 18-inch composite plastic piles to gather hydroacoustic data to inform future IHA requests for area E.

- Turbidity Curtain Pile Installations: Steel H-piles or steel shell piles, approximately 20, less than 24-inches in diameter, installed or removed using vibratory methods.
- Red and White Fleet (RWF) Temporary Relocation Piles: Relocation of the temporary berthing facility would require placement of approximately 16 coated steel pipe piles (8, 36-inch diameter guide piles and 8, 24-inch diameter fender piles) using primarily vibratory hammer installation method. Occasionally, an attenuated (bubble curtain) impact hammer may be required to install 24-inch fender piles.
- Sediment Pin Installation: Approximately, 120, 16-inch wood or composite tapered piles, primarily installed using vibratory hammer methods. Occasionally, an unattenuated impact hammer may be required to install sediment pins.

Construction is expected to commence in the second quarter of 2024. To allow sufficient time to coordinate resources and staff to meet the final conditions of the IHA, the Applicant is requesting the issuance of this IHA by February of 2024. It is expected that additional IHA requests will be required to complete sediment remediation within Remedial Response Areas C through E.

PROPOSED PROJECT

The purpose of the Project is to remediate (i.e., clean up) sediments impacted (i.e., contaminated) with polycyclic aromatic hydrocarbons (PAHs), likely attributable to the operations from the former Beach Street Manufactured Gas Plant (MGP), within the Project Area, to protect human health and the environment. The San Francisco Bay Regional Water Quality Control Board (Regional Water Board) Groundwater Protection & Waste Containment Division adopted a Water Code section 13304 cleanup and abatement order (CAO) to implement the approved remedy required to meet the following remedial action objective (RAO).

> Prevent toxicity to benthic invertebrates, birds, and humans who may be exposed to PAHs by consuming biota with PAH concentrations bioaccumulated in prey tissue via direct contact with sediments and associated pore water or through the aquatic food web.

The recommended remedy would include a combination of dredging and capping and/or armoring of the impacted sediments to minimize or reduce exposure to the impacted sediment and provide erosion protection measures to mitigate scour caused by ferry and boat traffic and other foreseeable hydrodynamic forces, coupled with monitoring and institutional controls (ICs). In addition, the project would require slope stabilization to ensure slope integrity during a seismic event. The Project presented within this application is consistent with the Feasibility Study/Remedial Action Plan (FS/RAP) expected to be approved by the Regional Water Board.

PROPOSED PROJECT ACTIVITIES

Project implementation within remedial actions Areas A and B will require removal of approximately 19,500 cubic yards of sediment and debris and the placement of approximately 12,500 cubic yards of fill (i.e., cap, armor, sediment pins, and erosion protection) (across 2.11 acres) near a known sea lion haulout (K-dock adjacent to Pier 39). Work will also require temporary relocation of the RWF berthing facilities.

Sound modeling was completed for the different source levels based on the NOAA Fisheries Technical Guidance and associated User Spreadsheet.[1] Required dredge and fill operations are not anticipated to create acoustic disturbances at a level that would result in harassment of marine mammals. However, other activities required for pile removal and installation could generate noise at sound levels sufficient to result in Level B harassment of marine mammals within the Project Area.

MARINE MAMMAL TAKE REQUESTED

The Applicant is requesting incidental take by Level B harassment of Pacific harbor seals (Phoca vitulina richardii), California sea lions (Zalophus californianus), and harbor porpoise (Phocoena phocoena) incidental to activities required for the remediation of PAH impacted sediment within Remedial Response Areas A and B throughout the Project Area. Incidental take by Level B harassment of northern elephant seals (Mirounga angustirostris), northern fur seals (Mirounga angustirostris), Steller sea lions (Eumetopias jubatus), and bottlenose dolphins (Tursiops truncatus) is also being requested in the rare event they are present within or adjacent to the Project Area. Based on acoustic assessments, sound generated during pile driving has the potential to result in take by Level B harassment of marine mammals. No Level A harassment, of any marine mammal, is anticipated.

[1] NOAA Fisheries, National Oceanic and Atmospheric Administration. 2018b. Revisions to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts.

1 DESCRIPTION OF SPECIFIED ACTIVITY

1.1 REQUEST SUMMARY

Pursuant to the Marine Mammal Protection Act (MMPA; 16 U.S.C. 1361 et seq.), PG&E (Applicant) requests an IHA from the National Oceanic and Atmospheric Administration's (NOAA), Office of Protected Resources (OPR) for the incidental harassment of marine mammals resulting from activities associated with sediment remediation.

1.2 PROJECT LOCATION

The Project Area consists of the Piers 39 to 45 offshore sediment remediation area (Figure 1. Project Area and Vicinity Map). The Project Area is located within the San Francisco North United States (U.S.) Geological Survey 7.5' topographic quadrangle (Section 28, Township 1 South, Range 5 West) (37.809666° N, 122.411817° W). The Port of San Francisco (the Port) owns and manages the waterfront.

1.3 PROJECT AREA

The sediment remediation area encompasses Pier 39, both the Pier 39 East Basin and West Basin, and the intertidal and subtidal area between Pier 39 and Pier 45 along the margin of the Bay in San Francisco, California. Representative site photographs have been included in Enclosure A. The sediment remediation area is divided into the following five remedial response areas (Figure 2. Remedial Response Areas and Remediation Action):

- Remedial Response Area A – Pier 43½ offshore area and western limit of the remedial response areas to the east of Pier 45;
- Remedial Response Area B – Pier 43 offshore area;
- Remedial Response Area C – Pier 41½ offshore area (Area C2) and the area under Pier 41½ (Area C1);
- Remedial Response Area D – Pier 39 West Basin; and
- Remedial Response Area E – Pier 39 East Basin and eastern limit of the remedial response areas.

Remediation is proposed to occur in phases, over a 5- to 7-year period. Construction would proceed from west to east, where most remedial response areas would be constructed in 1 year or less, except for Area E, which could take up to 2 years. Remedial Response Areas A and B would be completed within a single construction season, expected to commence in the second quarter of 2024. If the planned start dates and sequencing are maintained, the recommended remedial alternatives would be completed in 2029. It is expected that additional IHA requests will be required to complete sediment remediation within Remedial Response Areas C through E.

1.4 PROJECT PURPOSE

The purpose of the Project is to remediate (i.e., clean up) sediments impacted (i.e., contaminated) with polycyclic aromatic hydrocarbons (PAHs), likely attributable to the operations from the former Beach Street Manufactured Gas Plant (MGP), within the Project Area, to protect human health and the environment. The Regional Water Board, Groundwater Protection & Waste Containment Division will issue a cleanup and abatement order, in the first quarter of 2022, to establish the approved remedy required to meet the following remedial action objective (RAO).

> Prevent toxicity to benthic invertebrates, birds, and humans who may be exposed to PAHs by consuming biota with PAH concentrations bioaccumulated in prey tissue via direct contact with sediments and associated pore water or through the aquatic food web.

The recommended remedy would include a combination of dredging and capping and/or armoring of the impacted sediments to minimize or reduce exposure to the impacted sediment and provide erosion protection measures to mitigate scour caused by ferry and boat traffic and other foreseeable hydrodynamic forces, coupled with monitoring and institutional controls (ICs). In addition, the project would require slope stabilization to ensure slope integrity during a seismic event. Design has advanced, to the 90% level, within Remedial Response Areas A and B.

1.5 PROJECT COMPONENTS

1.5.1 Hydroacoustic Data Collection Test Piles

If deemed necessary, to gather hydroacoustic data, 18-inch composite plastic piles (up to 10) may be driven with an impact hammer within the project area. These Hydroacoustic Data Collection Test Piles would only be driven during the approved anadromous fish work window between June 1 to November 30.

1.5.2 Water Quality Containment

Increased turbidity may occur during dredging and capping activities. During active dredging and capping operations (limited to June 1 to November 30), a turbidity curtain would be deployed across the full depth of the water column extending to the sediment surface to minimize the potential for material loss outside the remedial response area. The turbidity curtain would be attached to temporary piles and additional temporary anchoring locations (such as an anchor barge), and would allow for shifting curtain configurations, if necessary, as work progresses through each remedial response area.

Within remedial response areas A and B turbidity curtains will be anchored to 20 temporary steel H-piles or to steel shell piles less than 24-inches in diameter installed using vibratory methods. Vibratory methods would be used to install turbidity curtain piles as installation can occur outside of the anadromous salmonid work window (June 1 to November 30).

1.5.3 Dredging

Impacted sediment would be removed to depths of up to approximately 8-feet below the anticipated future maintenance dredging elevation within the operational use limits (OULs) and up to 4 feet below the current sediment surface outside of OULs. A 6-inch overdredge allowance is assumed across the footprint of the proposed removal limit. The total removal/dredging volume is assumed to be approximately 105,00 cubic yards or less over approximately 10.8 acres over the course of the entire Project. Within remedial response areas A and B, the selected remedy would require removal of approximately 19,500 cubic yards of sediment and debris (across 2.11 acres).

Impacted sediment would generally be removed using mechanical dredges, operated from water-based equipment consisting of a barge-mounted crane or excavator, typically outfitted with an environmental clamshell bucket, modified excavation bucket, or conventional excavation bucket, based on material type being dredged.

1.5.4 Slope Stabilization

Based on pre-design investigations, field observations, and geotechnical evaluations completed in support of remedy design, slope stabilization may be necessary in certain areas of the Project. An analysis of the existing sediment characteristics and strength properties suggests that when modeled with design level seismic forces, select dredged and capped areas may be prone to either rotational or sliding failure. Sediment pinning would be used to promote slope stability pending further design evaluations.

Within Remedial Response Area A approximately 120 piles (referred to as sediment pins) would be required. Across all Remedial Response Areas, A to E, 1,600 sediment pins will be required (Figure 3. Slope Stability Pile Installation Areas Relative to Remedial and Restoration Areas). Sediment pins would be installed using vibratory methods but may require occasional use of an impact hammer to reach appropriate depth. Sediment pinning would include the installation of an array of approximately 16-inch-diameter tapered timber or composite piles/pins at approximately 6-foot centers across the face of select areas of the slopes to improve the connection between the various soil horizons and to tie the slope to deeper sediment units with improved strength. These permanent sediment pins would be installed vertically to a depth of approximately 25 feet below the dredge surface elevation, using primarily vibratory hammer methods, with impact (unattenuated, for composite or wood piles only) limited use, in a uniform array across the face of select dredge slopes. The sediment pins/piles would be driven such that the butt (or top) of the pile would stick up approximately 6 inches above the dredged surface before being covered with cap materials and armor stone, to better connect the sediment pins with the rest of the cap and provide global stability.

1.5.5 Capping

After debris removal and dredging is complete, impacted sediment to be left in place would be physically/chemically isolated through placement of an up to 8.5-foot-thick cap and/or armor layer (see below), where necessary, to protect against erosion (scour) caused by ferry and boat traffic and other foreseeable operational uses. The total cap/armor material volume, (across all remedial response areas) is assumed to be approximately 77,700 cubic yards. Within Remedial Response Areas A and B placement of approximately 12,600 cubic yards of cap/armor and placement of approximately 400 cubic yards of supplemental erosion protection (across 2.11 acres) would be required.

1.5.6 Armoring

Structural elements (such as riprap or engineered articulating tiles/mattresses) would be used, as necessary, to protect the constructed caps (conventional or reactive cap) throughout the Project Area from damage by erosion, scouring, heavy equipment, or other forces. As necessary, a granular filter layer would be installed between the capping and armoring layers to enhance cap stability and maintain isolation layer materials beneath the armor layer.

1.5.7 Supplemental Erosion Protection

An approximately 20-foot-wide strip of additional armoring would be placed over soft sediments between the capped/armored locations and the existing shoreline riprap revetment area to tie the capped/armored area into the subtidal revetment to protect this edge of the remedy from localized scouring. In addition, a photographic survey of the shoreline zone identified deficiencies in approximately 400 square feet of the riprap revetment (i.e., areas where riprap is missing). Within remedial response areas A and B approximately 0.13 acre of riprap revetment would be required. Suitably sized riprap would be placed over exposed sediment where there is a gap in the shoreline revetment. Upgrades of erosion protection around existing outfalls may also occur (e.g., stone spillways and aprons, head cut protection), as warranted.

1.5.8 Red and White Fleet Relocation

Relocation of the RWF would require removal of piles and overwater structures at the current location. Facilities would be reconstructed, in-kind attached to the east side of Pier 45, south of the USS Pampanito. Reconstruction of the temporary berthing facility would require placement of approximately 16 coated steel pipe piles, approximately 135 feet in length (8, 36-inch diameter guide piles and 8, 24-inch diameter fender piles). All piles will be installed primarily using vibratory methods. If an impact hammer is required to seat piles to the required tip elevation, work would be restricted to occur between June 1 and November 30, attenuation methods will be used, and impact hammering would be restricted to only piles less than 24 inches in diameter. The RWF relocation would include the moving approximately 2,000 square feet of decking and gangways. In addition, an additional 200 square feet of pile collars and fenders would be required. Upon completion of Remedial Response Areas A and B, the RWF would be returned to its current location, or in a new berthing area to be permitted and constructed by the RWF at a later date under a different project.

1.5.6 Pile Removal and Installation

Four Project components would require either the removal or installation of piles.

1. Hydroacoustic Data Collection Test Piles: Impact hammer installation, and vibratory removal, of up to 10, 18-inch composite plastic piles to gather hydroacoustic data to inform future IHA requests for area E.
2. Turbidity Curtain Structural Supports–Steel H-piles or 20, 24-inch diameter (or smaller) steel shell piles (Section 1.5.2. Water Quality Containment): Twenty temporary piles are expected to be driven at key locations, using vibratory methods, around each remedial response area to facilitate turbidity curtain configurations. The piles, along with temporary anchoring locations (such as an anchor barge), would allow for shifting curtain configurations as work progresses through each Remedial Response Area. These temporary piles would be removed upon completion of work. Piles used in this manner for the support of the turbidity curtains may be installed, removed, and temporarily stored for eventual reuse.
3. RWF Temporary Relocation Piles: Relocation of the temporary berthing facility would require placement of approximately 16 coated steel pipe piles (8, 36-inch diameter guide piles and 8, 24-inch diameter fender piles). RWF temporary relocation piles would be installed using vibratory methods; although an impact hammer may be required to seat, or finish, some piles. Use of the impact hammer would be restricted for use on piles less than 24-inches in diameter, and attenuation[2] methods will be employed to reduce the generated sound.

[2] Sound attenuation methods could include the use of a bubble curtain or other marine pile energy attenuator. See section 11.1 for bubble curtain performance standards.

4. Slope Stabilization–Sediment pins 14 to 16-inch tapered wood or composite (Section 1.5.5. Slope Stabilization): Where required for the purpose of establishing slope stability, approximately 120, 16-inch-diameter tapered piles (sediment pins), would be embedded below the dredged surface, to a depth of 25 feet, across the face of select areas of the slopes in all remedial response areas.

Proposed temporary piles include those required to install turbidity curtains and those required at the locations of the RWF relocation. Only sediment pins (installed below the Bay floor surface) would be permanently installed. Table 1 summarizes the estimated number of piles required, for turbidity curtains and slope stabilization, within Remedial Response Areas A and B. Seasonal species-protective work windows are addressed in Section 11. Minimization of Impacts from Pile Driving.

Based on site-specific assumptions and preliminary scoping by the construction estimator, it is anticipated that the installation of each pile will require 20 minutes of vibratory time and between 150 and 400 strikes for impact installation. Rationale for how estimated duration of time required for pile installation and the number of strikes required is included in the "Estimation of Underwater and Airborne Sound Levels for Marine Mammals- Piers 39 to 43 ½ Sediment Remediation Project, San Francisco, California" prepared by Illingworth and Rodkin, Inc. (I&R), dated May 11, 2021; revised November 15, 2023 (Enclosure B) (Hydroacoustic Assessment Report). Up to seven (7), 16-inch tapered timber sediment pins will be installed per day using vibratory or impact driving methods (depending on materials), with the installation. It is anticipated that four piles will be installed per day for all other pile types (turbidity curtain piles and RWF Relocation Piles).

For purposes of the marine mammal take estimate, the pile installation method (vibratory hammer) corresponding to the largest zone of effect for marine mammals is used (Section 6. Take Estimates for Marine Mammals). The sound generated during the removal and installation of piles via vibratory and impact hammering would be the primary potential source of incidental harassment of marine mammals.

Table 1. Piles to be Removed and Installed

Description	Number of Piles by Remedial Response Area A	B	Total
Hydroacoustic Data Collection Test Piles (temporary): 18-inch composite plastic piles	10	0	10
Turbidity Curtain Piles (temporary): Steel H-Pile or shell piles less than 24-inches in diameter	12	8	20
RWF Temporary Relocation Piles: 8 Fender- 24-inch diameter coated steel pipe piles 8 Guide- 36-inch diameter coated steel pipe piles	16	0	16
Sediment Pin Installation (permanent): 16-inch tapered timber or composite piles	120	0	120

1.6 PROJECT COMPONENTS WITH POTENTIAL TO RESULT IN MARINE MAMMAL HARASSMENT

Although avoidance and mitigation measures (AMMs) will reduce harassment of marine mammals (see Section 11. Mitigation Measures to Protect Marine Mammals and Their Habitat), certain project components could result in Level B harassment of marine mammals within, or adjacent to, the Project Area. Project components with the potential to generate acoustic disturbances include slope stabilization (Section 1.5.4), RWF relocation (Section 1.5.7), and pile removal and installation (Section 1.5.9). Acoustic effects associated with these activities are further assessed in the Hydroacoustic Assessment Report (Enclosure B).

1.7 PROJECT COMPONENTS WITH NO POTENTIAL TO RESULT IN MARINE MAMMAL HARASSMENT

All other project components would not generate noise, or have any other effect, at a level that would pursue, torment, or annoy marine mammals resulting in their potential injury or disturbance of normal behaviors. Underwater noise generated by dredging and capping activities originates primarily from the bucket, dredge equipment mechanisms, and sounds generated by the engine and propeller of the vessel. The noise associated with dredging activities for this Project is similar and within the range of other background noises in the Bay.

The active waterfront within the project limits supports extensive vessel traffic including the San Francisco Ferry (from Pier 41 with up to 16 trips a day), RWF (from Pier 43 ½ with up to 25 trips a day), and Blue and Gold fleet (from Piers 39 (West Basin) and Pier 41 with up to 21 trips a day). In addition, multiple other commercial industries operate vessels within the project limits.

Consistent with findings within the Biological Opinion issued for the Long-Term Management Strategy for the Placement of Dredged Material in the San Francisco Bay Region (LTMS), proposed dredging and capping would not generate noise that would rise to levels that would result in hearing loss, physical injury, or mortality of listed fish. Although the LTMS Biological Opinion focuses primarily on fishes, the sound produced by those same dredging and capping activities is also not expected to generate noise levels that would result in take through hearing loss, physical injury, or mortality, nor harassment of marine mammals, as the sound produced during dredging and capping activities are not expected to be higher than typical background noise within the project limits.

2 DATES, DURATION, AND SPECIFIED GEOGRAPHIC REGION

2.1 AUTHORIZATION DURATION

Remedial Response Areas A and B is expected to begin in the spring of 2024. To allow sufficient time to coordinate resources and staff to meet the final conditions of the IHA, the Applicant is requesting issuance of this IHA no later than February of 2024.

2.2 CONSTRUCTION DATES, DURATION, AND SCHEDULE

It is expected that construction will occur following the below outlined schedule.

Remedial Response Areas A and B

- Mobilization/Site Preparation/RWF Relocation: March to July (5 months)
- Sediment and Debris Removal: June to October (4 months)
- Backfilling/Capping/Armoring: July to November (4 months)

Turbidity curtain installation and RWF relocation is expected to occur in advance of sediment and debris removal as a part of mobilization and site preparation. Sediment pin installation (vibratory or impact hammer installed 16-inch tapered timber or composite piles) would occur after sediment and debris removal but prior to backfilling/capping/armoring. The number of days required to complete each of these activities has been included within Section 6. Take Estimates for Marine Mammals.

Work is assumed to take place Monday through Saturday (6 days per week). The hours would generally be 7 a.m. to 8 p.m. Some work could occur after hours and/or during nighttime, with the exception of pile installation or supplemental sediment investigations in which marine mammal monitoring and visualization of the zone of effect is required.

2.3 GEOGRAPHIC REGION AND MARINE MAMMAL OCCURRENCE

The Project Area is located between Piers 39 and 45 on the margins of the Bay near downtown San Francisco, California (Figure 1. Project Area Vicinity Map). The Project Area is situated approximately 3.7 mi (6.0 km) from the entrance to the Bay. Several marine mammals regularly or infrequently enter the Bay (depending on the species) and may occur in the vicinity of the work area. Distribution and abundance of marine mammals is discussed in detail in Sections 3 and 4.

California sea lions and Pacific harbor seals regularly frequent the Project Area. The well-known Pier 39 K-dock, a heavily used sea lion haulout, is adjacent to Area D of the Project Area (Figure 4. Marine Mammal Haulouts Near Project Area). Sea lion presence at the haulout fluctuates with the seasons; up to 1,700 sea lions may use the haulout during the peak fall season (August through October). There is one harbor seal haulout site approximately 3.1 mi (5.0 km) from the Project Area on Yerba Buena Island (YBI). This is the only harbor seal haulout within a 7.0-mi (11.3-km) radius.

3 SPECIES AND NUMBERS OF MARINE MAMMALS

3.1 SUMMARY OF MARINE MAMMALS WITH POTENTIAL TO OCCUR IN PROJECT AREA

Nine species of marine mammals have the potential to occur within or near the Project Area (Table 2), most commonly California sea lions (Zalophus californianus), Pacific harbor seals (Phoca vitulina richardii) and harbor porpoises (Phocoena phocoena). Less frequently, bottlenose dolphins (Tursiops truncatus) may be present in small numbers in the greater area of the Bay year-round. Northern elephant seals (Mirounga angustirostris), northern fur seals (Callorhinus ursinus), gray whales (Eschrichtius robustus), and humpback whales (Megaptera novaengliae) also enter the Bay seasonally, in low numbers. The Steller sea lion (Eumetopias jubatus) has been rarely documented at the Pier 39 K-Dock haulout. Only the humpback whale is listed as endangered under the Federal Endangered Species Act (ESA) and depleted under the MMPA. Given the rarity of occurrence and highly visible nature of whale species, work in the project area would be shut down if either a humpback or gray whale were to approach the project area's Level B harassment isopleth. Therefore, the Applicant is not requesting incidental take authorization of humpback or gray whales.

Quantitative information on the estimated densities of marine mammals in the vicinity of the Project Area was estimated from stranding and opportunistic sighting data reported by the public (NMFS 2021a, 2021b) and from marine mammal monitoring conducted in November of 2020. Stock status, local densities, and local distribution are presented in Section 4. Affected Species' Status and Distribution.

Table 2. Marine Mammals with Potential to Occur in the Bay

Species	Stock	Listing Status	Population Trend	Stock Abundance	Potential Biological Removal (PBR)[1]	Annual Human-caused Mortality and Serious Injury	Stock Status Factors (Unusual Mortality Events (UME)[2], spills, etc.)
Phocid							
Pacific Harbor Seal (Phoca vitulina)	CA	Not listed	Decreasing	30,968 (CV=0.157)	1,641	42.8	Fisheries, entrainment in power plants, other human-induced mortality
Northern Elephant Seal (Mirounga angustirostris)	CA Breeding	Not listed	Increasing	187,386	5,122	≥13.7 (n/a)	Shootings, entanglement in marine debris, fisheries
Otariid							
California Sea Lion (Zalophus californianus)	US	Not listed	Increasing	257,606	14,011	≥321	Domoic acid blooms, fisheries, shootings, entrainment in power plants, other human-induced mortality
Northern Fur Seal (Callorhinus ursinus)	CA; Ern N Pacific	Not listed	Increasing; Decreasing	14,050; 608,143	451; 11,067	1.8; 387	Fisheries, subsistence, entanglement in marine debris
Steller Sea Lion (Eumetopias jubatus)	Ern US	Not listed	Increasing	43,201	2,592	112	Fisheries, entanglement in marine debris

Species	Stock	Listing Status	Population Trend	Stock Abundance	Potential Biological Removal (PBR)[1]	Annual Human-caused Mortality and Serious Injury	Stock Status Factors (Unusual Mortality Events (UME)[2], spills, etc.)
Odontocete							
Bottlenose Dolphin (Tursiops truncatus)	Coastal CA	Not listed	Stable, possibly increasing	453 (CV=0.06)	2.7	≥2.0	Pollutants (especially DDT residues) and possibly morbillivirus
Harbor Porpoise (Phocoena phocoena)	SFB to RR	Not listed	Stable	7,777 (CV=0.62)	73	≥0.46	None, but sensitive to disturbance by anthropogenic sound sources
Mysticete							
Gray Whale (Eschrichtius robustus)	Ern N Pacific	Not listed	Stable	26,960 (CV=0.05)	801	131	Subsistence, fisheries, ship strikes
Humpback Whale (Megaptera novaengliae)	CA-OR-WA	Endangered (ESA); Depleted (MMPA)	Increasing in past years, but currently leveling off	4,973 (CV=0.054)	28.7	48.3	Fisheries, ship strikes, anthropogenic sound

Source: Sections 4.2–4.10.

[1] PBR is defined by the MMPA as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population.

[2] An UME is defined by the MMPA as a stranding event that is unexpected, involves a significant die-off of any marine mammal population, and demands immediate response.

4 AFFECTED SPECIES' STATUS AND DISTRIBUTION

4.1 SUMMARY OF AFFECTED SPECIES

The following marine mammals are found within the Bay: Pacific harbor seals, California sea lions, harbor porpoises, bottlenose dolphins, northern elephant seals, northern fur seals, Steller sea lions, gray whales, and humpback whales. Of these, only Pacific harbor seals, California sea lions, harbor porpoises and bottlenose dolphins are sighted year-round. The northern elephant seal, northern fur seal, Steller sea lion, gray whale, and humpback whale are seen occasionally or rarely in the Bay. The Applicant is not requesting take of humpback or gray whales: as previously described work will be shut down if this species were to approach the Level B isopleth of the project area.

Pacific harbor seals and California sea lions are known to be present in the Project Area in high numbers; there is a harbor seal haulout approximately 3.1 mi (5.0 km) away, and the well-known and highly used Pier 39 K-Dock sea lion haulout within remedial response area D, 150 meters from remedial response area B. Harbor porpoise and bottlenose dolphins, although low in number in the Bay, are primarily seen in the western Central Bay, in the vicinity of the Project Area. The remaining five species rarely enter the Bay; however, the Applicant is also evaluating their presence and potential to be taken by Level B harassment.

The following discussion outlines these species' distribution and current population status. A summary of biological characteristics of these marine mammals is summarized in Table 3.

4.2 PACIFIC HARBOR SEAL (CALIFORNIA STOCK)

Status: The Pacific harbor seal is protected under the MMPA but is not listed as a strategic or depleted species under the MMPA (Carretta et al. 2013), nor listed as endangered or threatened under the ESA. The California stock of harbor seals increased from 1972 through 2004 but declined from 2009 through 2012 (Carretta et al. 2015). The population of the California stock during the last count in 2012 was estimated at 30,968 seals (CV=0.157; Carretta et al. 2022).

Table 3. Biological Characteristics of Marine Mammals in the Bay

Species	Population in Bay	Distribution in Bay	Seasons Present in Bay	Pupping/ Calving Season	Dive Duration (Maximum)	Audiogram (Maximum Sensitivity)	Group or Pod Size in Bay	Haulout Sites (Distance to Project Site)
Pacific Harbor Seal	Up to 1,000	Throughout	Year-round	March–May (inside the Bay)	3–10 min (30 min)	1–180 kHz (0.5–40 kHz)	1	YBI (2.5 mi [4.0 km]), Alameda Breakwater (8.0 mi [12.9 km])
Northern Elephant Seal	Up to 100 (stranded juveniles)	Throughout	Spring to fall	December –March	10–15 min (45 min)	3.2–55 kHz (3.2–45 kHz)	1	Mostly stranded; rarely at the YBI and Treasure Island haulouts (2.5 mi [4.0 km])
California Sea Lion	Up to 2,000	Throughout	Year-round; more common in fall through winter	May–July (only outside the Bay)	<2.5 min (10 min)	0.1–43 kHz (15–30 kHz)	1	Pier 39 (0.0 mi [0.0 km])
Northern Fur Seal	Rare	Occasional stranding on YBI or Treasure Island	Fall to spring	May– October	3–7 min (10 min)	1–40 kHz (2–16 kHz)	1	Mostly stranded; rarely at the YBI and Treasure Island haulouts (2.5 mi [4.0 km)]
Steller Sea Lion, Eastern DPS	Rare	Rare in Northern Bay	Spring	May–July	20 min	1–25 kHz (1 kHz)	1	N/A; one male rarely seen at Pier 39 (0.0 mi [0.0 km])
Bottlenose Dolphin	1–5	Primarily western portion of Central Bay, and near former	Year-round; may be more common summer to fall	Spring; secondary peak in fall (only outside the Bay)	30 sec (15 min)	0.1–160 kHz (25–70 kHz)	1–5	N/A

Species	Population in Bay	Distribution in Bay	Seasons Present in Bay	Pupping/ Calving Season	Dive Duration (Maximum)	Audiogram (Maximum Sensitivity)	Group or Pod Size in Bay	Haulout Sites (Distance to Project Site)
		Alameda Air Station						
Harbor Porpoise	Up to 200	Primarily western Central Bay and Northern Bay	Year-round	Spring (inside and outside the Bay)	<1 min (5 min)	0.125–150 kHz (16–140 kHz)	1–6	N/A
Gray Whale	Rare	Rare to occasional in western Central Bay	March–May, during northward migration	Spring	15 min	20 Hz–21 kHz (20 Hz–1.2 kHz)	1	N/A
Humpback Whale	Rare	Rare to occasional in western Central Bay	Year-round	December –March	15 min	15 Hz – 3 kHz (1 kHz)	1	N/A

Source: Sections 4.2–4.10.

Distribution: Harbor seals are found from Baja California to the eastern Aleutian Islands of Alaska (Harvey and Goley 2011, Herder 1986). In California there are approximately 500 haulout sites along the mainland and on offshore islands, including intertidal sandbars, rocky shores, and beaches (Hanan 1996, Lowry et al. 2008). Harbor seals are the most common marine mammal species observed in the Bay. Within the Bay they primarily use haulouts on exposed rocky ledges and on sloughs in the southern Bay. Harbor seals are central-place foragers (Orians and Pearson 1979) and tend to exhibit strong site fidelity within season and across years, generally forage close to haulout sites, and repeatedly visit specific foraging areas (Grigg et al. 2012, Suryan and Harvey 1998, Thompson et al. 1998). Harbor seals in the Bay forage mainly within 7 mi (11.3 km) of their primary haulout site (Grigg et al. 2012), and often within just 1–3 mi (1–5 km; Torok 1994). Depth, bottom relief, and prey abundance also influence foraging location (Grigg et al. 2012). Most seals tagged in the Bay remain in the Bay (Grigg et al. 2012, Harvey and Goley 2011, Manugian 2013, 2016), although some animals may travel 186¬–311 mi (300–500 km) to find food or to breed (Harvey and Goley 2011, Herder 1986, Thompson et al. 1998, Torok 1994), and there is recent evidence that some tagged harbor seal pups travel as far as Oregon and Mexico (Greig et al. 2018).

The molt occurs from May through June. Peak numbers of harbor seals are found at haulouts sites in central California during late May to early June, which coincides with the peak molt. During both pupping and molting seasons, the number of seals and the length of time at the haulout increase, from an average of 7 hours per day to 10–12 hours during pupping and molting (Harvey and Goley 2011, Huber et al. 2001, Stewart and Yochem 1994).

Harbor seals tend to forage at night and return to the haulout during the day with a peak in the afternoon between 1 p.m. and 4 p.m. (Grigg et al. 2002, London et al. 2001, Stewart and Yochem 1994, Yochem et al. 1987). Tide levels affect the maximum number of seals at the haulout site, with the largest number of seals present at low tide, but time of day and season have the greatest influence on behavior (Manugian et al. 2017, Patterson and Acevedo-Gutiérrez 2008, Stewart and Yochem 1994).

Project Area: Harbor seals in the Bay typically haul out in groups ranging from a few individuals to over 300 during peak molt (National Park Service [NPS] unpublished data). The closest haulout to the Project Area is YBI, approximately 2.5 mi (4.0 km) to the east. The YBI haulout site has a daily range of zero to 188 harbor seals (Caltrans 2018c), with the largest numbers seen in the winter. More seals are present in the Bay during the winter months, attracted by spawning Pacific herring and migrating salmonids (Greig and Allen 2015). Harbor seals forage for Pacific herring in eelgrass beds in the winter (Schaeffer et al. 2007) but there are no eelgrass beds within 2.5 mi (4.0 km) of the Project Area. A second high use haulout site is located on the southwest side of Alameda Island near the Encinal Boat Ramp, but it is further than 3.1 mi from the Project Area, and therefore animals that use this haulout site are unlikely to enter the Project Area (see Diving and Foraging below).

Grigg et al. (2004) analyzed historical data from 1970 through 1997, and count data from 1998 through 2002 for harbor seals within the Bay. They concluded that the population had not rebounded significantly since implementation of the MMPA in 1972 but noted that it had increased slightly (Grigg et al. 2012). Manugian et al. (2016) examined aerial survey data from 2002 to 2012 and estimated 950 harbor seals in the Bay (95% CI=715–1,184), concluding that the local population was stable, although it has not rebounded as the California Stock has. The National Park Service (NPS) has conducted a yearly harbor seal survey since 2005 at the five primary haulout sites within the Bay: Alcatraz Island, Castro Rocks, YBI, Mowry Slough, and Newark Slough (Vanderhoof and Allen 2005). The 2018 maximum count in the Bay was the highest recorded: 527 adult and immature animals counted during the breeding season (NPS unpublished data); high counts were also recorded in 2010, 2014, and 2016 (Codde and Allen 2018). Although this is not a comprehensive count of seals in the Bay, the trend is supportive of a stable or increasing population.

Reproduction and Breeding: Pupping occurs from March through May in central California (Codde and Allen 2018). Pups are weaned in four weeks; most pups are weaned by mid-June (Codde and Allen 2018). Harbor seals molt from June through July (Codde and Allen 2018) and breed between late March and June (Greig and Allen 2015).

Diving and Foraging: As central-place foragers, harbor seals forage mainly within 0.6–3.1 mi (1–5 km) of their primary haulout site (Grigg et al. 2009, Grigg et al. 2012, Kopec and Harvey 1995, Torok 1994), and as such, rely heavily on local prey resources (Grigg et al. 2012). Harbor seals in the Bay are opportunistic predators (Middlemas et al. 2006, Thomas et al. 2011) with a large proportion of their foraging concentrated on benthic species (Grigg et al. 2012). Harbor seals generally are shallow divers, with about 90 percent of dives lasting less than 7 minutes (min; Eguchi and Harvey 2005, Gjertz et al. 1991), and a maximum recorded dive time of 32 min (Eguchi and Harvey 2005). Dive behavior is significantly influenced by haulout site, season, sex, and light (Wilson et al. 2014).

Acoustics: During the breeding season, adult males use underwater low-frequency vocalizations, primarily at night, to defend their “maritories” (underwater territories) and possibly to attract mates (Greig and Allen 2015, Matthews et al. 2017, Nikolich et al. 2018). Generally, they do not vocalize while traveling or foraging. Male harbor seals produce sounds in the frequency range of 100 to 1,000 Hertz (Hz; Richardson et al. 1995). Harbor seals hear frequencies from 1 to 180 kilohertz (kHz; Møhl 1968); however, the species’ hearing is most acute below 60 kHz, with peak underwater hearing at 0.5–40 kHz (Kastelein et al. 2010, Reichmuth et al. 2013).

4.3 NORTHERN ELEPHANT SEAL (CALIFORNIA BREEDING STOCK)

Status: The northern elephant seal (Mirounga angustirostris) is protected under the MMPA but is not listed as a strategic or depleted species under the MMPA (Carretta et al. 2015) or listed as endangered or threatened under the ESA. The population size of the California breeding stock is estimated at 187,386 seals and is increasing (Lowry et al. 2010, 2014; Carretta et al. 2022).

Distribution: Northern elephant seals are common on California coastal mainland and island sites, where the species pups, breeds, rests, and molts. The largest rookeries are on San Nicolas and San Miguel islands in the northern Channel Islands. Near the Bay, elephant seals breed, molt, and use the at Año Nuevo Island haulout site, the Farallon Islands, and Point Reyes National Seashore.

Northern elephant seals haul out to give birth and breed from December through March. Pups remain onshore or in adjacent shallow water through May. Both sexes make two foraging migrations each year: one after breeding and the second after molting (Stewart 1989; Stewart and DeLong 1995). Adult females migrate to the central North Pacific to forage, and males migrate to the Gulf of Alaska to forage (Robinson et al. 2012). Pup mortality is high when they make the first trip to sea in May, and this period correlates with the time of most strandings. Young-of-the-year pups return in the late summer and fall to haul out at breeding rookery and small haulout sites, but occasionally make brief stops in the Bay.

Project Area: Northern elephant seals do not have any established haulout sites in the Bay. Generally, only juvenile elephant seals enter the Bay seasonally and do not remain long if they are healthy. From mid-February to the end of June, The Marine Mammal Center (TMMC) reports the most strandings, primarily of malnourished juveniles (www.marinemammalcenter.org). Juvenile northern elephant seals occasionally forage in the Central Bay, and approximately 100 strandings are documented annually throughout the Bay (Caltrans 2018b).

Diving and Foraging: Northern elephant seals have the highest diving capacity of any pinniped. Elephant seal juveniles regularly dive for 10 to 15 min, with a maximum reported dive time of 45.5 min (Thorson and Le Boeuf 1994; Le Boeuf et al. 1996).

Acoustics: The audiogram of the northern elephant seal indicates that the highest sensitivity range is between 3.2 and 45 kHz, with greatest sensitivity at 6.4 kHz and an upper frequency cutoff of approximately 55 kHz (Kastak and Schusterman 1998).

4.4 CALIFORNIA SEA LION (UNITED STATES STOCK)

Status: The California sea lion is protected under the MMPA but is not listed as a strategic or depleted species under the MMPA (Carretta et al. 2012) or listed as endangered or threatened under the ESA. The United States stock increased from 1975 through 2008, with a current estimated population of 257,606 (Carretta et al. 2022). However, it has also been shown that population growth can be dramatically decreased by increasing sea surface temperature associated with El Niño events or similar regional ocean temperature anomalies (Laake et al. 2018, Melin et al. 2010).

Distribution: California sea lions are found from Vancouver Island, British Columbia, to the southern tip of Baja California. Sea lions breed on the offshore islands of southern and central

California from May through July (Heath and Perrin 2008). During the non-breeding season, adult and subadult males and juveniles migrate northward along the coast to central and northern California, Oregon, Washington, and Vancouver Island (Jefferson et al. 1993). They return south the following spring (Heath and Perrin 2008, Lowry and Forney 2005). Females and some juveniles tend to remain closer to rookeries (Antonelis et al. 1990, Melin et al. 2008).

Project Area: California sea lions have occupied K-Dock at Pier 39 in the Bay, adjacent to Area D of the Project Area, since 1987. The highest number recorded was 1,701 individuals in November 2009. Approximately 85 percent of the animals that use this haulout site are males, and no pupping has been observed here or at any other site in the Bay. Pier 39 is the only regularly used haulout site in the Project vicinity, but sea lions occasionally use human-made structures such as bridge piers, jetties, or navigation buoys (Riedman 1990) as a haulout location. Winter numbers of sea lions throughout the Bay are generally over 500 animals (Goals Project 2000).

Reproduction and Breeding: Pupping occurs primarily on the California Channel Islands from late May until the end of June (Peterson and Bartholomew 1967). Weaning and mating occur in late spring and summer during the peak upwelling period (Bograd et al. 2009). After the mating season, adult males migrate northward to feeding areas as far away as the Gulf of Alaska (Lowry et al. 1992), and they remain away until spring (March–May), when they migrate back to the breeding colonies. Adult females generally remain south of Monterey Bay, California throughout the year, feeding in coastal waters in the summer and offshore waters in the winter, alternating between foraging and nursing their pups on shore until the next pupping/breeding season (Melin and DeLong 2000; Melin et al. 2008).

Diving and Foraging: Adult lactating females have a range of mean dive durations from 1.6 to 8.1 min (Melin et al. 2008), with a maximum recorded dive of 9.9 min (Feldkamp et al. 1989). Most sea lions in the Bay are juveniles or subadult males and are similar in size to adult lactating female sea lions; therefore, these dive data should approximate the diving abilities of the Bay sea lions. Additional studies confirm that over all age and sex classes, dives are primarily less than 2.5 min (Kuhn and Costa 2014, McHuron et al. 2018, Weise et al. 2006).

Acoustics: California sea lions produce two types of underwater sounds: clicks (or short duration sound pulses) and barks (Schusterman 1969, Schusterman et al. 1966). Most of the energy of underwater sounds is below 4 kHz (Schusterman et al. 1967). Sea lions' full underwater hearing frequency range is approximately 100 Hz to 43 kHz, with peak sensitivities from 15 to 30 kHz, and relatively acute hearing sensitivity (62–86 dB re: 1 µPa; Reichmuth and Southall 2011, Reichmuth et al. 2013, Schusterman et al. 1972).

4.5 NORTHERN FUR SEAL (CALIFORNIA AND EASTERN NORTH PACIFIC STOCKS)

Status: Two northern fur seal (Callorhinus ursinus) stocks may occur near the Bay: the California and Eastern North Pacific stocks. The California northern fur seal stock is protected under the MMPA but is not listed as a strategic or depleted species under the MMPA (Carretta et al. 2012) or listed as endangered or threatened under the ESA. The California stock has an estimated population of 14,050 and is increasing (Orr et al. 2016).

The Eastern North Pacific Stock is protected under the MMPA and is listed as a strategic and depleted species (Carretta et al. 2012) but is not listed as endangered or threatened under the ESA. The Eastern North Pacific Stock has an estimated population of 608,143 and is currently in decline (Carretta et al. 2012, Muto et al. 2021).

Distribution: The California stock breeds and pups on the offshore islands of California, and forages off the California coast. The Eastern Pacific stock breeds and pups on islands in the North Pacific Ocean and Bering Sea, including the Aleutian Islands, Pribilof Islands, and Bogoslof Island, but females and juveniles move south to California waters to forage in the fall and winter months (Gelatt and Gentry 2018).

Project Area: Both the California and Eastern North Pacific stocks forage in the offshore waters of California, but usually only sick or emaciated juvenile fur seals seasonally enter the Bay in the fall and winter; fur seals occasionally strand on YBI and Treasure Island (NMFS 2019b), approximately 2.0 mi (3.2 km) from the Project Area.

Reproduction and Breeding: Breeding and pupping occur from mid- to late-May into July. Pups are weaned in September and move south to feed offshore of California (Gentry 1998).

Diving and Foraging: The average dive time of northern fur seals is 2.6 min, with a maximum between 5 and 7 min. The majority of dives are between 66 and 460 ft (20 and 140 meter; Kooyman et al. 1976; Gentry et al. 1986); the deepest recorded dive is 679 ft (207 meter).

Acoustics: Northern fur seals’ hearing range is 0.5 to 40 kHz (Moore and Schusterman 1987).

4.6 STELLER SEA LION (EASTERN U.S. STOCK)

Status: The Steller sea lion is protected under the MMPA but is not listed as a strategic or depleted species under the MMPA (Muto et al. 2020) or listed as endangered or threatened under the ESA. The eastern U.S. stock increased from 1971 through 2017 (Muto et al. 2020). The U.S. portion of the eastern stock is currently estimated at 43,201 (Muto et al. 2020).

Distribution: Steller sea lions are found along the North Pacific Rim from Japan to California. The eastern U.S. stock includes animals originating from rookeries east of Cape Suckling, Alaska, and ranges from approximately the Alaska-Canada border to California.

Project Area: Since 1993, a single adult male Steller sea lion has been observed using the Pier 39 K-Dock haulout intermittently during July and August, and occasionally in September (30 sightings in the last 10 years; NMFS 2006).

Reproduction and Breeding: Breeding and pupping occur from mid-May to mid-July. Females usually mate within two weeks of giving birth. Steller sea lions have a polygynous mating system in which only a small proportion of the males father most of the pups.

Diving and Foraging: Steller sea lions can dive to approximately 1,400 feet. They can remain submerged for up to 20 minutes.

Acoustics: Kastelein et al. (2005) measured the underwater maximum sensitivity hearing of a male Steller sea lion (77 dB re 1 µPa) at 1 kHz. The range of best hearing was from 1 to 16 kHz. Higher hearing thresholds were observed below 1 kHz and above 16 kHz.

4.7 COMMON BOTTLENOSE DOLPHIN (CALIFORNIA COASTAL STOCK)

Status: The common bottlenose dolphin is protected under the MMPA but is not listed as a strategic or depleted species under the MMPA (Carretta et al. 2015) or listed as endangered or threatened under the ESA. The population size for the California coastal stock is estimated at 453 animals based on 2009–2011 surveys (Weller et al. 2016). This stock of bottlenose dolphins remained stable between 1987 and 2005 (Dudzik et al. 2006).

Distribution: The California coastal stock of common bottlenose dolphin is found within 0.6 mi (1 km) of shore (Defran and Weller 1999) and occurs from northern Baja California, Mexico to Bodega Bay, CA. Their range has extended north over the last several decades with El Niño events and increased ocean temperatures (Hansen and Defran 1990). An offshore common bottlenose dolphin stock exists, but genetic studies have shown that no mixing occurs between the two stocks (Lowther-Thieleking et al. 2015).

Project Area: As the range of bottlenose dolphins extended north along the California coast, dolphins began entering the Bay in 2010 (Szczepaniak 2013). Bottlenose dolphins have regularly been observed in the western Central and South Bay, from the Golden Gate Bridge to Oyster Point and Redwood City, in the vicinity of the Project Area. Between one and five dolphins are thought to be year-round residents of the Bay.

Diving and Foraging: Navy bottlenose dolphins have been trained to reach maximum dive depths of about 984 ft (300 meters; Ridgway et al. 1969). Reeves et al. (2002) noted that the presence of deep-sea fish in the stomachs of some individual offshore bottlenose dolphins suggests that they dive to depths of more than 1,638 ft (500 meter). Dive durations up to 15 min have been recorded for trained individuals (Ridgway et al. 1969), but typical dives are shallower and of a much shorter duration (approximately 30 seconds [sec]; Bearzi et al. 1999, Mate et al. 1995). Bottlenose dolphins are opportunistic foragers: time of day, tidal state, and oceanographic habitat influence where they pursue prey (Hanson and Defran 1993).

Acoustics: The bottlenose dolphin has a functional high-frequency hearing limit of 160 kHz (Au 1993) and a low-frequency hearing limit near 40 to 125 Hz (Turl 1993). The audiogram of the Atlantic bottlenose dolphin shows that the lowest thresholds occurred near 50 kHz, at a level around 45 dB reference 1 micro-Pascal (re 1 µPa; Finneran and Houser 2006; Houser and Finneran 2007, Nachtigall et al. 2000). Atlantic bottlenose dolphins' range of best hearing sensitivity is between 25 and 70 kHz, with peaks in sensitivity at 25 and 50 kHz at levels of 47 and 46 dB re 1 µPa (Ljungblad et al. 1982, Nachtigall et al. 2000). Pacific bottlenose dolphins have significantly lower mean thresholds at 40 kHz and 60–115 kHz (10–20 dB) than Atlantic bottlenose dolphins, but their mean thresholds are similar for frequencies less than 30 kHz and greater than 130 kHz (Houser et al. 2008).

4.8 HARBOR PORPOISE (SAN FRANCISCO–RUSSIAN RIVER STOCK)

Status: The harbor porpoise is protected under the MMPA but is not listed as a strategic or depleted species under the MMPA (Carretta et al. 2013) or listed as endangered or threatened under the ESA. The population size for the San Francisco–Russian River stock is estimated at 7,777 porpoises (CV=0.574) and is stable (Forney et al. 2019, Caretta et al. 2022).

Distribution: Harbor porpoise occur along the US west coast from southern California to the Bering Sea (Allen and Angliss 2013, Barlow and Hanan 1995, Carretta et al. 2009, 2012). They are seldom found in waters warmer than 62.6 degrees Fahrenheit (17 degrees Celsius; Read 1990). The San Francisco–Russian River stock is found from Pescadero, 18 mi (30 km) south of the Bay, to 99 mi (160 km) north of the Bay at Point Arena (Carretta et al. 2012, Chivers et al. 2002). In most areas, harbor porpoise occur in small groups of just a few individuals.

Project Area: Harbor porpoise are seen frequently outside the Bay and re-entered the Bay beginning in 2008 (Stern et al. 2017). They are now commonly seen year-round within the Bay in groups of two to five individuals, primarily on the west and northwest side of the Central Bay near the Golden Gate Bridge, near Marin County, and near the city of San Francisco (Duffy 2015, Keener et al. 2012, Stern et al. 2017) in the vicinity of the Project Area. Over 100 porpoises have been seen at one time in the Bay, and over 600 individuals have been documented in a photo-ID database (GGCR 2010).

Diving and Foraging: Harbor porpoise are generally shallow, short-duration divers. A study in Japan found that 90 percent of dives were less than 32 ft (10 meter) deep, and 80 percent were less than one minute in duration (Otani et al. 1998). In Canadian waters, the maximum dive depth reported was 676 ft (206 meter) and maximum duration was 5.5 min (Westgate et al. 1995).

Harbor porpoise must forage nearly continuously to meet their high metabolic needs (Wisniewska et al. 2016). They consume up to 550 small fish (1.2–3.9 in [3–10 cm]; e.g., anchovies) per hour at a nearly 90 percent capture success rate (Wisniewska et al. 2016).

Acoustics: Harbor porpoise vocalizations include clicks and pulses (Ketten 1998), as well as whistle-like signals and echolocation clicks centered at 125 kHz (Kastelein et al. 2014, Verboom and Kastelein 1995). Their hearing ability extends from 0.125 to 150 kHz (Kastelein et al. 2015b). Their range of best hearing (defined as 10 dB within maximum sensitivity) is 16 to 140 kHz; sensitivity declines sharply above 125 kHz (Kastelein et al. 2002, 2017).

4.9 GRAY WHALE (EASTERN NORTH PACIFIC STOCK)

The gray whale (Eschrichtius robustus) is protected under the MMPA but is not listed as a strategic or depleted species under the MMPA (Carretta et al. 2015) or listed as endangered or threatened under the ESA. The population size of the eastern north Pacific stock is estimated at 26,960 (CV=0.05; Durban et al. 2017) and has been stable since the 1990s (Carretta et al. 2015). Gray whales breed during the winter along the west coast of Baja California and the southeastern Gulf of California (Braham 1984), and summer in the northern Bering Sea, the Chukchi Sea, and the western Beaufort Sea (Rice and Wolman 1971). They may enter the Bay in late winter/early spring or in the fall during their migrations (Rice and Wolman 1971). In recent years there have been an increased number of gray whales in the western and Central Bay, although their presence in the Bay remains rare (W. Keener, pers. comm. 2019). They may occasionally pass through the Project Area.

4.10 HUMPBACK WHALE (CALIFORNIA/OREGON/WASHINGTON STOCK)

The humpback whale is listed as a depleted and strategic stock under the MMPA (Carretta et al. 2018). Under the ESA, the California/Oregon/Washington stock in California and Oregon consists of humpback whales (Megaptera novaeangliae) from the endangered Central American DPS (distinct population segment) and threatened Mexican DPS (NOAA 2016).

The current best estimate for the California/Oregon/Washington stock is 4,973 whales (CV=0.05; Calambokidis et al. 2017). Humpbacks rarely enter the Bay but have occasionally been seen in the western Bay between April through November since 2016 (W. Keener, pers. comm. 2019). They may occasionally pass through the Project Area. The Applicant is not requesting take of humpback whales; work would be shut down if this species were to approach the Level B harassment isopleth.

5 TYPE OF INCIDENTAL TAKING AUTHORIZATION REQUESTED

5.1 SUMMARY OF TAKE REQUEST

Under the MMPA, "take" is defined as to "harass, hunt, capture, kill or collect, or attempt to harass, hunt, capture, kill or collect" marine mammals. Under the 1994 Amendment to the MMPA, harassment is statutorily defined as "any act of pursuit, torment, or annoyance which has the potential to injure or disturb a marine mammal or marine mammal stock in the wild." Harassment which has the potential to injure a marine mammal is further defined as Level A harassment. Harassment which has the potential to disturb a marine mammal by disrupting behavioral patterns including, but not limited to migration, breathing, nursing, breeding, feeding, or sheltering, but which does not have the potential to injure a marine mammal, is defined as Level B harassment.

Under section 101 (a)(5)(A) of the MMPA, the Applicant requests an authorization from NMFS for incidental take by Level B harassment (behavioral disturbance only) as defined in Title 50 CFR, Part 216.3 of small numbers of marine mammals. The Applicant is requesting Level B harassment of Pacific harbor seals, California sea lions, and harbor porpoise incidental to activities required for the remediation of PAH impacted sediment within remedial response areas A and B. Incidental take by Level B harassment of northern elephant seals, northern fur seals, Steller sea lions, and bottlenose dolphins is also being requested in the rare event they are present within or adjacent to the Project Area. Based on acoustic assessments, sound generated during pile driving have the potential to result in take by Level B harassment of marine mammals. All Level B "take by harassment" would occur as a result of elevated underwater noise disturbance and would not occur as a result of airborne noise as the K-dock haulout is located beyond the zone of elevated airborne noise as documented within the Hydroacoustic Assessment Report (Enclosure B).

5.2 PILE DRIVING FOR SEDIMENT REMEDIATION ACTIVITIES

Pile driving activities required for project implementation have the potential to result in Level B harassment of marine mammals. Vibratory pile driving produces non-impulsive (continuous) sounds that can cause behavioral disturbance to marine mammals and temporary threshold shift (TTS) in an animal's hearing. Both behavioral disturbance and TTS are categorized as Level B harassment. Permanent threshold shift (PTS) in an animal's hearing, or any physical injury (e.g., Level A harassment), is not anticipated to occur for any marine mammal as a result of pile driving associated with this project.

Impact pile driving produces impulsive sounds that can cause behavioral disturbance and TTS to marine mammals (Level B harassment) and, in some instances, slight injury (i.e., PTS) to an animal's hearing (Level A harassment). While Level A harassment could occur to marine mammals from impact pile driving, in general, it is not expected for this project given the small zones produced by the proposed impact pile driving, coupled with proposed monitoring and shutdown measures (see section 13) that would prevent animals from entering these small zones.

NMFS has established sound threshold criteria for behavioral disturbance (Level B harassment) and PTS (Level A harassment) to marine mammals from pile driving and other similar activities Table 4. The underwater sound pressure threshold for behavioral disturbance (Level B harassment) is 120 dB root-mean-square (RMS) for continuous sound (e.g., vibratory pile driving) and 160 dB RMS for impulsive sound (e.g., impact pile driving) for both cetaceans and pinnipeds (Table 4). The underwater sound pressure threshold for slight auditory injury, PTS (Level A harassment), is a dual metric criterion, including both a peak pressure (Peak) and cumulative sound exposure level (SELcum) threshold that is specific to the species hearing group (i.e., low-frequency cetaceans (LF), mid-frequency cetaceans (MF), high-frequency cetaceans (HF), phocids (PW), and otariids (OW). Underwater sound pressure thresholds for Level B and Level A harassment for each marine mammal hearing group from continuous and impulsive sounds are shown in Table 4.

Table 4. Underwater Sound Threshold Criteria for Pile Driving

	Continuous Sound (Vibratory Pile Driving)		Impulsivee Sound (Impact Pile Driving)		
				Level A Dual Criteria	
Species Hearing Group	Level B (dB RMS)	Level A (dB SELcum)	Level B (dB RMS)	(dB Peak SPL)	(dB SELcum)
Low-frequency Cetaceans (e.g., gray whales, humpback whales)	120	199	160	219	183
Mid-frequency Cetaceans (e.g., bottlenose dolphin)	120	198	160	230	185
High-frequency Cetaceans (e.g., harbor porpoise)	120	173	160	202	155
Phocids (e.g., harbor seal, northern elephant seal)	120	201	160	218	185
Otariids (e.g., California sea lion, northern fur seal)	120	219	160	232	203

Note: All decibels (dB) are referenced to 1 micro Pascal (re: 1 µPa).

Source: NMFS 2018

5.3 LEVELS AND TYPES OF MARINE MAMMAL TAKE

The following discussion provides additional information and background on the levels and types of marine mammal take for which NMFS has established threshold criteria.

5.3.1 Behavioral Responses

Generally, a louder sound results in a more intense behavioral response. Other factors, such as the proximity, type, and frequency of a sound source, and the animal's experience, motivation, and conditioning are also critical factors influencing the response (Southall et al. 2007). The distance from the sound source and whether it is perceived as approaching or moving away can also affect the type and intensity of the animal's response to a sound (Nowacek et al. 2007, Southall et al. 2007, Southall et al. 2019, Wartzok et al. 2003). Responses range from minor (e.g., changes in direction, swimming speed, dive profiles, vocalizations, and respiration rates) to strong (e.g., rapidly swimming away from the sound, or abandonment of the area). Behavioral responses to anthropogenic noise can potentially disrupt migrating, foraging, mating, and rearing of young (Thompson et al. 2013, Aarts 2017, Hastie et al. 2021).

Harbor porpoise (HF cetacean hearing group) exhibited changes in respiration and avoidance behavior when exposed to pile driving sounds between 90- and 140-dB Peak re 1 µPa (Kastelein et al. 2013). Pile driving for offshore wind farm installation displaced harbor porpoise up to 1.6 mi (2.5 km) from the source of impact driving that produced a sound exposure level (SEL) of 176 dB re 1µPa at 720 meter (Brandt et al. 2012). The duration of behavioral response decreased with distance from the source, and harbor porpoise returned to the area within 70 hours (Brandt et al. 2012).

Blackwell et al. (2004) observed that ringed seals (Phocid hearing group) exhibited little or no reaction to impact pile driving noise with mean underwater levels of 157 dB Peak re 1 µPa and suggested that the seals had habituated to the noise. Captive California sea lions (Otariid hearing group) avoided sounds from an impulsive source at levels of 165 to 170 dB RMS re 1 µPa (Finneran et al. 2003), and phocid seals showed avoidance reactions at or below 190 dB Peak re 1 µPa (Richardson et al. 1995).

Although pile driving has the potential to induce hearing loss or injury at very close range (Madsen et al. 2006), behavioral disruptions seem to be the primary reaction (Ellison et al. 2012). These behavioral responses can potentially disrupt foraging, mating, and rearing of young. Long-term impacts on population survival have not been positively identified (Thompson et al. 2013) but should not be overlooked (Bailey et al. 2014, Dahl et al. 2015).

5.3.2 Hearing Threshold Shift (TTS and PTS)

Temporary threshold shift (TTS) is an increase in the hearing threshold (i.e., a reduction in sensitivity) at a specific frequency after noise exposure that returns to normal over time. Permanent threshold shift (PTS) is also an elevation of hearing threshold at a specific frequency, but it involves irreversible tissue damage (Yost 2000). PTS has not been measured in marine mammals because of ethical concerns, but it is assumed that a noise exposure capable of inducing approximately 40 dB of TTS will cause an onset of PTS (Southall et al. 2007). This level is calculated to occur about 6 dB above the sound level that causes TTS (Southall et al. 2007).

The magnitude of TTS is dependent on sound exposure level (SEL; a measure of energy that takes into account both received level and duration of exposure): the higher the SEL, the higher the TTS induced (Kastelein et al. 2019). Recovery from TTS usually occurs within minutes to hours depending on the extent of the threshold shift and the duration of the exposure (Kastelein et al. 2018, Mooney et al. 2009).

TTS onset in harbor seals (Phocid hearing group) has been measured to occur around SELcum (a value equivalent to a single exposure for cumulative sound energy combining multiple pulses, e.g., impact hammer strikes) of 192 dB re 1 µPa2s, at 4 and 8 kHz, after 360 min of exposure to pile driving noise (Kastelein et al. 2018). Kastelein et al. (2013) induced severe 44 dB TTS in a harbor seal with 1 hour of exposure to very high sound pressure levels (SPLs; 22–30 dB above levels causing TTS onset) and concluded that the critical level at which PTS-onset would be induced in phocids was between 150 and 160 dB re 1µPa for a 60 min exposure to octave-band white noise (OBN) centered around 4 kHz.

Experiments exposing bottlenose dolphins (MF cetacean hearing group) to various frequencies and SPLs found that TTS onset and recovery are complex. TTS onset and growth in bottlenose dolphins is frequency-specific, with the maximum susceptibility between approximately 10 and 30 kHz (Finneran 2013, Nachtigall et al. 2004). Recovery to baseline hearing thresholds occurred faster after greater shifts, and recovery was longer after longer-duration exposures (Mooney et al. 2009).

A review of current harbor porpoise (HF cetacean hearing group) research found sound pressure thresholds 40–50 dB above their hearing thresholds induced avoidance reactions, and SELs about 100 dB above their hearing thresholds induced TTS (Tougaard et al. 2015). For pile driving in particular, when harbor porpoise were exposed to 60 min of playback of broadband pile driving sounds, they suffered TTS at 4 and 8 kHz, and recovered hearing within 48 min (Kastelein et al. 2015a). As with other marine mammals, response thresholds and TTS for harbor porpoise depend on the frequency (Tougaard et al. 2015) and SPL (Kastelein et al. 2014) of the stimulus.

5.3.3 Injury and Mortality

Injury from extreme impulsivee sounds (such as explosives), usually involves air-filled cavities such as the lungs, gastrointestinal tract, and nasal sinuses, as well as the auditory system (Craig and Hearn 1998, Goertner 1982, Yelverton et al. 1973). Damage to the tissues of the brain may also occur (Knudsen and Øen 2003). Injuries from impulsive sound to the respiratory system may consist of lung contusions, collapsed lungs, air in the chest cavity between the lungs, traumatic lung cysts, and/or interstitial or subcutaneous emphysema (Phillips and Richmond 1990). The reinforced trachea, flexible thoracic cavity, and ability to deflate and re-inflate the lungs during diving (Kooyman et al. 1970, Ridgway and Howard 1979) may decrease the risk of lung injury in marine mammals when exposed to loud sounds or pressures.

Rarely, impact pile driving of sufficient intensity (e.g., greater than 20 dB for harbor seals) has the potential to injure or kill marine mammals at very close range (within 50 meter; Thompson et al. 2013). But these injuries stemmed from pile driving associated with windfarm projects for large diameter piles. No mortality of marine mammals has been reported due to impact pile driving of the type and size of piles associated with this Project, or from any vibratory pile driving.

6 TAKE ESTIMATES FOR MARINE MAMMALS

6.1 METHOD OF TAKE ESTIMATES

The number of marine mammals that may be exposed to take, as defined in the MMPA, is determined by estimating abundance of marine mammal species in an area in which Level B harassment thresholds will be exceeded. For purposes of take estimate, the pile installation method (vibratory hammer) corresponding to the largest zone of effect for marine mammals is used. For example, the zone of take for a 24-inch steel shell pile is greater than for a steel H-pile. As such, the zone for a 24-inch steel shell pile is used as the basis for estimate of take. The sound generated during the removal and installation of piles via vibratory and impact hammering would be the primary potential source of incidental harassment of marine mammals.

Similarly, sediment pins (16-inch tapered wood or composite piles) take estimates based on vibratory installation which has the larger zone of effect. Use of impact hammer installation of steel piles (turbidity curtain piles and RWF relocation piles) is minimized (use of attenuation) and prohibited for steel piles larger than 24-inch diameter. Impact hammer use on steel piles larger than 24-inches in diameter would generate too large of a Level A take isopleth to confidently monitor for shutdown purposes. The distance to marine mammal threshold criteria corresponding to Level A and Level B harassment for sound generating activities for this Project have been modeled by the acoustic engineering firm Illingworth and Rodkin, Inc. (I&R), based on underwater and airborne sound and pressure measurements from similar construction activities within the Hydroacoustic Assessment Report (Enclosure B). For vibratory pile installation of 36-inch steel piles a transmission loss coefficient 18.7 was applied (Illingworth & Rodkin, Inc. 2018).

Take from Level B harassment associated with the project is expected to have no more than a behavioral effect on individual marine mammals and no effect on the populations of these species. Any effects experienced by an individual are anticipated to be limited to short-term disturbance of normal behavior or temporary displacement near the source of the noise. Monitoring conducted during all construction noise generating activities would ensure that marine mammals do not enter the Level A harassment zones. AMMs are discussed in Section 11. Mitigation Measures to Protect Marine Mammals and Their Habitat.

6.2 ESTIMATES OF OCCURRENCE OF MARINE MAMMALS IN THE PROJECT AREA

The age, sex, and reproductive condition of individuals of each species that may be taken is difficult to estimate given the lack of information on the class distribution within the Project Area and greater Bay. Several datasets were used to attain estimates of the abundance of marine mammals in the Bay which represent maximum potential of individual species to occur in the Project Area including:

- five years of sighting and stranding data from The Marine Mammal Center (TMMC),
- five years of sighting and stranding data from California Academy of Sciences (CAS),
- citizen-reported live sightings from iNaturalist.org (https://www.inaturalist.org/), and
- five days of sighting data within the Project Area in November of 2020.

Sightings of marine mammals found within the Bay between September 2016 and September 2021 were extracted from NMFS Level A data from TMMC and CAS (NMFS 2021a, NMFS 2021b) (available to the public upon request). All reports to TMMC and CAS of stranded animals (that were of confirmed species and associated with a confirmed location within the Bay) were included in this analysis regardless of whether they were living, dead (all stages of decomposition), floating, or stranded. TMMC and CAS often have duplicate sightings in their databases due to how information is received from the public. As TMMC receives the most reports from the public, their dataset was treated as the primary source. Duplicates were removed from the CAS dataset and CAS sightings are reported separately.

INaturalist.org, a crowdsourced species identification system, is a joint initiative of CAS and the National Geographic Society. For this analysis, only “Research Grade” observations of live marine mammals, reported between September 1, 2019 and September 30, 2021, were used. “Research Grade” observations require at least two positive identifications and GPS coordinates.

From 18 to 24 November 2020, two Marine Mammal Observers (MMOs) conducted over 43 hours of observations over five days within remedial response areas A, B, and C. MMOs were present to monitor while sediment investigations were conducted during the initial phase of Project operations (see Haase 2021). MMOs monitored a 400-meter shutdown (SD) zone, as well as the adjacent waters to the north of the Project Area. MMOs were located on opposite sides of the zone to ensure full coverage of the area; counts varied greatly between the monitoring locations due to the size of the area visible by each MMO and the use of the visible area by marine mammals. Given the proximity of the proposed work to the K-Dock haul out, observations made by the MMOs were likely of the same individuals observed multiple times throughout the day as they transitioned to and from the haul out. However, given the monitors could not identify individuals, each observation is treated as a single individual impact. As such, take estimates provided are conservative.

Data from all sources, when available, are presented below for each potential species in the Project Area. Additional data sources for counts of harbor seal and sea lion haulouts are also reported. Depending on the distribution of sightings and granularity of data, different sources have been used to estimate the number of individuals of each species within the Bay and therefore with the potential to occur the Project Isopleth. The Project isopleth is the extent of the project area that corresponds to the largest ensonified area, corresponding to the estimated Level B Harassment zones, based on distances established within the Hydroacoustic Assessment Report.

Although multiple IHA's have been issued within the San Francisco Bay Area, these take authorized are not analogous to the project presented herein due to proximity to the Pier 39 sea lion haulout. Therefore, estimates of take were made by conservatively interpreting the data sets referenced above in lieu of reliance on other IHAs issued within the Bay Area.

6.2.1 Pacific Harbor Seal Abundance Estimates

Harbor seals in the Bay forage mainly within 7.0 mi (11.3 km) of their primary haulout site (Grigg et al. 2012), and often within just 1–3 mi (1–5 km; Torok 1994). Only the haulout on YBI, which is located 3.1 mi (5.0 km) to the east is within 7.0 miles of the Project Area. The California Department of Transportation (Caltrans) has reported between zero and 188 harbor seals using the YBI haulout (Caltrans 2018a, Caltrans 2018c).

TMMC recorded 495 harbor seals in the Bay over the past five years (NMFS 2021a). CAS recorded an additional 34 for a total of 529 over five years (NMFS 2021b), yielding an average of 0.29 per day. INaturalist.org recorded 60 harbor seals in the Bay over the past two years, yielding an average of 0.082 per day.

Harbor seals were almost always present within the 400-meter SD zone during the five days of monitoring in 2020, to a maximum of 20 observations (Table 5; Haase 2021). Many of these observations were of the same animal(s) throughout the five-day period.

Table 5. Pacific Harbor Seal Observations during Supplemental Sediment Investigations, Remedial Response Areas A to C

	Pacific Harbor Seal Observations		
Date (2020)	MMO 1	MMO 2	Total per Day
Nov 18	2	6	8
Nov 19	1	5	6
Nov 20	12	8	20
Nov 23	5	7	12
Nov 24	3	11	14

As TMMC, CAS, and iNaturalist.org data represent a Bay-wide survey, and because TMMC and CAS data represent primarily dead animals, site specific data collected in 2020 was used to estimate daily individuals of Pacific harbor seals with potential to occur in the Project Area.

Based on this information, it is estimated that 20 harbor seals will occur within the Project area per day.

6.2.2 Northern Elephant Seal Abundance Estimates

TMMC recorded 903 elephant seals in the Bay over the past five years (NMFS 2021a). CAS recorded an additional 6 for a total of 909 over five years (NMFS 2021b), yielding an average of 0.50 per day. INaturalist.org recorded two elephant seals in the Bay over the past two years. No elephant seals were reported during the five days of observations within the Project Area in 2020.

To ensure sufficient authorization of take of northern elephant seals, it is assumed an abundance of 0.5 elephant seals will occur in the Bay and therefore Project isopleth per day (i.e., one elephant seal within the Project isopleth every two days as reported in Table 12. Total Level B Take Requested over 50 Total Days of All Project Activities).

6.2.3 California Sea Lion Abundance Estimates

The Pier 39 K-Dock California sea lion haulout supports up to 1,701 individuals, with the highest abundance occurring in August through October (The Sea Lion Center, pers. comm. 2021). Approximately 85 percent of the animals at this haulout are males. Pier 39 is the only regularly used haulout site in the Project vicinity, and is located adjacent to Area C. The Sea Lion Center at Pier 39 regularly counted the sea lions at K-Dock from 1991 through 2018; from 2016 through 2018, the yearly average ranged from 89 to 229 animals per day; the average per day over all three years was 191 (The Sea Lion Center, pers. comm. 2021). The maximum number of animals using the haulout each year was 707, 239, and 466 respectively; the average maximum per day was 324 (The Sea Lion Center, pers. comm. 2021). In addition, for 21 days between October 7, 2021 and November 3, 2021, the author counted the sea lions using the Pier 39 K-Dock haulout via the Pier 39 Sea Lion Webcam (https://www.pier39.com/sealions/). Between 77 and 195 animals were hauled out each day, with an average of 124 per day.

TMMC recorded 1,586 sea lions in the Bay over the past five years (NMFS 2021a). CAS recorded an additional 191 for a total of 1,777 over five years (NMFS 2021b), yielding an average of 0.97 per day. INaturalist.org recorded 57 sea lions in the Bay over the past two years, yielding an average of 0.078 per day.

Due to the proximity of the Pier 39 haulout, sea lions were almost always present in the 400-meter SD zone during the five days of monitoring in 2020 (Table 6; Haase 2021). There were approximately 50 sea lions, primarily adult and subadult males, at the Pier 39 colony in November 2020. There were up to two times this number of sightings per day (Table 6), indicating that animals were seen multiple times. As many as 11 sea lions were observed within the 400-meter SD zone at one time.

Table 6. California Sea Lion Observations during Supplemental Sediment Investigations, Remedial Response Areas A to C

	California Sea Lions		
Date (2020)	MMO 1	MMO 2	Total per Day
Nov 18	10	46	56
Nov 19	15	62	77
Nov 20	18	80	88
Nov 23	26	103	129
Nov 24	12	101	113

As TMMC, CAS, and iNaturalist.org data represent a Bay-wide survey, and because TMMC and CAS data represent primarily dead animals, site specific data collected in 2020 was used to estimate daily numbers of California sea lions in the Project Area. Both animals seen in the water and hauled out at Pier 39 K-Dock are represented.

Although there are times of the year when the K-dock is unoccupied or there are few individuals present, it is difficult to predict abundance based on time of year. As such, to be conservative, we relied on the high abundance number to ensure estimates are based on maximum animals expected to be present.

To ensure sufficient authorization of take of sea lions, we are assuming a local abundance estimate of 191 sea lions per day within the Project isopleth.

6.2.4 Northern Fur Seal Abundance Estimates

TMMC recorded 44 northern fur seals in the Bay over the past five years (NMFS 2021a). CAS recorded an additional 3 for a total of 50 over five years (NMFS 2021b), yielding an average of 10 per year or 0.03 per day. INaturalist.org recorded no northern fur seals in the Bay over the past two years. No northern fur seals were reported during the five days of observations at Pier 39 in 2020.

To ensure sufficient authorization of take of northern fur seals, we are assuming a frequency of ten northern fur seals in the Bay and the Project isopleth per year given the maximum potential siting in the bay, on average, over a five-year period is 10 individuals.

6.2.5 Steller Sea Lion Abundance Estimates

TMMC recorded 4 Steller sea lions in the Bay over the past five years (NMFS 2021a). CAS recorded no Steller sea lions over the past five years (NMFS 2021b). INaturalist.org recorded 4 Steller sea lions in the Bay over the past two years. No Steller sea lions were reported during the five days of observations at Pier 39 in 2020. The probability of Steller sea lion presence in the project area is incredibly low. A single Steller sea lion has only been observed on the haul-out once within recorded observations.

To ensure sufficient authorization of take of Steller sea lions, we are assuming a frequency of 0.1 Steller sea lion in the Bay and Project isopleth per day.

6.2.6 Common Bottlenose Dolphin Abundance Estimates

Historically, observations of bottlenose dolphins have occurred west of Treasure Island and were concentrated in the Project vicinity along the nearshore area of San Francisco south to Redwood City. Since 2016 one individual has been regularly seen near the former Alameda Air Station (W. Keener, pers. comm. 2017; Perlman 2017), and five animals were regularly seen in the summer and fall of 2018 in the same location (W. Keener, pers. comm. 2019). In February 2019, a single dolphin and adult and juvenile were seen on two separate occasions northwest of the Oakland Inner Harbor (W. Keener, pers. comm. 2019), 4.0 mi (6.3 km) from the Project Area.

Data for bottlenose dolphins were unavailable from TMMC. CAS recorded no bottlenose dolphins over the past five years (NMFS 2021b). INaturalist.org recorded no bottlenose dolphins in the Bay over the past two years. No bottlenose dolphins were reported during the five days of observations at Pier 39 in 2020. Therefore, despite the few sightings between 2016-2019, groups of bottlenose dolphins are rarely seen in the Bay.

However, to ensure sufficient authorization of take of bottlenose dolphins, we are assuming a frequency of 0.5 bottlenose dolphins in the Project isopleth per day.

6.2.7 Harbor Porpoise Abundance Estimates

Harbor porpoise are primarily seen near the Golden Gate Bridge, Marin County, and the city of San Francisco on the northwest side of the Bay (Keener et al. 2012, Stern et al. 2017), in the vicinity of the Project Area.

Data for harbor porpoise were unavailable from TMMC. CAS recorded 29 harbor porpoise (only two of which were alive) over the past five years (NMFS 2021b). INaturalist.org recorded 11 harbor porpoise in the Bay over the past two years. An individual harbor porpoise was seen on the outskirts of the 400-meter SD zone on two different days in 2020, and a group of two individuals was reported on one day during the five days of monitoring (Table 7; Haase 2021).

Table 7. Harbor Porpoise Observations during Supplemental Sediment Investigations, Remedial Response Areas A to C

	Harbor Porpoise		
Date (2020)	MMO 1	MMO 2	Total per Day
Nov 18	0	1	1
Nov 19	0	0	0
Nov 20	0	1	1
Nov 23	0	0	0
Nov 24	0	2	2

To ensure sufficient authorization of take of harbor porpoise, it is estimated that two harbor porpoises will occur within the Project isopleth per day.

6.2.8 Gray Whale Abundance Estimates

Gray whales may enter the Bay in late winter/early spring or in the fall during their migrations (Rice and Wolman 1971). In recent years there have been an increased number of gray whales in the western and Central Bay (W. Keener, pers. comm. 2019). They may occasionally pass through the Project Area. As project activities will be shutdown if a gray whale approaches the Level B harassment zone, no take of a gray whales is required.

6.2.9 Distances to Marine Mammal Criteria for Project Activities

As discussed in Section 5. Type of Incidental Taking Authorization Requested, NMFS has established sound threshold criteria for behavioral disturbance (Level B harassment) and PTS (Level A harassment) to marine mammals from pile driving and other similar activities (Table 4). The Applicant is proposing:

- Hydroacoustic Data Collection Test Piles: 18-inch composite piles driven with impact hammers and removed for the purpose of collecting hydroacoustic information to inform future IHA applications.
- Turbidity Curtin Pile Installations: Vibratory driving and removal of steel piles (H-pile or shell piles less than 24-inches in diameter).
- RWF Temporary Relocation Piles: Relocation of the temporary berthing facility would require placement of approximately coated steel pipe piles (36-inch diameter guide piles and 24-inch diameter fender piles.
- Sediment Pin Installation: Vibratory (wood or composite,) with limited impact driving of 16-in tapered piles.

The distances to the marine mammal threshold criteria for vibratory and impact driving were modeled by the acoustic engineering firm I&R based on measurements for similar activities. Measured sound pressure levels (SPLs) for the type and size of piles proposed for this project were taken from other projects compiled in the Caltrans Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish (2020), which provides information on sound pressures resulting from pile driving measured throughout northern California. Distances to marine mammal threshold criteria were modeled for all pile types and installation methods required to complete remediation of all remedial response areas A to E. These distances were calculated by I&R using the NMFS' User Spreadsheet Tool Version 2.0 associated with the 2020 revision of the Marine Mammal Hearing Technical Guidance (NMFS 2020; spreadsheet available at http://www.nmfs.noaa.gov/pr/acoustics/guidelines.htm). A practical spreading model was used to calculate transmission loss.

The following inputs were used for all vibratory calculations.

- Spreadsheet tab A.1: "Vibratory Pile Driving (STATIONARY SOURCE: Non-impulsive, Continuous)"
- Weighting factor adjustment = 2.5 kHz,
- Duration to drive a single pile = 10 to 20 min (Table 8)
- Propagation (xLogR) = 15 x Log(R_1/R_2)
- Distance of source level = 10 meter

Four hundred strikes per pile was used to model impact driving, based on input from the Project contractor. The following inputs were used for all impact calculations.

- Spreadsheet tab E.1: "Impact Pile Driving (STATIONARY SOURCE: Impulsive, Intermittent)"
- Input method E.1–2: ALTERNATIVE METHOD TO CALCULATE PK AND SELcum (SINGLE STRIKE EQUIVALENT)
- Weighting factor adjustment = 2.0 kHz,
- Number of strikes per pile = 400,
- Propagation (xLogR) = 15 x Log (R_1/R_2
- Distance of single strike SEL measurement = 10 meter

Unique inputs for the User Spreadsheet and screenshots of User Spreadsheets used to calculate vibratory and impact Level A harassment isopleths are provided within the Hydroacoustic Assessment Report, Enclosure B (see Table 8 and Appendix).

Table 8. NMFS' User Spreadsheet Source Level Inputs

Vibratory Pile Driving					
	Duration (minutes)	Piles per Day	Peak1	RMS1	One-second SEL1
Turbidity Curtain Installation or Removal					
Steel H-Pile	10	4	--	143	143
24-inch diameter steel shell pile	20	4	--	153	153
RWF Temporary Relocation Piles					
24-inch diameter steel shell pile	20	4	--	153	153
36-inch diameter steel shell pile	20	4	--	168	168
Sediment Pin Installation					
Timber pile	20	20	---	158	158
Composite/Plastic	20	10	---	152	152
Hydroacoustic Data Collection Test Piles					
Timber pile (removal)	20	20	---	158	158

Impact Pile Driving					
	Duration (Strikes)	Piles per Day	Peak1	RMS1	One-second SEL1
Hydroacoustic Data Collection Test Piles					
18-inch Composite/Plastic	400	10	185	160	150
RWF Temporary Relocation Piles					
24-inch diameter steel shell pile	400	4	208	193	178
Sediment Pin Installation					
Timber pile	400	20	184	157	145
Composite/Plastic	400	10	177	153	145

[1] All sound values are expressed in dB re 1 µPa at 10 meters from the sound source. See Appendix B of I&R's report for documentation of source levels (Enclosure B; Table 6).

For calculation of SELcum threshold distances, the following assumptions were made:

- Only one type/size of pile will be installed on the same day.
- Up to approximately seven timber piles will be installed per day (impact or vibratory).

- A maximum of four turbidity curtain piles will be installed (vibratory hammer only) if outside June 1 to November 30 which corresponds to the ESA-listed fish work window on the same day.

The distances to the Level A and Level B marine mammal threshold criteria for these project activities are shown in Table 9.

Table 9. Distances to Level A and Level B Harassment Threshold Criteria for Pile Installation/Removal

Pile Type & Method	# Piles Per day	Level A/PTS isopleth (m) Hearing Groups					Level B Isopleth (m)	Ensonified area (km^2)
		Cetaceans			Pinnipeds			
		LF	MF	HF	Phocids	Otariids		
Hydroacoustic Data Collection Piles								
18-inch composite (Impact)[2]	10	16	<1	19	9	<1	10	0.0002
18-inch Composite (Vibratory)[1]	10	4	<1	6	2	<1	1,360	3.58
Turbidity Curtain								
Steel H-Pile (Vibratory)[1]	4	<1	0	<1	<1	<1	341	0.29
Steel Shell Pile ≤ 24 inches (Vibratory)[1]	4	2	<1	4	2	<1	1,585	4.61
RWF Temporary Relocation Piles								
24-inch Steel Shell Pile (Vibratory)[1]	4	2	<1	4	2	<1	1,585	4.54
24-inch Steel Shell Pile (Impact, Attenuated)[2]	4	294	11	351	158	12	736	1.06
36-inch Steel Shell Pile (Vibratory)[1,3]	4	20	3	28	14	2	3,688	23.46
Sediment Pins								
14 to 16-inch Timber Pile (Vibratory)	20	16	2	23	10	1	3,415	19.17
12 to 18-inch Timber Pile (Impact)[2]	20	12	<1	14	6	<1	<10	0.002
14 to 16-inch Composite Pile (Vibratory)[1]	10	4	<1	6	3	<1	1,360	3.20
14 to 16-Inch Composite Pile (Impact)[2]	10	7	<1	9	4	<1	<10	0.0007

1. Data from Table 7 from the Hydroacoustic Assessment (Enclosure B).
2. Data from Table 8 from the Hydroacoustic Assessment (Enclosure B).
3. A Transmission loss of 18.7 was used (Enclosure B, Appendix A).

The calculations of Level A/PTS threshold distances (isopleths) for impulsive sounds are based on a dual metric threshold between the higher level of the SELcum or Peak SPL calculations. Since the onset of PTS based on the distance to the SELcum threshold is further from the pile for all pile types than for the Peak SPL calculations (see Appendix A of Enclosure B), only Level A/PTS isopleths based on SELcum computations are included in this analysis.

The docks, piers, and breakwaters surrounding the Project Area are not built on solid foundations, therefore we assume sound can pass through the water uninterrupted. The distance to the 120 dB RMS Level B threshold for vibratory pile driving was calculated to be 341 meters for turbidity curtain piles (steel H-piles) or 1,585 meters for turbidity curtain piles (24-inch diameter steel shell piles), 1,585 meters for RWF temporary relocation piles (24-inch steel shell piles), 3,688 meters (36-inch steel shell piles), and 3,415 meters for timber sediment pins (14 to 16-inch tapered piles). The distance to 160 dB RMS Level B threshold for impact driving was calculated to be less than 10 meters for hydroacoustic data collection test piles and <10 meters for timber sediment pins (14 to 16-inch tapered piles), and 736 meters for RWF (attenuated 24-inch steel shell piles).

The Project Area is very active with tourism, boater traffic (excursion and ferry vessels), and infrastructure (Piers, breakwaters, and docks) that can obstruct visibility. In addition, this location is frequently windy further reducing the MMO ability to observe the extent of the project isopleth. As it is not practical to monitor the full zones for a project of this extended length, MMOs would be positioned such that at least 20 percent of the Level B zone is observed when monitoring is required. Efforts should be made to observe the maximum extent of the monitoring zone possible. Estimates of take will be extrapolated proportional to the full Level B zone (Section 11. Mitigation Measures to Protect Marine Mammals and Their Habitat). MMOs will fully monitor the area surrounding the Level A zone to ensure shutdown if a marine mammal were to enter these very small zones.

6.3 NUMBER OF MARINE MAMMALS, BY SPECIES, THAT MAY BE TAKEN BY PILE DRIVING AND PILE REMOVAL ACTIVITIES

During the supplemental sediment investigations conducted in remedial response areas A to C in 2020, California sea lions and Pacific harbor seals were almost always present (Section 4. Affected Species Status and Distribution). As work was conducted without an IHA, no take was allowed. Consequently, there was a total of 19 mitigation measures (shutdowns and delays) implemented over the five days of the Project to safeguard marine mammals from Project work (Haase 2021). To ensure authorization of sufficient take, without prescription of significant delays, daily estimates of the number of individual species to occur within the Project isopleth (Section 6.2 Estimates of Occurrences of Marine Mammals in the Project Area) have been assumed using the best available data.

Take that may occurring during pile installation or removal was estimated using the abundance of animals within the Project Area multiplied by the number of days of vibratory pile installation. The number of days of work was estimated based on the Project construction assumptions plus a 10% buffer (Table 10 through Table 12).

The total take predicted is the sum of estimated take for vibratory driving. To estimate maximum potential take, it was assumed that impact hammering would not be used for the majority of all work would occur using vibratory installation methods. A transmission loss of 18.7 (see Enclosure B, page 21) for the vibratory installation of 36-inch steel shell piles (Illingworth & Rodkin, Inc. 2018.) Take estimates assume that Project pile installation activities will occur on a maximum total of 50 days. Inputs used to calculate take estimates, and requested take numbers, are shown in Table 10 through Table 14. Take by Level A harassment is not requested, as use of monitored shutdown zones within the small Level A sound isopleths would prevent marine mammals from entering these shutdown zones and avoid this type of take.

Table 10. Estimated Number of Days of Pile Driving and Removal in Remedial Response Areas A & B

Type of Pile	Total Number of Pile Installation and/or Removals	Number of Piles Installed/Removed per Day	Days of Vibratory Driving or Removal
Remedial Response Area A			
Turbidity Curtain	24 (12 installation and 12 removal)	4	6
RWF Temporary Relocation	32 (16 installation and 16 removal)	4	8
Sediment Pin Installation	120 (installation only)	7	17*
Hydroacoustic Data Collection Test Piles	20 (10 installation and 10 removal)	2	10
Remedial Response Area B			
Turbidity Curtain	16 (8 installation and 8 removal)	4	4
Total	180		45
Total (+10% buffer)			50*

* Rounded to the maximum number of full days.

Work proposed to occur during the 2024 construction season.

Table 11. Requested Level B Take for Remedial Response Areas A & B

Species	Estimated Abundance in Project Area per Day	Estimated Level B Take (50 Days of Pile Driving * Animal Abundance)	Requested Level B Take Remedial Response Areas A & B (rounded up to whole number/animal)
Pacific Harbor Seal	20	1,000	1,000
Northern Elephant Seal	0.5	25	25
California Sea Lion[1]	191	9,550	9,550
Northern Fur Seal	0.027[2]	5	5
Steller Sea Lion	0.1	5	5
Bottlenose Dolphin	0.5	25	25
Harbor Porpoise	2	100	100

1. Assumes multiple repeated takes of some individuals from a small portion of the stock.

2. Equivalent to 10 per year

The total take from Level B harassment of California sea lions requested, for described project activities, is 9,550 individuals (Table 11). Most take would be repeated takes of the same individuals at the Pier 39 K-Dock haulout.

All Level A shutdown zones are less than 10 meters for vibratory and less than 351 meters for attenuated impact hammer driving (i.e., seating) of the 24-inch diameter steel shell RWF relocation piles (Enclosure B). This represents the maximum distance based upon the isopleth corresponding to the HF cetacean thresholds during the final seating of the piles, if necessary. The vast majority of pile installation will occur with the use of a vibratory hammer. As such, most of the monitored zones for shutdown are expected to be less than 15 meters from the sound source.

In the final report to NOAA OPR, estimates of animals observed within the Project isopleth will be extrapolated proportional to the number of animals observed within the Level B monitoring zone (MZ) fully monitored by MMOs (Section 13. Monitoring and Reporting).

Level A harassment of any marine mammals is not anticipated. If a marine mammal is observed in a Level A/PTS Marine Mammal Shutdown Zone (MMSZ), pile driving will be delayed until the animal has moved out of the area or has not been observed for 15 minutes (Figure 5. Remedial Response Area A; Level A Marine Mammal Shutdown Zone, Figure 6. Remedial Response Area B; Level A Marine Mammal Shutdown Zone, and Figure 7. Monitoring and Shutdown Zones for RWF Temporary Relocation Pile Installation). In addition, attenuated impact installation of steel piles is limited to piles 24-inches or less in diameter, and would only be conducted to seat the piles after vibrating them into the majority of their required depth. With proposed monitoring and establishment of MMSZs, Level A harassment of marine mammals will be avoided. Therefore, PG&E is not requesting authorization of take through Level A harassment of marine mammals for this Project.

Table 12. Total Level B Take Requested over 50 Total Days of All Project Activities

Species	Estimated Abundance in Project Area per Day	Total Take Requested	Stock Abundance	Percent of Stock (take/abundance* 100)
Pacific Harbor Seal	20	1,000	30,968	3.23
Northern Elephant Seal	0.5	25	187,386	0.010
California Sea Lion[1]	191	9,550	257,606	3.71
Northern Fur Seal	0.027	5	14,050; 608,143	0.01; 0.0002
Steller Sea Lion	0.1	5	43,201	0.01
Bottlenose Dolphin	0.5	25	453	5.52
Harbor Porpoise	2	100	7,777	1.29

7 ANTICIPATED IMPACT OF THE ACTIVITY

7.1 SPECIES IMPACTS FROM PILE DRIVING

Take estimates represented in Table 12 provide estimated exposures of marine mammals to pile driving generated sound corresponding to hearing threshold criteria that could result in harassment under the MMPA. Threshold zones in Table 9 were calculated by I&R based on measurements collected during numerous previous pile driving activities in the northwest U.S. (Caltrans 2015b, Caltrans 2020, Greenbusch Group 2018). Exposures of marine mammal species and stocks to pile driving are anticipated to result in only short-term behavioral effects on individuals exposed to areas with temporary increased levels of sound. These exposures and effects are not anticipated to affect annual rates of recruitment or overall survival of marine mammal species. Implemented AMMs will prevent Level A exposures or mortality and take of federally listed marine mammals (i.e., humpback whales).

Only occasionally, as needed, use of an impact hammer is proposed for installation of sediment pin piles or RWF temporary relocation piles less than 24-inches in diameter. According to the Hydroacoustic Assessment Report (Enclosure B) the Level B (120 dB RMS) behavioral harassment zone for 14 to 16-inch composite piles would result in behavioral harassment of marine mammals within a less than 10-meter zone of the pile installation location (Table 9). Similarly, attenuated impact hammer use for the purpose of seating 24-inch steel shell piles required for RWF relocation would result in behavioral harassment of marine mammals within a 736 meter zone. If marine mammals (HF cetaceans) were to occur within a 351 -meter zone of the pile installation location Level A take could occur. However, AMMs (e.g., shutdown zones) are proposed which should preclude this from occurring in the rare event that seating of piles with an impact hammer is required. As such, this minimal impact hammer installation of piles is not expected to increase marine mammal take estimates above that estimated by vibratory hammer installation of piles. Implementation of the protective measures described herein will assure that no permanent injury or mortality will occur to animals, and no impacts (permanent or long-term) will occur on the populations or stocks of marine mammals that regularly inhabit or occasionally enter the Bay.

7.1.1 Pacific Harbor Seal

Pacific harbor seals and California sea lions are the most numerous marine mammal species in the Project Area. A maximum of 1,000 harbor seals are expected to be exposed to Level B harassment levels during project activities described herein. Harbor seals typically have limited home ranges; we can presume a limited number of harbor seals (approximately 300–400) will be repeatedly taken throughout the effective period of the IHA (Table 12). It is possible a limited number of harbor seals may enter the Bay occasionally from nearby coastal haulouts, however these seals would likely not be repeatedly exposed throughout the Project duration. The potential repeated exposure of YBI animals would not necessarily be on sequential days and would only occur for a total maximum of 50 days of pile driving.

Based on Pacific harbor seal behavior and low abundance in the Bay coupled with project low level sound disturbance and implementation of AMMs, (Section 11. Mitigation Measures to Protect Marine Mammals and Their Habitat) project activities are expected to result in a small number of juveniles and adults exposed to Level B sound exposure thresholds for a short duration while they are transiting or foraging within the Project isopleth. Level A harassment or mortality of Pacific harbor seals would not occur given mandatory shutdown requirements established in the Marine Mammal Monitoring Plan (MMMP, Enclosure C).

7.1.2 Northern Elephant Seal

Most northern elephant seals in the Bay are stranded, sick, or injured juveniles. It is estimated that a maximum of 25 northern elephant seals may be exposed to Level B harassment levels during pile driving over effective period of the IHA (Table 12).

Based on northern elephant seal behavior and low abundance in the Bay, coupled with the project's low level sound disturbance and implementation of AMMs, (Section 11. Mitigation Measures to Protect Marine Mammals and Their Habitat) project activities are expected to result in a small number of juveniles exposed to Level B sound exposure thresholds for a short duration while they are transiting or foraging within the Project isopleth. Level A harassment or mortality of northern elephant seals would not occur given the rarity of the species in the Bay and monitoring of the MMSZ with mandatory shutdown requirements established in the MMMP (Enclosure C).

7.1.3 California Sea Lion

California sea lions are the most numerous marine mammal species in the Project Area. Due to the proximity of the Pier 39 K-Dock sea lion haulout, sea lions are expected to occur within the Level B behavioral harassment monitoring zone during pile driving activities; a maximum of 9,550 sea lions are expected to be exposed to Level B harassment levels during pile driving over the effective period of the IHA (Table 12). Most of the anticipated take would occur, repeatedly, to a limited number of sea lions (approximately 2,000), that use the K-Dock haulout. Exposure of these animals would not necessarily be on sequential days and would only occur for a total maximum of 50days of pile driving work over two years.

Exposure to elevated sound would be only for a short duration as most animals would be transitioning through the Project isopleth. Exposure may cause a short-term behavioral response, such as altering the travel path through the area, but is unlikely to affect animals' reproductive, foraging, or hearing abilities.

Project activities may result in Level B harassment of adult male, subadult male, and juvenile sea lions that are transiting or foraging within the Project isopleth. Level A harassment or mortality of California sea lions would not occur given monitoring of the MMSZ with mandatory shutdown requirements established in the MMMP (Enclosure C).

7.1.4 Northern Fur Seal

Most northern fur seals in the Bay are stranded, sick, or injured juveniles. It is estimated a maximum of two northern fur seals may be exposed to Level B harassment levels during 50 days of pile driving over the effective period of the IHA (Table 12).

Based on northern fur seal behavior and low abundance in the Bay coupled with project low level sound disturbance and implementation of AMMs, (Section 11. Mitigation Measures to Protect Marine Mammals and Their Habitat) project activities are expected to result in a small number of juveniles exposed to Level B sound exposure thresholds for a short duration while they are transiting or foraging within the Project isopleth. Level A harassment or mortality of northern fur seals would not occur given the rarity of the species in the Bay and monitoring of the MMSZ with mandatory shutdown requirements established in the MMMP (Enclosure C).

7.1.5 Steller Sea Lion

Steller sea lions may rarely be found in the Bay. It is estimated a maximum of five Steller sea lions may be exposed to Level B harassment levels during 50 days of pile driving over the effective period of the IHA (Table 12).

Based on Steller sea lion behavior and low abundance in the Bay coupled with project low level sound disturbance and implementation of AMMs, (Section 11. Mitigation Measures to Protect Marine Mammals and Their Habitat) project activities are expected to result in a small number of individuals exposed to Level B sound exposure thresholds for a short duration while they are transiting or foraging within the Project isopleth. Level A harassment or mortality of Steller sea lions would not occur given the rarity of the species in the Bay and monitoring of the MMSZ with mandatory shutdown requirements established in the MMMP (Enclosure C).

7.1.6 Common Bottlenose Dolphin

Two bottlenose dolphin females were regularly observed near Alameda in 2017, and up to five individuals were seen regularly in 2018 (W. Keener, pers. comm., 2019). This indicates a maximum of five bottlenose dolphins may potentially be resident in the Bay. Coastal bottlenose dolphins are known to occasionally enter the Bay and could occur near the Project Area (Perlman 2017).

Level B take of twentyfive bottlenose dolphins is anticipated during pile driving activities over the effective period of the IHA (Table 12). This take could include both Bay residents and coastal dolphins.

Based on bottlenose dolphin behavior patterns and low abundance in the Bay coupled with project low level sound disturbance and implementation of AMMs, (Section 11. Mitigation Measures to Protect Marine Mammals and Their Habitat) project activities are expected to result in a small number of individuals exposed to Level B sound exposure thresholds for a short duration while they are transiting or foraging within the Project isopleth. Level A harassment or mortality of bottlenose dolphins would not occur given the rarity of the species in the Bay and monitoring of the MMSZ with mandatory shutdown requirements established in the MMMP (Enclosure C).

7.1.7 Harbor Porpoise

Based on observed frequency near the Project Area, it is anticipated that a maximum of 100 harbor porpoise may be exposed to Level B harassment levels during pile driving over the effective period of the IHA (Table 12).

Both juvenile and adult harbor porpoise were observed near YBI and Treasure Island, approximately 2.5 mi (4.0 km) from the Project Area, in 2017 and 2018 (Caltrans 2018a, 2019). Establishing the gender of harbor porpoise in the water is difficult. However, both male and female harbor porpoise could presumably be present.

Based on harbor porpoise behavior and low presence in the Bay coupled with project activity low level acoustic disturbance and implementation of AMMs (Section 11. Mitigation Measures to Protect Marine Mammals and Their Habitat), project activities are expected to result in Level B behavioral harassment of a small number of both juvenile and adult harbor porpoise transiting or foraging within the Project isopleth. Level A harassment or mortality to any harbor porpoise would not occur given monitoring of the MMSZ with mandatory shutdown requirements established in the MMMP (Enclosure C).

8 ANTICIPATED IMPACTS ON SUBSISTENCE USES

Not applicable; none of the species or stocks of marine mammals regularly found in the Bay are used for subsistence purposes.

9 ANTICIPATED IMPACTS ON HABITAT

Through implementation of the recommended remedy and attainment of the RAO, sediment with PAH concentrations in bulk sediment greater than 100,000 µg/kg (micrograms per kilogram; the Project site-specific, risk-based RAL [Remedial Action Level]) within the Project Area would be removed or contained (i.e., capped in such a way that no exposure to ecological receptors would occur). The remedy would result in long-term beneficial improvement to the habitat by either removing or physically isolating the PAHs from marine mammals and their habitats present within the Project Area. Once contaminated sediment is removed, a cap and/or armor layer would be placed within most removal areas to isolate any potentially impacted sediment left in place. The cap has been designed based on engineering analysis that shows the effectiveness of the cap in terms of chemical isolation and protection against erosion, which would further minimize habitat loss or degradation. The Project would result in long-term net benefits to habitat through the removal and capping of contaminated sediments.

Additional effects on marine mammal habitat would be associated with temporary noise and sound pressure exposures from pile driving, temporary impacts to water clarity, and benthic habitat changes from dredging and capping. Site conditions are anticipated to be substantively unchanged from existing conditions for marine mammals following project completion.

Pile driving within the Project Area is not likely to negatively affect marine mammal habitat in the long term, because no permanent loss of habitat would occur. Temporary modification of habitat would occur as a result of adverse hydroacoustic conditions associated with pile driving. Pressure waves that are generated by impact pile driving may result in minor injury and mortality to fish and may alter the abundance and distribution of fish in the immediate vicinity of impact pile driving for a few hours during and immediately following pile driving activities. Isolated fish mortality events are not anticipated to have a substantial effect on marine mammal prey species populations or their availability as a food resource for marine mammals. The disturbed area (i.e., Level B harassment isopleth) is only a small portion of foraging habitat for species (i.e., the Bay). While there could be a temporary displacement of animals during foraging activities, they will have access to other areas and resume or continue normal behaviors.

Short-term impacts on water clarity may result from disturbance of sediment during pile driving, dredging, and capping, but turbidity curtains would minimize these effects to the maximum extent practicable. Increased turbidity levels during dredging would be minor, short-term, localized to the immediate work area, and be contained within the work area by turbidity curtains. Effects of increased turbidity on marine mammals would be greatly reduced through implementation of avoidance measures that prescribe suspended sediment containment and required work window restrictions. Dredging would disturb and remove benthic invertebrates and the substrate they use, temporarily reducing the diversity and productivity of benthic habitat within the Project Area. Recolonization of benthic habitat following dredging is controlled by many physical and ecological factors including site-specific bathymetry, hydrodynamics, depth of deposited sediment, the spatial scale of the disturbance, sediment type, and the timing and frequency of the disturbance (Wilber and Clark 2001). The proposed remediation design is not expected to change factors that affect benthic recolonization (i.e., primarily sedimentation rates) within the Project Area. Capping and armoring would temporarily convert approximately 2.11 acres, within remedial response areas A and B, of Bay substrate to a cap made of sand, carbon-amended sand, and armor cover. Additionally, large areas of undisturbed sediment would surround the remedial response areas, and therefore colonization through adult immigration from surrounding undisturbed areas would facilitate habitat recolonization by fishes. It has also been demonstrated that communities from hydrodynamic fishing grounds that are well adapted to natural physical stress, like Project Area conditions, are not highly affected by dredging (Constantino et al. 2009). Following dredging and capping, the deposition of sediments, comparable to pre-dredging conditions, would begin almost immediately and the benthic community inhabiting those sediments would be expected to recover to pre-dredging composition and abundances within a few months to up to two years, depending on when dredging occurs and other ecological factors affecting recolonization (Newell et al. 1998; Blake et al. 1996).

The proposed Project is not anticipated to result in long-term adverse effects to marine mammal species and is expected to result in long-term beneficial improvement to the habitat used by a known populated marine mammal haul out.

10 ANTICIPATED EFFECTS OF HABITAT IMPACTS ON MARINE MAMMALS

Sediment remediation implementation would protect marine mammals from toxic bioaccumulation of PAHs. The Project is not expected to result in negative impacts to marine mammals resulting from loss or modification of marine mammal habitat.

Project activities would not affect any harbor seal haulout sites or pupping sites. The YBI harbor seal haulout is 2.5 mi (4.0 km) away from the Project site; sound and pressure from the Project would not reach this location. The closest recognized harbor seal pupping site is at Castro Rocks, approximately 8.3 mi (13.4 km) from the Project Area. Other harbor seal haulout sites are also at a sufficient distance from the Project Area that they would not be affected.

California sea lions at the Pier 39 K-Dock haulout adjacent to remedial response area D of the Project Area are commonly subjected to high levels of noise and water turbidity disturbance, primarily from small boat traffic. It is expected that sea lions would be exposed to low levels of sound and pressure throughout the Project Area that may affect the short-term behavior of some of these animals, but their haulout site would be unaffected and there would be no long-term effects on behavior. Elephant seals, fur seals, Steller sea lions, and cetaceans are found so infrequently in the Bay that effects from Project sound levels would be nearly undetectable, and any effects from dredging and capping will not reduce the quality of the habitat they transit through. No elephant seal, fur seal, or Steller sea lion haulouts or rookeries are found in the Bay.

11 MITIGATION MEASURES TO PROTECT MARINE MAMMALS AND THEIR HABITAT

11.1 MINIMIZATION OF IMPACTS FROM PILE DRIVING

Project activities have the potential to result in MMPA take through Level B harassment of harbor seals, northern elephant seals, California sea lions, northern fur seals, Steller sea lions, harbor porpoise, and bottlenose dolphins. Level B harassment may occur, resulting in negligible short-term effects on marine mammals transiting or foraging in the area. Project activities, however, would not cause long-term effects on individuals and would not result in population-level effects.

The following measures would be taken to minimize the exposure of marine mammals and their habitat to the effects of sound from pile driving.

- Marine mammal monitoring will be conducted during all construction noise-generating activities (pile installations or sediment sampling) to ensure that marine mammals do not enter Level A harassment zones and that marine mammal presence in the sound isopleth does not exceed authorized take levels. Construction will be shut down if a MMO observes a humpback or gray whale approaching the Level B isopleth. As it is not practical to monitor the full zones for a project of this extended length, MMOs would be positioned such that at least 20 percent of the Level B zone is observed when monitoring is required. Efforts should be made to observe the maximum extent of the monitoring zone possible. More information regarding proposed monitoring is included within Enclosure D. Should use of an impact hammer be required for steel piles less than 24-inch diameter, required, MMOs would be positioned such that 100 percent of the Level A zone is clearly visible.
- No pile driving will occur at night when MMOs are not able to visibly observe the project shutdown zones.
- Vibratory hammering may be conducted between March 15 to December 1 without attenuation.
- Only vibratory installation may be used to install steel piles; with the exception of occasional, attenuated impact hammering required to seat RWF relocation piles less than 24-inches in diameter. Permanent timber or composite sediment pins may be installed using vibratory or unattenuated impact installation methods.
- A bubble curtainwith the following performance standards shall be implemented:
  - The bubble curtain must distribute air bubbles around 100 percent of the piling perimeter for the full depth of the water column.

  - The lowest bubble ring shall be in contact with the mudline for the full circumference of the ring, and the weights attached to the bottom ring shall ensure 100 percent mudline contact. No parts of the ring or other objects shall prevent full mudline contact.
  - The contractor will ensure that personnel are trained in the proper balancing of air flow to the bubblers and will submit an inspection/performance report for approval by the Port within 72 hours following the performance test. Corrections to the attenuation device to meet the performance standards shall occur prior to impact driving.
- A soft start will be implemented before operating impact pile driving hammers at full capacity. The soft start will consist of an initial set of strikes at reduced energy, followed by a 30-second waiting period, then two subsequent reduced-energy strikes separated by the waiting period. A soft start will be implemented at the start of each day's impact pile driving and at any time following cessation of impact pile driving for 30 minutes or longer.

These measures will limit the intensity of pile driving sound in the marine environment. In addition, the use of vibratory hammers to install and remove piles where feasible, and employment of a soft start for the impact hammer, is expected to encourage marine mammals to move away from disturbance areas so that they are less likely to be present during full-power pile driving activities. Establishment of MMSZs and implementation of a monitoring plan will ensure that no marine mammals are exposed to Level A harassment sound thresholds, and that exposure of any animals to Level B harassment sound thresholds is minimized and documented. Therefore, with these measures, the effects of the pile driving will be mitigated to the level of least practical adverse impact on marine mammals.

11.2 MONITORING PLAN AND ESTABLISHMENT OF MARINE MAMMAL SHUTDOWN ZONES

A NOAA OPR-approved Project-specific MMMP for noise-producing activities (Enclosure C) will be employed to avoid the potential for individual exposure to Level A harassment, ensure no take of humpback or gray whales, and document the number and species potentially exposed to Level B harassment. Before the start of impact pile driving activities, MMSZs will be established. The MMSZs are intended to include all areas where the underwater SPLs are anticipated to equal or exceed thresholds for slight injury/PTS Level A harassment thresholds for the species-specific hearing groups, shown in Table 9. NOAA OPR-approved observers will survey the MMSZs for at least 30 minutes before pile driving activities start. If marine mammals are found within the MMSZ, pile driving will be delayed until the animal has moved out of the shutdown zone, either verified by sight by an observer or by waiting until 15 minutes has elapsed without a sighting, which assumes that the animal has moved beyond the MMSZ. With implementation of these avoidance and minimization measures, exposure of marine mammals to SPLs that can result in PTS Level A harassment will be avoided, and exposure of marine mammals to Level B SPLs will be minimized.

11.3 ACOUSTIC MONITORING AND REPORTING

An acoustic monitoring program of all pile driving and removal methods will be approved 90-days prior to commencement of pile driving activities and will be implemented as required within the NOAA Fisheries Biological Opinion for the project (Enclosure D). Data will be collected on a subset of representative piles (minimum of five) for each installation or removal method, as well as similar water depths and substrate types. As part of the mitigation and monitoring report, or in a separate report, the Applicant will provide an acoustic monitoring report for this work. Hydroacoustic monitoring results would be used to adjust the size of the Level A and B harassment and monitoring zones after a request is made and approved by NOAA OPR if the sound levels and distances to thresholds are found to be different than project estimates. Further, monitoring results would be used to inform future requests for additional work in remedial response areas C through E.

The acoustic monitoring report would, at minimum, include the following information:

1. Size and type of piles being driven or removed.
2. A detailed description of the name type of noise attenuation device, including design specifications (if applicable).
3. Attenuation rates (and effective decibel reductions for bubble curtain or other sound attenuation method if applicable).
4. The impact hammer energy rating used to drive the piles, make and model of the hammer.
5. A description of the sound monitoring equipment: Hydrophone equipment and recording devices.
6. The distance between hydrophone(s) or microphone(s) and pile.
7. The depth of the hydrophone(s) and depth of water at hydrophone locations.
8. The depth of water in which the pile was driven.
9. The depth into the substrate that the pile was driven.
10. The physical characteristics of the bottom substrate into which the piles were driven.
11. Number of strikes for an impact hammer or duration (vibratory or other non-impulsive sources) per pile measured, one-third octave band spectrum and power spectral density plot for all piles driven during a 24-hour period.

12. For impact pile driving: Pulse duration and mean, median, and maximum sound levels: SELcum dB re: 1µPa2-s, peak sound pressure level (SPLpeak dB re: 1µPa), and single-strike sound exposure level (SELs-s) for all piles driven during a 24-hour period.
13. For vibratory removal and other non-impulsive sources: Mean, median, and maximum sound levels (dB re: 1µPa): Root mean square sound pressure level (SPLrms), SELcum dB re: 1µPa2-s.
14. The distance at which peak, SELcum, and rms values exceed the respective threshold values.
15. Airborne noise monitoring is not expected to be required at the marine mammal haulout.
16. A description of any observable marine mammal, fish, or bird behavior in the immediate area and if possible, correlation to underwater sound levels occurring at that time.

12 MITIGATION MEASURES TO PROTECT SUBSISTENCE USES

Not applicable; no activities will occur within Arctic subsistence hunting areas.

13 MONITORING AND REPORTING

A NOAA OPR-approved MMMP will be employed to avoid the potential Level A harassment of marine mammals and document the number of individuals by species taken by Level B harassment (Enclosure C). All observational monitoring results during construction will be provided to NMFS within 90 days after the authorization expires, and monitoring results will be presented as stipulated in the approved monitoring plan.

13.1 MONITORING PLAN FOR PILE DRIVING

The MMMP includes Level A injury MMSZs and Level B TTS and behavioral response harassment MZs extending out to a pre-determined distance from pile driving, based on conservatively estimated distances to acoustic threshold criteria. The following are the general elements of the MMMP. The complete plan is provided in Enclosure C and includes all NMFS monitoring and reporting requirements.

13.2 PRE-CONSTRUCTION BRIEFINGS

Briefings will be conducted for construction supervisors and crews, the marine mammal monitoring team, and Applicant staff prior to the start of all pile driving activity, and when new personnel join the work. Briefings will explain personnel responsibilities, communication procedures, the marine mammal monitoring protocol, and operational procedures.

13.3 LEVEL A HARASSMENT—INJURY AND MORTALITY SHUTDOWN ZONES

The MMSZs will include all areas where the underwater SPLs are anticipated to equal or exceed thresholds for Level A harassment. Before impact or vibratory pile driving or pile removal, initial hearing-group-specific MMSZs will be established at a radial distance, as shown in Table 9. The MMSZs will be monitored by MMOs for at least 30 minutes before pile driving begins. If any marine mammal is observed inside the MMSZs, pile driving will be delayed until the animal leaves the area or at least 15 minutes have passed since the last observation of the animal. Some Level A MMSZs will utilize an initial shutdown distance which is greater than the calculated threshold. These initial shutdown distances have been combined by species and rounded up for ease of use in the field (Table 13 and Table 14).

Table 13. Level A and B Harassment Isopleth Distances for Vibratory Pile Driving

Pile Description	Maximum Piles Installed/ Removed per Day	Level A/PTS Shutdown Zone for All Species (meter)	Level B (120 dB RMS) Behavioral Monitoring Zone for All Species (meter)
Turbidity Curtain Installation or Removal–Steel H-Pile	4	1	341
RWF Temporary Relocation Piles or Turbidity Curtain Installation (24-inch steel shell piles)	4	4	1,585
RWF Temporary Relocation Piles (36-inch steel shell piles)	4	9	3,688
Sediment Pin Installation–16-inch tapered timber or composite pile	20	10	1,360

Table 14. Summary of Level A Harassment Shutdown and Level B Harassment Monitoring Zones for Impact Pile Driving

Pile Description	Attenuation	Maximum Number of Piles Installed per Day	Level A/PTS Shutdown Zone (meter) All Species	Level B (160 dB RMS) Behavioral Harassment Zone for All Species
Hydroacoustic Data Collection Test Piles (18-inch composite/plastic)	Unattenuated	10	19	10
RWF Temporary Relocation Piles (24-inch steel shell piles)[1]	Attenuated	4	351	736
Sediment Pin Installation–14 to 16-inch tapered timber or composite pile	Unattenuated	20	10	10

1. Rarely required to seat RWF relocation piles, assumed to be only one per day.

For all in-water construction using heavy machinery other than pile driving equipment (e.g., use of barge-mounted dredging equipment), a 10-meter shutdown (SD) zone will be in effect. If a marine mammal comes within 10 meter, operations will be ceased and vessel speed reduced to the minimum required to maintain steerage and safe working conditions.

Monitoring of this SD zone does not require an MMO; the contractor can implement this measure.

After impact pile driving begins, hydroacoustic measurements will be collected for the specific activity (location and size/type of pile). These hydroacoustic monitoring results will be provided to NOAA OPR, and the radius of the shutdown zones may be adjusted based on measured SPLs (Enclosure D).

13.4 LEVEL B HARASSMENT—BEHAVIORAL RESPONSE AND TTS MONITORING ZONES

Behavioral harassment MZs will include areas where the underwater SPLs are anticipated to equal or exceed thresholds for Level B behavioral responses and TTS for all species–120 dB RMS for continuous sounds (vibratory pile driving), and 160 dB RMS for impulsive sounds (impact pile driving). Before impact or vibratory pile driving, initial Level B harassment MZs will be established at the radial distances shown in Table 13 and Table 14. For larger zones, MMOs will be positioned to cover a representative area of the Level B zone surrounding the Level A zone.

After pile driving activity begins, hydroacoustic measurements will be collected for each specific size and type of pile. These hydroacoustic monitoring results will be provided to NMFS, and the radius of the Level B harassment MZs or the Level A MMSZ may be adjusted, based on measured SPLs. For example, if vibratory pile driving cannot be differentiated from underwater background noise at less than 1,000 meter, the Applicant would confer with NMFS to decrease the Level B zone radius below 1,000 meter. A hydroacoustic monitoring plan will be provided to NMFS for approval at least 90 days prior to commencement of pile driving activities.

13.5 MARINE MAMMAL OBSERVERS (MMOS)

Between one and three MMOs will be required during pile driving so MMSZs will be fully monitored, and a representative portion of Level B harassment zones will be monitored to provide an accurate sample size of animals taken by Project activities, and to ensure that animals approaching the MMSZs will be detected. One MMO will be designated as the Lead MMO and will receive updates from other MMOs on the presence or absence of marine mammals within the monitoring zones. The Lead MMO will notify the construction foreman of a cleared MMSZ before the start of pile driving.

13.6 MONITORING PROTOCOL

Pile driving will be conducted only during daylight hours and with enough time for pre- and post-construction monitoring, and with full visibility of the MMSZs. If the entire MMSZ is not visible (e.g., due to fog or heavy rain), pile driving, and removal will be delayed until the MMOs are confident that marine mammals within the MMSZ could be detected. The Lead MMO will be in contact with other MMOs and the construction foreman. MMOs will begin monitoring at least 30 minutes before pile driving begins. If any marine mammal enters a MMSZ within 15 minutes of the beginning of pile driving, the Lead MMO will notify the foreman to inform that pile driving may need to be delayed. The Lead MMO will keep the foreman informed of the location of the animal. If the animal remains in the MMSZ, pile driving will be delayed until it has left the MMSZ. If the animal dives and is not seen again, pile driving will be delayed at least 15 minutes. If a species for which authorization has not been granted (e.g., humpback whale), or a species for which authorization has been granted but the authorized takes are met, is observed approaching or within the Level B harassment zone, pile driving and removal activities will shut down immediately using delay and shut-down procedures. Activities will not resume until the animal has been confirmed to have left the area or the observation time period (15 minutes), has elapsed. After pile driving has ended for the day, MMOs will continue to monitor the area for at least 30 minutes.

13.7 DATA COLLECTION

Standardized data collection sheets will be provided to the MMOs (see Enclosure C for example datasheet). Each MMO will record the following information:

- Dates and times (beginning and end) of all marine mammal monitoring.
- MMO locations during 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 cloud cover, visibility, Beaufort 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.
- Distances and bearings of each marine mammal observed to the pile being driven or removed for each sighting (if pile driving or removal was occurring at time of sighting).
- Description of any marine mammal behavior patterns during observation, including direction of travel.
- Age and sex class, if possible, of all marine mammals observed.
- Detailed information about 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. A full description of the bubble curtain will be described should one be required.

13.8 COMMUNICATION

All MMOs will be equipped with a radio and have a mobile phone as backup. One channel of the radios will be dedicated to the MMOs. The Lead MMO will be in constant contact with the construction foreman as needed. The Lead MMO will coordinate marine mammal sightings with the other MMOs. The Lead MMO will contact other MMOs when a sighting is made within the MMSZ or near the MMSZ, so that the MMOs within overlapping areas of responsibility can continue to track the animal. If an animal has entered or is near the MMSZ within 15 minutes of pile driving, the Lead MMO will notify the construction foreman, who will be kept informed of the location of the animal.

13.9 MMO QUALIFICATIONS

MMOs will have the following minimum qualifications:

- Independent MMOs (i.e., not construction personnel) who have no other assigned tasks during monitoring periods will be used.
- If a team of three or more MMOs is required, a lead observer (i.e., Lead MMO) or monitoring coordinator will be designated. The Lead MMO will have prior experience working as a marine mammal observer during construction.
- Other MMOs may substitute education (degree in biological science or related field) or training for experience.
- The Applicant will submit MMO resumes for approval by NMFS 30 days prior to the onset of pile driving. If NMFS does not respond within 30 days, it will be assumed that MMOs are approved until otherwise notified.
- MMOs will have the following additional qualifications:
  - Ability to conduct field observations and collect data according to assigned protocols.
  - Experience or training in the field identification of marine mammals, including the identification of behaviors.
  - Sufficient training, orientation, or experience with the construction operation to provide for personal safety during observations.
  - Writing skills sufficient to prepare a report of observations including but not limited to the number and species of marine mammals observed; dates and times when in-water construction activities were conducted; dates, times, and reason for implementation of mitigation (or why mitigation was not implemented when required); and marine mammal behavior.

– Ability to communicate orally, by radio or in person, with project personnel to provide real-time information on marine mammals observed in the area as necessary.

13.10 REPORTING

The Applicant will submit a draft report on all monitoring conducted under the IHA within 90 calendar days of the completion of marine mammal and acoustic monitoring or sixty days prior to the issuance of any subsequent IHA for this Project, whichever comes first. A final report will be prepared and submitted within 30 days following resolution of comments on the draft report from NMFS. This report will contain the informational elements described within this section and in the MMMP.

In addition, the report will contain the following information:

- 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.
- 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.
- In the case where MMOs were not able to observe the entire Level B harassment zone, an extrapolation of the estimated takes by Level B harassment based on the number of observed exposures within the Level B harassment zone and the percentage of the Level B harassment zone that was not visible will be included.
- The Applicant will submit all MMO datasheets and/or raw sighting data in a separate file from the final report referenced above.

13.11 TAKE OF MARINE MAMMAL DUE TO PROJECT ACTIVITY

In the unanticipated event that the Project activity clearly causes the take of a marine mammal in a manner prohibited by the MMPA, such as serious injury or mortality, the Applicant will immediately cease the specified activities and report the incident to the NMFS Office of Protected Resources and West Coast Region Stranding Coordinator. The report will include the following information:

- Time and date of the incident;
- Description of the incident;
- Environmental conditions (e.g., wind speed and direction, Beaufort sea state, cloud cover, and visibility);

- Description of all marine mammal observations and active sound source use in the 24 hours preceding the incident;
- Species identification or description of the animal(s) involved;
- Fate of the animal(s); and
- Photographs or video footage of the animal(s).

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

13.12 DISCOVERY OF INJURED OR DEAD MARINE MAMMAL

In the event the Applicant discovers an injured or dead marine mammal, and the Lead MMO determines that the cause of the injury or death is unknown, and the death is relatively recent (e.g., in less than a moderate state of decomposition), the Applicant will immediately report the incident to the NMFS Office of Protected Resources and the West Coast Region Stranding Coordinator. The report will include the same information listed in Section 13.11 above. Activities may continue while NMFS reviews the circumstances of the incident. NMFS will work with the Applicant to determine whether additional mitigation measures or modifications to the activities are appropriate.

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

14 SUGGESTED MEANS OF COORDINATION

Members of the Project team have coordinated with and worked closely with the local marine mammal stranding, rescue, and rehabilitation center (TMMC) in the past. TMMC, CAS, and The Sea Lion Center have provided data for this Project on marine mammal occurrences in the Bay to inform the analysis of potential takes.

All Project activities will be conducted in accordance with applicable federal, state, and local regulations. The Applicant will coordinate Project activities with relevant agencies including NMFS, San Francisco Bay Conservation and Development Commission, U.S. Army Corps of Engineers, San Francisco Bay Regional Water Quality Control Board, and the California Department of Fish and Wildlife. Results of the monitoring effort described in Section 13.10 will be provided to NMFS in a final report. The IHA application for the Project will be available for a public comment period in accordance with the MMPA, and the Applicant in coordination with NOAA OPR will respond to any public comments.

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PERSONAL COMMUNICATIONS

Keener, W. Research Associate, The Marine Mammal Center, Sausalito, California. 2017–2019. Personal communications to Patti Haase/Alameda Marina Shoreline Improvement Project team.

The Sea Lion Center. San Francisco, California. M. Rivas. October 2021. Personal communications to Patti Haase/Pier 39 to 43½ Sediment Remediation team

Piers 39 to 43 ½ Sediment Remediation Project

Figure 1. Project Area Vicinity Map

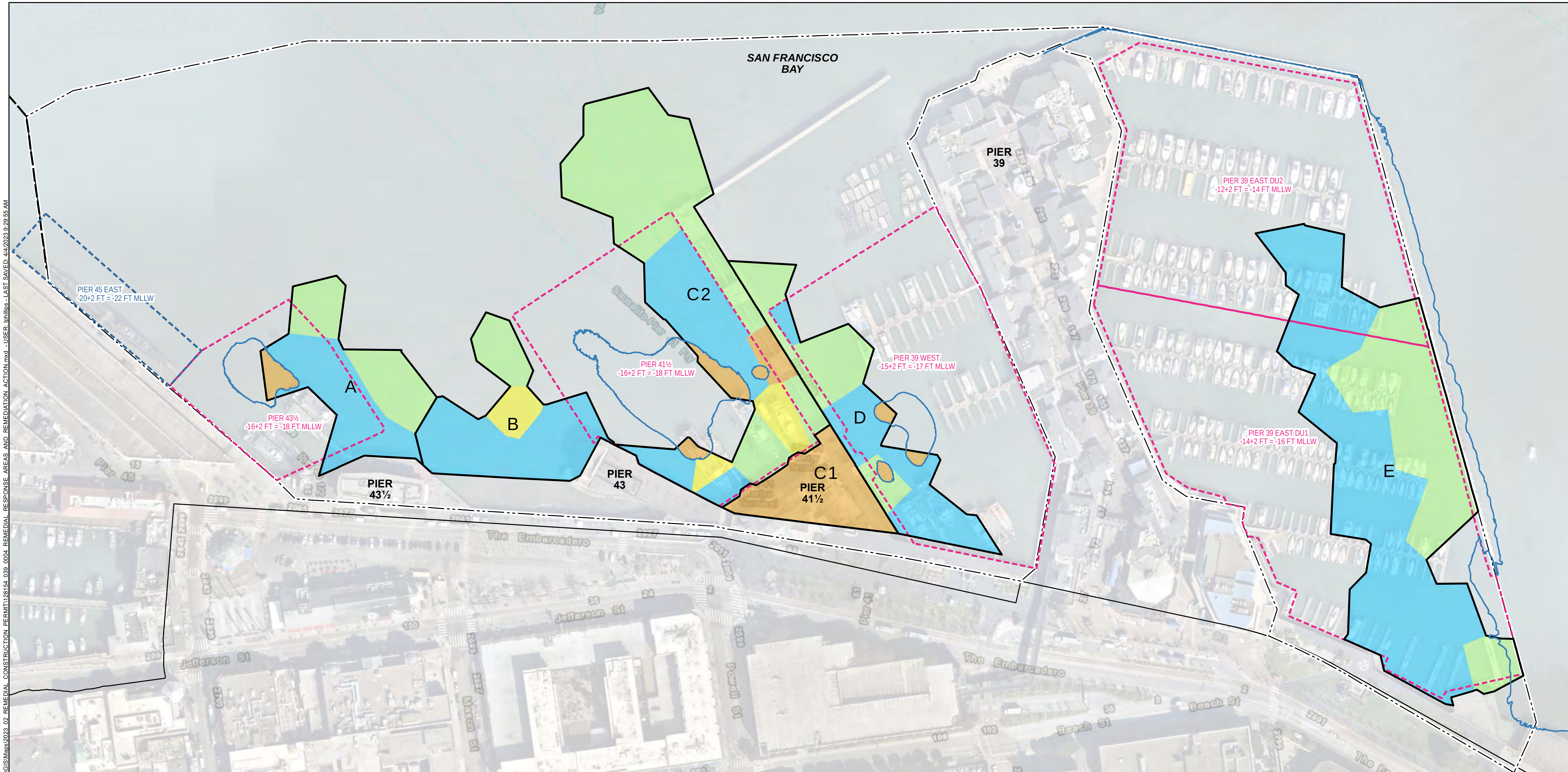
Project Area

Project Area

integral

0 0.5 1 1.5 2
Miles

N



REMEDIAL AREA

REMOVE SEDIMENT WITH PAH CONCENTRATION GREATER THAN 100,000 ug/kg SCREENING THRESHOLD, INSTALL CAP, AND ADMINISTER INSTITUTIONAL CONTROLS

ADMINISTER INSTITUTIONAL CONTROLS FOR SEDIMENT WITH PAH CONCENTRATION GREATER THAN 100,000 ug/kg SCREENING THRESHOLD UNDER EXISTING OR FUTURE COVER OF AT LEAST 3 FEET

REMOVE SEDIMENT WITH PAH CONCENTRATION GREATER THAN 100,000 ug/kg SCREENING THRESHOLD AND ADMINISTER INSTITUTIONAL CONTROLS FOR SEDIMENT WITH PAH CONCENTRATION GREATER THAN SCREENING THRESHOLD UNDER EXISTING COVER OF AT LEAST 3 FEET

INSTALL CAP AND ADMINISTER INSTITUTIONAL CONTROLS

SCOUR FEATURE BELOW OPERATIONAL USE LIMITS (INCLUDING 2-FT ALLOWANCE)

INFERRED SEAWALL LOCATION (SOURCE: 1913 SANBORN FIRE INSURANCE MAPS)

NATIONAL PARK SERVICE LEGISLATIVE BOUNDARY

PORT ANTICIPATED MAINTENANCE DREDGE BOUNDARY

OPERATIONAL USE LIMITS (OUL)

SITE BOUNDARY

NOTES

1. ALL LOCATIONS ARE APPROXIMATE.
2. μg/kg = MICROGRAMS PER KILOGRAM
3. AERIAL IMAGERY SOURCE: NEARMAP, 1 MARCH 2021

N

0 180 360
SCALE IN FEET

HALEY ALDRICH

PACIFIC GAS AND ELECTRIC COMPANY (PG&E)
PIER 39 TO PIER 43½ SEDIMENT INVESTIGATION AREA
SAN FRANCISCO, CALIFORNIA

REMEDIAL RESPONSE AREAS AND REMEDIATION ACTION

APRIL 2023

FIGURE 2

GIS FILE PATH: \\haleyaldrich.com\share\oak_common\42711_Pier_39\Global\GIS\Maps\2023_02_REMEDIAL_CONSTRUCTION_PERMIT\128154_039_0004_REMEDIAL_RESPONSE_AREAS_AND_REMEDIATION_ACTION.mxd - USER: lphillips - LAST SAVED: 4/4/2023 9:29:55 AM

NOTES

1. BATHYMETRIC AND TOPOGRAPHIC SURVEYS WERE CONDUCTED BY DIXON MARINE SERVICES, ETRAC, AND TOWILL, JANUARY-APRIL 2019. VERTICAL DATUM IS IN REFERENCE TO MLLW BASED ON SAN FRANCISCO TIDE STATION 9414290. HORIZONTAL DATUM IS IN REFERENCE TO NAD83 CALIFORNIA STATE PLANE ZONE 3.
2. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE AND SUBJECT TO REFINEMENT DURING THE DESIGN PHASE.
3. BCDC JURISDICTION BOUNDARY IS APPROXIMATELY 100 FEET INLAND FROM THE MEAN HIGH WATER ELEVATION.

LEGEND

- PROPOSED REMEDIAL WORK AREAS (DREDGE LIMITS)
- OPERATIONAL USE LIMITS
- 5-FOOT MAJOR ELEVATION CONTOUR
- SEA WALL
- BCDC JURISDICTION BOUNDARY
- APPROXIMATE FERRY DOCKING AREA
- SLOPE STABILITY PILE INSTALLATION AREA
- FUTURE SOFTSCAPE HABITAT
- FUTURE HARDSCAPE HABITAT
- MEAN LOWER LOW WATER CONTOUR (0FT MLLW)
- MEAN SEA LEVEL CONTOUR (3.12FT MLLW)
- MEAN HIGH WATER CONTOUR (EL 5.23 FT MLLW)
- MEAN HIGHER HIGH WATER CONTOUR (5.84 FT MLLW)

N

0 150 300
SCALE IN FEET

HALEY ALDRICH

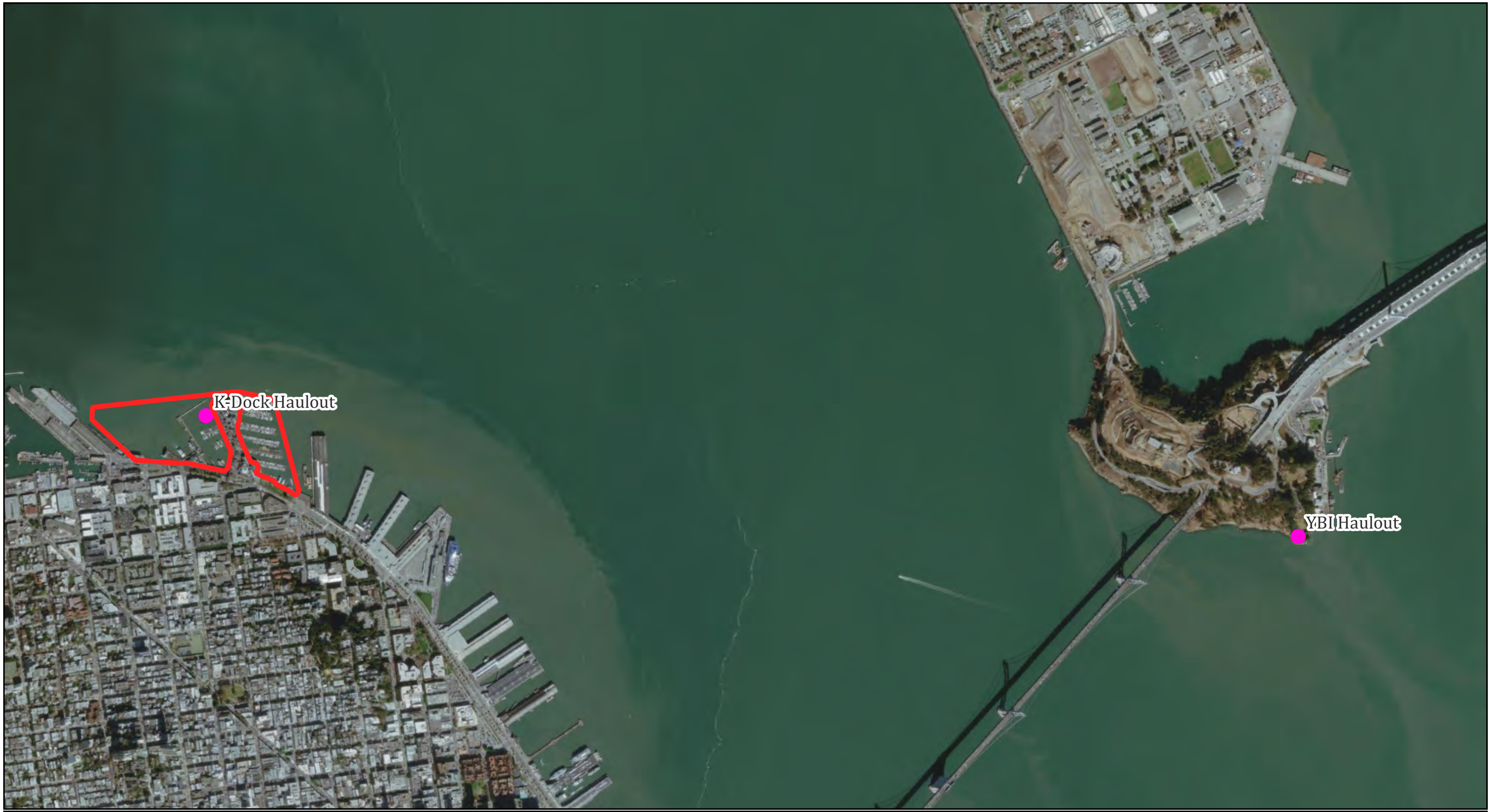
PACIFIC GAS AND ELECTRIC COMPANY (PG&E)
PIER 39 TO PIER 43 1/2 SEDIMENT INVESTIGATION AREA
SAN FRANCISCO, CALIFORNIA

SLOPE STABILITY PILE INSTALLATION AREAS RELATIVE TO REMEDIAL AND RESTORATION AREAS

SCALE: AS SHOWN
FEBRUARY 2023

FIGURE 3

JRIPLEY Printed: 4/3/2023 7:38 AM Sheet: FIG 8
\\HALEYALDRICH.COM\SHARE\OAK_COMMON\42711_PIER_39\GLOBAL\CAD\FIGURES\PERMITTING\AREA AB 90% FIGURES\128154_PERMITTING_HABITAT MITIGATION.DWG



Piers 39 to 43 ½ Sediment Remediation Project

Figure 4. Marine Mammal Haulouts Near Project Area

Legend
Project Site
Marine Mammal Haul Outs

Imagery Source: ESRI
Map Created on: 11/11/21
by S. McGarvey

JOHNSON MARIGOT CONSULTING, LLC

0 0.25 0.5
Mile

N

Piers 39 to 43 ½ Sediment Remediation Project

Figure 5. Remedial Response Area A;
Level A, Marine Mammal Shutdown Zone

Legend

Remedial Response Area A

Area A Shutdown Zones

Sediment Pin Installation

14 to 16-inch Timber Pile (impact) (14 meters)

14 to 16-inch Timber Pile (vibratory) (23 meters)

Turbidity Curtain Pile Installation/Removal

24-inch Steel Shell Pile (vibratory) (4 meters*)
*rounded to 10 meters

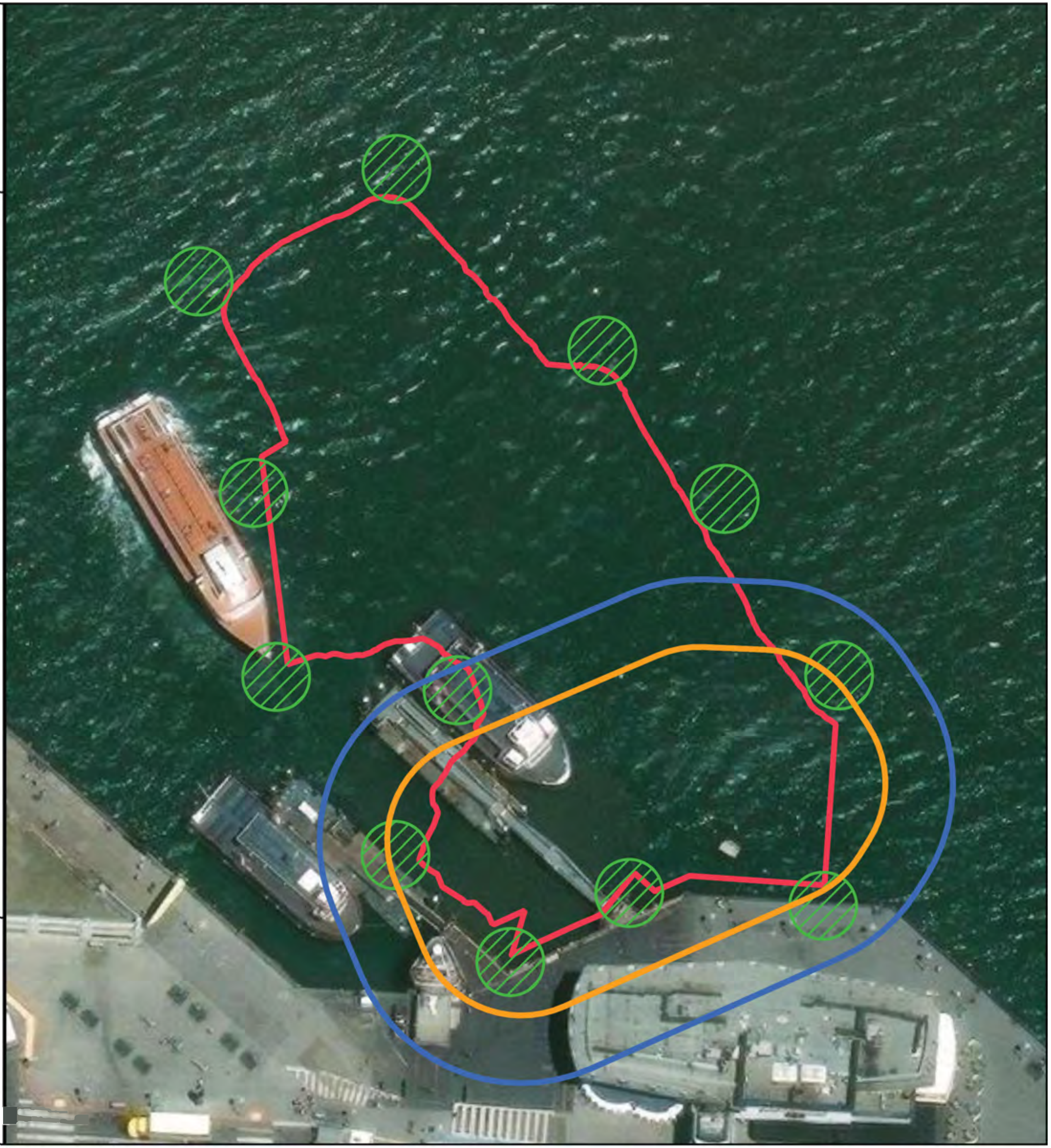
0 25 50 75 100

Feet

N

integral

Imagery Source: ESRI Map
Created on: 11/16/23
by S. McGarvey



Piers 39 to 43 ½ Sediment Remediation Project

Figure 6. Remedial Response Area B;
Level A, Marine Mammal Shutdown Zone

Legend

Remedial Response Area B

Area B Shutdown Zones

Turbidity Curtain Pile Installation/Removal

24-inch Steel Shell Pile (vibratory) (4 meters*)

Hydroacoustic Data Collection Piles

18-inch Composite Pile (Impact) (19 meters)

18-inch Composite Pile (Vibratory, removal) (6 meters*)

*rounded to 10 meters

0 25 50 75 100

Feet

N

integral

Imagery Source: ESRI
Map Created on:
11/16/23
by S. McGarvey

Piers 39 to 43 ½ Sediment Remediation Project

Figure 7. Monitoring and Shutdown Zones for RWF Temporary Relocation Pile Installation

Legend

Level A Shutdown Zones*

- 24-inch Steel Shell Pile (impact, attenuated) (351 meters)
- 24-inch Steel Shell Pile (vibratory) (4 meters**)
- 36-inch Steel Shell Pile (vibratory) (28 meters)

Level B Zones*

- 24-inch Steel Pile (impact, attenuated) (736 meters)
- 24-inch Steel Pile (vibratory) (1,585 meters)
- 36-inch Steel Pile (vibratory) (3,688 meters)

*Use of impact hammer on 36-inch steel piles prohibited

**Rounded to 10 meters

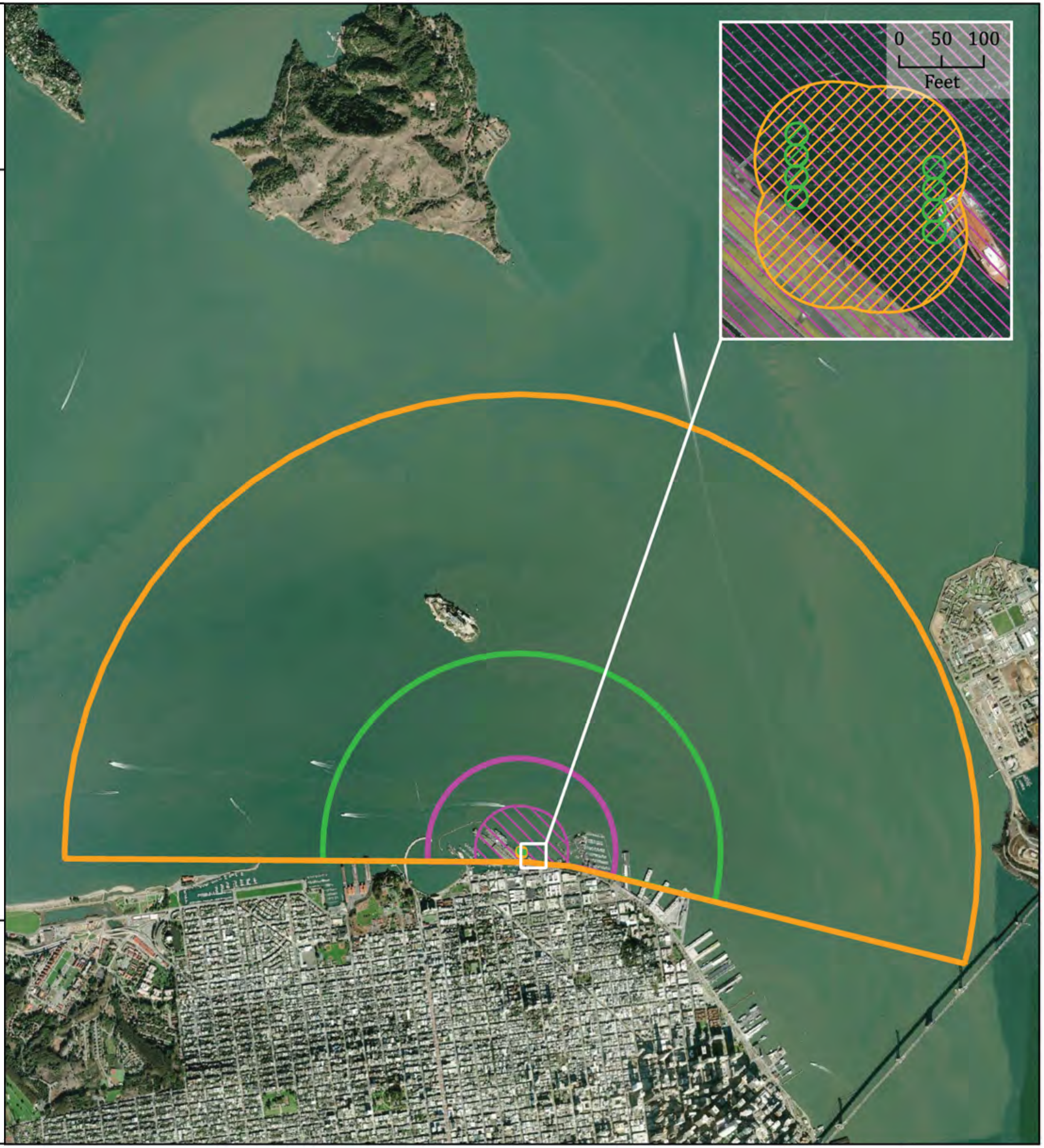
0 0.5 1 1.5

Miles

N

integral

Imagery Source: ESRI Map
Created on: 11/16/23
by S. McGarvey

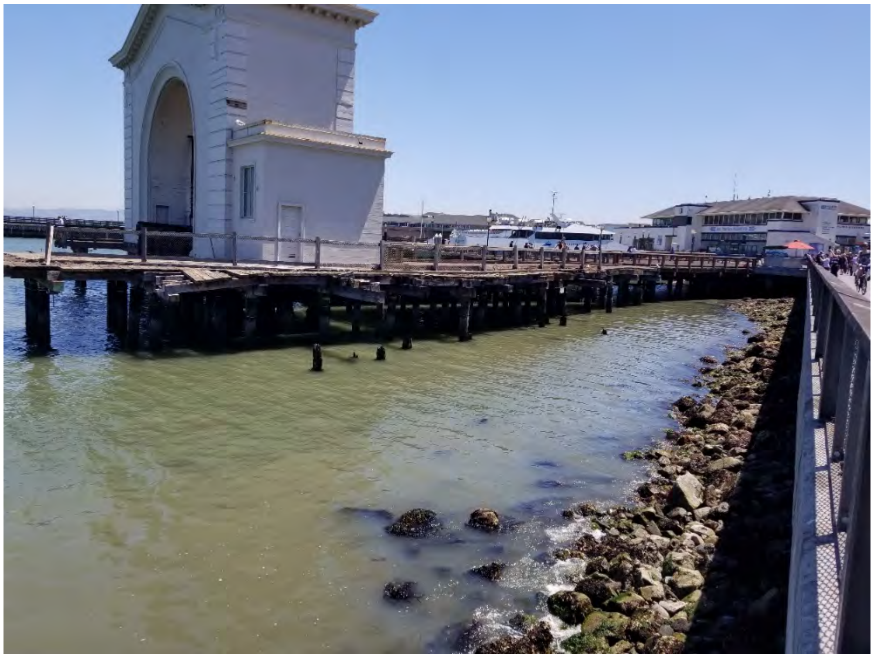


Photograph 1: Taken at Pier 39 West Basin looking northwest.

Photograph 2: Taken between Piers 43 and 43 ½ looking north.

Photograph 3: Taken on Pier 41 ½ looking north along east side of the fishing pier.

Photograph 4: Taken between Piers 39 West Basin and 41 ½ looking south.

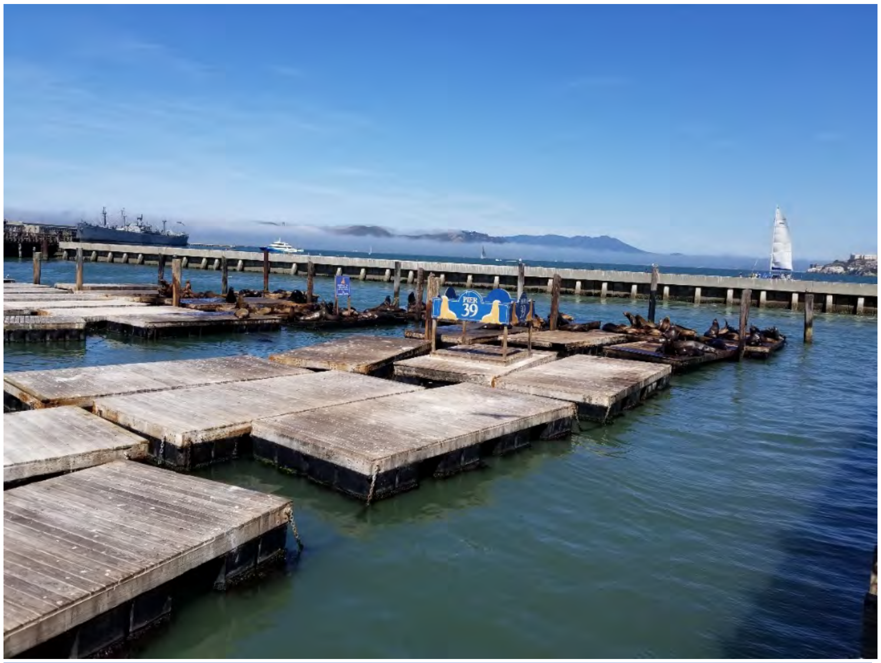


Photograph 5: Taken looking east along shoreline toward Pier 43 Ferry Arch.

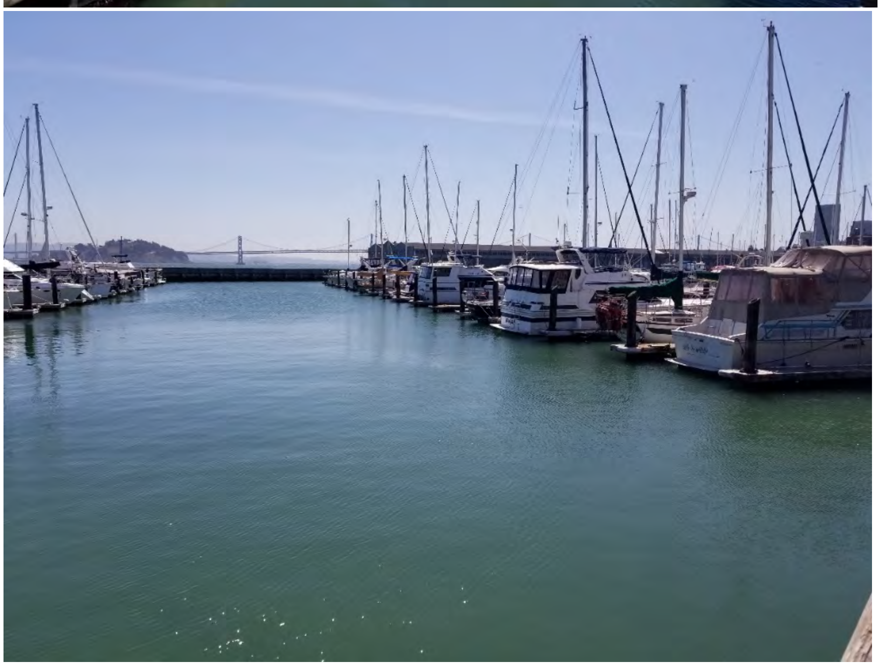
Photograph 6: Taken looking west along shoreline between Pier 43 Ferry Arch and Pier 43 ½.

Photograph 7: Taken looking north from Pier 43 ½.

Photograph 8: Taken looking north at Ferry dock.



Photograph 9: Taken at Pier 39 West Basin K Dock Sea Lion colony.



Photograph 10: Taken looking east across Pier 39 East Basin.

ESTIMATION OF UNDERWATER AND AIRBORNE SOUND LEVELS FOR MARINE MAMMALS– PIERS 39 to 43½ SEDIMENT REMEDIATION PROJECT, SAN FRANCISCO, CALIFORNIA

May 11, 2021
REVISED: November 15, 2023

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Project No: 20-088

INTRODUCTION

This study is an assessment of potential sound levels generated by activities required for the Piers 39 to 43½ Sediment Remediation Project, within the City of San Francisco, CA. Potential noise-generating activities required for the project would include geotechnical or sediment sampling, removal and installation of piles, and dredging and capping operations.

This report includes the estimation of underwater and airborne sound levels calculated based on the results of measurements for similar projects. Noise-generating activities proposed by the project were estimated using these data combined with an understanding of how and where these activities will occur. These estimates are based on empirical data and engineering judgment and include a certain degree of uncertainty due to the limited data sets. The duration and number of strikes anticipated to occur for each activity was estimated based on experience with other projects and from the data sets used. Estimated underwater sound levels are compared against marine mammal thresholds that have been accepted by the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries/NMFS).

UNDERWATER SOUNDS

Fundamentals of Underwater Noise

When a pile driving hammer strikes a pile, a pulse is created that propagates through the pile and radiates sound into the water, the ground, and the air. Sound pressure pulse as a function of time is referred to as the waveform. In terms of acoustics, these sounds are described by the peak sound pressure level (SPL), the root-mean-square pressure (RMS), and the sound exposure level (SEL), as defined by the International Standards Organization (ISO) [1]. Table 1 provides the definitions of acoustical terms. The peak pressure is the highest absolute value of the measured waveform and can be a negative or positive pressure peak. For pile driving pulses, RMS level is determined by analyzing the waveform and computing the square root of the average of the squared pressures over the time that comprises that portion of the waveform containing the sound energy. The pulse RMS has been approximated in the field for pile driving sounds by measuring the signal with a precision sound level meter set to the "impulse" RMS setting and is typically used to assess impacts to marine mammals. Another measure of the pressure waveform that can be used to describe the pulse is the sound energy itself. The total sound energy in the pulse is referred to in many ways, most commonly as the "total energy flux"[2]. The "total energy flux" is equivalent to the unweighted SEL for a plane wave propagating in a free field, a common unit of sound energy used in airborne acoustics to describe short-duration events. The unit used is decibel (dB) re 1µPa^2-sec. In this report, peak pressure levels are expressed in decibels re 1 µPa; however, in other literature, they

[1] ISO (International Standards Organization) 18405 and 18406:2017.

[2] Finerran, et. al., *Temporary Shift in Masked Hearing Thresholds in Odontocetes after Exposure to Single Underwater Impulses from a Seismic Watergun*, Journal of the Acoustical Society of America, June 2002

can take varying forms such as Pascals or pounds per square inch. The total sound energy in an impulse accumulates over the duration of that pulse. How rapidly the energy accumulates may be significant in assessing the potential effects of impulses on marine mammals. Table 1 includes the definitions of terms commonly used to describe underwater sounds. Figure 1 illustrates the acoustical characteristics of an underwater pile driving pulse.

The variation of instantaneous pressure over the duration of a sound event is referred to as the waveform. The waveform can provide an indication of rise time or how fast pressure fluctuates with time; however, rise time differences are not clearly apparent for pile driving sounds due to the numerous rapid fluctuations that are characteristic of this type of impulse. A plot showing the accumulation of sound energy over the duration of the pulse (or at least the portion where much of the energy accumulates) illustrates the differences in source strength and rise time (see Figure 1).

SEL is an acoustic metric that provides an indication of the amount of acoustical energy contained in a sound event. For pile driving, the typical event can be one pile driving pulse or many pulses such as pile driving for one pile or for one day of pile driving. Typically, SEL is measured for a single strike and a cumulative condition. The cumulative SEL associated with the driving of a pile can be estimated using the single strike SEL value and the number of pile strikes through the following equation:

SELCUMULATIVE = SELSINGLE STRIKE + 10 log (# of pile strikes)

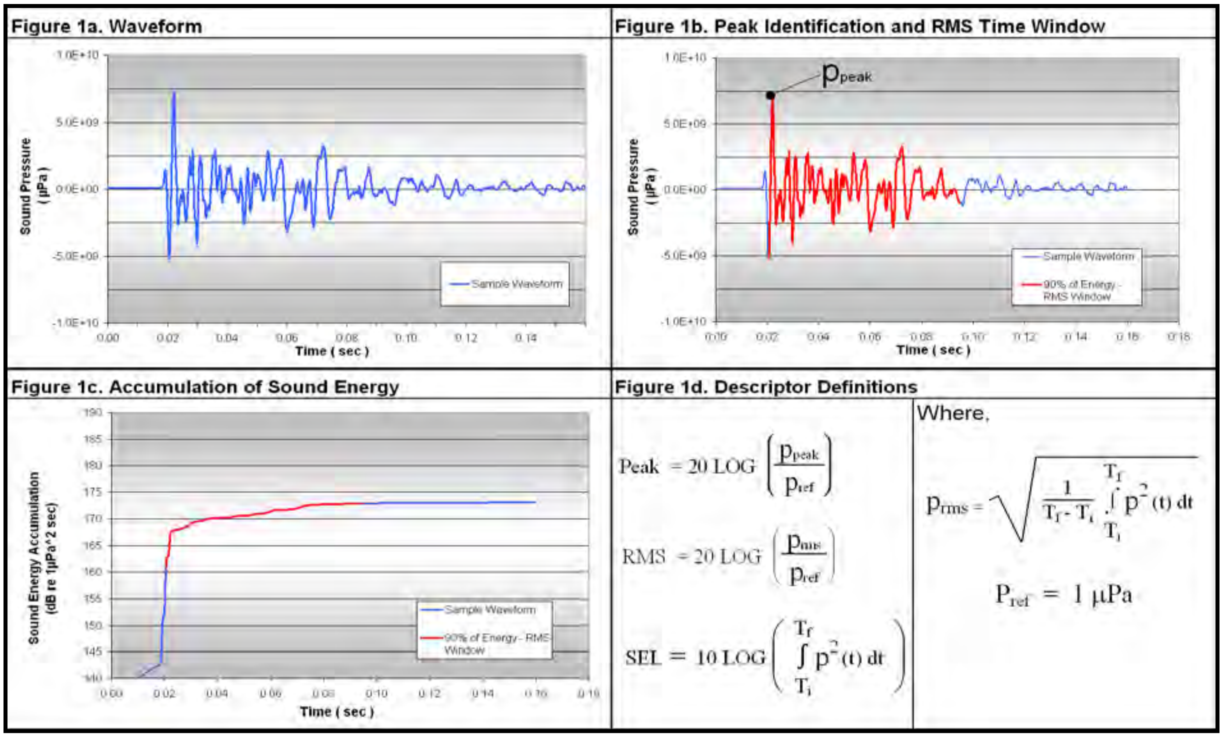
For example, if a single strike SEL for a pile is 165 dB and it takes 1000 strikes to drive the pile, 10 * Log_{10}(1000) = 30dB, the cumulative SEL would be 195 dB; (165 dB + (10*$_{Log10}$ (1,000)) = 195 dB).

Table 1 - Definitions of Underwater Acoustical Terms

TERM	DEFINITIONS
Peak Sound Pressure, unweighted (dB), dB re 1 µPa	Peak sound pressure level is based on the largest absolute value of the instantaneous sound pressure. This pressure is expressed in this report as a decibel (referenced to a pressure of 1 µPa) but can also be expressed in units of pressure, such as µPa or PSI.
RMS Sound Pressure Level, dB re 1 µPa	The square root of the average of the squared pressures over the time that comprises that portion of the waveform containing 90 percent of the sound energy for one pile driving impulse.[3] This measure is typically used to assess acoustical impacts on marine mammals.
Sound Exposure Level (SEL), dB re 1 µPa^2 sec	Proportionally equivalent to the time integral of the pressure squared and is described in this report in terms of dB re 1 µPa^2 sec over the duration of the impulse. Similar to the unweighted SEL standardized in airborne acoustics to study noise from single events.
Cumulative SEL, dB re 1 µPa^2 sec	A measure of the total energy received through a pile driving event (here defined as pile driving that occurs within a day).
Waveforms, µPa over time	A graphical plot illustrating the time history of positive and negative sound pressure of individual pile strikes and shown as a plot of µPa over time (i.e., seconds).
Frequency Spectra, dB over the frequency range	A graphical plot illustrating the distribution of sound pressure vs. frequency for a waveform, dimension in RMS pressure and defined frequency bandwidth. Typically, the power spectral density is used, with units of dB re 1 uPa2/Hz

[3] The underwater sound measurement results obtained during the California Department of Transportation Pile Installation Demonstration Project (2001 – 2003) indicated that most pile driving impulses occurred over a 50 to 100 millisecond (msec) period. Most of the energy was contained in the first 30 to 50 msec. Analysis of that underwater acoustic data for various pile strikes at various distances demonstrated that the acoustic signal measured using the standard “impulse exponential-time-weighting” (35-msec rise time) correlated to the RMS (impulse) level measured over the duration of the impulse.

Figure 1 – Underwater Acoustical Characteristics of a Pile Driving Pulse



Underwater Sound Thresholds

Under the Marine Mammal Protection Act, levels of harassment are defined for marine mammals. Level A harassment means "any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild." Level B harassment is "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."

Table 2 below outlines the current adopted Level A harassment (injury) and Level B harassment (behavior) marine mammal sound criteria. The application of the 120 dB RMS threshold for non-impulsive continuous sound, like drilling, can sometimes be problematic because this threshold level can be either at or below the ambient noise level of certain locations. For continuous sounds, NMFS has provided guidance for reporting RMS sound pressure levels [4]. RMS levels are based on a time-constant of 10 seconds; RMS levels should be averaged across the entire event. For impact pile driving, the overall RMS level should be characterized by integrating sound for each acoustic pulse across 90 percent of the acoustic energy in each pulse and averaging all the RMS for all pulses.

[4] NMFS 2012 Guidance Document: Data Collection Methods to Characterize Impact and Vibratory Pile Driving Source Levels Relevant to Marine Mammals

Current NMFS guidance categorizes marine mammals into several hearing groups, as shown in Table 3. For this project location, functional hearing groups assumed to be present include low-frequency cetaceans (humpback and gray whales), high-frequency cetaceans (harbor porpoise), phocid pinnipeds (harbor and northern elephant seals) and otariid pinnipeds (Steller, California sea lions, and northern fur seals).[5] Level A harassment (injury) takes into consideration the onset of auditory injury thresholds as defined by permanent threshold shifts (PTS). Level A harassment thresholds are distinct for each hearing group, based on the frequency-weighted hearing sensitivity of the associated species. Exposure to impulse sounds includes the evaluation of the Peak and SEL_{cum} as a dual criterion, whereas exposure to continuous sound relies solely on the SEL_{cum}.

Level B harassment (behavior) is considered to have occurred when marine mammals are exposed to sounds of 160 dB RMS or greater for impulse sounds (e.g., impact pile driving) and 120 dB RMS or greater for non-impulsive continuous sounds (e.g., vibratory pile driving, drilling). The application of the 120 dB RMS threshold can sometimes be problematic because this threshold level can be either at or below the ambient noise level of certain locations.

Table 2 - Adopted Underwater Acoustic Criteria for Marine Mammals

<table>
<tr><th rowspan="3">Species Hearing Group</th><th colspan="2">Non-Impulse Sound
(Drilling and Vibratory Pile Driving)</th><th colspan="3">Impulse Sound
(Core Sampling and Impact Pile Driving)</th></tr>
<tr><th rowspan="2">Level A
(dB SEL_{cum})</th><th rowspan="2">Level B
(dB RMS)</th><th colspan="2">Level A Dual Criteria</th><th rowspan="2">Level B
(dB RMS)</th></tr>
<tr><th>(dB Peak SPL)</th><th>(dB SEL_{cum})</th></tr>
<tr><td>Low-Frequency Cetaceans
(baleen whales)</td><td>199</td><td rowspan="5">120</td><td>219</td><td>183</td><td rowspan="5">160</td></tr>
<tr><td>Mid-Frequency Cetaceans
(dolphins, toothed whales, beaked whales, bottlenose whales)</td><td>198</td><td>230</td><td>185</td></tr>
<tr><td>High-Frequency Cetaceans
(true porpoises, Kogia, river dolphins, cephalorhynchid, Lagenorhynchus cruciger and L.australis)</td><td>173</td><td>202</td><td>155</td></tr>
<tr><td>Phocids
(true seals)</td><td>201</td><td>218</td><td>185</td></tr>
<tr><td>Otariids
(sea lions and fur seals)</td><td>219</td><td>232</td><td>203</td></tr>
<tr><td colspan="6">Note: All decibels (dB) are referenced to 1 micro-Pascal (re: 1 μPa).</td></tr>
</table>

[5] NMFS. 2016 Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts. July.

Table 3 - Marine Mammal Hearing Groups

Hearing Group	Generalized Hearing Range*
Low-Frequency cetaceans	7 Hz to 35 kHz**
Mid-Frequency cetaceans	150 Hz to 160 kHz
High-Frequency cetaceans	275 Hz to 160 kHz
Phocid pinnipeds	50 Hz to 86 kHz
Otariid pinnipeds	60 Hz to 39 kHz

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

** Hertz (Hz) and kilohertz (kHz)

Underwater Sound-Generating Activities

There are several noise sources associated with the project with the primary source of underwater sound being the various pile driving activities. Within the Project Area, the area of remediation activities is divided into the following five remedial response areas:

- Area A – Pier 43½ offshore area and western limit of the remedial response areas to the east of Pier 45.
- Area B – Pier 43 offshore area which includes two subareas (B1 and B2).
- Area C – Pier 41½ offshore area (Area C2) and the area under Pier 41½ (Area C1).
- Area D – Pier 39 West Basin; and
- Area E – Pier 39 East Basin and eastern limit of the remedial response areas.

Work within these response areas would include the following:

A. **Dredging** - Impacted sediment would be removed using mechanical dredges, operated primarily from water-based equipment consisting of a barge-mounted crane or excavator, typically outfitted with an environmental clamshell bucket, modified excavation bucket, or conventional excavation bucket, based on the material type being dredged. Diver-assisted micro (hydraulic) dredging, land-based excavation using a mini-excavator, and/or manual labor could be used to perform removal in areas beneath docks, piers, or wharves that are inaccessible to water-based mechanical dredge equipment.

B. **Capping -** After debris removal and dredging is complete, impacted sediment to be left in place would be physically/chemically isolated through the placement of a cap and/or armor layer where necessary to protect against erosion (scour) caused by ferry and boat traffic and other foreseeable operational uses.

Cap and armor material options include granular cap media (e.g., sand or rock), bay mud, and/or beneficial reuse of clean dredge materials from the Bay, which is generally a mixture of bay mud and coarser grained sediments (silts and sands).

Cap materials would be placed using barge-mounted cranes or excavators, using broadcasting equipment (e.g., conveyors, impellers), or by pumping as a slurry, depending on access.

C. **Pile Driving** - The primary underwater noise generation would be from the removal and installation of various pile types. There are four project components where pile driving will be required. The first is for water quality and containment where steel H-piles or up to 24-inch diameter steel shell piles are expected to be driven at key locations to facilitate turbidity curtain configurations. The piles, along with temporary anchoring locations (such as an anchor barge), would allow for shifting curtain configurations as work progresses through each Area (see Table 4). These temporary piles would be removed upon completion of work each construction season. Piles may be installed, removed, and temporarily stored for eventual reuse. The second project component involving pile driving where existing docks will need to be removed, replace, or temporarily relocated replaced to allow the dredging and cap installation. Thirdly, slope stabilization may be necessary in certain areas of the Project. Soil pinning could be used to promote slope stability, if necessary, pending further design evaluations. Soil pinning would include the installation of an array of approximately 16-inch diameter tapered piles (e.g., timber) at approximately 6-foot centers across the face of select areas. These permanent piles would be installed vertically to a depth of approximately 25 feet below the dredge surface elevation, using impact or vibratory methods, in a uniform array across the face of select dredge slopes. Finally, 18-inch composite plastic piles will be installed with an impact hammer (and removed) using to gather hydroacoustic data.

D. **Relocation of Red and White Fleet -** Relocation of the RWF would require removal of piles and overwater structures at the current existing location. Facilities would be reconstructed, in-kind adjacent to Pier 45, south of the USS Pampanito. Reconstruction of the temporary berthing facility would require placement of approximately 16 coated steel pipe piles (8, 36-inch diameter guide piles and 8, 24-inch diameter fender piles). Piles would be installed using vibratory methods; if an impact hammer is required to seat piles work would be restricted to occur between June 1 and October 30.

Table 5 – Summary of Pile Installation Locations and Number of Piles

Description	Remedial Response Area					TOTAL
	A	B	C	D	E	
Hydroacoustic Data Collection Test Piles (temporary): 18-inch composite plastic piles	10					
Turbidity Curtain Piles (temporary): Steel H-Pile or shell piles less than 24-inches in diameter	12	8	16	9	6	51
RWF Temporary Relocation Piles: Fender- 24-inch diameter coated steel pipe piles. Guide- 36-inch diameter coated steel pipe piles	0	0	0	0	226	226
Sediment Pin Installation (permanent): 16-inch tapered timber or composite piles	120	0	500	310	325	1,255
Relocation of Red and White Fleet	16	0	0	0	0	16

Discussion of Dredging and Capping Underwater Noise Levels from Construction

Underwater noise generated by dredging and capping activities originates primarily from the bucket, dredge equipment mechanisms, and sounds generated by the engine and propeller of the vessel. The active waterfront within the project limits supports extensive vessel traffic including the San Francisco Ferry (from Pier 41 with up to 16 trips a day), Red and White fleet (from Pier 43½ with up to 25 trips a day), and Blue and Gold fleet (from Piers 39 (West Basin) and Pier 41 with up to 21 trips a day). In addition, multiple other commercial industries operate vessels within the project limits.

Consistent with findings within the Biological Opinion issued for the Long-Term Management Strategy for the Placement of Dredged Material in the San Francisco Bay Region (LTMS), proposed dredging and capping would not generate noise that would rise to levels that would result in hearing loss, physical injury, or mortality of listed fish. Noise generated by dredging operations may result in behavioral changes including startling, avoidance of the remedial response area in which dredging is occurring, or the departure of fish (including green sturgeon) from the immediate vicinity of the activity. As such, it is not expected that dredging and capping would generate noise levels that would result in take or would produce higher than typical background noise within the project limits.

Temporary Relocation of Red and White Fleet

Relocation of the Red White Fleet would require removal of piles and overwater structures at the current existing location. Facilities would be reconstructed, in-kind adjacent to Pier 45, south of the USS Pampanito. Reconstruction of the temporary berthing facility would require placement of approximately 16 coated steel pipe piles (8, 36-inch diameter guide piles and 8, 24-inch diameter fender piles). Piles would be installed using vibratory methods; if an impact hammer is required to seat piles work would be restricted to occur between June 1 and October 30. Impact hammering is anticipated to occur over relatively short durations that are estimated to include up to 400 pile strikes.

Estimation of Underwater Sound Levels from Project Pile Driving

Sounds from pile driving and dredging operations have been measured in water in multiple locations. As shown in Table 5 most of the pile driving on this project will involve removing and reinstalling timber piles in Remedial Response Area E. The remainder of the pile driving will occur at various locations within all the Remedial Response Areas for the purpose of water quality containment. The data used to estimate the impact zones from the various pile driving activities was gathered from the Caltrans Compendium.[6] Table 6 presents a summary of the measured underwater sound levels in these studies that were used in this analysis.

Based on site-specific assumptions and preliminary scoping by the construction estimator, it is anticipated that the installation of each pile will require between 150 and 400 strikes for impact driving and up to 20 minutes for vibratory driving. Up to approximately 20 timber and 10 steel piles will be installed per day. It is anticipated that up to 10 pairs of sheet piles will be installed per day, whereas four piles will be installed per day for all other pile types, up to the maximum number of piles proposed.

Table 6 – Data Used in Analysis of Pile Driving Operations

Pile type	Duration or Pile strikes	Piles per day	Distance (Meters)	Peak (dB re 1µPa)	RMS (dB re 1µPa)	One Second SEL (dB re 1µPa)
Timber Pile - Impact	400 strikes	20	10	184	157	145
Timber Pile – Vibratory	20 minutes	20	10	--	158	158
24-inch Steel – Impact	400 Strikes	4	10	208	193	178
24-inch Steel – Vibratory	20 minutes	4	10	--	153	153
36-inch Steel – Vibratory	20 minutes	4	10	--	168	168
12x84 90-foot H-Pile Vibratory	10 minutes	4	10	--	143	143
14- to 16-inch Composite/Plastic – Impact	400 strikes	10	10	177	153	145
14- to 16-inch Composite/Plastic – Vibratory	20 minutes	10	10	--	152	152
18-inch Composite/Plastic – Impact[1]	400 strikes	10	10	185	160	150
18-inch Composite/Plastic – Vibratory[1]	20 minutes	10	10	--	152	152

[1] Data for 18-inch composite/plastic piles estimated from 13-inch plastic pile data from Compendium.

[6] Caltrans. 2020. *Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish*. November. Document prepared by ICF Jones & Stokes and Illingworth & Rodkin, Inc. under contract to Caltrans.

Discussion of Analysis

The various PTS Marine Mammal Thresholds are based on the following modeling assumptions:

1. The assumed production rate for timber piles was a maximum of twenty piles installed or removed per day.
2. For concrete piles, H-piles, and steel shell piles the production rate of four piles per day was used.
3. For composite piles, a production rate of 10 piles per day was used.
4. For impact driving of piles a 5 dB reduction in the sound levels was assumed to be achieved with attenuation, i.e., a bubble ring or dewatered isolation casing.

<u>Estimated Impacts to Marine Mammals</u>

The following threshold distances were computed to assess impacts to marine mammals:

- Distance to the onset of PTS Isopleth (Level A harrasment) for both attenuated and unattenuated underwater sound for each hearing group
- Distance for unweighted 120-dB RMS vibratory and 160-dB RMS Impulse Level B harassment isopleth for both attenuated and unattenuated underwater sound

The NMFS Companion User Spreadsheet (Version 2.0 [2020]) to the *National Marine Fisheries Service (NMFS): Technical Guidance for Assessing the Effects of Anthropogenic Noise on Marine Mammal Hearing: Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts* was used to predict zones where the onset of PTS to marine mammal hearing could occur. Source sound levels from Tables 5 and 6 were used to calculate PTS isopleths with a propagation assumption of 15 x Log(R1/R2). Computations for the vibratory driving of 36-inch piles used a site-specific propagation rate of 18.7 x Log(R1/R2). The default weighting factor adjustment of 2.0 kHz was applied to impact pile driving calculations and the default weighting factor adjustment of 2.5 kHz was applied to vibratory pile driving calculations. Screenshots of user spreadsheets used to calculate Level A harassment isopleths are shown in Appendix A.

The calculations of PTS threshold distances (isopleths) for impulsive sounds are based on a dual metric threshold between the higher level of the SEL_{cum} or Peak SPL. Since the onset of PTS based on the distance to the SEL_{cum} threshold isopleth is further from the pile for all pile types than it would be using Peak SPL computations, Tables 7 and 8 only includes PTS isopleths based SEL_{cum} computations since this represents the entire project area where Level A harassment could occur. The PTS isopleths based on Peak SPL computations are included in Appendix A. While distances are shown for areas of threshold exceedances, estimated to occur at less than 10 meters, monitoring is generally not performed within areas less than 10 meters of pile driving due to safety concerns and the inherent variability of drop-off rates in close proximity to the pile.

Table 7 shows the anticipated distances to the various adopted marine mammal sound thresholds for vibratory driving and Table 8 shows the distances for impact driving. Calculations of PTS threshold distances for maximum daily activity are shown in these tables and are included in Appendix A.

Table 7 – Distances in Meters to the Adopted Marine Mammal Thresholds for Vibratory Pile Driving

Activity		Level A injury Threshold (m) (SEL CUM)					Level B harassment zone (m)			
		Cetaceans			Pinnipeds		Cetaceans		Pinnipeds	
		LF	MF	HF	PW	OW	LF	MF	HF	PW
Timber Piles - Twenty Piles per day										
Timber Piles (12-18 inches)	Vibratory Removal	16	2	23	10	1	3,415			
H-Piles (Alternative Turbidity Piles) Four Piles per day										
12x84 H-Piles	Vibratory Pile Driving	<1	0	<1	<1	<1	341			
24-Inch Steel Shell Piles (Turbidity Piles) Four Piles per day										
24-inch Steel Pile	Vibratory	2	<1	4	2	<1	1,585			
36-Inch Steel Shell Piles Four Piles per day										
36-inch Steel Pile	Vibratory	20	3	28	14	2	3,688			
18-Inch Composite Piles Ten Piles per day										
18-inch Composite Pile	Vibratory	4	<1	6	2	<1	1,360			
14- to 16-Inch Composite Piles Ten Piles per day										
14- to 16-inch Composite Pile	Vibratory	4	<1	6	3	<1	1,360			

Table 8 – Distances in Meters to the Adopted Marine Mammal Thresholds for Impact Pile Driving

<table>
<tr><th colspan="2" rowspan="3">Activity</th><th colspan="5">Level A injury Threshold (m) (SEL CUM)</th><th colspan="5">Level B harassment Threshold (m)</th></tr>
<tr><th colspan="3">Cetaceans</th><th colspan="2">Pinnipeds</th><th colspan="3">Cetaceans</th><th colspan="2">Pinnipeds</th></tr>
<tr><th>LF</th><th>MF</th><th>HF</th><th>PW</th><th>OW</th><th>LF</th><th>MF</th><th>HF</th><th>PW</th><th>OW</th></tr>
<tr><td colspan="12">Timber Piles - Twenty Piles per day</td></tr>
<tr><td>Timber Piles (12-18 inches)</td><td>Impact Installation</td><td>12</td><td><1</td><td>14</td><td>6</td><td><1</td><td colspan="5"><10</td></tr>
<tr><td colspan="12">24-Inch Steel Shell Piles (Turbidity Piles) Four Piles per day</td></tr>
<tr><td>24-inch Steel Pile</td><td>Impact</td><td>634</td><td>23</td><td>755</td><td>339</td><td>25</td><td colspan="5">1,585</td></tr>
<tr><td></td><td>Impact Attenuated</td><td>294</td><td>11</td><td>351</td><td>158</td><td>12</td><td colspan="5">736</td></tr>
<tr><td colspan="12">13-Inch Composite/Plastic piles Ten Piles per day</td></tr>
<tr><td rowspan="2">14- to 16-inch Composite/Plastic Piles</td><td>Impact Installation</td><td>7</td><td><1</td><td>9</td><td>4</td><td><1</td><td colspan="5"><10</td></tr>
<tr><td>Impact Attenuated</td><td>3</td><td><1</td><td>4</td><td>2</td><td><1</td><td colspan="5"><10</td></tr>
<tr><td colspan="12">18-Inch Composite/Plastic piles Ten Piles per day</td></tr>
<tr><td rowspan="2">18-inch Composite/Plastic Piles</td><td>Impact Installation</td><td>16</td><td><1</td><td>19</td><td>9</td><td><1</td><td colspan="5">10</td></tr>
<tr><td>Impact Attenuated</td><td>7</td><td><1</td><td>9</td><td>4</td><td><1</td><td colspan="5"><10</td></tr>
</table>

The distances to the PTS or Level A harassment for unattenuated impact pile driving would occur during the installation of the largest piles, the 24-inch steel shell piles. Sound levels from the installation of the these piles can be mitigated/reduced by including an attenuation device such as a bubble curtain. With attenuation during the driving of the 24-inch piles the distances to the Level A harassment zone would be reduced for the harbor seals from 339 meters to 158 meters and for the California sea lions from 25 to 12 meters. The bulk of the pile driving would be the removal and installation of timber piles in Area E where 226 piles would need to be removed and replaced. The Level A harassment zone for this operation would be a maximum of 6 meters for harbor seals and less than a meter for California sea lions.

AIRBORNE NOISE

Fundamentals of Airborne Noise

Sound from a single source (i.e., a "point" source) radiates uniformly outward in a spherical pattern as it travels away from the source. The sound level attenuates (or drops off) at a rate of 6 dBA for each doubling of distance. Usually, the noise path between the source and the observer is very close to the ground. Noise attenuation from ground absorption and reflective wave canceling adds to the rate of attenuation. Traditionally, the excess attenuation has also been expressed in terms of attenuation per doubling of distance. This approximation is done for simplification only; for distances of less than 300 feet, prediction results based on this scheme are sufficiently accurate. For acoustically "hard" sites (i.e., sites with a reflective surface such as a smooth body of water between the source and the receiver), no excess ground attenuation is assumed.

Sounds generated from construction activities are considered point sources, rather than a line source such as a freeway or roadway. The marine environment around the project site is mostly water and would be considered a "hard" site. The Transmission Loss drop-off rate of sound is based on spherical spreading loss (a 20 $\log_{10}$ function). This equates to a 6-dB reduction in sound per doubling distance. The formula for calculating the drop-off is the source level plus $20*\text{Log}_{10}(D_1/D_2)$, where D_1 is the reference position and D_2 is the receiver position. For example, if a drop hammer has a reference level of 83 dBA at 50 feet the noise level at 500 feet would be calculated as follows for conditions where excess attenuation is not anticipated:

Received level at 50 feet = 83 dBA

+20Log$_{10}$*(50/500) dBA Received level*

=110+(-20) dBA

Received level at 500 feet = 63 dBA

Airborne Criteria for Marine Mammals

The criteria used for disturbance of marine mammals is 90 dB RMS (unweighted) for harbor seals, and 100 dB RMS (unweighted) for sea lions and all other pinnipeds (re: 20 $\mu Pa^2 sec$).[7] Acoustic in-air thresholds for marine mammals specified by NOAA Fisheries are unweighted and should not be confused with A-weighted metrics used for human hearing.

Modeling Inputs

There are relatively few data regarding the unweighted sound levels for continuous or pulse sound. Table 10 shows the L_{max}[8] measured (unweighted levels) for vibratory and impact pile driving at Norfolk Naval station and the Joint Expeditionary Force Base Little Creek and 24-inch concrete pile at Craney Island near Naval Station Norfolk in Norfolk, Virginia. Data from the Waterfront Repairs at the USCG Station in Monterey was used for the 24-inch steel shell piles. The pile size measured was 18-inch steel shell piles which would produce similar noise levels as the 24-inch

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[7] Source: https://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/threshold_guidance.html

[8] L_{max} level is the typical maximum RMS sound level measured with a Sound Level Meter set to the "fast" response (or 1/8th second response time). The Leq is the energy average sound level measured over a driving event.

steel shell piles.[9] Airborne Noise Levels for Impact and Vibratory Pile Driving of 36-inch steel piles were taken from the Bangor Test Pile Program[10].Table 9 shows the median measured levels (unweighted) for both vibratory and impact pile driving sound levels used in this analysis.

Table 9 – Airborne Noise Levels from Vibratory and Impact Pile Driving

Measurement	L_{max} at 15 m, dB
H-Pile Vibratory Installation	78
H-Pile Vibratory Removal	82
H-Pile Impact	103
24-inch Steel Shell Impact	108
24 and 36-Inch Steel Shell Vibratory	100
36-Inch Steel Pipe Impact	112
Concrete Pile driving	100
Concrete Pile Vibratory	95
Timber Pile Vibratory	102
Timber Pile Impact Installation	96
Sheet Pile Vibratory Installation	91
Sheet Pile Impact Installation	100

Airborne Impacts from Vibratory Pile Driving/Removal

Measured Lmax sound levels for the vibratory pile driving and removal varied from as low as 78 dB to as high as 100 dB at 15 meters. A 20 $\log_{10}$ attenuation rate was used to calculate the distances to the various NMFS thresholds that are presented in Table 10. The distances shown are based on the unweighted L_{max} levels.

Table 10 – Distance to Disturbance Thresholds for Vibratory Pile Installation and Removal Based on L_{max} Criteria

Operation	**Disturbance Distance (meters)**	
	100 dB (California sea lions)	**90 dB (Pacific harbor seals)**
H-Pile Vibratory Installation	2	4
H-Pile Vibratory Removal	2	6
24 and 36-inch Steel Shell	15	48
Composite Pile Vibratory	8	27
Timber Pile Vibratory Installation/Removal	19	60

[9] Illingworth and Rodkin, Inc. 2018. Waterfront Repairs at USCG Station Monterey Monitoring Report. Report. Submitted to Rincon Consultants, Inc., California

[10] U.S Navy Base Kitsap, Bangor Test Pile Program (2012)

Airborne Impacts from Impact Hammering

Measured L_{max} sound levels for the impact pile driving varied from as low as 84 dB to as high as 112 dB at 15 meters. A 20 $\log_{10}$ attenuation rate was used to calculate the distances to the various NMFS thresholds that are presented in Table 11. The distances shown are based on the unweighted L_{max} levels.

Table 11 – Distance to Level B Thresholds for Impact Pile Driving Based on L_{max} Criteria

Operation	**Distance (meters)**	
	100 dB (California sea lions)	**90 dB (Pacific harbor seals)**
24-Inch Steel	38	119
Composite Piles	15	47
Timber Pile	9	30

Discussion

During the vibratory work and depending on the type of pile being installed, the disturbance area (Level B harassment) for the Pacific harbor seals when on the docks or land (e.g., haul-outs) would be between 4 and 48 meters of the vibratory installation of the different types of piles. Harbor seal disturbance areas would extend out 30 to 119 meters with impact driving. The disturbance area for the California sea lions would be much smaller than for the harbor seals, extending out to 20 meters for vibratory driving and 38 meters for impact driving. California sea lions on the docks or land would typically be 15 to 60 meters. The bulk of the pile driving would be during the removal and installation of the timber piles. During these operations, the distance to the disturbance thresholds would be 19 to 60 meters, depending on the seal type for both impact and vibratory pile driving.

APPENDIX A – NMFS Spreadsheet Inputs

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

VERSION 2.2: 2020

KEY

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

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Pier 39 to 43 ½ Sediment Remediation Project
PROJECT/SOURCE INFORMATION	Timber pile removal at Port Townsend 2010

Please include any assumptions

PROJECT CONTACT	Keith Pommerenck - Illingworth & Rodkin (707) 794-0400 Ext. 107

STEP 2: WEIGHTING FACTOR ADJUSTMENT

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

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

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

STEP 3: SOURCE-SPECIFIC INFORMATION

Sound Pressure Level (L_{rms}), specified at "x" meters (Cell B30)	158
Number of piles within 24-h period	20
Duration to drive a single pile (minutes)	20
Duration of Sound Production within 24-h period (seconds)	24000
10 Log (duration of sound production	43.80
Transmission loss coefficient	15
Distance of sound pressure level (L_{rms}) measurement (meters)	10

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

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	**15.3**	**1.4**	**22.6**	**9.3**	**0.7**

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.

Timber Piles (Vibratory), *Underwater sound based on consultation with NMFS*[11]

[11] Email from Cara Hotchkin (NOAA), dated September 26, 2023: *For timber piles, we do not have site-specific data on propagation loss, and will therefore apply practical spreading (TL=15). With respect to source level, instead of the highest measured value, we propose the average of the five available projects (SL = 158 dB RMS).*

VIBRATORY PILE DRIVING REPORT

PRINT IN **LANDSCAPE** TO CAPTURE ENTIRE SCREEN

VERSION 1.2-Multi-Species: 2022

(if OTHER INFO or NOTES get cut-off, please include information elsewhere)

Pier 39 to 43 1/2 Sediment Remediation Project

PROJECT INFORMATION	RMS
Sound pressure level (dB)	152
Distance associated with sound pressure level (meters)	10
Transmission loss constant	15
Number of piles per day	10
Duration to drive pile (minutes)	20
Duration of sound production in day	12000
Cumulative SEL at measured distance	193

OTHER INFO: Timber Piles used as surrogate for composite piles

NOTES: extra information

Attenuation: 0

RESULTANT ISOPLETHS
(Range to Effects)

FISHES

Fishes present	BEHAVIOR RMS Isopleth
ISOPLETHS (meters)	13.6
ISOPLETHS (feet)	44.6

SEA TURTLES

NO SEA TURTLE	PTS ONSET SEL_{cum} Isopleth	BEHAVIOR RMS Isopleth
ISOPLETHS (meters)	0.2	0.3
ISOPLETHS (feet)	0.5	1.0

MARINE MAMMALS

	LF Cetacean	MF Cetaceans	HF Cetaceans	PW Pinniped	OW Pinnipeds
PTS ONSET (SELcum isopleth, meters)	3.8	0.3	5.7	2.3	0.2
PTS ONSET (SELcum isopleth, feet)	12.6	1.1	18.6	7.6	0.5
	ALL MM	MF Cet. presen	HF Cet. present	Phocids present	Otariids present
Behavior (RMS isopleth, meters)	1,359.4	LF Cet. present			
Behavior (RMS isopleth, feet)	4,459.8				

Composite Piles (Vibratory), *Underwater sound based on consultation with NMFS*[11]

VERSION 2.2: 2020

KEY

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

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Pier 39 to 43 ½ Sediment Remediation Project
PROJECT/SOURCE INFORMATION	H-Piles - Parson Slough 2011
Please include any assumptions	
PROJECT CONTACT	Keith Pommerenck - Illingworth & Rodkin (707) 794-0400 Ext. 107

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)	143
Number of piles within 24-h period	4
Duration to drive a single pile (minutes)	10
Duration of Sound Production within 24-h period (seconds)	2400
10 Log (duration of sound production	33.80
Transmission loss coefficient	15
Distance of sound pressure level (L_{rms}) measurement (meters)	10

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

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	0.3	0.0	0.5	0.2	0.0

Steel H Piles (Vibratory), Parson Slough Sill Project, Moss Landing, CA – Table I.4-6; *Caltrans. 2020. Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish. November*. Document prepared by ICF Jones & Stokes and Illingworth & Rodkin, Inc. under contract to Caltrans.

VERSION 2.2: 2020

KEY

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

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Pier 39 to 43 ½ Sediment Remediation Project
PROJECT/SOURCE INFORMATION	24-inch Steel Pipe pile Prichard Lake Project
Please include any assumptions	
PROJECT CONTACT	Keith Pommerenck - Illingworth & Rodkin (707) 794-0400 Ext. 107

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)	153
Number of piles within 24-h period	4
Duration to drive a single pile (minutes)	20
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)	2.4	0.2	3.6	1.5	0.1

24-inch Steel pipe Piles (Vibratory), Prichard Lake Pumping Station, Sacramento, CA – Table I.2-1a; *Caltrans. 2020. Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish. November*. Document prepared by ICF Jones & Stokes and Illingworth & Rodkin, Inc. under contract to Caltrans.

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

VERSION 2.2: 2020

KEY

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

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Pier 39 to 43 ½ Sediment Remediation Project
PROJECT/SOURCE INFORMATION	36-inch Steel Pipe pile WETA Downtown Ferry San Francisco, CA & NMFS

Please include any assumptions

PROJECT CONTACT	Adwait Ambaskar - Illingworth & Rodkin (707) 794-0400 Ext. 111

STEP 2: WEIGHTING FACTOR ADJUSTMENT

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

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

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

STEP 3: SOURCE-SPECIFIC INFORMATION

Sound Pressure Level (L_{rms}), specified at "x" meters (Cell B30)	168
Number of piles within 24-h period	4
Duration to drive a single pile (minutes)	20
Duration of Sound Production within 24-h period (seconds)	4800
10 Log (duration of sound production	36.81
Transmission loss coefficient	18.7
Distance of sound pressure level (L_{rms}) measurement (meters)	10

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

RESULTANT ISOPLETHS

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	199	198	173	201	219
PTS Isopleth to threshold (meters)	**20.3**	**2.9**	**27.8**	**13.6**	**1.6**

WEIGHTING FUNCTION CALCULATIONS

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

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

36-inch Steel pipe Piles (Vibratory), Based on consultation with NMFS[12].

[12] Email from Cara Hotchkin (NOAA), dated September 26, 2023: For 36" pipe piles, we accept the average TL value of 18.7 shown in the WETA report. With respect to source level, instead of the highest measured value of those we sent previously, we propose the average of the San Francisco Bay measurements (SL = 168 dB RMS).

VERSION 2.2: 2020

KEY

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

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Pier 39 to 43 ½ Sediment Remediation Project
PROJECT/SOURCE INFORMATION	Cpncrete Piles - Data from Timber Piles

Please include any assumptions

PROJECT CONTACT	Keith Pommerenck - Illingworth & Rodkin (707) 794-0400 Ext. 107

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)	150
Number of piles within 24-h period	4
Duration to drive a single pile (minutes)	20
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)	**1.5**	**0.1**	**2.3**	**0.9**	**0.1**

PROJECT TITLE	Pier 39 to 43 ½ Sediment Remediation Project
PROJECT/SOURCE INFORMATION	Timber Piles - Pier 39 Dock Repairs

Please include any assumptions

PROJECT CONTACT	Keith Pommerenck - Illingworth & Rodkin (707) 794-0400 Ext. 107

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-specifi 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-

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)	184.0

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	145
Number of strikes per pile	400
Number of piles per day	20
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)	184
Distance of $L_{p,0\text{-}pk}$ measurement (meters)+	10
$L_{p,0\text{-}pk}$ Source level	199.0

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)	11.7	0.4	13.9	6.3	0.5
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.

14-inch Timber Piles (Impact), Pier 39, San Francisco Bay, CA – Table I.2 – 1d. (Page I-17); *Caltrans. 2020. Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish. November*. Document prepared by ICF Jones & Stokes and Illingworth & Rodkin, Inc. under contract to Caltrans.

VERSION 2.2: 2020

KEY

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

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE	Pier 39 to 43 ½ Sediment Remediation Project
PROJECT/SOURCE INFORMATION	24-inch Steel Pipe Piles Prichard Lake

Please include any assumptions

PROJECT CONTACT	Keith Pommerenck - Illingworth & Rodkin (707) 794-0400 Ext. 107

STEP 2: WEIGHTING FACTOR ADJUSTMENT

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

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

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

STEP 3: SOURCE-SPECIFIC INFORMATION

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

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

Unweighted $SEL_{cum\ (at\ measured\ distance)}$ = SEL_{ss} + 10 Log (# strikes)	**210.0**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	178
Number of strikes per pile	400
Number of piles per day	4
Transmission loss coefficient	15
Distance of single strike SEL_{ss} ($L_{E,p,\ single\ strike}$) measurement (meters)	10

PK

$L_{p,0\text{-}pk}$ specified at "x" meters (Cell G29)	208
Distance of $L_{p,0\text{-}pk}$ measurement (meters)	10
$L_{p,0\text{-}pk}$ Source level	223.0

RESULTANT ISOPLETHS*

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

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	183	185	155	185	203
PTS Isopleth to threshold (meters)	**634.1**	**22.6**	**755.3**	**339.3**	**24.7**
PK Threshold	219	230	202	218	232
PTS PK Isopleth to threshold (meters)	**1.8**	**NA**	**25.1**	**2.2**	**NA**

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

24-inch Steel pipe Piles (Impact), Illingworth & Rodkin, Inc. 2014. *Memo to Elena Barnett (HDR, Inc.) transmitting Underwater Sound Measurement Results for Port of Coeymans Pile Driving, New York/Tappan Zee Bridge*. November 21 and December 2.

PROJECT TITLE	Pier 39 to 43 ½ Sediment Remediation Project
PROJECT/SOURCE INFORMATION	13-inch Composite/Plastic piles from Compendium data

Please include any assumptions

PROJECT CONTACT	Adwait Ambaskar - Illingworth & Rodkin (707) 794-0400 Ext. 111

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-spec 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

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)	181.0

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p,\ single\ strike}$) specified at "x" meters (Cell B32)	145
Number of strikes per pile	400
Number of piles per day	10
Transmission loss coefficient	15
Distance of single strike SEL_{ss} ($L_{E,p,\ single\ strike}$) measurement (meters)	10

PK

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

RESULTANT ISOPLETHS*

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

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	183	185	155	185	203
PTS Isopleth to threshold (meters)	7.4	0.3	8.8	3.9	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.

13-inch Plastic piles (Impact), SR37 fender repair, Napa, CA – Table I.2 – 1d. (Page I-17); *Caltrans. 2020. Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish. November*. Document prepared by ICF Jones & Stokes and Illingworth & Rodkin, Inc. under contract to Caltrans.

PROJECT TITLE	Pier 39 to 43 ½ Sediment Remediation Project
PROJECT/SOURCE INFORMATION	18-inch Composite/Plastic piles estimated from Compendium data
Please include any assumptions	
PROJECT CONTACT	Adwait Ambaskar - Illingworth & Rodkin (707) 794-0400 Ext. 111

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-spec 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

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

Unweighted SEL_{cum} (at measured distance) = SEL_{ss} + 10 Log (# strikes)	**186.0**

SEL_{cum}

Single Strike SEL_{ss} ($L_{E,p, single strike}$) specified at "x" meters (Cell B32)	150
Number of strikes per pile	400
Number of piles per day	10
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)	185
Distance of $L_{p,0-pk}$ measurement (meters)[+]	10
$L_{p,0-pk}$ Source level	200.0

RESULTANT ISOPLETHS*

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

Hearing Group	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds
SEL_{cum} Threshold	183	185	155	185	203
PTS Isopleth to threshold (meters)	**15.9**	**0.6**	**18.9**	**8.5**	**0.6**
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.

National Marine Fisheries Service
Office of Protected Resources

Marine Mammal Monitoring Plan

Piers 39 to 43½ Sediment Remediation Project, Remedial Response Areas A and B

San Francisco, San Francisco County, California

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March 16, 2022
Revised: July 11 2023; November 16, 2023

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ACRONYMS AND ABBREVIATIONS

Applicant	Pacific Gas and Electric Company
dB	decibel
ESA	Federal Endangered Species Act
HF cetacean	high-frequency cetacean
IHA	Incidental Harassment Authorization
I&R	Illingworth and Rodkin, Inc.
LF cetacean	low-frequency cetacean
MF cetacean	mid-frequency cetacean
MGP	manufactured gas plant
MMSZ	marine mammal shutdown zone
MMMP	Marine Mammal Monitoring Plan
MMO	Marine Mammal Observer
MMPA	Marine Mammal Protection Act
MMSZ	marine mammal shutdown zones
MZ	monitoring zone
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OPR	Office of Protected Resources
OW	otariids
PAH	polycyclic aromatic hydrocarbon
Peak	peak pressure
PG&E	Pacific Gas and Electric Company
Project	Piers 39 to 43½ Sediment Remediation Project
PSO	Protected Species Observer
PTS	permanent threshold shift
PW	phocids
re 1μPa	reference 1 micro-Pascal
RMS	root mean square

RWF	Red and White Fleet
SELcum	cumulative sound exposure level
SPL	sound pressure level
TTS	temporary threshold shift

1 DESCRIPTION OF SPECIFIED ACTIVITY

1.1 PROJECT SUMMARY

Pacific Gas and Electric Company (PG&E; Applicant) has requested an incidental harassment authorization (IHA) to authorize incidental take of marine mammals by Level B harassment from activities to be conducted during the Piers 39 to 43½ Sediment Remediation Project (the Project), Remedial Response Areas A and B.

Project components generating Level B harassment hydroacoustic effects would include the following:

- **Hydroacoustic Data Collection Test Piles**: Impact hammer installation and vibratory removal of up to 10, 18-inch composite plastic piles may occur to gather hydroacoustic data to inform future IHA requests for Remedial Response Area E.
- **Turbidity Curtain Pile Installations**: Steel H-piles or steel shell piles, approximately 20, less than 24-inches in diameter, installed or removed using vibratory methods.
- **Red and White Fleet (RWF) Temporary Relocation Piles**: Relocation of the temporary berthing facility would require placement of approximately 16 coated steel pipe piles (8, 36-inch diameter guide piles and 8, 24-inch diameter fender piles) using primarily vibratory hammer installation method. Occasionally, attenuated impact hammer may be required to install 24-inch fender piles.
- **Sediment Pin Installation**: Approximately, 120, 16-inch wood or composite tapered piles, primarily installed using vibratory hammer methods. Occasionally, an unattenuated impact hammer may be required to install sediment pins.

No Level A take of marine mammals is anticipated. The purpose of the project is to remediate (i.e., clean up) sediments impacted (i.e., contaminated) with polycyclic aromatic hydrocarbons (PAHs), likely attributable to the operations from the former Beach Street Manufactured Gas Plant (MGP), within the Project Area (Figure 1. Project Area and Vicinity Map), to protect human health and the environment. The Project will prevent toxicity to benthic invertebrates, birds, and humans who may be exposed to PAHs by consuming biota with PAH concentrations bioaccumulated in prey tissue via direct contact with sediments and associated pore water or through the aquatic food web. The recommended remedy would include a combination of dredging and capping and/or armoring of the impacted sediments to minimize or reduce exposure to the impacted sediment and provide erosion protection measures to mitigate scour caused by ferry and boat traffic and other foreseeable hydrodynamic forces, coupled with monitoring and institutional controls. In addition, the project would require slope stabilization to ensure slope integrity during a seismic event.

1.2 PURPOSE OF THE DOCUMENT

This Marine Mammal Monitoring Plan (MMMP) has been prepared based on guidance provided by National Oceanic and Atmospheric Administration's (NOAA) Office of Protected Resources (OPR). The MMMP discusses activities associated with sediment remediation within remedial response areas A and B, potential impacts to marine mammals from these activities, and methods for monitoring and reporting the activity of marine mammals near the remediation site.

2 BACKGROUND

2.1 MARINE MAMMAL SPECIES OF CONCERN

Nine species of marine mammals have the potential to occur within or near the Project Area, most commonly California sea lions (*Zalophus californianus*), Pacific harbor seals (*Phoca vitulina richardii*) and harbor porpoises (*Phocoena phocoena*). Less frequently, bottlenose dolphins (*Tursiops truncatus*) may be present in small numbers in the greater area of the Bay year-round. Northern elephant seals (*Mirounga angustirostris*), northern fur seals (*Callorhinus ursinus*), gray whales (*Eschrichtius robustus*), and humpback whales (*Megaptera novaengliae*) also enter the Bay seasonally, in low numbers. The Steller sea lion (*Eumetopias jubatus*) has been rarely documented at the Pier 39 K-Dock haulout. Incidental take authorization of seven of marine mammals, by Level B harassment from activities to be conducted during the Project, has been requested.

Only the humpback whale is listed as endangered under the Federal Endangered Species Act (ESA) and depleted under the Marine Mammal Protection Act (MMPA). Given the rarity of occurrence and highly visible nature of both whale species, work in the project area would be shut down if these species were to enter the project area's Level B harassment isopleth. Therefore, the Applicant is not requesting incidental take authorization of humpback or gray whales.

2.2 MARINE MAMMAL REGULATIONS

Under the MMPA, "take" is defined as to "*harass, hunt, capture, kill or collect, or attempt to harass, hunt, capture, kill or collect*" marine mammals. Under the 1994 Amendment to the MMPA, harassment is statutorily defined as "*any act of pursuit, torment, or annoyance which has the potential to injure or disturb a marine mammal or marine mammal stock in the wild*." Harassment which has the potential to injure a marine mammal is further defined as Level A harassment. Harassment which has the potential to disturb a marine mammal by disrupting behavioral patterns including, but not limited to migration, breathing, nursing, breeding, feeding, or sheltering, but which does not have the potential to injure a marine mammal, is defined as Level B harassment.

2.3 POTENTIAL IMPACTS ON MARINE MAMMALS FROM PILE DRIVING ACTIVITIES

Sound generated during pile driving required for sediment remediation activities have the potential to result in Level B "take by harassment" of marine mammals. Vibratory pile driving produces non- impulsive (continuous) noise that can cause behavioral disturbance to marine mammals and a temporary threshold shift (TTS) in an animal's hearing. Both behavioral disturbance and TTS are considered to be Level B harassment. These non-impulse sounds from vibratory pile driving can also cause slight injury in the form of a permanent threshold shift (PTS) in an animal's hearing, which is a form of Level A harassment. Impact pile driving produces impulsive noise that can cause behavioral disturbance and TTS to marine mammals (Level B harassment), and slight injury (i.e., PTS) in an animal's hearing (Level A harassment).

The National Marine Fisheries Service (NMFS) has established sound threshold criteria for behavioral disturbance (Level B harassment) and PTS (Level A harassment) to marine mammals from pile driving and other similar activities (Table 1).

The underwater sound pressure threshold for behavioral disturbance (Level B harassment) is 120 dB root-mean-square (RMS) for continuous sound (e.g., vibratory pile driving) and 160 dB RMS for impulsive sound (e.g., impact pile driving) for all species (Table 1). The underwater sound pressure threshold for slight auditory injury, PTS (Level A harassment), is a dual metric criterion, including both a peak pressure (Peak) and cumulative sound exposure level (SELcum) threshold that is specific to the species hearing group (i.e., low-frequency cetaceans (LF), mid-frequency cetaceans (MF), high-frequency cetaceans (HF), phocids (PW), and otariids (OW). Underwater sound pressure thresholds for Level B and Level A harassment for each marine mammal hearing group from continuous and impulsive sounds are shown in Table 1.

Table 1. Underwater Sound Threshold Criteria for Pile Driving

	Continuous Sound (Vibratory Pile Driving)		Impulse Sound (Impact Pile Driving)		
				Level A Dual Criteria	
Species Hearing Group	Level B (dB RMS)	Level A (dB SELcum)	Level B (dB RMS)	(dB Peak SPL)	(dB SELcum)
Low-frequency Cetaceans (baleen whales)	120	199	160	219	183
Mid-frequency Cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales)	120	198	160	230	185
High-frequency Cetaceans (e.g., true porpoises, *Kogia*, river dolphins, cephalorhynchids, *Lagenorrhynchus cruciger* and *L. australis*)	120	173	160	202	155
Phocids (true seals)	120	201	160	218	185
Otariids (e.g., sea lions and fur seals)	120	219	160	232	203

Note: All decibels (dB) are referenced to 1 micro Pascal (re: 1 µPa).

Source: NMFS 2018

2.4 AVOIDANCE AND MINIMIZATION MEASURES

The following measures would be taken to minimize the exposure of marine mammals and their habitat to the effects of sound from pile driving.

- Marine mammal monitoring will be conducted during all construction noise-generating activities (pile installations) to ensure that marine mammals do not enter Level A harassment zones and that marine mammal presence in the sound isopleth does not exceed authorized take levels. Construction will be shut down if a marine mammal observer (MMO) observes a humpback or gray whale approaching the Level B isopleth. As it is not practical to monitor the full zones for a project of this extended length, MMOs would be positioned such that at least 20 percent of the Level B zone is covered when monitoring is required. Efforts should be made to observe the maximum extent of the monitoring zone possible. Should use of an impact hammer be required for steel piles less than 24-inch diameter, be required, MMOs would be positioned such that 100 percent of the Level A zone is clearly visible.

- No pile driving or sediment sampling investigations will occur at night when MMOs are not able to visibly observe the project shutdown zones.
- Vibratory hammering may be conducted between March 15 to December 1 without attenuation.
- Only vibratory installation may be used to install steel piles; with the exceptions of occasional attenuated impact hammering required to seat RWF relocation piles less than 24-inches in diameter. Permanent timber or composite soil pins may be installed using vibratory or unattenuated impact installation methods.
- Sound attenuation would occur using a bubble curtain, when required. When a bubble curtain is required, the following performance standards shall be implemented:
  - The bubble curtain must distribute air bubbles around 100 percent of the piling perimeter for the full depth of the water column.
  - The lowest bubble ring shall be in contact with the mudline for the full circumference of the ring, and the weights attached to the bottom ring shall ensure 100 percent mudline contact. No parts of the ring or other objects shall prevent full mudline contact.
  - The contractor will ensure that personnel are trained in the proper balancing of air flow to the bubblers and will submit an inspection/performance report for approval by the Port within 72 hours following the performance test. Corrections to the attenuation device to meet the performance standards shall occur prior to impact driving.
- A soft start will be implemented before operating impact pile driving hammers at full capacity. The soft start will consist of an initial set of strikes at reduced energy, followed by a 30-second waiting period, then two subsequent reduced-energy strikes separated by the waiting period. A soft start will be implemented at the start of each day's impact pile driving and at any time following cessation of impact pile driving for 30 minutes or longer.

These measures will limit the intensity of pile driving sound in the marine environment. In addition, the use of vibratory hammers to install and remove piles where feasible, and employment of a soft start for the impact hammer, is expected to encourage marine mammals to move away from disturbance areas so that they are less likely to be present during full-power pile driving activities. Establishment of marine mammal shutdown zones (MMSZs) and implementation of this monitoring plan will ensure that no marine mammals are exposed to Level A sound thresholds, and that exposure of any animals to Level B sound thresholds is minimized and documented. Therefore, with these measures, the effects of the pile driving will be mitigated to the level of least practical adverse impact on marine mammals.

2.5 NOISE LEVELS FROM CONSTRUCTION ACTIVITIES

The distance to marine mammal threshold criteria corresponding to Level A and Level B harassment for sound generating activities for this Project have been modeled by the acoustic engineering firm Illingworth and Rodkin, Inc. (I&R), based on underwater sound and pressure measurements from similar construction activities (Caltrans 2020).

Threshold distances were calculated by I&R using the NMFS' User Spreadsheet Tool Version 2.0 associated with the 2020 revision of the Marine Mammal Hearing Technical Guidance (NMFS 2020; spreadsheet available at http://www.nmfs.noaa.gov/pr/acoustics/guidelines.html). For calculation of SELcum threshold distances, it was assumed that only one type and size of pile would be installed on the same day. Estimates are based on the number of piles to be driven each day are listed in Table 2 with the resulting estimated distances to the Level A and Level B marine mammal threshold criteria for each pile type summarized in Table 3. Monitoring zones are prescribed based on distances reported in Table 3. Some Level A thresholds have been rounded up for ease of use in the field.

Table 2. NMFS' User Spreadsheet Source Level Inputs

Vibratory Pile Driving					
	Duration (minutes)	Piles per Day	Peak1	RMS1	One-second SEL1
Turbidity Curtain Installation or Removal					
Steel H-Pile	10	4	--	143	143
24-inch diameter steel shell pile	20	4	--	153	153
RWF Temporary Relocation Piles					
24-inch diameter steel shell pile	20	4	--	153	153
36-inch diameter steel shell pile	20	4	--	168	168
Sediment Pin Installation					
Timber pile	20	20	---	158	158
Composite/Plastic	20	10	---	152	152
Hydroacoustic Data Collection Test Piles					
Timber pile (removal)	20	10	---	158	158

Impact Pile Driving					
	Duration (Strikes)	Piles per Day	Peak1	RMS1	One-second SEL1
Hydroacoustic Data Collection Test Piles					
18-inch Composite/Plastic	400	10	185	160	150
RWF Temporary Relocation Piles					
24-inch diameter steel shell pile	400	4	208	193	178
Sediment Pin Installation					
Timber pile	400	20	184	157	145
Composite/Plastic	400	10	177	153	145

[1] All sound values are expressed in dB re 1µPa at 10 meters from the sound source. See Appendix B of I&R's report for documentation of source levels (Enclosure B; Table 6).

Table 3. Distances to Level A and Level B Harassment Threshold Criteria for Pile Installation/Removal

Pile Type & Method	# Piles Per day	Level A/PTS isopleth (m) Hearing Groups: Cetaceans			Pinnipeds		Level B Isopleth (m)	Ensonified area (km²)
		LF	MF	HF	Phocids	Otariids		
Hydroacoustic Data Collection Piles								
18-inch composite (Impact)[2]	10	16	<1	19	9	<1	10	0.0002
18-inch Composite (Vibratory)[1]	10	4	<1	6	2	<1	1,360	3.58
Turbidity Curtain								
Steel H-Pile (Vibratory)[1]	4	<1	0	<1	<1	<1	341	0.29
Steel Shell Pile ≤ 24 inches (Vibratory)[1]	4	2	<1	4	2	<1	1,585	4.61
RWF Temporary Relocation Piles								
24-inch Steel Shell Pile (Vibratory)[1]	4	2	<1	4	2	<1	1,585	4.54
24-inch Steel Shell Pile (Impact, Attenuated)[2]	4	294	11	351	158	12	736	1.06
36-inch Steel Shell Pile (Vibratory)[1,3]	4	20	3	28	14	2	3,688	23.46
Sediment Pins								
14 to 16-inch Timber Pile (Vibratory)[1]	20	16	2	23	10	1	3,415	19.17
12 to 18-inch Timber Pile (Impact)[2]	20	12	<1	14	6	<1	<10	0.002
14 to 16-inch Composite Pile (Vibratory)[1]	10	4	<1	6	3	<1	1,360	3.20
14 to 16-Inch Composite Pile (Impact)[2]	10	7	<1	9	4	<1	<10	0.0007

1. Data from Table 7 from the Hydroacoustic Assessment (Enclosure B).
2. Data from Table 8 from the Hydroacoustic Assessment (Enclosure B).
3. A Transmission loss of 18.7 was used (Enclosure B, Appendix A).

* Distances to Level A and Level B Harassment Threshold Criteria for impact hammer use on a 36-inch steel pile is not included as this activity is prohibited.

3 TAKE AUTHORIZATION

The Applicant has requested authorization from NMFS for the incidental taking of Pacific harbor seals, northern elephant seals, California sea lions, northern fur seals, Steller sea lions, common bottlenose dolphins, and harbor porpoise by Level B harassment over 50 days of construction over the effective period of the IHA. No Level A take was requested, as avoidance and minimization measures will prevent such take.

The numbers of marine mammals by species that may be taken by each type of construction activity were calculated based on the estimated density of each species in the Project Area multiplied by the number of days of vibratory and impact pile driving and drilling sediment investigation, including a 10-percent buffer added to the number of construction days. Take estimates were separated by remedial response area. Table 4 shows the total take requested over the effective period of the IHA. A single animal can be taken only once per day.

Table 4. Requested Level B Take for Remedial Response Areas A & B

Species	Estimated Abundance in Project Area per Day	Estimated Level B Take (50 Days of Pile Driving * Animal Abundance)	Requested Level B Take Remedial Response Areas A & B (rounded up to whole number/animal)
Pacific Harbor Seal	20	1,000	1,000
Northern Elephant Seal	0.5	25	25
California Sea Lion[1]	191	9,550	9,550
Northern Fur Seal	0.027[2]	5	5
Steller Sea Lion	0.1	5	5
Bottlenose Dolphin	0.5	25	25
Harbor Porpoise	2	100	100

1. Assumes multiple repeated takes of some individuals from a small portion of the stock.
2. Equivalent to 10 per year

4 MARINE MAMMAL MONITORING

This MMMP will be employed to document the number and species of animals potentially exposed to Level B harassment, to avoid take of any species in exceedance of what is authorized by NOAA OPR, and to avoid taking in a manner not authorized by NOAA OPR under the requested IHA for Project activities.

4.1 PRE-CONSTRUCTION BRIEFINGS

Briefings will be conducted for construction supervisors and crews, the marine mammal monitoring team, and Applicant staff prior to the start of all pile driving activity, and when new personnel join the work. Briefings will explain personnel responsibilities, communication procedures, the marine mammal monitoring protocol, and operational procedures.

4.2 SHUTDOWN AND MONITORING ZONES FOR PILE DRIVING ACTIVITIES

Behavioral monitoring zones (MZs, Figures 2 through 6) and marine mammal shutdown zones (MMSZs Figures 4 through 6) and were established based on consultation with NOAA OPR. MMSZs include all areas where underwater sound pressure levels (SPLs) are expected to reach or exceed the Level A harassment criteria for marine mammals. MZs include all areas where SPLs are expected to reach or exceed the Level B behavioral disturbance criteria.

Before vibratory or impact pile driving, Level A MMSZs and Level B MZs will be established at the conservatively estimated distances to acoustic threshold criteria shown in Table 3. MMSZs will be fully monitored by MMOs and a representative portion of Level B MZs will be fully monitored to provide an accurate sample size of animals taken by Project activities, and to ensure that animals approaching the MMSZs are detected. Figures 4 through 6 show the Level A MMSZs and Level B MZs for pile driving for each remedial response area as a function of the geography in the Project area.

After pile driving activity begins, hydroacoustic measurements will be collected by I&R for the specific activity (location and size/type of pile). These hydroacoustic monitoring results will be provided to NOAA OPR, and the radius of the Level A and B monitoring zone may be adjusted, based on measured sound pressure levels. A hydroacoustic monitoring plan will be provided 90-days prior to commencement of pile driving for approval.

4.3 MARINE MAMMAL OBSERVERS

Monitoring during pile driving activities will be conducted by qualified NOAA OPR-approved MMOs. Between one and three MMOs will be on site at all times during pile driving activities. One MMO will be designated as the Lead MMO and will receive updates from other MMOs on the presence or absence of marine mammals within the applicable MMSZs and MZs. The Lead MMO will be stationed at the active pile driving rig or at the best vantage point practicable to monitor the MMSZs for marine mammals and implement shutdown and delay procedures when applicable through communication with the on-site supervisor. The other MMO(s) will be stationed at the best vantage points practicable to observe the monitoring zones. Exact locations will be determined in the field based on the pile driving site, field conditions, and in coordination with the contractors, but may include docks, barges, and tower structures. Observations will be made using binoculars (10x42 or similar) or spotting scopes and the naked eye during daylight hours. Each member of the monitoring team will have a radio (and mobile phone for backup) for contact with the Lead MMO and other observers.

4.4 MINIMIZATION OF IMPACTS FROM PILE DRIVING

Pile driving activities have the potential to result in Level B take under the MMPA of harbor seals, northern elephant seals, California sea lions, northern fur seals, Steller sea lions, harbor porpoise, bottlenose dolphins, and gray whales. Level B harassment may occur, resulting in negligible short- term effects on marine mammals transiting or foraging in the area. Project activities, however, would not cause long-term effects on individuals and would not result in population-level effects.

The following measures would be taken to minimize the exposure of marine mammals and their habitat to the effects of sound from pile driving.

- Marine mammal monitoring will be conducted during all construction noise-generating activities (pile installations or sediment sampling) to ensure that marine mammals do not enter Level A harassment zones and that marine mammal presence in the sound isopleth does not exceed authorized take levels. Construction will be shut down if a MMO observes a humpback or gray whale approaching the Level B isopleth. As it is not practical to monitor the full zones for a project of this extended length, MMOs would be positioned such that at least 20 percent of the Level B zone is observed when monitoring is required. Efforts should be made to observe the maximum extent of the monitoring zone possible. Should seating of steel piles be required, MMOs would be positioned such that 100 percent of the Level A zone is clearly visible.
- No pile driving will occur at night when MMOs are not able to visibly observe the isopleth.
- Vibratory hammering may be conducted between March 15 to December 1 without attenuation.

- An impact hammer may not be used on a steel pile larger than 24-inches in diameter.
- Only vibratory installation may be used to install steel piles; with the exception of occasional seating of RWF relocation piles less than 24-inches in diameter. Permanent timber or composite sediment pins may be installed using vibratory or unattenuated impact installation methods.
- A soft start will be implemented before operating impact pile driving hammers at full capacity. The soft start will consist of an initial set of strikes at reduced energy, followed by a 30-second waiting period, then two subsequent reduced-energy strikes separated by the waiting period. A soft start will be implemented at the start of each day's impact pile driving and at any time following cessation of impact pile driving for 30 minutes or longer.

These measures will limit the intensity of pile driving sound in the marine environment. In addition, the use of vibratory hammers to install and remove piles where feasible, and employment of a soft start for the impact hammer, is expected to encourage marine mammals to move away from disturbance areas so that they are less likely to be present during full-power pile driving activities. Establishment of MMSZs and implementation of a monitoring plan will ensure that no marine mammals are exposed to Level A harassment sound thresholds, and that exposure of any animals to Level B harassment sound thresholds is minimized and documented. Therefore, with these measures, the effects of the pile driving will be mitigated to the level of least practical adverse impact on marine mammals.

4.5 DATA COLLECTION AND OBSERVATION RECORDING

Standardized data collection sheets will be provided to the MMOs (see example datasheet). Each MMO will record the following information:

- Dates and times (beginning and end) of all marine mammal monitoring.
- MMO locations during 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 cloud cover, visibility, Beaufort 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.
- Distances and bearings of each marine mammal observed to the pile being driven or removed for each sighting (if pile driving or removal was occurring at time of sighting).

- Description of any marine mammal behavior patterns during observation, including direction of travel.
- Age and sex class, if possible, of all marine mammals observed.
- Detailed information about 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. A full description of the bubble curtain will be described should one be required.

4.6 MARINE MAMMAL MONITORING DURING PILE DRIVING

Predetermined Level A MMSZs and Level B MZs will be monitored during all vibratory and impact pile driving, as defined in Table 3 and Table 4 and Figures 4 through 6.

Pile driving will be conducted only during daylight hours and with enough time for pre- and post- construction monitoring, and with full visibility of the MMSZs. If the entire MMSZ is not visible (e.g., due to fog or heavy rain), pile driving and removal will be delayed until the MMOs are confident that marine mammals within the MMSZ could be detected.

The Lead MMO will be in contact with other MMO(s) and the construction foreman. MMOs will begin monitoring at least 30 minutes before pile driving begins and will continue to monitor the area for at least 30 minutes after pile driving has ended for the day.

4.6.1 Impact Pile Driving Soft Starts

Before operating impact pile driving hammers at full capacity, a soft start will be implemented. The soft start will consist of an initial set of strikes at reduced energy, followed by a 30-second waiting period, then two subsequent reduced-energy strikes separated by the waiting period. A soft start will be implemented at the start of each day's impact pile driving and at any time following cessation of impact pile driving for 30 minutes or longer.

4.6.2 Delay and Shutdown Procedures

If any marine mammal enters a MMSZ within 15 minutes of the beginning of pile driving, pile driving will be delayed until the animal leaves the area or at least 15 minutes have passed since the last observation of the animal. If a marine mammal approaches or enters the MMSZ during pile driving, the activity will be halted. The Lead MMO will notify the on-site supervisor that a marine mammal is approaching or within a MMSZ and the pile driving activity needs to be temporarily shut down. The on-site supervisor will direct the equipment operator to temporarily shut down pile driving activity. Pile driving may resume after the animal has moved out of and is moving away from the MMSZ or after at least 15 minutes have passed since the last observation of the animal, if it is not seen leaving the MMSZ.

If a species for which authorization has not been granted (i.e., humpback or gray whale), or a species for which authorization has been granted but the authorized takes are met, is observed approaching or within the Level B harassment zone (i.e., MZ), pile driving and removal activities will shut down immediately. Activities will not resume until the animal has been confirmed to have left the area or the observation period (15 minutes), has elapsed.

For all in-water construction using heavy machinery other than pile driving equipment (e.g., use of barge-mounted excavators or riprap placement in water), a 10-meter shutdown zone will be in effect. If a marine mammal comes within 10 meters, the Applicant will cease operations and reduce vessel speed to the minimum required to maintain steerage and safe working conditions. Monitoring of this shutdown zone does not require an MMO; the contractor can implement this measure.

4.6.3 Minimum Qualifications for MMOs

MMOs will have the following minimum qualifications:

- Independent MMOs (i.e., not construction personnel) who have no other assigned tasks during monitoring periods will be used.
- If a team of three or more MMOs is required, a lead observer (i.e., Lead MMO) or monitoring coordinator will be designated. The Lead MMO will have prior experience working as a marine mammal observer during construction.
- Other MMOs may substitute education (degree in biological science or related field) or training for experience.
- The Applicant will submit MMO resumes for approval by NMFS 30 days prior to the onset of pile driving. If NMFS does not respond within 30 days it will be assumed that MMOs are approved unless otherwise notified.
- MMOs will have the following additional qualifications:
  - Ability to conduct field observations and collect data according to assigned protocols.
  - Experience or training in the field identification of marine mammals, including the identification of behaviors.
  - Sufficient training, orientation, or experience with the construction operation to provide for personal safety during observations.
  - Writing skills sufficient to prepare a report of observations including but not limited to the number and species of marine mammals observed; dates and times when in-water construction activities were conducted; dates, times, and reason for

implementation of mitigation (or why mitigation was not implemented when required); and marine mammal behavior.

- Ability to communicate orally, by radio or in person, with project personnel to provide real-time information on marine mammals observed in the area as necessary.

4.7 REPORTING

The Applicant will submit a draft report on all monitoring conducted under the IHA 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, whichever comes first. A final report will be prepared and submitted within 30 days following resolution of comments on the draft report from NMFS. This report will contain the informational elements described in Section 4.3.2.

In addition, the report will contain the following information:

- 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.
- 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.
- In the case where MMOs were not able to observe the entire Level B harassment zone, an extrapolation of the estimated takes by Level B harassment based on the number of observed exposures within the Level B harassment zone and the percentage of the Level B harassment zone that was not visible.
- The Applicant will submit all Protected Species Observer (PSO) datasheets and/or raw sighting data in a separate file from the final report referenced above.

4.7.1 Take of Marine Mammal due to Project Activity

In the unanticipated event that the Project activity clearly causes the take of a marine mammal in a manner prohibited by the MMPA, such as serious injury or mortality, the Applicant will immediately cease the specified activities and report the incident to the NMFS OPR and West Coast Region Stranding Coordinator. The report will include the following information:

- Time and date of the incident,
- Description of the incident,
- Environmental conditions (e.g., wind speed and direction, Beaufort sea state, cloud cover, and visibility),

- Description of all marine mammal observations and active sound source use in the 24 hours preceding the incident,
- Species identification or description of the animal(s) involved,
- Fate of the animal(s), and
- Photographs or video footage of the animal(s).

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

4.7.2 Discovery of an Injured or Dead Marine Mammal

In the event the Applicant discovers an injured or dead marine mammal, and the Lead PSO determines that the cause of the injury or death is unknown and the death is relatively recent (e.g., in less than a moderate state of decomposition), the Applicant will immediately report the incident to the NMFS OPR and the West Coast Region Stranding Coordinator. The report will include the same information listed in Section 4.4.1 above. Activities may continue while NMFS reviews the circumstances of the incident. NMFS will work with the Applicant to determine whether additional mitigation measures or modifications to the activities are appropriate.

In the event that the Applicant discovers an injured or dead marine mammal, and the Lead PSO determines that the injury or death is not associated with or related to the specified activities (e.g., previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), the Applicant will report the incident to the NMFS OPR and the NMFS West Coast Region Stranding Coordinator within 24 hours of the discovery.

5 REFERENCES

California Department of Transportation (Caltrans). 2020. Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish. Document prepared by ICF Jones & Stokes and Illingworth and Rodkin, Inc. under contract to Caltrans.

National Marine Fisheries Service (NMFS). 2020. *2020 Revisions to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts*. U.S. Dept. of Commerce, NOAA. NOAA Technical Memorandum NMFS-OPR-59, 167 p.

Piers 39 to 43 ½ Sediment Remediation Project

Figure 1. Project Area Vicinity Map

Project Area

Project Area

integral

0 0.5 1 1.5 2

Miles

N

Piers 39 to 43 ½ Sediment Remediation Project

Figure 2. Remedial Response Area A; Level B Harassment, Marine Mammal Monitoring Zone

Legend

Remedial Response Area A

Level B Zones

Turbidity Curtain Pile Installation/Removal

24-inch Steel Pile (vibratory) (1,585 meters)

Steel H-Pile (vibratory) (341 meters)

Sediment Pin Installation

14 to 16-inch Timber Pile (impact) (<10 meters)

14 to 16-inch Timber Pile (vibratory) (3,415 meters)

Hydroacoustic Data Collection Piles

18-inch Composite Pile (Vibratory) (1,360 meters)

18-inch Composite Pile (Impact) (10 meters)

0 1,000 2,000

Feet

N

integral

Imagery Source: ESRI Map
Created on: 11/16/23 by S. McGarvey

Piers 39 to 43 ½ Sediment Remediation Project

Figure 3. Remedial Response Area B; Level B Harassment, Marine Mammal Monitoring Zone

Legend

Remedial Response Area B

Level B Zones

Turbidity Curtain Pile Installation/Removal

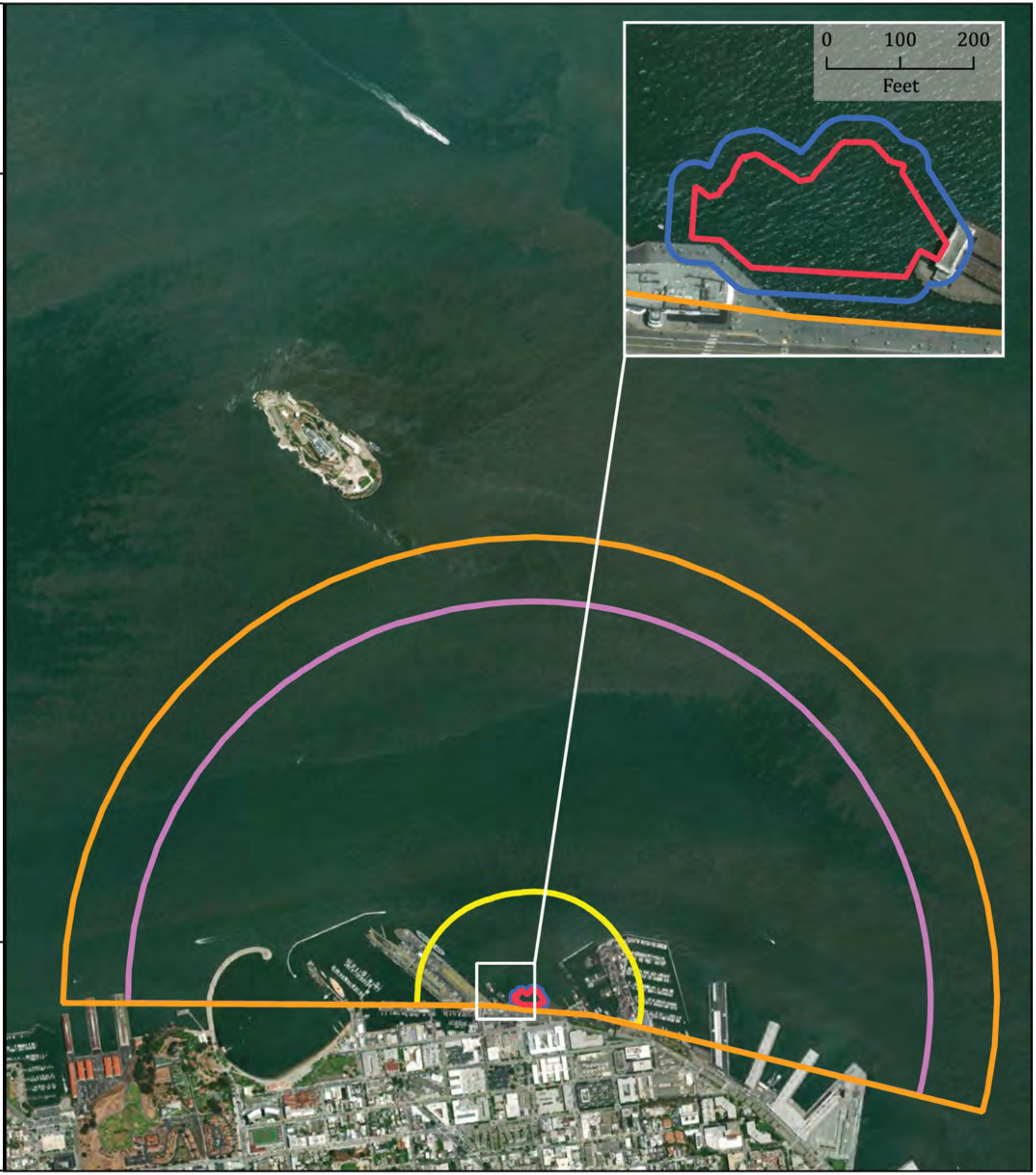
24-inch Steel Pile (vibratory) (1,585 meters)

Steel H-Pile (vibratory) (341 meters)

Hydroacoustic Data Collection Piles

18-inch Composite Pile (Vibratory) (1,360 meters)

18-inch Composite Pile (Impact) (10 meters)



0 500 1,000

Feet

N

integral

Imagery Source: ESRI Map
Created on: 11/16/23 by S. McGarvey

Piers 39 to 43 ½ Sediment Remediation Project

Figure 4. Remedial Response Area A;
Level A, Marine Mammal Shutdown Zone

Legend

Remedial Response Area A

Area A Shutdown Zones

Sediment Pin Installation

14 to 16-inch Timber Pile (impact) (14 meters)

14 to 16-inch Timber Pile (vibratory) (23 meters)

Turbidity Curtain Pile Installation/Removal

24-inch Steel Shell Pile (vibratory) (4 meters*)
*rounded to 10 meters

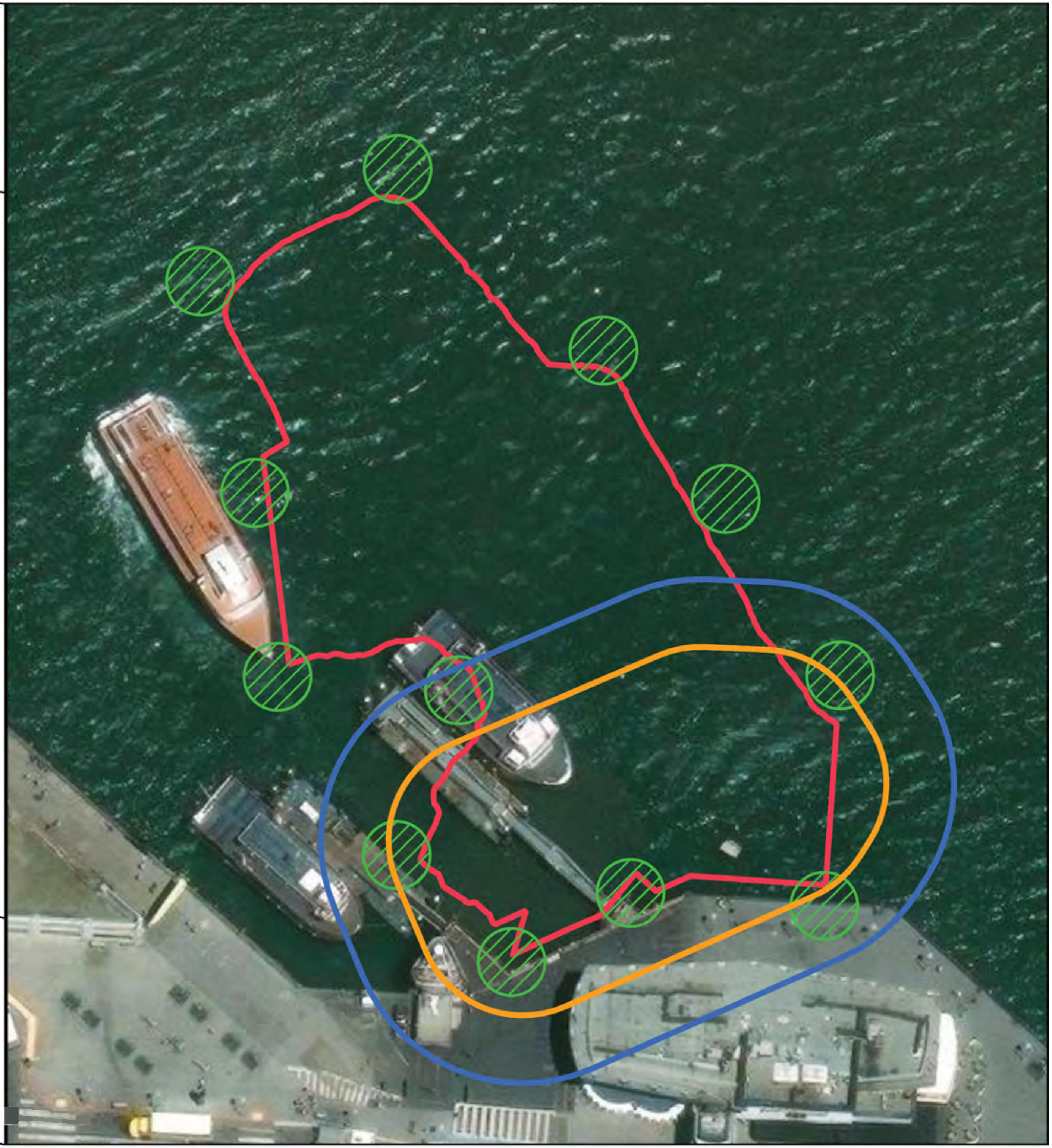
0 25 50 75 100

Feet

N

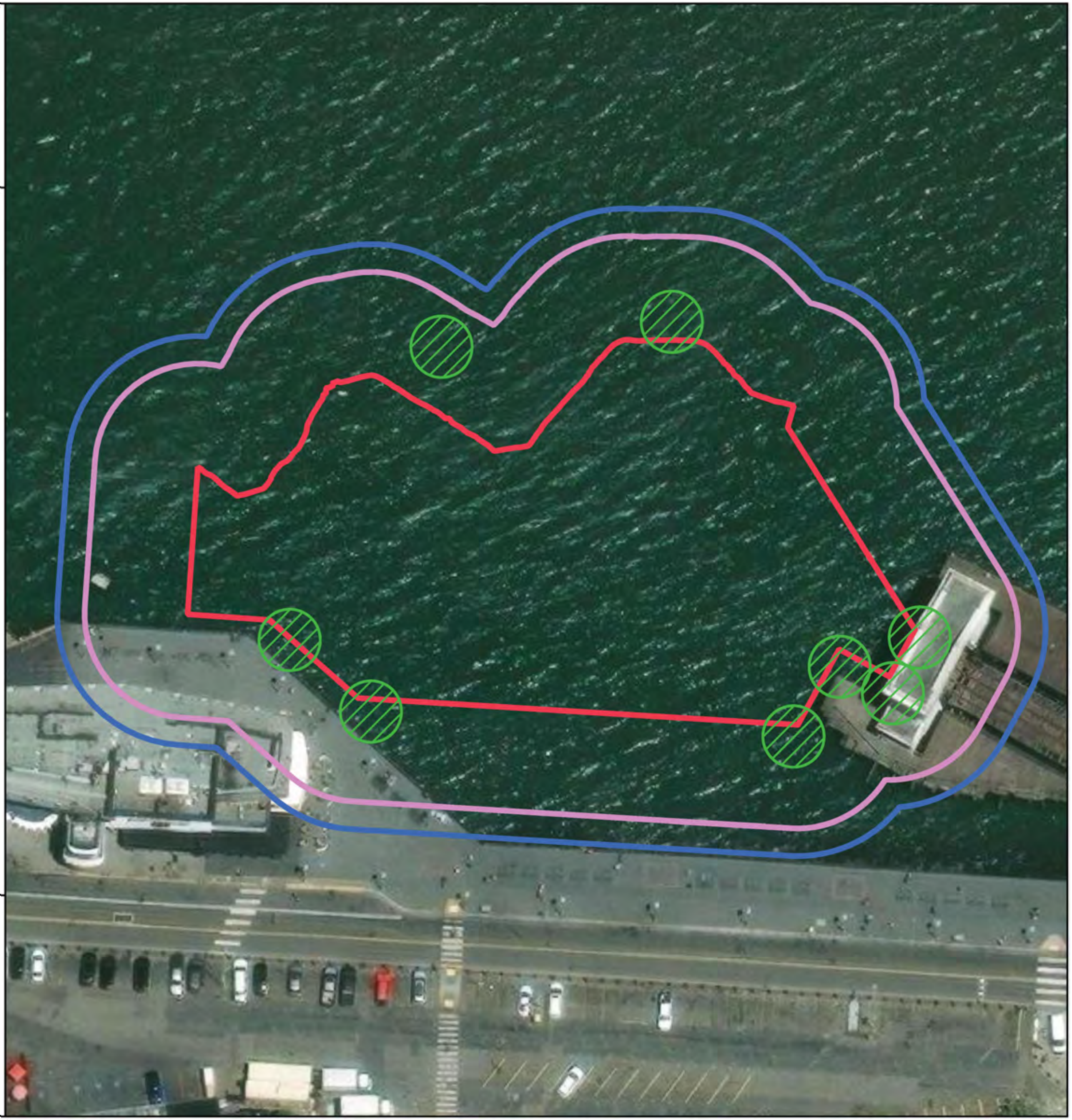
integral

Imagery Source: ESRI Map
Created on: 11/16/23
by S. McGarvey



Piers 39 to 43 ½ Sediment Remediation Project

Figure 5. Remedial Response Area B;
Level A, Marine Mammal Shutdown Zone



Legend

Remedial Response Area B

Area B Shutdown Zones

Turbidity Curtain Pile Installation/Removal

24-inch Steel Shell Pile (vibratory) (4 meters*)

Hydroacoustic Data Collection Piles

18-inch Composite Pile (Impact) (19 meters)

18-inch Composite Pile (Vibratory, Removal) (6 meters*)

*rounded to 10 meters

0 25 50 75 100

Feet

N

integral

Imagery Source: ESRI
Map Created on:
11/16/23
by S. McGarvey

Piers 39 to 43 ½ Sediment Remediation Project

Figure 6. Monitoring and Shutdown Zones for RWF Temporary Relocation Pile Installation

Legend

Level A Shutdown Zones*

- 24-inch Steel Shell Pile (impact, attenuated) (351 meters)
- 24-inch Steel Shell Pile (vibratory) (4 meters**)
- 36-inch Steel Shell Pile (vibratory) (28 meters)

Level B Zones*

- 24-inch Steel Pile (impact, attenuated) (736 meters)
- 24-inch Steel Pile (vibratory) (1,585 meters)
- 36-inch Steel Pile (vibratory) (3,688 meters)

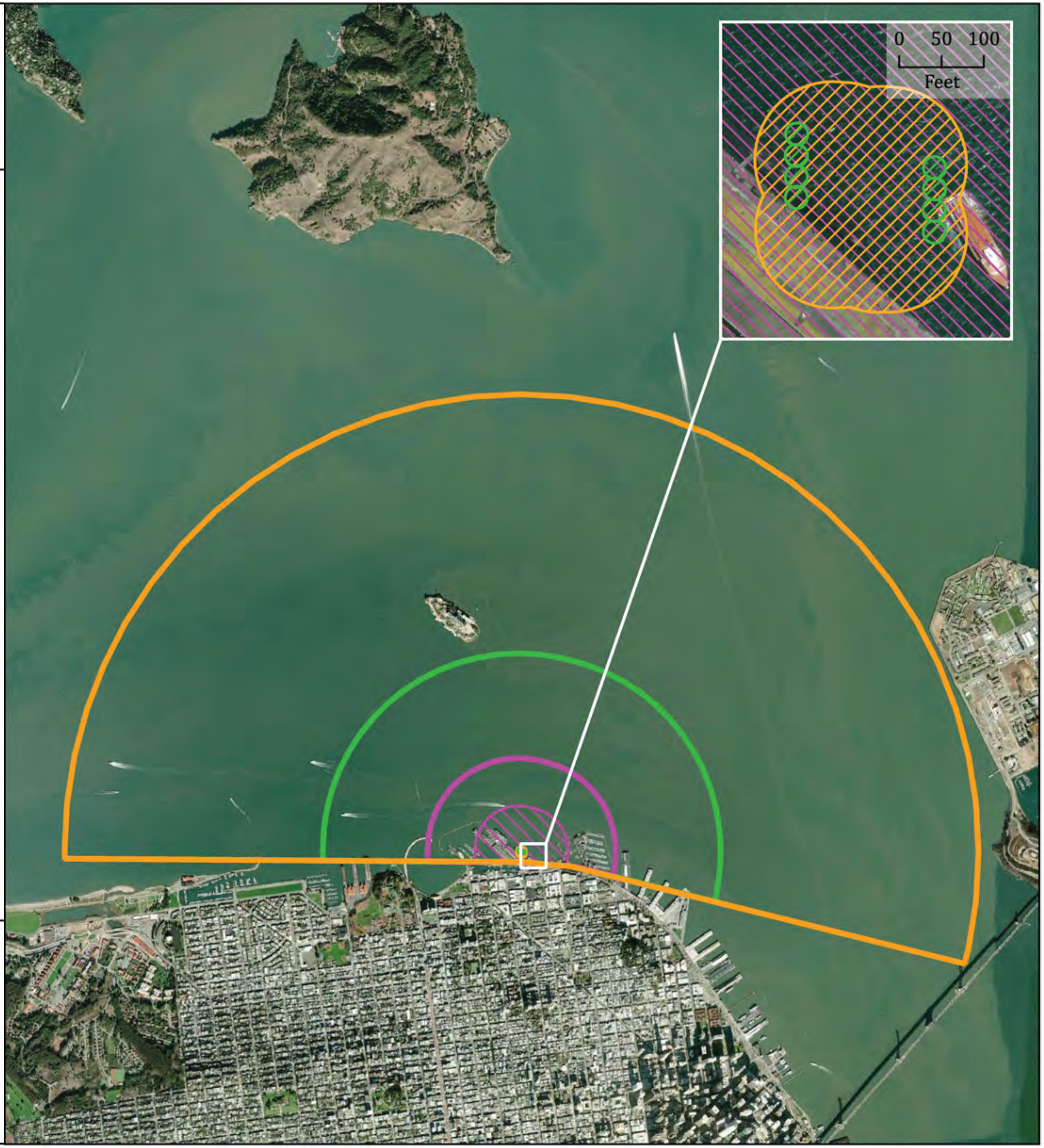
*Use of impact hammer on 36-inch steel piles prohibited
**Rounded to 10 meters

0 0.5 1 1.5
Miles

N

integral

Imagery Source: ESRI Map
Created on: 11/16/23
by S. McGarvey



Legend

Remedial Response Areas

Potential Marine Mammal Monitor Locations

Piers 39 to 43 ½ Sediment Remediation Project

Figure 7. Marine Mammal Monitoring Locations

Imagery Source: ESRI
Map Created on: 7/11/23
by S. McGarvey

0 50 100 150
Feet

N