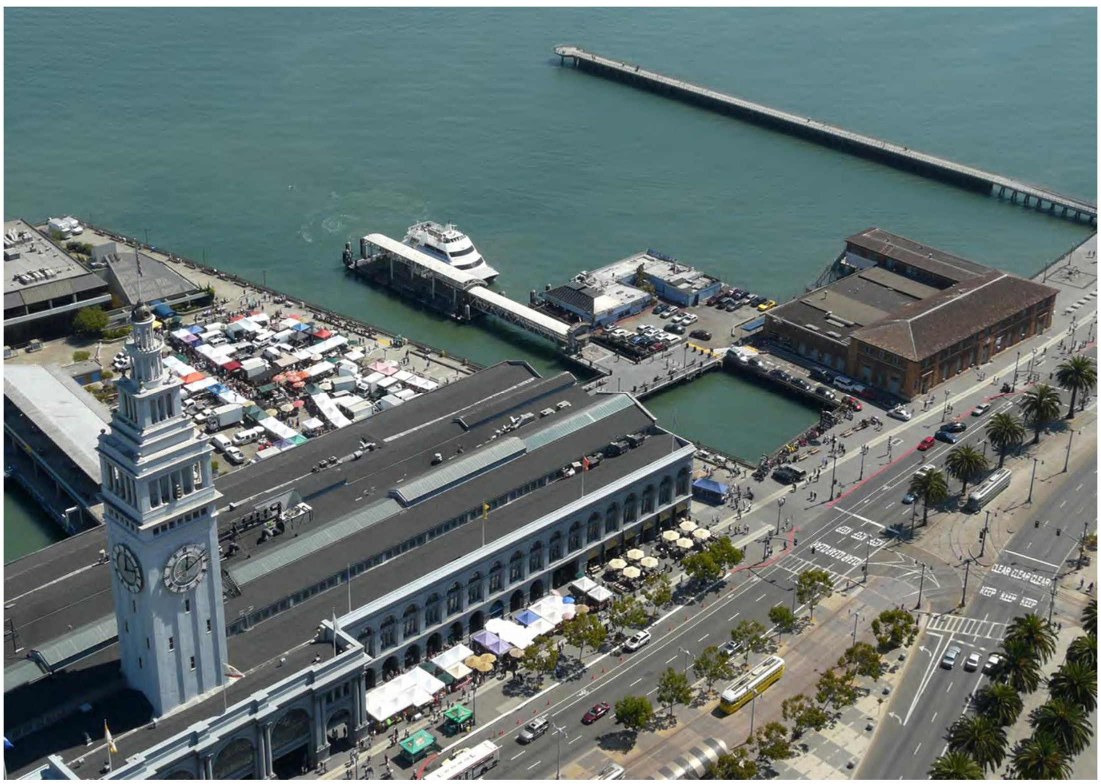
National Marine Fisheries Service

Application for Incidental Harassment Authorization for Marine Mammals

Downtown San Francisco Ferry Terminal Expansion Project South Basin Improvements



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ACRONYMS AND ABBREVIATIONS

ADA	Americans with Disabilities Act
BCA	Bubble curtain attenuation
Caltrans	California Department of Transportation
cSEL	cumulative sound exposure level
dB	decibels
EFH	Essential Fish Habitat
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ESA	Endangered Species Act
Ferry Building	San Francisco Ferry Building
Ferry Terminal	Downtown San Francisco Ferry Terminal
FTA	Federal Transit Administration
GGCR	Golden Gate Cetacean Research
Hz	hertz
IHA	Incidental Harassment Authorization
IOP	Implementation and Operations Plan
IWC	International Whaling Commission
kHz	kilohertz
L_{max}	maximum sound level measurement
µPa	microPascal
MLLW	mean lower low water
MMPA	Marine Mammal Protection Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
Port	Port of San Francisco
PTS	Permanent Threshold Shift
RMS	root mean square
SEL	sound exposure level
SFOBB	San Francisco – Oakland Bay Bridge
SPCC	Spill Prevention Control and Countermeasure
SPL_{peak}	peak sound pressure level
TMMC	The Marine Mammal Center
USACE	U.S. Army Corps of Engineers
WETA	Water Emergency Transportation Authority

1.0 INTRODUCTION

The San Francisco Bay Area Water Emergency Transportation Authority (WETA) is expanding berthing capacity at the Downtown San Francisco Ferry Terminal (Ferry Terminal), located at the San Francisco Ferry Building (Ferry Building), to support existing and future planned water transit services operated on San Francisco Bay by WETA and WETA's emergency operations. The project area and vicinity are shown on Figure 1.

The Downtown San Francisco Ferry Terminal Expansion Project would eventually include phased construction of three new water transit gates and overwater berthing facilities, in addition to supportive landside improvements, such as additional passenger waiting and queuing areas, circulation improvements, and other water transit–related amenities. The new gates and other improvements would be designed to accommodate future planned water transit services between Downtown San Francisco and Antioch, Berkeley, Martinez, Hercules, Redwood City, Richmond, and Treasure Island, as well as emergency operation needs. According to current planning and operating assumptions, WETA will not require all three new gates (Gates A, F, and G) to support existing and new services immediately. As a result, WETA is planning that project construction will be phased. The first phase will include construction of Gates F and G, as well as other related improvements in the South Basin.[1] Therefore, the Downtown San Francisco Ferry Terminal Expansion Project – South Basin Improvements are the subject of this application, and are herein referred to as the project.

The expansion of water transit service at the Ferry Terminal is being developed consistent with WETA's Implementation and Operations Plan (IOP) and its Program Environmental Impact Report (EIR) for the IOP (WETA, 2003a; WETA, 2003b).

WETA and the Federal Transit Administration (FTA) prepared an Environmental Impact Statement (EIS)/EIR to address the environmental effects of the proposed Ferry Terminal improvements (WETA and FTA, 2014). The FTA was the National Environmental Policy Act lead agency, and issued their Record of Decision on September 5, 2014. WETA was the California Environmental Quality Act lead agency, and certified the Final EIR on October 2, 2014. In addition, WETA and FTA completed consultation with the National Marine Fisheries Service (NMFS) under Section 7 of the Endangered Species Act (ESA) for impacts to special-status species and critical habitat, and for impacts to Essential Fish Habitat (EFH) under the Magnuson-Stevens Fishery Conservation and Management Act. Copies of the Final EIS/EIR and Biological Opinion are available upon request.

1.1 PROJECT PURPOSE

The project supports existing and future planned water transit services operated by WETA, and regional policies to encourage transit uses. Furthermore, the project addresses deficiencies in the transportation network that impede water transit operation, passenger access, and passenger circulation at the Ferry Terminal.

- **Transit Service.** The project will accommodate the existing and future planned water transit service outlined in WETA's IOP for the San Francisco Bay Area. The addition of two new gates will accommodate an expansion of WETA services from 5,100 to 19,160 passengers per weekday by 2035; and an increase in AM peak-period WETA vessel arrivals from 14 to approximately 30. The Ferry Terminal currently has an insufficient number of gates and berthing facilities to accommodate the expansion of water transit service. The improvements will encourage a shift from automobiles to water transit use in the Bay Area. The expansion of water transit as an alternative mode of transportation supports the region's regional transportation and land use plan, *Plan Bay Area,* as well as regional air quality goals.

[1] The second phase will involve construction of Gate A and all related improvements in the North Basin.

- **Emergency Operations.** Water transit provides a viable alternative for transportation when unexpected disruption renders other components of the regional transportation system inoperable. To the extent feasible, improvements will be constructed to withstand damage from flood, wind, or earthquakes, to ensure that the improved circulation areas (e.g., the new Embarcadero Plaza) would be available for emergency operations and evacuee queuing, if necessary. With the improvements in place, WETA will have the capacity to evacuate approximately 7,200 passengers per hour from its four gates. In the South Basin, 36,700 square feet will be available for emergency response and passenger staging.

- **Access and Pedestrian Circulation.** The construction of the circulation improvements (i.e., extension of the East Bayside Promenade, improvement of the South Apron of the Agriculture Building, and creation of the Embarcadero Plaza) would provide improved passenger circulation at the Ferry Terminal. Passengers will have adequate queuing and waiting areas and clearly designated pedestrian linkages, which would reduce bottlenecks and avoid conflicts with other activities and uses at the Ferry Building.

2.0 DESCRIPTION OF SPECIFIED ACTIVITY

2.1 PROJECT IMPROVEMENTS

The full project includes construction of two new water transit gates and associated overwater berthing facilities, in addition to supportive improvements, such as additional passenger waiting and queuing areas and circulation improvements in a 7.7-acre area. Figure 1 depicts the project area, and Figure 2 depicts the project improvements. The full project, which began construction in 2017, includes the following elements:

- Removal of portions of existing deck and pile construction (portions will remain as open water, and other portions will be replaced);

- Construction of two new gates (Gates F and G);

- Relocation of an existing gate (Gate E); and

- Improved passenger boarding areas, amenities, and circulation, including extending the East Bayside Promenade along Gates E, F, and G; strengthening the South Apron of the Agriculture Building; creating the Embarcadero Plaza; and installing weather protection canopies for passenger queuing.

These project elements are described in detail in the following sections and summarized in Table 1. Many activities undertaken as part of the full project, and included in Table 1, were completed in 2017 and were covered under a previous Incidental Harassment Authorization (IHA). Coverage under this new IHA application is only being sought for pile-driving activities scheduled for 2018; all in-water work is expected to be completed during the 2018 in-water work window (June 1 – November 30). Descriptions of activities that occurred in 2017 are provided for informational purposes only.

Implementation of the project improvements will result in a change in the type and area of structures over San Francisco Bay, as summarized in Table 2. As part of the full project, some structures will be demolished and then rebuilt. The remaining portions of in-water work will require installation of piles, as summarized in Table 3; this is scheduled to occur in 2018.

Table 1
Summary of Demolition and New Construction

Project Element	Approximate Area	Type of Work
Pier 2 and additional deck structure in the South Basin	21,448 square feet	Demolition of deck and 350 piles. **(Completed)**
South Apron of the Agriculture Building	2,100 square feet	Temporary repair of apron structure for use during construction. **(Completed)**
Gate E	Existing Gangway = 1,260 square feet New Gangway = 1,470 square feet Net increase = 210 square feet	The existing float (5,670 square feet) will be moved 43 feet to the east and reinstalled. A new gangway will be installed that is slightly longer than the existing gangway.
Gate F	Gangway = 1,470 square feet Float = 5,670 square feet Total = 7,140 square feet	New berthing facilities for new gate.
Gate G	Gangway = 1,470 square feet Float = 5,670 square feet Total = 7,140 square feet	New berthing facilities for new gate.
Embarcadero Plaza and East Bayside Promenade	36,700 square feet total	Surface improvements, as well as new deck and piles.
Interim Access Structure	1,600 square feet	Installation of a pedestrian walkway between the Embarcadero Promenade and the East Bayside Promenade south of the Agriculture Building. **(Completed)**
Weather protection canopies	Two 125-foot-long by 20-foot-wide canopies	Installation of steel, glass, and photovoltaic cell overhead canopies on the pier deck.

Table 2
Summary of Changes to Structures over San Francisco Bay

Type of Structure/ Project Element	Area Removed	Area of New Construction	Net Change in Area
South Basin			
Floating Features		**11,340 square feet**	**11,340 square feet**
Gate F and G Floats		11,340 square feet	
Overwater Features	**21,448 square feet**	**37,615 square feet**	**16,167 square feet**
Pier Deck	21,000 square feet	32,500 square feet	
New Gate F and G Gangways and net increase in Gate E Gangway		3,150 square feet	
Interim Access Structure		1,600 square feet	
Fendering		365 square feet	
Net Change in Area of Structures in the South Basin			**27,507 square feet**

Table 3
Summary of 2018 Pile Installation

Project Element	Pile Diameter	Pile Type	Method	Number of Piles/Schedule
Embarcadero Plaza, East Bayside Promenade, and Interim Access Structure	30 inches	Steel: 135 to 155 feet in length	Impact or Vibratory Driver	(18) 30-inch piles/up to 9 days
Embarcadero Plaza, East Bayside Promenade, and Interim Access Structure	24 inches	Steel: 135 to 155 feet in length	Impact or Vibratory Driver	(30) 24-inch piles/up to 15 days
Gates E, F, and G Dolphin Piles	36 inches	Steel: 145 to 155 feet in length	Impact or Vibratory Driver	10 total: two at each of the floats for protection; two between each of the floats/up to 5 days
Gate F and G Guide Piles	36 inches	Steel: 140 to 150 feet in length	Impact or Vibratory Driver	12 (6 per gate)/up to 6 days
Gate E Guide Piles	36 inches	Steel: 145 to 155 feet in length	Impact or Vibratory Driver	Six/up to 3 days
Barrier Piles near Pier 14	24 inches	Steel: 135 to 155 feet in length	Impact or Vibratory Driver	Five/up to 3 days

2.1.1 Removal of Existing Facilities

As part of the project, the remnants of Pier 2 were demolished and removed during the 2017 construction season. Approximately 21,448 square feet of existing deck structure supported by approximately 350 wood and concrete piles were removed. The demolition requirements of the full project have been completed, and no existing facilities will be removed in 2018.

2.1.2 Construction of Gates and Berthing Structures

The new gates (Gates F and G) will be built similarly. Each gate will be designed with an entrance portal—a prominent doorway providing passenger information and physically separating the berthing structures from the surrounding area. The entrance portal will also contain doors, which can be secured.

Berthing structures will be provided for each new gate, consisting of floats, gangways, and guide piles. Figure 3 depicts a simulated view of the berthing structures. The steel floats will be approximately 42 feet wide by 135 feet long. The steel truss gangways will be approximately 14 feet wide and 105 feet long. The gangway will be designed to rise and fall with tidal variations while meeting Americans with Disabilities Act (ADA) requirements. The gangway and the float will be designed with canopies, consistent with the current design of existing Gates B and E. The berthing structures will be fabricated off site and floated to the project area by barge.

Six steel guide piles will be required to secure each float in place. In addition, dolphin piles may be used at each berthing structure to protect against the collision of vessels with other structures or vessels. A total of up to 14 dolphin piles may be installed, consisting of ten new dolphin piles and four relocated dolphin piles.

Chock-block fendering will be added along the East Bayside Promenade, to adjacent structures to protect against collision. The chock-block fendering will consist of square, 12-inch-wide, polyurethane-coated, pressure-treated wood blocks that are connected along the side of the adjacent pier structure, and supported by polyurethane-coated, pressure-treated wood piles.

In addition, the existing Gate E float will be moved 43 feet to the east, to align with the new gates and East Bayside Promenade. The existing six 36-inch-diameter steel guide piles will be removed using vibratory extraction, and reinstalled to secure the Gate E float in place. Because of Gate E's new location, to meet ADA requirements, the existing 90-foot-long steel truss gangway will be replaced with a longer, 105-foot-long gangway.

Details of the number of piles, pile size, and installation method scheduled for 2018 are provided in Table 3, above.

2.1.3 Passenger Boarding and Circulation Areas

Several improvements will be made to passenger boarding and circulation areas to provide adequate space for passenger queuing; reduce circulation bottlenecks and use conflicts between water transit passengers, users of the Ferry Building, and delivery vehicles; and enhance public access. New deck and pile-supported structures will be built to meet essential facility standards to support queuing and circulation needs for evacuation purposes in the event of an emergency.[2] The new improvements are also designed to meet the elevation requirements for sea-level rise, as described in more detail in the section titled "Design Considerations."

- An Embarcadero Plaza, elevated approximately 3 to 4 feet above current grade, will be created. The Embarcadero Plaza will require new deck and pile construction to fill an open-water area and replace existing structures that do not comply with Essential Facilities requirements. The plaza will include amphitheater steps to provide seating, and could include bicycle racks, planters, and other furnishings as determined in the Final Design.

- The East Bayside Promenade will be extended to create continuous pedestrian access to Gates E, F, and G, as well as to meet public access and pedestrian circulation requirements along San Francisco Bay. It will extend approximately 430 feet in length, and will provide an approximately 25-foot-wide area for pedestrian circulation and public access along Gates E, F, and G. The perimeter of the East Bayside Promenade will also include a curbed edge with a guardrail.

- Short access piers, approximately 30 feet wide and 45 feet long, will extend from the East Bayside Promenade to the portal for each gate. The perimeter of the access piers will also include a curbed edge with a guardrail.

- The South Apron of the Agriculture Building will be upgraded to temporarily support access for passenger circulation. The improvements will include construction of steps and an ADA-accessible ramp to meet the grade of the improved East Bayside Promenade, as well as a guard rail along its edge. Depending on their condition, as determined during Final Design, the piles supporting this apron may need to be strengthened with steel jackets.

- Two canopies will be constructed along the East Bayside Promenade: one between Gates E and F, and one between Gates F and G. Each of the canopies will be 125 feet long and 20 feet wide. Each canopy will be supported by four columns at 35 feet on center, with 10-foot cantilevers at either end. The canopies will be constructed of steel and glass, and will include photovoltaic cells. The canopy structures will include lighting, passenger information, and 12 two-sided benches, for a total of 24 benches under each canopy.

The new deck will be constructed on the piles, using a system of beam-and-flat-slab-concrete construction, similar to what has been built in the Ferry Building area. The beam-and-slab construction will be either precast or cast-in-place concrete (or a combination of the two), and approximately 2.5 feet thick. Above the structure, granite paving or a concrete topping slab will provide a finished pedestrian surface.

[2] As defined by the California Building Code 2010 and the International Building Code 2009, Essential Facilities are buildings and structures that are intended to remain operational in the event of extreme environmental loading from flood, wind, snow, or earthquakes.

The passenger facilities, amenities, and public space improvements—such as the entrance portals, canopy structures, lighting, guardrails, and furnishings—will be surface-mounted on the pier structures after the new construction and repair are complete. The canopies and entrance portals will be constructed offsite, delivered to the site, craned into place by barge, and assembled onsite. The glazing materials, cladding materials, granite pavers, guardrails, and furnishings will be delivered to the site via truck and assembled onsite. In addition to the use of barges for material storage and construction staging, when the structural deck of the Embarcadero Plaza has been completed, it will also be used for material storage and for construction staging.

Stormwater runoff in the project area currently drains directly to San Francisco Bay, and a significant portion of the existing area is used for vehicular circulation and parking. WETA worked with the Port to develop a stormwater management plan, in compliance with the City and County of San Francisco and the Port's stormwater management guidelines. The plan includes a multi-pronged approach for compliance with the Port's guidelines by addressing treatment for the sources of potential pollution, while minimizing fill in San Francisco Bay and recognizing the constraints of pile-supported structures that could be subject to inundation.

2.2 DREDGING REQUIREMENTS

The side-loading vessels require a depth of 12.5 feet below mean lower low water (MLLW) on the approach and in the berthing area. All initial dredging activities were completed in 2017, and no dredging activities are planned in 2018.

Based on observed patterns of sediment accumulation in the Ferry Terminal area, significant sediment accumulation will not be expected, because regular maintenance dredging is not currently required to maintain operations at existing Gates B and E. However, some dredging will likely be required on a regular maintenance cycle beneath the floats at Gates F and G, due to their proximity to the Pier 14 breakwater. It is expected that maintenance dredging will be required every 3 to 4 years, and will require removal of approximately 5,000 to 10,000 cubic yards of material.

Any future maintenance dredging and disposal of dredged materials would be conducted in cooperation with the San Francisco Dredged Materials Management Office, including development of a sampling plan, sediment characterization, a sediment removal plan, and disposal in accordance with the Long-Term Management Strategy for San Francisco Bay to ensure beneficial reuse, as appropriate.

2.3 OPERATING ELEMENTS

In the South Basin, WETA plans to operate the existing Alameda/Oakland and Alameda Harbor Bay service, as well as the new Treasure Island and Richmond services from Gates E, F, and G with 19,160 daily passengers and 30 AM peak-period arrivals by 2035. Gate G will also provide spare berthing capacity to accommodate emergency evacuations, guest or visiting vessels, layover berthing, and the ability to maintain operations should an existing berth be taken out of service for maintenance or repair. In addition, Gate G could serve other Central or South Bay routes, as operational needs require.

The project improvements will not require operational staff at the Ferry Terminal. All current and future WETA vessels will be stocked and serviced at other terminal locations. Vessel crews will also board in the outlying terminal locations.

2.3.1 Emergency Operations

The project will also improve facilities that will support emergency operations when unexpected and long-term disruption renders other components of the regional transportation system inoperable.

WETA's emergency planning includes developing scenarios for evacuation. For a large evacuation, WETA could operate up to six 299- to 399-passenger vessels per hour from each of its gates. Therefore,

the existing and new gates (Gates B, E, F, and G) will have an emergency evacuation capacity of approximately 7,200 passengers per hour.

The passengers will be queued at WETA's existing and new gates, as well as in the circulation areas that will be created in the South Basin as a part of the project. In the South Basin, a total of approximately 36,700 square feet, built to Essential Facilities standards, will be available for emergency response and passenger staging in the Embarcadero Plaza, and along East Bayside Promenade.

2.4 COMPONENTS OF THE ACTIVITY THAT MAY RESULT IN TAKE

Construction of the project improvements requires pile-driving. Pile-driving for the project includes impact or vibratory pile driving associated with construction of the berthing structures, the Embarcadero Plaza, and East Bayside Promenade. Much of the pile driving associated with the full project was completed in 2017 and was covered under a previous IHA. All pile driving completed in 2017 was vibratory, no impact driving was conducted. The pile types, numbers, and sizes that will be driven in 2018 are described in Table 3. Underwater sound and acoustic pressure resulting from pile driving could affect marine mammals by causing behavioral avoidance of the construction area, and/or injury to sensitive species. The anticipated impact of these activities is described in detail in Section 8.

The construction of overwater structures would not result in take of marine mammals, and would not be expected to have an effect on habitat quality for marine mammals, as discussed in Section 10.

3.0 DATES, DURATION, AND SPECIFIED GEOGRAPHIC REGION

Figure 1 depicts the areas in the project area that will be affected by construction activities, including construction of project elements, material and equipment storage, and staging. Construction staging will be in areas managed by the Port that are not in other lease boundaries. Due to the lack of potential landside construction staging and access areas in the Ferry Building area, the majority of demolition and construction will be staged and conducted from barges. The barges will be approximately 60 feet by 130 feet. The barges are towed into place by diesel-powered tugboats, and anchored where needed. Tugboats will also be required to move the barge as necessary during construction. Barges and construction equipment to be used in the water will be sourced from areas in San Francisco Bay.

Night work will not occur, so minimal lighting, if any, will be required. Onsite power will be provided by the Port during construction, and used to power construction equipment where feasible. Generators for equipment operation could also be required, and will be located on the construction barges and on the landside structural improvements when completed.

In-water construction activities (i.e., pile driving) will be scheduled to be completed during the authorized work window for construction in San Francisco Bay established by the Long-Term Management Strategy. In the project area, the authorized work window is June 1 through November 30. This application only covers potential take of marine mammals for the 2018 work window.

4.0 SPECIES AND NUMBERS OF MARINE MAMMALS IN THE REGION

Although at least 35 species of marine mammals can be found off the coast of California, very few species venture into San Francisco Bay; only Pacific harbor seals (*Phoca vitulina richardsi*), California sea lions (*Zalophus californianus*), harbor porpoises (*Phocoena phocoena*), and in recent years, bottlenose dolphin (*Tursiops truncatus*) maintain residential status, meaning they are sighted year round. Other marine mammal species that have been seen occasionally in San Francisco Bay include the gray whale (*Eschrichtius robustus*), individual humpback whales (*Megaptera novaeangliae*), the northern elephant seal (*Mirounga angustirostris*), the Guadalupe fur seal (*Arctocephalus townsendi*), and the northern fur seal (*Callorhinus ursinus*). Most cetacean sightings tend to occur in the central Bay (the area bound by the Golden Gate Bridge, the San Francisco – Oakland Bay Bridge [SFOBB], and Richmond

Bridge). The most common marine mammals in San Francisco Bay are Pacific harbor seals and California sea lions, which are the species most likely to occur in the project area. Table 4 summarizes the status of marine mammal stocks potentially present in San Francisco Bay.

Table 4
Stock Assessment of Marine Mammal Stocks Potentially Present in San Francisco Bay

Species	Stock Name/ Status[1]	Stock Abundance	Relative Occurrence in San Francisco Bay	Season(s) of Occurrence
Pacific harbor seal *Phoca vitulina*	California stock/NS	30,968	Common	Year-round
California sea lion *Zalophus californianus*	U.S. stock/NS	296,750	Common	Year-round
Harbor porpoise *Phocoena phocoena*	San Francisco-Russian River Stock/NS	9,886	Common in the vicinity of the Golden Gate and Richardson's Bay. Rare elsewhere.	Year-round
Gray whale *Eschrichtius robustus*	Eastern North Pacific stock/NS	20,990	Rare to occasional, in the vicinity of the Golden Gate	Winter and Spring[2]
Humpback whale (*Megaptera novaeangliae*)	California/Oregon/ Washington stock/ D,S; ESA-E	1,918	Rare to occasional, in the vicinity of the Golden Gate	Summer and fall
Bottlenose dolphin *(Tursiops truncates)*	California Coastal stock/NS	453	Common in the vicinity of the Golden Gate and Richardson's Bay. Rare elsewhere.	Year-round
Northern elephant seal (*Mirounga angustirostris*)	California Breeding Stock/NS	81,368	Rare	Spring and fall
Guadalupe fur seal (*Arctocephalus townsendi*)	Entire/D,S; ESA-T	20,000	Rare; stranding may occur in San Francisco Bay during El Niño years.	Year-Round
Northern fur seal (*Callorhinus ursinus*)	California stock/NS	14,050	Rare; stranding may occur in San Francisco Bay during El Niño years.	Year-round

Table Source: NMFS, 2017a

[1] Status:
NS = No special designation under the MMPA, not listed in the Endangered Species Act (ESA).
D.S = Designated as Depleted and Strategic under the MMPA.
ESA-E = listed in the ESA as Endangered.
ESA-T = listed in the ESA as Threatened.

[2] Source: Self, 2012

MMPA = Marine Mammal Protection Act

4.1 PACIFIC HARBOR SEAL

The Pacific harbor seal is one of five subspecies of *Phoca vitulina*, or the common harbor seal, and belongs to the family Phocidae. They are a true seal, with a rounded head and visible ear canal, distinct from the eared seals, or sea lions, which have a pointed head and an external ear. Males and females are similar in size and can exceed 6 feet and 300 pounds. Harbor seals generally do not migrate annually. They display year-round site fidelity, although they have been known to swim several hundred miles to find food or suitable breeding habitat.

Harbor seals forage in shallow waters on a variety of fish and crustaceans that are present throughout much of San Francisco Bay, and therefore could occasionally be found foraging in the action area. They are opportunistic, generalist foragers (Gibble, 2011). The harbor seal diet generally consists of fish, although they also consume shrimp and shellfish. In San Francisco Bay, harbor seals forage in shallow, intertidal waters on a variety of fish, crustaceans, and a few cephalopods (e.g., octopus). The most numerous prey items identified in harbor seal fecal samples from haul-out sites in San Francisco Bay include yellowfin goby (*Acanthogobius flavimanus*), northern anchovy (*Engraulis mordax*), Pacific herring (*Clupea harengus pallasi*), staghorn sculpin (*Leptocottus armatus*), plainfin midshipman (*Porichthys notatus*), and white croaker (*Genyonemus lineatas*) (Harvey and Torok, 1994).

Although generally solitary in the water, harbor seals come ashore at haul-outs—shoreline areas where pinnipeds congregate to rest, socialize, breed, molt—as well as for thermoregulation, birthing, and nursing pups. Habitats used as haul-out sites include tidal rocks, bayflats, sandbars, and sandy beaches (Zeiner et al., 1990). Haul-out sites are relatively consistent from year-to-year (Kopec and Harvey, 1995), and females have been recorded returning to their own natal haul-out when breeding (Cunningham et al., 2009). Although harbor seals haul-out at approximately 20 locations in San Francisco Bay, there are three locations that serve as primary locations: Mowry Slough in the south Bay, Corte Madera Marsh and Castro Rocks in the north Bay, and Yerba Buena Island in the central Bay (Grigg, 2008; Gibble, 2011). Detailed information regarding the number and distribution of Pacific harbor seals in the project area is provided in Section 5.1.

4.2 CALIFORNIA SEA LION

The California sea lion (*Zalophus californianus*) belongs to the family Otariidae or “eared seals,” referring to the external ear flaps not shared by other pinniped families. California sea lions are sexually dimorphic: males can reach up to 8 feet long and weigh 700 pounds; whereas females are smaller, at approximately 6 feet long and 200 pounds. Sexual maturity occurs within 4 to 5 years. Although California sea lions forage and conduct many activities in the water, they also use haul-outs. California sea lions breed in Southern California and along the Channel Islands during the spring. Although most females remain in southern California waters year-round, males and some subadult females range widely and occupy protected embayments like San Francisco Bay throughout the year (Caltrans, 2012). Pupping does not occur in San Francisco Bay. They are extremely intelligent and social, and spend much of their time aggregated at communal haul-outs. Group hunting is common and they may cooperate with other species, such as dolphins, when hunting large schools of fish. The California sea lion feeds on a mixture of fish species and squid (NMFS, 2015b). Detailed information regarding the number and distribution of California sea lions in the project area is provided in Section 5.2.

4.3 HARBOR PORPOISE

The harbor porpoise (*Phocoena phocoena*) is a member of the Phocoenidae family. They generally occur in groups of two to five individuals, and are considered to be shy, relatively nonsocial animals. The harbor porpoise has a small body, with a short beak and medium-sized dorsal fin. They can grow to approximately 5 feet and 170 pounds. Females are slightly larger than the males, and reach sexually maturity at 3 to 4 years. They are typically found in waters less than 250 feet deep in coastal waters,

bays, estuaries, and harbors. Their prey base consists of demersal and benthic species, such as schooling fish and cephalopods (NMFS, 2014). Detailed information regarding the number and distribution of harbor porpoise in the project area is provided in Section 5.3.

4.4 GRAY WHALE

Gray whales (*Eschrichtius robustus*) are large baleen whales. They grow to approximately 50 feet in length and weigh up to 40 tons. They are one of the most frequently seen whales along the California Coast, easily recognized by their mottled gray color and lack of dorsal fin. Adult whales carry heavy loads of attached barnacles, which add to their mottled appearance. Gray whales are the only baleen whales known to feed on the sea floor, where they scoop up bottom sediments to filter out benthic crustaceans, mollusks, and worms (NMFS, 2015c). They feed in northern waters primarily off the Bering, Chukchi, and western Beaufort seas during the summer, before heading south to the breeding and calving grounds off Mexico over the winter. Between December and January, late-stage pregnant females, adult males, and immature females and males will migrate southward. The northward migration occurs between February and March. Coastal waters just outside San Francisco Bay are considered a migratory Biologically Important Area for the northward progression of gray whales (Calambokidis et al., 2015). During this time, recently pregnant females, adult males, immature females, and females with calves move north to the feeding grounds (Calambokidis et al., 2014). A few individuals will enter into the San Francisco Bay during their northward migration. Detailed information regarding the number and distribution of gray whales in the project area is provided in Section 5.4.

4.5 NORTHERN ELEPHANT SEAL

Northern elephant seals are common on California coastal mainland and island sites where they pup, breed, rest, and molt. The largest rookeries are on San Nicolas and San Miguel islands in the Northern Channel Islands. In the vicinity of San Francisco Bay, elephant seals breed, molt, and haul out at Año Nuevo Island, the Farallon Islands, and Point Reyes National Seashore (Lowry et al., 2014). Adults reside in offshore pelagic waters when not breeding or molting. Northern elephant seals haul out to give birth and breed from December through March, and pups remain onshore or in adjacent shallow water through May, when they may occasionally make brief stops in San Francisco Bay (Caltrans, 2015b). The most recent sighting was in 2012 on the beach at Clipper Cove on Treasure Island, when a healthy yearling elephant seal hauled out for approximately one day. Approximately 100 juvenile northern elephant seals strand in San Francisco Bay each year, including individual strandings at Yerba Buena Island and Treasure Island (fewer than 10 strandings per year) (Caltrans, 2015b). When pups of the year return in the late summer and fall to haul out at rookery sites, they may also occasionally make brief stops in San Francisco Bay.

4.6 NORTHERN FUR SEAL

The range of the northern fur seal (*Callorhinus ursinus*) extends from southern California, north to the Bering Sea and west to the Okhotsk Sea and Honshu Island, Japan (NMFS, 2015e). During the breeding season, the majority of the worldwide population is found on the Pribilof Islands in the southern Bering Sea, with the remaining animals spread throughout the North Pacific Ocean. On the coast of California, small breeding colonies are present at San Miguel Island off southern California, and the Farallon Islands off central California (NMFS, 2015e). Northern fur seal are a pelagic species and are rarely seen near the shore away from breeding areas. Juveniles of this species occasionally strand in San Francisco Bay, particularly during El Niño events (TMMC, 2016). The shoreline in the vicinity of the project is developed waterfront, consisting of piers and wharves where northern fur seal are unlikely to strand. Incidental take of this species is being requested in the rare event they are present in San Francisco Bay during pile driving.

4.7 BOTTLENOSE DOLPHIN

Since the 1982-83 El Niño, which increased water temperatures off California, bottlenose dolphins have been consistently sighted along the central California coast (NMFS, 2017b). The northern limit of their regular range is currently the Pacific coast off San Francisco and Marin County, and they occasionally enter San Francisco Bay, sometimes foraging for fish in Fort Point Cove. Bottlenose dolphin sightings occur frequently just east of the Golden Gate Bridge. Members of the California Coastal Stock are transient and make movements up and down the coast, and into some estuaries, throughout the year. Incidental take of this species is being requested, because their presence in San Francisco Bay has increased in recent years. Detailed information regarding the number and distribution of bottlenose dolphin in the project area is provided in Section 5.7.

4.8 EXTRALIMITAL SPECIES

The following species may be occasionally or incidentally present in San Francisco Bay. A review of the status of these species is presented below, indicating why take of these species is not being requested. For the pinnipeds described below, such occurrences often take the form of stranded individuals that are sick or malnourished.

4.8.1 Guadalupe Fur Seal

The Guadalupe fur seal (*Arctocephalus townsendi*) is listed as threatened under the ESA. Currently, the only breeding colonies are on Isla Guadalupe off Baja California, Mexico, and a few other small islands in that area (Simon, 2016; NMFS, 2017c). Outside of the breeding season, this species occasionally ranges into the waters of Northern California and the Pacific Northwest. The Farallon Islands (off central California) and the Channel Islands (off southern California, including San Miguel, San Nicolas, Santa Barbara and San Clemente Islands) are used as haul outs during these movements (Simon, 2016). Juvenile Guadalupe fur seal occasionally strand in the vicinity of San Francisco, and stranding rates increase during El Niño events. Most strandings along the California coast are animals younger than 2 years old, with evidence of malnutrition (NMFS, 2017c). The potential for this species to occur in the project area is very low. Because this is a threatened species under the ESA, no take is being requested. In the rare event that Guadalupe fur seal are detected within the Level A or Level B zones, work will cease until the animal has left the area.

4.8.2 Humpback Whale

During the summer and fall months, humpback whales (*Megaptera noveangliae*) are sometimes seen outside of or just within the Golden Gate. Humpback whales are rare—although well-publicized—visitors to the interior of San Francisco Bay. A humpback whale nicknamed “Humphrey” journeyed through San Francisco Bay and up the Sacramento River in 1985 and re-entered San Francisco Bay in the fall of 1990, stranding on mudflats near Candlestick Park (Fimrite, 2005). In May 2007, a humpback whale mother and calf spent just over 2 weeks in San Francisco Bay and the Sacramento River before finding their way back out to sea. A recent, seasonal influx of whale counts inside San Francisco Bay near the Golden Gate was recorded from April to November in 2016 and 2017 (Keener, 2017). The same measures taken to minimize and mitigate for effects to gray whales would adequately protect a stray humpback whale if one did enter the project vicinity. This species will not be considered further in this application, because incidental take of humpback whale is not being requested.

5.0 AFFECTED SPECIES STATUS AND DISTRIBUTION IN THE ACTION AREA

5.1 PACIFIC HARBOR SEAL

The Pacific harbor seal is protected under the Marine Mammal Protection Act (MMPA), but is not listed as strategic or depleted under the MMPA; nor is it listed as endangered or threatened under the ESA (NMFS, 2015a). Harbor seals have the broadest range of any pinniped, inhabiting both the Atlantic and Pacific oceans. In the Pacific, they are found in near-shore coastal and estuarine habitats from Baja California to Alaska, and from Russia to Japan. Of the three recognized populations of Pacific harbor seals along the west coast of the continental United States, the California stock occurs in California coastal waters. Although there is genetic distinction among some populations, geographical boundaries define the difference between the Oregon, Washington, and California Coastal stocks. Population assessments are extrapolated from 2009 and 2012 survey observations of the number of Pacific harbor seals ashore during the peak haul-out period (May to July) across an estimated 400 to 600 haul-out sites in California, and from 180 radio-tagged seals (Harvey and Goley, 2011; NMFS, 2015a). The number of pacific harbor seals observed was multiplied by a correction that is equal to the "inverse of the estimated fraction of seals on land" (NMFS, 2015a). The estimated population of the California stock is 30,968 (Table 4).

The 2015 Draft Marine Mammal Stock Assessment Report for the Pacific Region does not include a write-up of the California Stock, so information from the 2012 Marine Mammal Stock Assessment Report for the Pacific Region was used to describe the California stock (NMFS, 2015a). Between 1981 and 2004, the Pacific harbor seal population increased, followed by a steady decrease between 2005 and 2010. A partial reason for this decrease could be mortalities associated with human activity such as commercial hook and line fisheries, vessel strikes, entrainment in power plants, and research-related deaths (NMFS, 2015a).

Long-term monitoring studies have been conducted at the largest harbor seal colonies in Point Reyes National Seashore and Golden Gate National Recreation Area since 1976. Castro Rocks and other haul-outs in San Francisco Bay are part of the regional survey area for this study and have been included in annual survey efforts. Between 2007 and 2012, the average number of adults observed ranged from 126 to 166 during the breeding season (March through May), and from 92 to 129 during the molting season (June through July) (Truchinski et al., 2008; Flynn et al., 2009; Codde et al., 2010; Codde et al., 2011; Codde et al., 2012; Codde and Allen, 2015). Marine mammal monitoring at multiple locations inside San Francisco Bay was conducted by the California Department of Transportation (Caltrans) from May 1998 to February 2002, and determined that at least 500 harbor seals populate San Francisco Bay (Green et al., 2002). This estimate agrees with previous seal counts in the San Francisco Bay, which ranged from 524 to 641 seals from 1987 to 1999 (Goals Project, 2000). The main pupping areas in the San Francisco Bay are at Mowry Slough and Castro Rocks (Caltrans, 2012). Pupping season for harbor seals in San Francisco Bay spans from approximately March 15 through May 31, with pup numbers generally peaking in late April or May (NMFS, 2015a). Births of harbor seals have not been observed at Corte Madera Marsh and Yerba Buena Island, but a few pups have been seen at these sites.

The nearest harbor seal haul-out site to the project is Yerba Buena Island, approximately 1.5 miles from the project vicinity. Harbor seals use Yerba Buena Island year round, with the largest numbers seen during winter months, when Pacific Herring spawn (Grigg, 2008). During marine mammal monitoring for construction of the new Bay Bridge, harbor seal counts at Yerba Buena Island ranged from zero to a maximum of 188 individuals (Caltrans, 2012). Higher numbers also occur during molting and breeding seasons. Foraging areas in the vicinity are focused in between Yerba Buena Island and Treasure Island, and an area southeast of Yerba Buena Island (Caltrans, 2015b). Scat analysis from Yerba Buena Island in 2007-2008 concluded that harbor seal diet changes seasonally, with an emphasis on northern anchovy in the spring and summer during pupping season (Gibble, 2011).

5.2 CALIFORNIA SEA LION

The California sea lion is protected under the MMPA, but is not listed as strategic or depleted under the MMPA; nor is it listed as endangered or threatened under the ESA (NMFS, 2015b). Based on genetic variations in the mitochondrial DNA, there are five genetically distinct populations of California sea lions: Pacific temperate, Pacific subtropical, Southern Gulf of California, Central Gulf of California, and the Northern Gulf of California. Members of the Pacific temperate population, which range between Canada and Baja California, occur in the project area. This population is estimated to be around 296,750 individuals (Table 4). Because different age and sex classes are not all ashore at any given time, the population assessment is based on an estimate of the number of births and number of pups in relation to the known population. The current population estimate is derived from visual surveys, conducted in 2007, 2008, and 2011 of the different age and sex classes observed ashore at the primary rookeries and haul-out sites in southern and central California, coupled with an assessment done in 2008 of the number of pups born in the southern California rookeries (NMFS, 2015b). Because the 2015 Draft Marine Mammal Stock Assessment Report for the Pacific Region does not include a write-up of the Pacific temperate population (NMFS, 2015b), information from the 2012 Marine Mammal Stock Assessment Report for the Pacific Region was used to describe the California stock (NMFS, 2017a).

Statistical analysis of the pup counts between 1975 and 2011 determined an approximate 5.4 percent annual increase between 1975 and 2008. However, this does not take into account decreases associated with El Niño years observed in 1983, 1984, 1992, 1993, and 2003. During these periods, pup counts decreased by between 20 and 64 percent. Although pup counts reached pre-El Niño levels within 2 years of the 1992-1993, 1997-1998, and 2003 El Niño events, it took 5 years after the 1983-1984 El Niño event for pup production to reach pre-1982 levels. According to the National Oceanic and Atmospheric Administration (NOAA), one of the reasons for this could be that during El Niño events, there is an increase in pup and juvenile mortality, which in turn affects future age and sex classes. Additionally, because there are fewer females present in the population after such events, pup production is further limited. The decline in pup production observed during 2000 and 2003 can be attributed in part to previous El Niño events, which affected the number of reproductive females in the population; and in part to domoic poisoning and an infestation of hookworms, which caused an increase in pup mortality (NMFS, 2017a). There was an unusual mortality event (UME) declared in 2013 due to a high number of strandings with reasons unknown, but hypothesized to be associated with low forage fish availability close to pupping areas (NMFS, 2015b).

In San Francisco Bay, sea lions haul out primarily on floating K docks at Pier 39 in the Fisherman's Wharf area of the San Francisco Marina. The Pier 39 haul out is approximately 1.5 miles from the project vicinity. The Marine Mammal Center (TMMC) in Sausalito, California has performed monitoring surveys at this location since 1991. A maximum of 1,706 sea lions was seen hauled out during one survey effort in 2009 (TMMC, 2015). Winter numbers are generally over 500 animals (Goals Project, 2000). In August to September, counts average from 350 to 850 (NMFS, 2004). Of the California sea lions observed, approximately 85 percent were male. No pupping activity has been observed at this site or at other locations in the San Francisco Bay (Caltrans, 2012). The California sea lions usually frequent Pier 39 in August after returning from the Channel Islands (Caltrans, 2013). In addition to the Pier 39 haul-out, California sea lions haul out on buoys and similar structures throughout San Francisco Bay. They mainly are seen swimming off the San Francisco and Marin shorelines within San Francisco Bay, but may occasionally enter the project area to forage.

Although there is little information regarding the foraging behavior of the California sea lion in the San Francisco Bay, they have been observed foraging on a regular basis in the shipping channel south of Yerba Buena Island. Foraging grounds have also been identified for pinnipeds, including sea lions, between Yerba Buena Island and Treasure Island, as well as off the Tiburon Peninsula (Caltrans, 2001). The California sea lions that use the Pier 39 haul-out site may be feeding on Pacific herring (*Clupea harengus*), northern anchovy, and other prey in the waters of San Francisco Bay (Caltrans, 2013).

5.3 HARBOR PORPOISE

The harbor porpoise is protected under the MMPA but is not listed as a strategic or depleted species under the MMPA, nor is it listed as endangered or threatened under the ESA (NMFS, 2014). Harbor porpoise have a broad range in both the Atlantic and Pacific Oceans. In the Pacific, they are found from Point Conception, California to Alaska; and from Kamchatka to Japan. Distribution is discontinuous due to a habitat preference of continental shelf waters and partially enclosed areas such as bays or fjords. The harbor porpoise population along the Pacific coastline consists of nine distinct stocks (the Morro Bay, Monterey Bay, San Francisco-Russian River, northern California/southern Oregon, northern Oregon/ Washington coast, Inland Washington, Southeast Alaska, Gulf of Alaska, and Bering Sea stocks). The San Francisco-Russian River stock is the population that could occur in the project area. The San Francisco-Russian River stock consists of an estimated 9,886 individuals (Table 4). These estimates are based on aerial surveys that were conducted between 2007 and 2011. The current population estimate is similar to the 2002-2007 estimates of 9,189 individuals (NMFS, 2014). Over the last 5 years, there have been no reported fishery-related deaths or injury of harbor porpoises within the range of the San Francisco-Russian River stock (NMFS, 2014).

In the last 6 decades, harbor porpoises were observed outside of San Francisco Bay. The few harbor porpoises that entered were not sighted past central Bay close to the Golden Gate Bridge. In recent years, however, there have been increasingly common observations of harbor porpoises in central, north, and south San Francisco Bay. According to observations by the Golden Gate Cetacean Research team as part of their multi-year assessment, over 100 porpoises may be seen at one time entering San Francisco Bay; and over 600 individual animals are documented in a photo-ID database. Porpoise activity inside San Francisco Bay is thought to be related to tide-dependent foraging, as well as mating behaviors (Keener, 2011; Duffy, 2015). Sightings are concentrated in the vicinity of the Golden Gate Bridge and Angel Island, with lesser numbers sighted south of Alcatraz and west of Treasure Island (Keener 2011).

5.4 NORTHERN ELEPHANT SEAL

The Northern elephant seal is protected under the MMPA but is not listed as a strategic or depleted species under the MMPA, nor is it listed as endangered or threatened under the ESA (NMFS, 2015f). Northern elephant seal population size is estimated by approximation from the number of pups produced because all age classes are not ashore simultaneously. Based on counts of elephant seals at U.S. rookeries in 2010, Lowry et al. (2014) reported that 40,684 pups were born. From this, a total population estimate of approximately 179,000 elephant seals has been made (Lowry et al., 2014), of which approximately 81,000 are the California Breeding stock (NMFS, 2015f).

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 and DeLong, 1995). Pup mortality is high when they make the first trip to sea in May, and this period correlates with the time of most strandings. Pups of the year return in the late summer and fall to haul out at rookery sites, but may occasionally make brief stops in San Francisco Bay. Approximately 100 juvenile northern elephant seals of the California Breeding stock strand in San Francisco Bay each year, including individual strandings at Yerba Buena Island and Treasure Island (fewer than 10 strandings per year) (Caltrans, 2015b).

5.5 GRAY WHALE

The gray whale is protected under the MMPA but is not listed as a strategic or depleted species under the MMPA, nor is it listed as endangered or threatened under the ESA (NMFS, 2015c). Although gray whales were once found in three populations across the globe, the Atlantic population is believed extinct, and the species is now limited to the Pacific Ocean, where they are divided into the Eastern North Pacific stock and Western North Pacific stocks. Both Eastern North Pacific and Western North Pacific gray whales migrate each year along the west coast of continental North America and Alaska. They may consequently

enter San Francisco Bay, although the Eastern North Pacific stock is much larger and more likely to occur in the area. Based on surveys from 2010/2011, the population of the Eastern North Pacific stock is estimated to consist of 20,990 individuals (NMFS, 2015c) (Table 4). With the exception of an unusual mortality event in 1999 and 2000, the population of the Eastern North Pacific gray whale stock has increased over the last 20 years, and has been stable since the 1990s (NMFS, 2015c). Those Eastern North Pacific stock gray whales that summer along the west coast of North America to forage are additionally defined as the Pacific Coast Feeding Group, and are separately monitored between June 1 and November 1 between northern California and northern British Columbia by the International Whaling Commission (IWC, 2012; Calambokidis et al., 2015). The Pacific Coast Feeding Group stock has increased in abundance estimates since the 1990s, and has been stable since 2003 (Calambokidis et al., 2014).

Caltrans Richmond-San Rafael Bridge project monitors recorded 12 living and two dead gray whales in the surveys performed in 2012. All sightings were in either the central or north Bay; and all but two sightings occurred during the months of April and May. One gray whale was sighted in June, and one in October (the specific years were unreported). The Oceanic Society has tracked gray whale sightings since they began returning to San Francisco Bay regularly in the late 1990s. Most sightings occurred just a mile or two inside San Francisco Bay, with some traveling into San Pablo Bay (Self, 2012). The Oceanic Society data show that all age classes of gray whales are entering San Francisco Bay, and that they enter as singles or in groups of up to five individuals. However, the data do not distinguish between sightings of gray whales and number of individual whales (Winning, 2008). It is estimated that two to six gray whales enter San Francisco Bay in any given year.

5.6 NORTHERN FUR SEAL

The Northern fur seal is separated into two stocks: the California and the Eastern Pacific stock. Both are protected under the MMPA. The Eastern Pacific stock is listed as strategic and depleted under the MMPA, but not threatened or endangered under the ESA. The California stock is not listed as strategic or depleted under the MMPA, nor is it listed as threatened or endangered under the ESA (NMFS, 2015e). The Eastern Pacific stock uses the Pribilof and Bogoslof Islands off of Alaska for breeding; the California stock breeds on the Farallons and San Miguel Island (NMFS, 2015e). The most recent estimate of the California stock is 14,050 seals, based on surveys from 2008 to 2013. The Eastern Pacific stock is estimated at 626,734 seals (NMFS, 2015e). Both the Eastern Pacific and California stocks forage in offshore waters outside San Francisco Bay. Northern fur seal populations experience significant declines as a result of El Niño events, which reduced food availability for the species (NMFS, 2015e). In normal years, TMMC in Sausalito admits about five northern fur seals that stranded on the Central California Coast (TMMC, 2016). During El Niño years, this number dramatically increases; for example, during the 2006 El Niño event, 33 fur seals were admitted (TMMC, 2016). Some of these stranded animals were collected from shorelines in San Francisco Bay.

5.7 BOTTLENOSE DOLPHIN

The California Coastal Stock of Common bottlenose dolphin is protected under the MMPA but is not listed as a strategic or depleted species under the MMPA, nor is it listed as endangered or threatened under the ESA (NMFS, 2017b). The California Coastal Stock is relatively small (453 animals), but they are frequently seen because they spend the majority of time in nearshore waters (NMFS, 2017b). Bottlenose dolphin are most often seen just within the Golden Gate or just east of the bridge when they are present in San Francisco Bay, and their presence may depend on the tides (GGCR, 2016). Beginning in the summer of 2015, one to two bottlenose dolphins have been observed frequently swimming in the Oyster Point area of South San Francisco (GGCR, 2016; GGCR, 2017; Perlman, 2017). Despite this recent occurrence, this stock is highly transitory in nature, and is not expected to spend extended periods of time in San Francisco Bay; however, the number of sightings in the Central Bay has increased, which may indicate they are becoming more of a resident species.

6.0 TYPE OF INCIDENTAL TAKING AUTHORIZATION REQUESTED

6.1 TAKE AUTHORIZATION REQUEST

Under Section 101 (a)(5)(D) of the MMPA, WETA requests an authorization from the NMFS for incidental take by Level B harassment (as defined by Title 50 Code of Federal Regulations, Part 216.3) (i.e., IHA) of small numbers of marine mammals—specifically, Pacific harbor seals, California sea lions, harbor porpoise, gray whales, northern elephant seal, northern fur seals, and bottlenose dolphin—during pile-driving activities associated with expanding the Ferry Terminal. With implementation of the measures outlined in Section 12, no slight injury from Permanent Threshold Shift (PTS) in an animal's hearing, serious injury, or mortality (Level A harassment) is anticipated.

The noise exposure assessment methodology used in this IHA request attempts to quantify potential exposures to marine mammals resulting from underwater and airborne noise generated during pile extraction and pile installation. Section 7 presents a detailed description of the acoustic exposure assessment methodology. Results from this approach tend to provide an overestimation of exposures because all animals are assumed to be available to be exposed 100 percent of the time. The effects will depend on the species, pile-driving methods, received level of sound, and distance from the work area; however, temporary behavioral reactions are most likely to occur. The analysis for the project predicts potential exposures (see Section 7 for estimates of exposures by species) over the course of the construction that could be classified as Level B harassment, as defined under MMPA.

6.2 METHOD OF TAKE

The project, as outlined in Sections 2 and 3, has the potential to result in incidental take of marine mammals by underwater and airborne noise disturbance during pile-driving activities. These activities have the potential to disturb or displace marine mammals. Specifically, the proposed activities may result in "take" in the form of Level B harassment (behavioral disturbance only) from airborne or underwater noise generated from pile installation. Level A harassment is not anticipated, given the methods of installation and measures designed to minimize the possibility of injury to marine mammals. Section 12 contains additional details on impact reduction and mitigation measures that are proposed for this project.

7.0 TAKE ESTIMATE FOR MARINE MAMMALS

Project activities may result in temporary behavioral changes in marine mammals, primarily from underwater and airborne noise levels generated during pile-driving activities. This section describes the noise levels that are expected to be generated by the project activities, and the potential impacts of the noise levels on marine mammal species that could be found in the project area.

7.1 FUNDAMENTALS OF SOUND

Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air or water. Sound is generally characterized by several variables, including frequency and intensity. Frequency describes the pitch of a sound, and is measured in the number of cycles per second, or hertz (Hz). Intensity describes the pressure per unit of area (i.e., loudness) of a sound, and is measured in decibels (dB). A dB is a unit of measurement describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure. For underwater sounds, a reference pressure of 1 microPascal (µPa) is commonly used to describe sounds in terms of decibels, and is expressed as "dB re 1 µPa." Therefore, 0 dB on the decibel scale would be a measure of sound pressure of 1 µPa. Sound levels in dB are calculated on a logarithmic basis. An increase of 10 dB represents a tenfold increase in acoustic energy, while 20 dB is 100 times more intense, 30 dB is 1,000 times more intense, etc. For airborne sound pressure, the reference amplitude is usually 20 µPa, and is expressed as "dB re 20 µPa."

The method commonly used to quantify airborne sounds consists of evaluating all frequencies of a sound according to a weighting system that reflects of human hearing. This method is less sensitive at low frequencies and extremely high frequencies than at the mid-range frequencies. The method is called A-weighting, and the dB level that is measured using this method is called the A-weighted sound level. Sounds levels measured underwater are not weighted, and include the entire frequency range of interest.

When a pile-driving hammer strikes a pile, a pulse is created that propagates through the pile and radiates sound into the water, substrate, and air. The sound pressure pulse is a function of time, and is referred to as the waveform. The instantaneous peak sound pressure level (SPL_{peak}) is the highest absolute value of pressure over the measured waveform, and can be a negative or positive pressure peak. In this document, the SPL_{peak} is also referenced as the peak levels or thresholds. Sound is frequently described as a root mean square (RMS) level, which is a statistical average of the sound wave amplitude. The RMS level is determined by analyzing the waveform and computing the average of the squared pressures over the time that constitutes the portion of the waveform containing 90 percent of the sound energy (Richardson et al., 1995). Sound levels are also described in relation to cumulative sound exposure levels (cSEL) where the A-weighted instantaneous sound pressures are squared and summed[3] throughout the duration of an event, referenced to 1 μPa.

Table 5 contains definitions of these terms. In this document, dB for underwater sound is referenced to 1 μPa and 1 μPa^2-sec (RMS and cSEL, respectively), and dB for airborne noise is referenced to 20 μPa. The practical spreading model has been used to estimate underwater noise in this analysis. In common use, noise refers to any unwanted sound. This meaning of noise will be used in the following discussion in reference to marine mammals; that is—pile driving noise may harass marine mammals.

Table 5
Definitions of Underwater Acoustical Terms

Term	Definition
dB, Decibel	A unit describing, the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure. The reference pressure for air is 20 μPa, and 1 μPa for underwater.
SPL_{peak}, Peak Sound Pressure Level (dB)	Peak sound-pressure level, based on the largest absolute value of the instantaneous sound pressure. This pressure is expressed in this report as a decibel (referenced to 1 μPa), but can also be expressed in units of pressure, such as μPa or pounds per square inch.
cSEL, cumulative Sound Exposure Level (dB)	cSEL is calculated by summing the cumulative pressure squared over the measurement duration, integrating over time, and normalizing to 1 second, referenced to 1 $microPascal^2$-second (1 μPa^2-sec).
RMS, root mean square Level, (NMFS Criterion)	The average of the squared pressures over the time that comprise that portion of the waveform containing 90 percent of the sound energy for one pile-driving impulse (referenced to a pressure of 1 μPa).

Notes:
μPa = microPascal
NMFS = National Marine Fisheries Service

3 SEL values are logarithms and must first be converted to antilogs for summation. Because the single strike SEL varies over the sequence of strikes, a linear sum of the energies for all the different strikes needs is computed. This is done as follows: divide each SEL decibel level by 10 and then take the antilog to convert the decibels to linear units (or uPa^2-s). Then the linear units can be summed and converted back into dB by taking 10Log10 of the value. This will be the cumulative SEL for all of the pile strikes.

7.2 APPLICABLE NOISE THRESHOLDS

In 2010, NMFS established interim thresholds regarding the exposure of marine mammals to high-intensity noise that may be considered take under the MMPA. Updated NOAA guidance on assessing the effects of underwater noise on marine mammals for agency impact analysis was adopted in 2016 (NMFS, 2016a). The 2016 guidance includes sound thresholds for slight injury to an animal's hearing, or PTS (Level A Harassment). The underwater sound pressure threshold for slight injury or PTS (Level A harassment) is a dual metric criterion for impulse noise (e.g., impact pile-driving), including both a peak pressure and cSEL threshold, which is specific to the species hearing group (i.e., high-frequency cetaceans [i.e., harbor porpoise], mid-frequency cetaceans [i.e., bottlenose dolphin], low-frequency cetacean [i.e., gray whale], phocids [i.e., Pacific harbor seal and northern elephant seal], and otariids [i.e., California sea lion and northern fur seal]). For continuous noise (e.g., vibratory pile extraction or driving), the PTS threshold is based on cSEL for each species hearing group.

The 2010 thresholds for Level B behavioral harassment levels are still applicable: 160 dB RMS for impulse sounds and 120 dB for nonimpulsive or continuous sounds. Level B Behavioral harassment is considered to have occurred when marine mammals are exposed to noise of 160 dB RMS or greater for impulse noise and 120 dB RMS for continuous noise. In some instances, ambient noise levels may be used in place of the 120 dB RMS threshold for continuous noise. For continuous noise, RMS levels are based on a time constant of 10 seconds, and those RMS levels should be averaged across the entire event. For impact pile-driving, the overall RMS level should be characterized by integrating sound energy for each acoustic pulse across 90 percent of the acoustic energy in each pulse, and averaging all the RMS levels for all pulses. Harassment thresholds for the various types of airborne and underwater noise are shown in Table 6.

Table 6
Injury and Behavioral Disruption Thresholds for Airborne and Underwater Noise

Hearing Group and species considered in this IHA	Airborne Threshold (Impact and Vibratory Pile-Driving)	Underwater Continuous Noise Thresholds (e.g., Vibratory Pile-Driving)		Underwater Impulse Noise Thresholds (e.g., Impact Pile-Driving)		
	Level B RMS Threshold[1]	Level A cSEL Threshold	Level B RMS Threshold	Level A Peak Threshold[2]	Level A cSEL Threshold[2]	Level B RMS Threshold
Phocids (Pacific harbor seals, northern elephant seals)	90 dB (unweighted)	201 dB	120 dB	218 dB	185 dB	160 dB
Otariids (California sea lions, northern fur seals)	100 dB (unweighted)	219 dB	120 dB	232 dB	203 dB	160 dB
Low-Frequency Cetaceans (gray whales)	N/A	199 dB	120 dB	219 dB	183 dB	160 dB
Mid-Frequency Cetaceans (bottlenose dolphins)	N/A	198 dB	120 dB	230 dB	185 dB	160 dB
High-Frequency Cetaceans (harbor porpoises)	N/A	173 dB	120 dB	202 dB	155 dB	160 dB

Notes:
1 The airborne disturbance guideline applies to hauled-out pinnipeds.
2 Level A threshold for impulse noise is a duel criterion based on peak pressure and cSEL. Thresholds are based on the NMFS 2016 Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing.

cSEL = cumulative sound exposure level
dB = decibel
IHA = Incidental Harassment Authorization
N/A = Not applicable, no thresholds exist
NMFS = National Marine Fisheries Service
RMS = root mean square
sec = second
Underwater peak and RMS are re: 1 µPa; cSEL is re: 1 μPa^2-sec; Airborne RMS is re: 20 µPa.

The application of the standard 120 dB RMS threshold for underwater continuous noise can sometimes be problematic, because this threshold level can be either at or below the ambient noise level of certain locations, and not all species may respond to noise at that level. Exposure thresholds for continuous noise have been developed based on the best available scientific information on the response of gray whales to underwater noise. To date, there is very little research or data supporting a response by pinnipeds or odontocetes to continuous noise from vibratory pile extraction and driving as low as the 120 dB threshold. Southall et al. (2007) summarized numerous behavioral observations made of low-frequency cetaceans to a range of nonpulse noise sources, such as vibratory pile-driving. Generally, the data suggest no or limited responses to received levels of 90 to 120 dB RMS, and an increasing probability of behavioral effects in the 120 to 160 dB RMS range. There is limited data available on the behavioral effects of continuous noise on pinnipeds while underwater; however, field and captive studies to date collectively suggest that pinnipeds do not react strongly to exposures between 90 and 140 dB re 1 μPa RMS (Southall et al., 2007). Additionally, ambient underwater noise levels in urbanized estuaries often far exceeds 120 dB RMS, as a result of the nearly continuous noise from recreational and commercial boat traffic.

Background underwater sound levels in the action area are considered in the assessment of the project's construction impacts. Ambient noise levels have been used as a threshold for behavioral harassment from pile driving in other IHA authorizations, such as for the Mukilteo Multimodal Project Tank Farm Pier Removal in Washington and the Anacortes Ferry Terminal Tie-up Slip Dolphin and Wingwall Replacement Project in Washington, both authorized on September 1, 2015. Underwater noise in the Ferry Terminal area is regularly generated by small- to medium-sized boats, including the existing water transit vessels. Underwater sound levels for water transit vessels, which operate throughout the day from the San Francisco Ferry Building (Figure 4), ranged from 152 dB to 177 dB (WETA, 2003a). Site-specific ambient noise data were collected for the San Francisco Ferry Terminal during the 2017 in-water work window. Results indicated that the ambient noise level was approximately 120 dB, with daily variability. As a result, the standard Level B threshold of 120 dB RMS will be used in this assessment.

Airborne noise levels at which pinniped behavioral disturbance at haul-out sites has been documented are used to determine potential disturbance from airborne construction noise. It should be noted that these are not official thresholds, but are used as guidelines to determine impacts associated with changes in airborne noise levels.

7.3 ESTIMATION OF PILE-DRIVING NOISE

A review of underwater sound measurements for similar projects was undertaken to estimate the near-source sound levels for vibratory pile extraction and driving, and impact pile-driving. Pile-driving sounds from similar types and sizes of piles have been measured from other projects and can be used to estimate the noise levels that the project would generate. This analysis uses the practical spreading loss model, which NMFS and United States Fish and Wildlife Service have accepted to estimate transmission loss of sound through water.

The significant sources of underwater noise during construction in 2018 would be pile-driving. Two different methods will be used to install new piles in San Francisco Bay: (1) vibratory hammer installation; and (2) impact hammer installation. This includes installing 24-inch, 30-inch, and 36-inch hollow-steel piles, as described in Section 2 and summarized in Table 3. All piles will be installed from a marine derrick barge. Pile installation would occur in water depths ranging from approximately 4 to 15 feet, depending on location and tidal phase. The substrate at the pile-driving locations is primarily Bay Mud.

Reference sound levels were based on underwater sound measurements documented from the 2017 construction season of the project, as well as other pile-driving projects with similar pile sizes and types at similar sites (i.e., estuarine areas of soft substrate where water depths are less than 16 feet [Caltrans, 2009]). For vibratory driving, this application uses the average transmission loss measured in 2017 minus one standard deviation of those measurements (F value of 22.26 - 3.51 = 18.75), a dissipation rate of

5.6 dB per doubling of distance. For impact driving, in the absence of site-specific data it is assumed that the noise energy would dissipate as it spreads from the pile at a rate of at least 4.5 dB per doubling of distance (Caltrans, 2009). This is a conservative value for areas of shallow water with soft substrates, and actual dissipation rates would likely be higher.

Using this information, and the number and size of piles presented in Tables 7 and 8, underwater sound levels were estimated using the practical spreading model to determine whether and over what distance the thresholds would be exceeded. In addition, as noted in Section 12, Mitigation Measures, during impact pile-driving of steel piles, WETA will also use a bubble curtain to attenuate underwater sound levels. According to Caltrans guidance, it can be assumed that an air bubble curtain will provide approximately 10 dB of sound reduction (Caltrans, 2015a). Because it is anticipated that ambient noise levels in the vicinity of the project will often be equal to or exceed 120 dB, the actual area of Level B harassment is likely much smaller than what is presented below. Tables 7 and 8 show the expected underwater sound levels for pile-driving activities and the estimated distances to the Level A and Level B thresholds.

Table 7
Expected Pile-Driving Noise Levels and Distances of Level A Threshold Exceedance with Impact and Vibratory Driver

Project Element Requiring Pile Installation	Source Levels at 33 feet (10 meters) (dB)			Distance to Level A Threshold[1], in feet[2] (meters in parentheses)				
	Peak[3]	RMS	SEL	Phocids	Otariids	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans
36-Inch Steel Piles – Vibratory Driver	191	173	159	86 (26)	10 (3)	125 (38)	16 (5)	171 (52)
36-Inch Steel Piles – Impact Driver (BCA)	200	183	173	887 (270)	65 (20)	1,658 (505)	59 (18)	1,975 (602)
30-Inch Steel Piles – Vibratory Driver	181	157	153	10 (3)	1 (<1.0)	13 (4)	3 (<1.0)	20 (6)
30-Inch Steel Piles – Impact Driver (BCA)	200	180	167	463 (141)	34 (10)	865 (264)	31 (9)	1,030 (314)
24-Inch Steel Piles- Vibratory Driver	183	165	160	26 (8)	3 (<1.0)	39 (12)	7 (2)	56 (17)
24-Inch Steel Piles – Impact Driver (BCA)	193	180	167	463 (141)	34 (10)	865 (264)	31 (9)	1,030 (314)

Notes:
1 Level A thresholds are based on the NMFS 2016 Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing; cSEL threshold distances are shown. See footnote 3 below.
2 Where noise will not be blocked by land masses or other solid structures. Values in feet have been converted from fractional meters values, which may affect rounding during unit conversion.
3 All distances to the peak Level A thresholds are less than 33 feet (10 meters).
Distances are rounded to the nearest foot or to "<1.0 (0)" for values less than 1 foot.
Peak and cSEL are re: 1 µPa and 1 μPa^2-sec, respectively.
BCA = Bubble curtain attenuation; BCA will be used during impact driving of steel piles.
cSEL = cumulative sound exposure level
dB = decibels
µPa = microPascal
NMFS = National Marine Fisheries Service
SEL = sound exposure level

Table 8
Expected Pile-Driving Noise Levels and Distances of Level B Threshold Exceedance with Impact and Vibratory Driver

Project Element Requiring Pile Installation	Source Levels at 33 feet (10 meters) (dB)		Distance to Level B Threshold, in feet[1] (meters in parentheses)	Area of Potential Level B Threshold Exceedance Acres (square kilometers)
	Peak	RMS	160/120 dB RMS (Level B)[2]	
36-Inch Steel Piles – Vibratory Driver	191	173	22,011 (6,709)	8,278 (33.50)
36-Inch Steel Piles – Impact Driver (BCA)	200	183	1,120 (341)	44 (0.18)
30-Inch Steel Piles – Vibratory Driver	181	157	3,084 (940)	267 (1.08)
30-Inch Steel Piles – Impact Driver (BCA)	200	180	705 (215)	20 (0.08)
24-Inch Steel Piles- Vibratory Driver	183	165	8,241 (2,512)	1,804 (7.30)
24-Inch Steel Piles – Impact Driver (BCA)	193	180	705 (215)	20 (0.08)

Notes:
1 Where noise will not be blocked by land masses or other solid structures. Values in feet have been converted from fractional meters values, which may affect rounding during unit conversion.
2 For underwater noise, the Level B harassment (disturbance) threshold is 160 dB for impulsive noise and 120 dB for continuous noise.
Peak and RMS are re:1 µPa.
BCA = Bubble curtain attenuation; BCA will be used during impact driving of steel piles.
dB = decibels
RMS = root mean square

7.3.1 Underwater Noise from Impact Driving of 24-, 30-, and 36-Inch Steel Pipe Piles

Piles will be driven approximately 120 to 140 feet below MLLW, and will consist of 24-, 30-, or 36-inch diameter steel pipes. Installation of these pipe piles may require up to 1,800 blows from an impact hammer using a DelMag D46-32, or similar diesel hammer, producing approximately 122,000 foot-pounds maximum energy per blow, and 1.5 seconds per blow average.

Other projects conducted under similar circumstances were reviewed to estimate the approximate noise produced by the 24-, 30-, and 36-inch steel piles. These projects include the driving of similarly sized piles at the Alameda Bay Ship and Yacht project; the Rodeo Dock Repair project; and the Amorco Wharf Repair project (Caltrans, 2012). During impact pile-driving associated with these projects, measured peak noise levels ranged from 195 to 205 dB; and the RMS averaged about 193 dB for 36-inch piles, and 190 dB for 24- and 30- inch piles (Caltrans, 2012). Anticipated sound exposure levels (SELs) for unattenuated impact pile driving would be 183 dB for 36-inch pile driving and 178 dB for 30- and 24-inch piles (Caltrans, 2015a). Bubble curtains will be used during the installation of these piles, which, based on guidance provided by Caltrans for a mid-sized steel pile (with a dimension greater than 24 but less than 48 inches), is expected to reduce noise levels by about 10 dB RMS (Caltrans, 2015a). Based on the above sound levels, installation of the 24-, 30-, and 36-inch steel pipe piles could have the potential to produce cSEL and peak values above Level A thresholds and the Level B RMS threshold at distances summarized in Tables 7 and 8. It is estimated that three piles would be installed per day, with an average blow count of 1,800 blows per pile. Figures 4 and 5 show the distances to the Level A thresholds for impact pile driving and vibratory pile driving, respectively. Figures 6 and 7 show the distances to the Level B thresholds for impact pile driving and vibratory pile driving, respectively. For impact pile driving, the standard transmission loss value of 15 is conservatively used.

7.3.2 Underwater Noise from Vibratory Driving of 24-, 30-, and 36-Inch Steel Pipe Piles

During the 2017 construction season, all piles were installed with a vibratory hammer. The hydroacoustic monitoring conducted for vibratory driving during the 2017 construction season has been used to establish the expected source values of piles driven during the 2018 construction season. The maximum peak, maximum RMS, and mean SEL values for each of the pile types (24-, 30-, and 36-inch steel piles) were chosen for use as the source values to estimate take from vibratory driving. These values are provided in Tables 7 and 8, above. Additionally, monitoring conducted during 2017 established that for vibratory pile driving in the project area, the transmission loss is greater than the standard value of 15 used in prior take calculations. For estimating take from vibratory driving, this application uses the average transmission loss measured in 2017 minus one standard deviation of those measurements (22.26 - 3.51 = 18.75).

For the purposes of establishing the areas of Level A exceedance, it is estimated that an average of four of these piles would be driven per day of pile driving during the proposed project, with an average drive time of 900 seconds for 24- and 30- inch piles and 1,200 seconds for 36-inch piles. Based on the above sound levels, vibratory installation of the steel pipe piles could have the potential to exceed the Level A thresholds at the distances included in Table 7 and shown on Figure 5, and produce RMS values above the Level B threshold at distances summarized in Table 8 and displayed on Figure 7.

7.3.3 Airborne Noise

Pile driving generates airborne noise that could potentially result in behavioral disturbance to pinnipeds (e.g., sea lions and harbor seals) that are hauled-out or at the water's surface. As with the underwater noise, the practical spreading model is used to determine the extent over which sound levels may result in harassment of marine mammals. A 20 $\log_{10}$ attenuation rate was used to calculate the distances to the NMFS thresholds for pinnipeds, presented in Table 6.

The closest haul-out sites to the project area are Yerba Buena Island (for harbor seals), approximately 2 miles from the Ferry Terminal; and Pier 39 (for California sea lions), approximately 1.5 miles from the Ferry Terminal. These distances are far enough from the action area that if pile-driving noise is detectable, it would not be louder than background noise both from anthropogenic and natural sources in the vicinity, which includes an active port area and major highway bridge.

Measured sound levels of airborne noise from impact pile driving used in this analysis are also based on measurements made during the Navy Test Pile Project in Bangor, Washington (NAVFAC, 2012), where 24- and 36-inch steel shell piles were used, which are the smallest and largest sized piles that would be used on the project and therefore the best and worst case scenarios. The maximum measured unweighted L_{max}[4] was 112 dB, and the average L_{max} was 103 dB at 50 feet (15 meters). To conservatively estimate the distances to the specified airborne noise thresholds for pinnipeds, the L_{max} will be used, which for a typical noise event is higher than the average airborne RMS value.

Measured airborne noise levels from vibratory driving used in this analysis are also based on measurements made during the Navy Test Pile Project (NAVFAC, 2012). For vibratory driving of 36-inch steel shell piles, the greatest L_{max} value measured was 105 dB, and the average L_{max} was 97 dB (standardized to 50 feet [15 meters]).

Table 9 provides distances using the average L_{max} levels, which should conservatively estimate the distance to the NMFS threshold, because L_{max} is typically higher than the RMS value for a noise event.

[4] The 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).

Table 9
Modeled Extent of Sound Pressure Levels for Airborne Noise

Pile Driving Activity	Distance to Level B Guideline Thresholds	
	100 dB RMS (California Sea Lions)	90 dB RMS (Pacific Harbor Seals)
Impact Driving – All pile types	200 feet (61 meters)	630 feet (192 meters)
Vibratory Driving – All pile types	62 feet (19 meters)	196 feet (60 meters)

Notes:
RMS is re: 20 µPa.
dB = decibel
µPa = microPascal
RMS = root mean square

Any pinnipeds that surface in the area over which the airborne noise thresholds may be exceeded would have already been exposed to underwater noise levels above the applicable thresholds; therefore, no additional incidental take would occur (see Section 7.4.1).

7.4 DESCRIPTION AND ESTIMATION OF TAKE

For this analysis, the potential numbers of marine mammals that may be exposed to take as defined in the MMPA is determined by comparing the calculated areas over which the Level B and Level A harassment thresholds may be exceeded, as described in Section 7.3, with the expected distribution of marine mammal species within the vicinity of the proposed project, as described in Section 5. Estimates here are determined by using observational data taken during marine mammal monitoring associated with the 2017 pile driving for this project as well as the Richmond-San Rafael Bridge retrofit project, the SFOBB replacement project, and other marine mammal observations for San Francisco Bay.

The mechanisms of take requested are expected to have no more than a behavioral effect on individual animals, and no effect on the populations of these species. Any effects experienced by individual marine mammals are anticipated to be limited to short-term disturbance of normal behavior or temporary displacement of animals near the source of the noise. Monitoring will ensure that no cetaceans or pinnipeds are present in the Level A harassment area during pile driving. Impact pile driving calculations are included for informational purposes, because this application covers both types of pile driving. Only vibratory pile driving take calculations are used for the take request in this application, because they are more conservative (i.e., they result in a higher amount of Level B take).

7.4.1 Pacific Harbor Seal

In terms of the number of animals that may occur in the project area, Yerba Buena Island is the nearest haul-out site, with as many as 188 animals observed hauled-out, as described in Section 5.1. Harbor seals are more likely to be hauled out in the late afternoon and evening, and are more likely to be in the water during the morning and early afternoon (Green et al., 2002). However, during the molting season, harbor seals spend more time hauled out, and tend to enter the water later in the evening. Tidal stage is a major controlling factor of haul-out use by harbor seals, with more seals present during low tides than high-tide periods (Green et al., 2002). Therefore, the number of harbor seals in the vicinity of Yerba Buena Island will vary throughout the work period. Monitoring of marine mammals in the vicinity of the SFOBB has been ongoing for 16 years; from those data, Caltrans has produced at-sea density estimates for Pacific

harbor seal of 2.15 animals per square mile (0.83 animal per square kilometer) for the fall-winter season (Caltrans, 2016). Even though work will predominantly occur during the summer, when at-sea density has been observed to be lower (Caltrans 2016), the higher value of fall-winter at-sea density is conservatively used. Marine mammal monitoring occurred during the first year of construction on this project (during the 2017 pile-driving window) and the results were used to calculate a project-specific estimate of take per driving day. In conjunction with the Caltrans at-sea densities, the project-specific take per driving day was used to calculate the daily average take by Level B harassment, as summarized in Table 10. The potential average daily take for the areas over which the Level B harassment thresholds may be exceeded (Table 8) are estimated in Table 10.

Table 10
Estimated Level B Take per Day for Pacific Harbor Seal

Pile Type	Area of Level B Threshold Exceedance		At-Sea Density (Caltrans 2016) (Animals per area)		Per Day Takes from At-Sea Density	Per Day Takes from 2017 Monitoring	Total per Day Level B Take per Day
	Square Miles	Square Kilometers	Per Square Mile	Per Square Kilometer			
36-inch Steel Pile – Impact Driving	0.068	0.177	2.15	0.83	0.15	3.18	3.33
30-inch Steel Pile – Impact Driving	0.032	0.084	2.15	0.83	0.07	3.18	3.25
24-inch Steel Pile – Impact Driving	0.032	0.084	2.15	0.83	0.07	3.18	3.25
36-inch Steel Pile – Vibratory Driving	12.933	33.497	2.15	0.83	27.80	3.18	30.98
30-inch steel Pile – Vibratory Driving	0.418	1.083	2.15	0.83	0.90	3.18	4.08
24-inch Steel Pile – Vibratory Driving	2.820	7.304	2.15	0.83	6.06	3.18	9.24

Using the per-day take estimates provided in Table 10, the total take by Level B harassment by pile type is calculated as described in Section 7.5.

7.4.2 California Sea Lion

As described in Section 5.2, summer counts average of California sea lion at Pier 39 ranged from 350 to 850 (NMFS, 2004). Monitoring of marine mammals in the vicinity of the SFOBB has been ongoing for 15 years; from those data, Caltrans has produced at-sea density estimates for California sea lion of 0.23 animal per square mile (0.09 animal per square kilometer) for the summer-late fall season (Caltrans, 2016). Marine mammal monitoring occurred during the first year of construction on this project (during the 2017 pile-driving window) and the results were used to calculate a project-specific density. In conjunction with the Caltrans at-sea densities, the project-specific density was used to calculate the daily average take by Level B harassment, as summarized in Table 11. The potential average daily take for the areas over which the Level B harassment thresholds may be exceeded (Table 8) is estimated in Table 11.

Table 11
Estimated Level B Take per Day for California Sea Lion

Pile Type	Area of Level B Threshold Exceedance		At-Sea Density (Caltrans 2016) (Animals per Area)		Per Day Takes from At-Sea Density	Per Day Takes from 2017 Monitoring	Total per Day Level B Take per Day
	Square Miles	Square Kilometers	Per Square Mile	Per Square Kilometer			
36-inch Steel Pile – Impact Driving	0.068	0.177	0.23	0.09	0.02	1.29	1.31
30-inch Steel Pile – Impact Driving	0.032	0.084	0.23	0.09	0.01	1.29	1.30
24-inch Steel Pile – Impact Driving	0.032	0.084	0.23	0.09	0.01	1.29	1.30
36-inch Steel Pile – Vibratory Driving	12.933	33.497	0.23	0.09	3.02	1.29	4.31
30-inch steel Pile – Vibratory Driving	0.418	1.083	0.23	0.09	0.10	1.29	1.39
24-inch Steel Pile – Vibratory Driving	2.820	7.304	0.23	0.09	0.66	1.29	1.95

Using the per-day take estimates provided in Table 11, the total take by Level B harassment by pile type is calculated, as described in Section 7.5. During El Niño conditions, the density of California sea lions in San Francisco Bay may be much greater than the value used above. The likelihood of El Niño conditions occurring in 2018 is currently low, with La Niña conditions expected to develop (NOAA, 2018). To account for the potentiality of El Niño developing during 2017, daily take estimated from the observed density has been increased by a factor of 10 for pile type, as presented in Table 12.

7.4.3 Harbor Porpoise

As described in Section 4.3, a small but growing population of harbor porpoises uses San Francisco Bay. Harbor porpoises are typically spotted in the vicinity of Angel Island and the Golden Gate Bridge (Keener, 2011), but may use other areas in the Central Bay in low numbers, including the project area. During marine mammal monitoring for the project's 2017 construction season, eight sightings of harbor porpoise were recorded, involving a pod of two to three individuals that was seen three times over the course of the pile-driving season. Harbor porpoise generally travel individually or in small groups of two or three (Sekiguchi, 1995), and a pod of up to four individuals has been observed in the area south of Yerba Buena Island on multiple occasions during the 2017 SFOBB monitoring window. It is possible that these sightings are of a resident pod that could potentially enter the Level B harassment area (Table 8) on as many as 8 days of pile driving. Therefore, we request take by Level B harassment of up to 32 harbor porpoises.

Marine mammal monitoring, as outlined in Section 14, would ensure that impact pile driving does not occur if harbor porpoises are within the Level A exclusion zone for high-frequency cetaceans (up to 2,000 feet [600 meters] for impact driving and 200 feet [60 meters] for vibratory driving).

Table 12
Summary of Estimated Take by Species (Level B Harassment)

Pile Type	Pile-Driver Type	# of Piles	# of Driving Days	Estimated Take by Level B Harassment (take per day/total based on SFOBB at-sea densities and 2017 Downtown San Francisco Ferry Terminal Expansion Project monitoring)						
				Harbor Seal	California Sea Lion[1]	Northern Elephant Seal	Harbor Porpoise[2]	Gray Whale[2]	Northern Fur Seal	Bottlenose Dolphin
2018 Work Season										
36-inch steel piles	Vibratory[3]	28	14	30.98/434	4.31/578	NA	NA	NA	NA	NA
30-inch steel piles	Vibratory[3]	18	9	4.08/37	1.39/125	NA	NA	NA	NA	NA
24-inch steel piles	Vibratory[3]	35	18	9.24/166	1.95/351	NA	NA	NA	NA	NA
Project Total (2018)		**81**	**41**	**637**	**1,054**	**26**	**32**	**2**	**10**	**30**

Notes:
[1] To account for potential 2018 El Niño conditions, take calculated from at-sea densities for California sea lion has been increased by a factor of 10.
[2] Take is not calculated by activity type for these species with a low potential to occur, only a yearly total is given.
[3] Piles of this type may also be installed with an impact hammer, which would reduce the estimated take.
SFOBB = San Francisco – Oakland Bay Bridge

7.4.4 Northern Elephant Seal

As described in Section 4.5.1, small numbers of this species haul out or strand on Yerba Buena Island and Treasure Island. Monitoring of marine mammals in the vicinity of the SFOBB has been ongoing for 15 years; from those data, Caltrans has produced an estimated at-sea density for northern elephant seal of 0.16 animal per square mile (0.06 animal per square kilometer) (Caltrans, 2015b). Most sightings of northern elephant seal in San Francisco Bay occur in spring or early summer, and are less likely to occur during the periods of in-water work for this project. As a result, densities during pile driving for the proposed action would be much lower. It is possible that a lone northern elephant seal may enter the Level B harassment area (Table 8) once per week during pile driving (26 weeks from June 1 to November 30), for a total of 26 takes.

7.4.5 Whales

The only whale species that enters San Francisco Bay with any regularity is the gray whale. As described in Section 4.4.1, gray whales occasionally enter San Francisco Bay during their northward migration period of February and March. Pile driving is not expected to occur during this time, and gray whales are not likely to be present at other times of year. As described in Section 5.4, it is estimated that two to six gray whales enter San Francisco Bay in any given year, but they are unlikely to be present during the work period (June 1 through November 30). However, individual grey whales have occasionally been spotted in San Francisco Bay during the work period (Section 5.4), and therefore it is estimated that at most, one gray whale may be exposed to Level B harassment during 2 days of pile driving if they enter the areas over which the Level B harassment thresholds may be exceeded (Table 8).

Because the Level A zone for low-frequency cetaceans is similar to that of high-frequency cetaceans for impact pile driving, marine mammal monitoring, as outlined in Section 14, would ensure that pile driving does not occur if gray whales are within their respective exclusion zone.

7.4.6 Northern Fur Seal

The incidence of northern fur seal in San Francisco Bay depends largely on oceanic conditions, with animals more likely to strand during El Niño events. The likelihood of El Niño conditions occurring in 2018 is currently low, with La Niña conditions expected to develop (NOAA, 2018). Using guidance provided by NMFS, it is anticipated that at most 10 animals would be in San Francisco Bay and enter the area of Level B Harassment (Table 8) during construction (NMFS, 2016b).

7.4.7 Bottlenose Dolphin

When this species is present in San Francisco Bay, it is more typically found close to the Golden Gate. Recently, beginning in 2015, two individuals have been observed frequently in the vicinity of Oyster Point (GGCR, 2016; GGCR 2017; Perlman, 2017). The average reported group size for bottlenose dolphins is five. Reports show that a group normally comes into San Francisco Bay, is near Yerba Buena Island once per week for approximately a 2-week stint and then leaves (NMFS, 2017b). Assuming the dolphins come into San Francisco Bay approximately three times per year, 30 takes of up to five individuals would be anticipated, if the group enters the areas over which the Level B harassment thresholds may be exceeded (Table 8).

Although a small Level A zone for mid-frequency cetaceans is estimated during impact driving of the 24- and 36-inch piles with the use of bubble curtains (approximately 50-foot and 40-foot radius, respectively), marine mammal monitoring, as outlined in Section 14, would ensure that driving does not occur if bottlenose dolphins are in the exclusion zone.

7.5 SUMMARY AND SCHEDULE OF ESTIMATED TAKE

Pile driving associated with the proposed project would occur within the in-water work window of June 1 through November 30. Take that would occur through Level B harassment would occur during short periods of pile driving within these windows. Table 12 summarizes the estimate of take for each species by pile-driving activity. The estimates are based on the number of individuals assumed to be exposed per day and the number of days of pile driving expected, based on an average installation rate of two piles per day. These totals assume that only one pile driver would be installing one type of pile work per day, and that vibratory driving is used, which results in a greater area of threshold exceedance, and therefore a higher amount of estimated take by Level B harassment. It is also assumed that an individual animal can only be taken once per method of installation during a 24-hour period. There will be day-to-day variability in the presence of marine mammals in the area; therefore, the take per day is only included to demonstrate how the total take was calculated. Rounding of the take values occurs after the fractional take per day is multiplied by the number of driving days for each pile type. For California sea lion, the rounded take value for each pile type is then increased by a factor of 10 to account for potential local population increases that occur during El Niño conditions. The likelihood of El Niño conditions occurring in 2018 is currently low, with La Niña conditions expected to develop (NOAA, 2018).

8.0 ANTICIPATED IMPACT OF THE ACTIVITY

The proposed project will produce underwater noise that may potentially harass marine mammals, as described in Section 7. The estimated level of take by such harassment, as estimated in Section 7, is low when compared to the overall size of the affected stocks provided in Section 5.

Exposure to high-intensity underwater noise may cause a loss of hearing sensitivity in marine mammals. If loss of hearing is permanent (i.e., PTS), NMFS considers it a Level A harassment; whereas temporary hearing loss is considered Level B harassment. PTS is presumed to be likely if the hearing threshold is reduced by equal to or greater than 40 dB (i.e., 40 dB of temporary threshold shift) (NMFS, 2010). Behavioral effects, such as fleeing and the temporary cessation of feeding or spawning behaviors, could also result from underwater noise. However, the above criteria do not address these effects. In assessing the potential effects of noise, Richardson et al. (1995) have suggested criteria for defining four zones of effect. These zones are discussed in Sections 8.1.1 through 8.1.4, from greatest effect to least.

Marine mammals reviewed in this document are considered solitary foragers; however, underwater communicative signals for social reasons or predator avoidance may be disrupted during pile-driving activity that could lead to adverse impacts. Pinniped communication occurs mostly in low-frequency signals underwater (NMFS, 2010). Harbor porpoises are considered high-frequency cetaceans with an estimated auditory bandwidth range from 200 Hz to 180 kilohertz (kHz). Gray whales, like other baleen whales, are in the low-frequency hearing group. Underwater sounds produced by gray whales range from 20 Hz to 20 kHz (NMFS, 2010). San Francisco Bay is highly industrialized; other vessels and anthropogenic noise within the action area, especially in the nearby shipping channel, would mask construction sounds. Seals, sea lions, and harbor porpoises have also shown habituation to anthropogenic noise and activity in San Francisco Bay, which would decrease behavioral reactions to construction activity.

8.1.1 Zone of Hearing Loss, Discomfort, or Injury

The zone of hearing loss, discomfort, or injury is the area in which the received sound energy is potentially high enough to cause discomfort or tissue damage to auditory or other systems. The possible

effects of damaging sound energy are a temporary hearing threshold shift,[5] a temporary loss in hearing, PTS, and a loss in hearing at specific frequencies, or deafness. Non-auditory physiological effects or injuries that can theoretically occur in marine mammals exposed to strong underwater noise are stress, neurological effects, bubble formation, resonance effects and other types of organ or tissue damage. These effects would be considered Level A harassment; applicable NMFS acoustic thresholds for this type of harassment are species-specific, depending on the hearing group and use duel criteria metrics, including peak pressure and cSEL. The Level A Harassment thresholds are summarized in Table 6, and the distances to those thresholds are summarized in Table 7. These distances are considered very conservative, because they are based on cumulative noise from a full day of pile driving, and an animal would have to be present within that distance for an extended period to potentially experience PTS.

No physiological responses are expected from pile-driving operations occurring during project construction. Vibratory pile extraction and driving does not generate high-peak sound-pressure levels commonly associated with physiological damage. Impact driving can produce noise levels in excess of the Level A thresholds, but only during impact-driving of 24- and 36-inch piles. Marine mammal observers will monitor the exclusion zone for the presence of marine mammals (Section 12 provides a detailed discussion of mitigation measures). They will alert work crews to the presence of pinnipeds or cetaceans in or near the exclusion zone, and advise when to begin or stop work to reduce the potential for acoustic harassment. The exclusion zone will be equivalent to the area over which Level A harassment may occur.

8.1.2 Zone of Masking

The zone of masking is the area in which noise may interfere with the detection of other sounds, including communication calls, prey sounds, and other environmental sounds. This effect would be considered Level B harassment; the applicable thresholds for the zone where this effect occurs are 160 dB for impulse sounds (i.e., impact pile driving), and 120 dB for continuous sounds (i.e., vibratory pile driving).

8.1.3 Zone of Responsiveness

The zone of responsiveness is the area in which animals react behaviorally. The behavioral responses of marine mammals to noise depend on a number of factors, including (1) the acoustic characteristics of the noise source of interest; (2) the physical and behavioral state of the animals at the time of exposure; (3) the ambient acoustic and ecological characteristics of the environment; and (4) the context of the noise (e.g., does it sound like a predator?) (Richardson et al., 1995; Southall et al., 2007). However, temporary behavioral effects are often simply evidence that an animal has heard a noise, and may not indicate lasting consequence for exposed individuals (Southall et al., 2007). These types of effects would be considered Level B harassment; the applicable thresholds for the zone where these effects occur are 160 dB for impulse sounds, and 120 dB for continuous sounds.

8.1.4 Zone of Audibility

The zone of audibility is the area in which the marine mammal may hear the noise. Marine mammals as a group have functional hearing ranges of 10 Hz to 180 kHz, with best thresholds near 40 dB (Southall et al., 2007). Study data show reasonably consistent patterns of hearing sensitivity in three groups: small odontocetes (such as the harbor porpoise), medium-sized odontocetes (toothed whales such as killer whales), and pinnipeds (such as the California sea lion). No thresholds apply to this zone because it is difficult to determine the audibility of a particular noise for a particular species. This zone does not fall

[5] On exposure to noise, the hearing sensitivity may decrease as a measure of protection. This process is referred to as a shift in the threshold of hearing, meaning that only sounds louder than a certain level will be heard. The shift may be temporary or permanent.

within the noise range of a take as defined by NMFS. The zone of audibility is also limited by background noise levels, which may mask the particular noise in question. Background noise is produced both by natural (waves, rain, and other organisms) and anthropogenic sources (watercraft, bridges, etc.).

8.2 EXPECTED RESPONSES TO PILE EXTRACTION AND DRIVING

With both vibratory extraction and vibratory and impact pile-driving, it is likely that the onset of activities could result in temporary, short-term changes in typical behavior, and/or avoidance of the affected area. A marine mammal may show signs that it is startled by the noise, and/or may swim away from the noise source and avoid the area. Other potential behavioral changes could include increased swimming speed, increased surfacing time, and decreased foraging in the affected area. Pinnipeds may increase their haul-out time, possibly to avoid in-water disturbance. Because pile replacement work would occur for a just few hours a day, it is unlikely to result in permanent displacement of animals. Any potential impacts from pile-extraction and -driving activities could be experienced by individual marine mammals, but would not cause population-level impacts or affect the long-term fitness of the species in San Francisco Bay.

The expected responses to pile replacement work noise depend partly on the average ambient background noise of the site. San Francisco Bay in the area surrounding the project experiences frequent boat traffic, foot traffic on accessible portions of the wharf, and noise from the tankers and tugs accessing the wharf. For marine mammals that use San Francisco Bay regularly, or harbor seals that are part of a resident population, responses to noise may be lessened due to habituation.

8.3 EFFECTS OF AIRBORNE NOISE ON MARINE MAMMALS

Marine mammals could be exposed to airborne noise levels at sound-pressure levels that would constitute Level B harassment during impact or vibratory pile-driving (see Section 7 for results). However, such exposure would occur to animals that have already been exposed to underwater noise above the Level B threshold, and therefore would not constitute additional take. Injury or Level A harassment is not expected to occur from airborne noise.

Pacific harbor seals and California sea lions may be exposed to airborne noise if they surface in proximity to pile-driving work. Airborne noise would likely cause behavioral responses similar to those discussed above in relation to underwater noise. For instance, the noise generated could cause pinnipeds to exhibit changes in their normal behavior, such as causing them to move farther from the noise source.

As with underwater noise, because of the relatively short duration of the work and the limited amount of time per day when pile replacement work would occur, exposure to airborne noise would not result in population-level impacts or affect the long-term fitness of these species.

8.4 EFFECTS OF HUMAN DISTURBANCE ON MARINE MAMMALS

There is regular and daily activity in the project area as part of baseline conditions related to marine traffic and other urban uses. Neither of the pinniped haul-outs in the vicinity of the project have a clear line-of-site to the project area. As a result of these factors, visual disturbance associated with the proposed project will not affect haul-out locations.

9.0 ANTICIPATED IMPACTS ON SUBSISTENCE USES

No subsistence uses of marine mammals occur in San Francisco Bay. No impacts are expected to the availability of the species stock as a result of the proposed project.

10.0 ANTICIPATED IMPACTS ON HABITAT

10.1 UNDERWATER NOISE DURING PILE DRIVING

Pile driving involved with the ferry terminal expansion may temporarily impact marine mammals in the action area due to elevated in-water noise levels. A temporary, small-scale loss of foraging habitat may occur for marine mammals, if marine mammals avoid the area during pile-extraction and -driving activities.

Harbor seals and California sea lions around the project site would likely be transiting or opportunistically foraging. Frequency of pinniped activity could increase in the event of a herring spawn. Herring spawning events have historically occurred between December and February, which could result in sporadic, unpredictable pinniped congregations near the project area if the event occurs in the vicinity of the ferry terminal. WETA plans to conduct all piling installation and dredging between approved work windows, between June 1 and November 30, which avoids the herring spawn period.

Acoustic energy created during pile replacement work would have the potential to disturb fish in the vicinity of the pile replacement work. As a result, the affected area could temporarily lose foraging value to marine mammals. During pile driving, high noise levels may exclude fish from the vicinity of the pile driving; Hastings and Popper (2005) identified several studies that suggest fish will relocate to avoid areas of damaging noise energy. The frequency and decibel ranges that have been shown to negatively impact fish (FHWG, 2008), and an analysis of potential noise output of the proposed project, indicates that the maximum distance[6] from underwater pile driving at which noise has the potential to cause temporary hearing loss in fish is a distance of approximately 408 feet (124 meters) from pile-driving activity. Therefore, if fish leave the area of disturbance, pinniped foraging habitat may have temporarily decreased foraging value when piles are driven using impact hammering.

The duration of fish avoidance of this area after pile driving stops is unknown. However, the affected area represents an extremely small portion of the total area within foraging range of marine mammals that may be present in the project area. Because all piling installation, extraction, and dredging will be conducted between approved work windows (June 1 and November 30), in-water work during the herring spawn would not occur.

San Francisco Bay, including the project area, is classified as EFH under the Magnuson-Stevens Fisheries Conservation and Management Act. EFH provisions are designed to protect fisheries habitat from being lost due to disturbance and degradation. The act requires implementation of measures to conserve and enhance EFH. WETA and the FTA completed consultation with NMFS regarding potential impacts to EFH in 2014 (a consultation record is attached). NMFS determined that with the minimization and mitigation measures being implemented as a part of the project, the project would not adversely affect EFH.

10.2 DREDGING AND OVERWATER STRUCTURES

Dredging is not planned during the 2018 in-water work window. All initial dredging activities were completed in 2017.

Expansion of the Ferry Terminal would add 27,955 square feet of floating and shading fill over the waters of San Francisco Bay. Overwater or floating structures that shade marine waters are typically located in intertidal and shallow subtidal areas, and these structures can alter the primary physical processes, including

[6] Distance where underwater noise exceeded the FHWG threshold of 187 dB SEL for adult fish during impact driving of the 36-inch steel piles.

depth (elevation), substrate type, wave energy, light, and water quality (USACE, 2009). Additionally, installation of the new piles would permanently remove 745 square feet of soft-bottomed subtidal benthic habitat, while creating a proportionally larger area of hard-substrate benthic habitat in the water column. Effects from shading due to implementation of the project would expect to be relatively minor. Reduction in photosynthesis would not be significant due to the tidal influence and constant water circulation in the area.

11.0 ANTICIPATED EFFECTS OF HABITAT IMPACTS ON MARINE MAMMALS

The project's activities are not expected to result in any habitat-related effects that could cause significant or long-term consequences for individual marine mammals or populations. Foraging and dispersal habitat for marine mammals will be temporarily modified by disturbance from increased airborne and underwater noise levels during pile extraction and driving. This modification is expected to have no impact on the ability of marine mammals to disperse and forage in undisturbed areas within their foraging range. As described in Section 10, the proposed project would result in a small net increase in Bay fill; this would not have a measurable influence on habitat for marine mammals in San Francisco Bay. The project also requires dredging of 2.42 acres in the existing Ferry Terminal, which would have minimal effects on habitat quality for marine mammals, as described in Section 10.

Pupping season for harbor seals in San Francisco Bay spans approximately March 15 through May 31, with pup numbers generally peaking in late April or May (NMFS, 2012). In-water work is scheduled during a time that will avoid the primary pupping season. The haul-out areas on Yerba Buena Island and Pier 39 are not primary pupping habitat for harbor seals or sea lions. The majority of sea lions hauled-out at Pier 39 are young males, and the only sea lion pupping event documented in San Francisco Bay was during a domoic acid event, which creates irregular behavior and can result in neurological damage (NMFS, 2015b). For these reasons, construction activity is not anticipated to effect pinnipeds' reproductive or pupping success.

12.0 MITIGATION MEASURES

WETA is committed to implementing the following best management practices to further minimize impacts of the project.

- A Spill Prevention Control and Countermeasure (SPCC) plan has been prepared to address the emergency cleanup of any hazardous material, and will be available on site. The SPCC plan incorporates SPCC, hazardous waste, stormwater, and other emergency planning requirements. In addition, the project will comply with the Port's stormwater regulations. Fueling of land and marine-based equipment will be conducted in accordance with procedures outlined in the SPCC.

- WETA and the Port will develop a Site Maintenance Plan prior to project initiation. The plan will designate responsibility and a schedule for regular maintenance and cleaning of the new facilities (e.g., canopies), as well as general site maintenance activities (e.g., wash-down; litter removal and trash receptacle management; lighting and landscape management).

- Well-maintained equipment will be used to perform work, and except in the case of a failure or breakdown, equipment maintenance will be performed off site. Equipment will be inspected daily by the operator for leaks or spills. If leaks or spills are encountered, the source of the leak will be identified, leaked material will be cleaned up, and the cleaning materials will be collected and properly disposed.

- Fresh cement or concrete will not be allowed to enter San Francisco Bay.

- All construction materials, wastes, debris, sediment, rubbish, trash, fencing, etc., will be removed from the site once project construction is complete, and transported to an authorized disposal area.

- Piles driven with an impact hammer will employ a "soft start" technique to give fish and marine mammals an opportunity to move out of the area before full-powered impact pile-driving begins. This soft start will include an initial set of three strikes from the impact hammer at reduced energy, followed by a 30-second waiting period, then two subsequent three-strike sets. Soft start will be required at the beginning of each day's impact pile driving work and at any time following a cessation of impact pile driving of 30 minutes or longer.

- Impact hammers will be cushioned using a 12-inch-thick wood cushion block.

- Only a single impact or vibratory hammer will be operated at a time.

- During impact pile-driving of steel piles, the contractor will use a bubble curtain to attenuate underwater sound levels. Care will be taken to ensure that the bubble ring seats well onto the substrate and that tidal current are not disrupting or displacing the bubbles during use. If needed, confinement around the bubble curtain will be used to maintain integrity of the bubble field around the pile.

- If any Guadalupe fur seal are observed within the Level A or Level B zones for otariid pinnipeds, all pile driving will cease until the animal has left the area. WETA will work closely with the local marine mammal rehabilitation center to determine whether any local sightings have occurred near the exclusion zones.

- In the event that impact driving is used, hydroacoustic monitoring will be conducted as described in Appendix A. Verification of underwater noise levels for vibratory pile driving was completed in 2017, so hydroacoustic monitoring of vibratory pile driving is not proposed.

- WETA developed a marine mammal monitoring plan in consultation with the NMFS prior to the start of construction. This plan provides details on the methods used to ensure that marine mammals are not exposed to Level A harassment, and to record the number and behaviors of animals exposed to Level B harassment. For more information, see Section 14. The Marine Mammal Monitoring Plan, attached as Appendix B, provides details of the exclusion zones that will be employed, depending on pile type and installation method.

13.0 ARCTIC PLAN OF COOPERATION

Not applicable. The proposed activity would take place in San Francisco Bay and no activities would occur in or near a traditional Arctic subsistence hunting area.

14.0 MONITORING AND REPORTING

WETA developed detailed monitoring plans for conducting hydroacoustic measurements, marine mammal monitoring and documentation of marine mammal observations. The hydroacoustic monitoring plan will ensure that measurements are recorded during impact driving to provide data on actual noise levels during construction, and provide data to ensure that the marine mammal exclusion zone is enforced during impact pile-driving activities. The marine mammal monitoring plan provides details on data collection for each distinct marine mammal species observed in the project area during the construction period. Monitoring will include the following: marine mammal behavior observations, count of the individuals observed, and the frequency of the observations. The monitoring plan sections are described in more detail below.

14.1 HYDROACOUSTIC MONITORING

The proposed hydroacoustic monitoring plan, to be implemented for impact pile driving only, is provided as Appendix A. Verification of underwater noise levels for vibratory pile driving was completed in 2017, so further hydroacoustic monitoring of vibratory pile driving is not proposed.

14.2 MARINE MAMMAL MONITORING

The proposed marine mammal monitoring plan is provided as Appendix B. The plan includes specific details of the biological monitoring that will be conducted during construction, including details of the exclusion zones that will be employed (depending on pile type and installation method) and all data recording and reporting requirements.

15.0 SUGGESTED MEANS OF COORDINATION

All marine mammal data gathered during construction will be made available to NMFS, researchers, and other interested parties, as specified in Section 12 and 14 above. To minimize the likelihood that impacts will occur to the species, stocks, and subsistence use of marine mammals, construction activities will be conducted in accordance with federal, state, and local regulations; and the minimization measures proposed in Section 12 to protect marine mammals. WETA will coordinate all activities as needed with relevant federal and state agencies. These include, but are not limited to: NMFS, U.S. Army Corps of Engineers, and the California Department of Fish and Wildlife.

Marine mammal and acoustic monitoring reports would provide useful information that would allow design of future projects to reduce incidental take of marine mammals. WETA will share field data and behavioral observations on marine mammals that occur in the project area. Results of each monitoring effort will be provided to NMFS in a summary report at the conclusion of monitoring. This information could be made available to federal, state, and local resource agencies, scientists, and other interested parties upon written request to NMFS.

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Figures

Project Area

Mean High Water/High Tide Line

N

0 100 200 FEET

PROJECT AREA AND VICINITY MAP

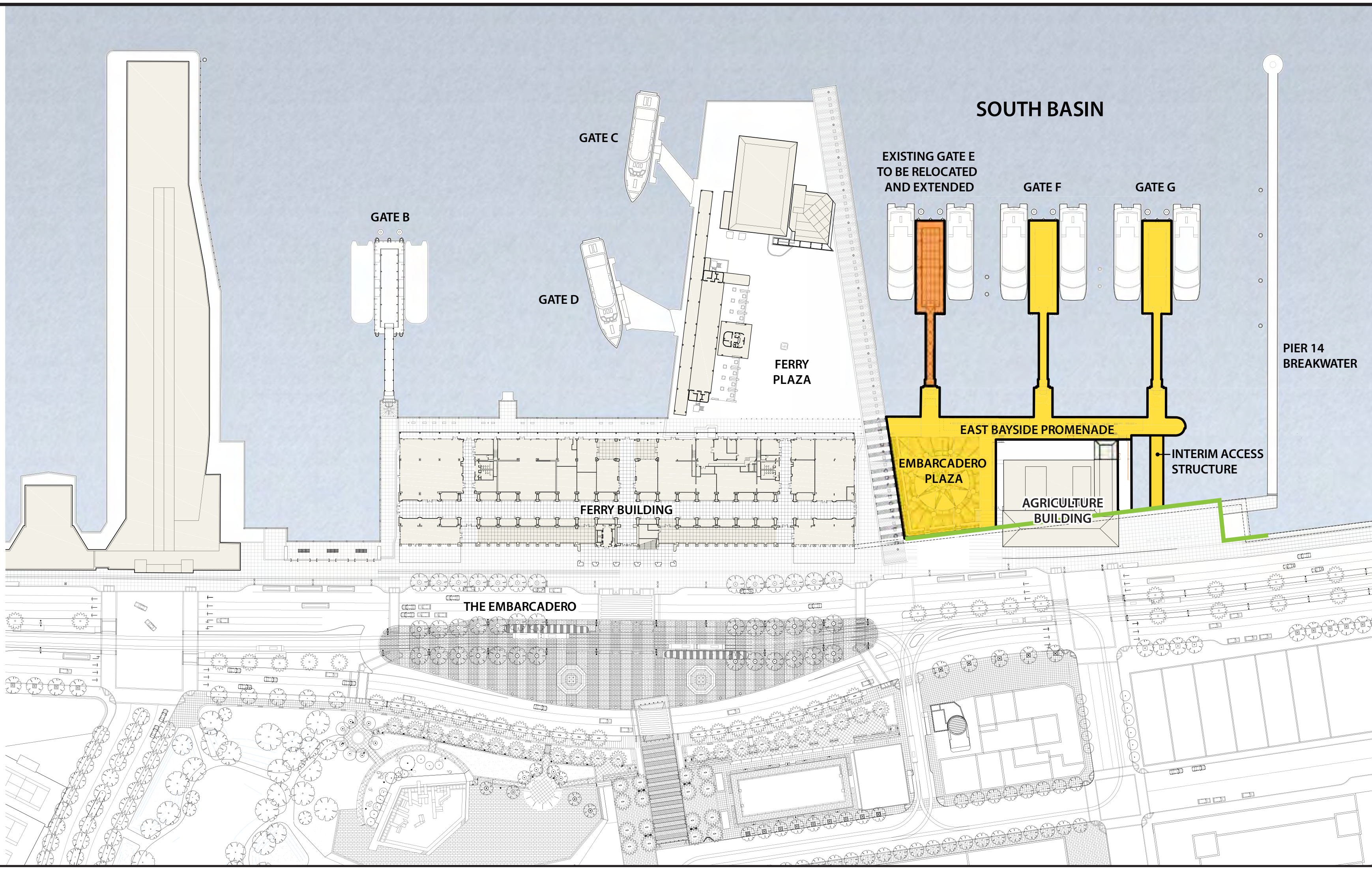
Downtown San Francisco Ferry Terminal
South Basin Expansion

28067812 San Francisco Bay Area Water Emergency Transportation Authority

FIGURE 1

8/5/15 hk...T:\WETA\Permits 2015\July2015\Fig1_project_area_vicinity_map.ai

Source: Roma Design Group, et al, 2010, Google Earth Pro 2013.



Existing Elements

New Project Improvements

Mean High Water/High Tide Line

N

0 75 150
FEET

SOUTH BASIN IMPROVEMENTS PLAN VIEW

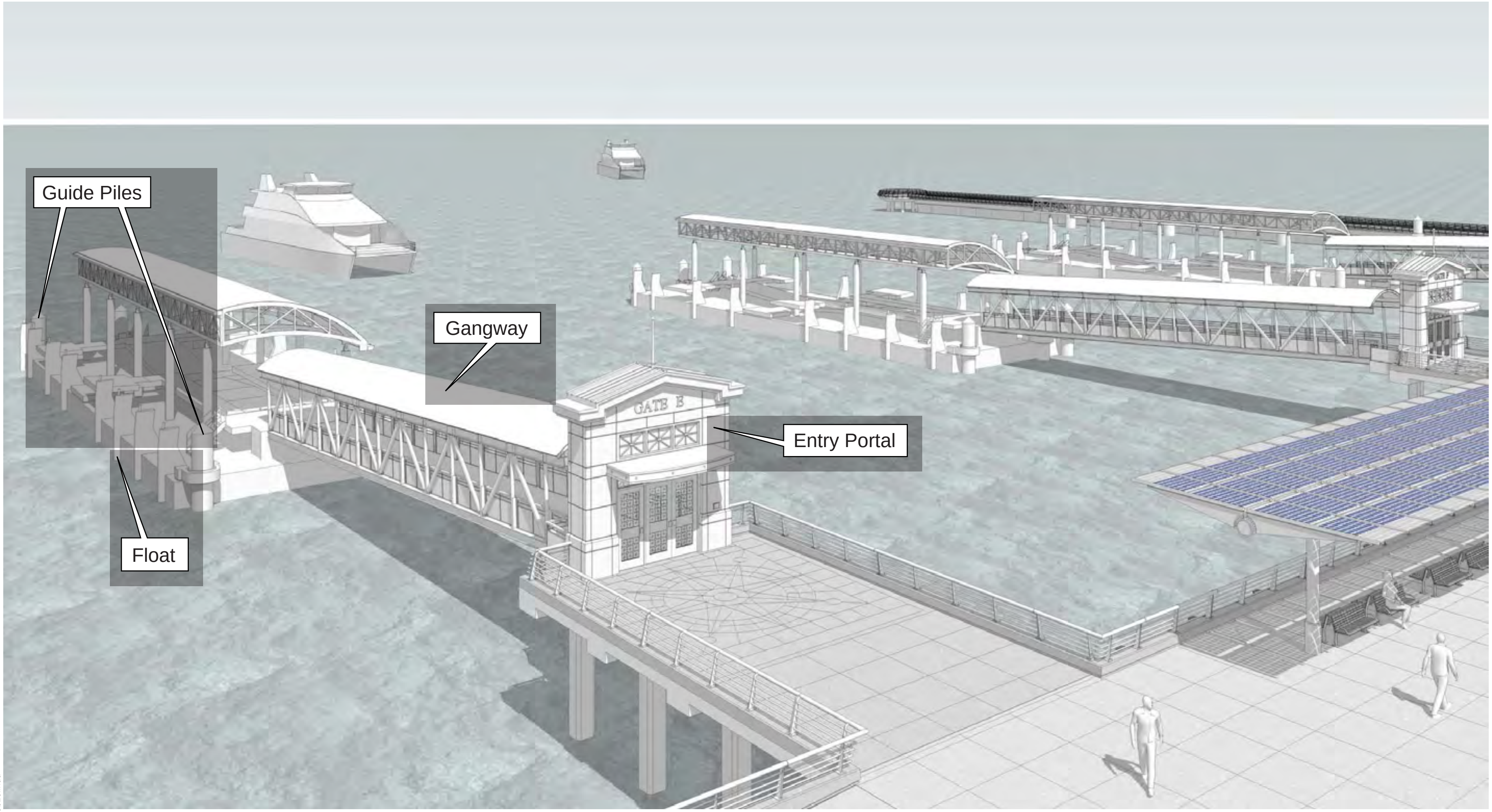
Downtown San Francisco Ferry Terminal
South Basin Expansion

28067812 San Francisco Bay Area Water Emergency Transportation Authority

FIGURE 2

10/08/15 hk T:\WETA\Permits 2015\BCDC Sept15\Figs WETA BCDC Sept15.indd

Source: Roma Design Group, et al, 2015

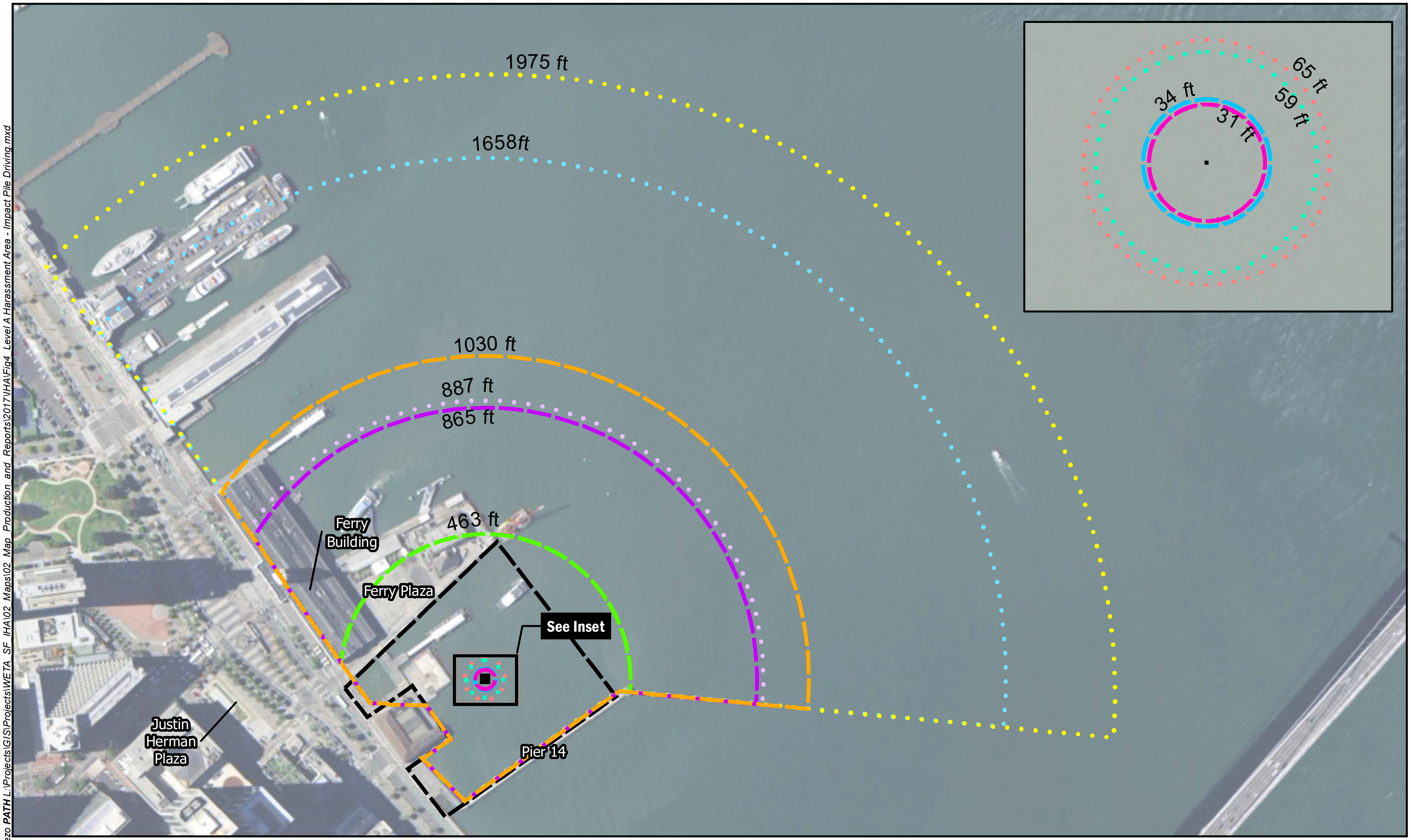


SIMULATED VIEW OF BERTHING FACILITIES

FIGURE 3

02/02/16 hk T:\WETA\Permits 2016\IHA\Figs_WETA_IHA_Feb16.indd

Source: Roma Design Group, et al, 2015



	PTS Isopleth to Threshold	24 and 30-inch Steel Pile	36-inch Steel Pile
Approximate Pile Driving Location	Mid-Frequency Cetaceans	31 ft	59 ft
Project Area	Otariid Pinnipeds	34 ft	65 ft
	Phocid Pinnipeds	463 ft	887 ft
	Low-Frequency Cetaceans	865 ft	1658 ft
	High-Frequency Cetaceans	1030 ft	1975 ft

N

0 500 1,000 Feet

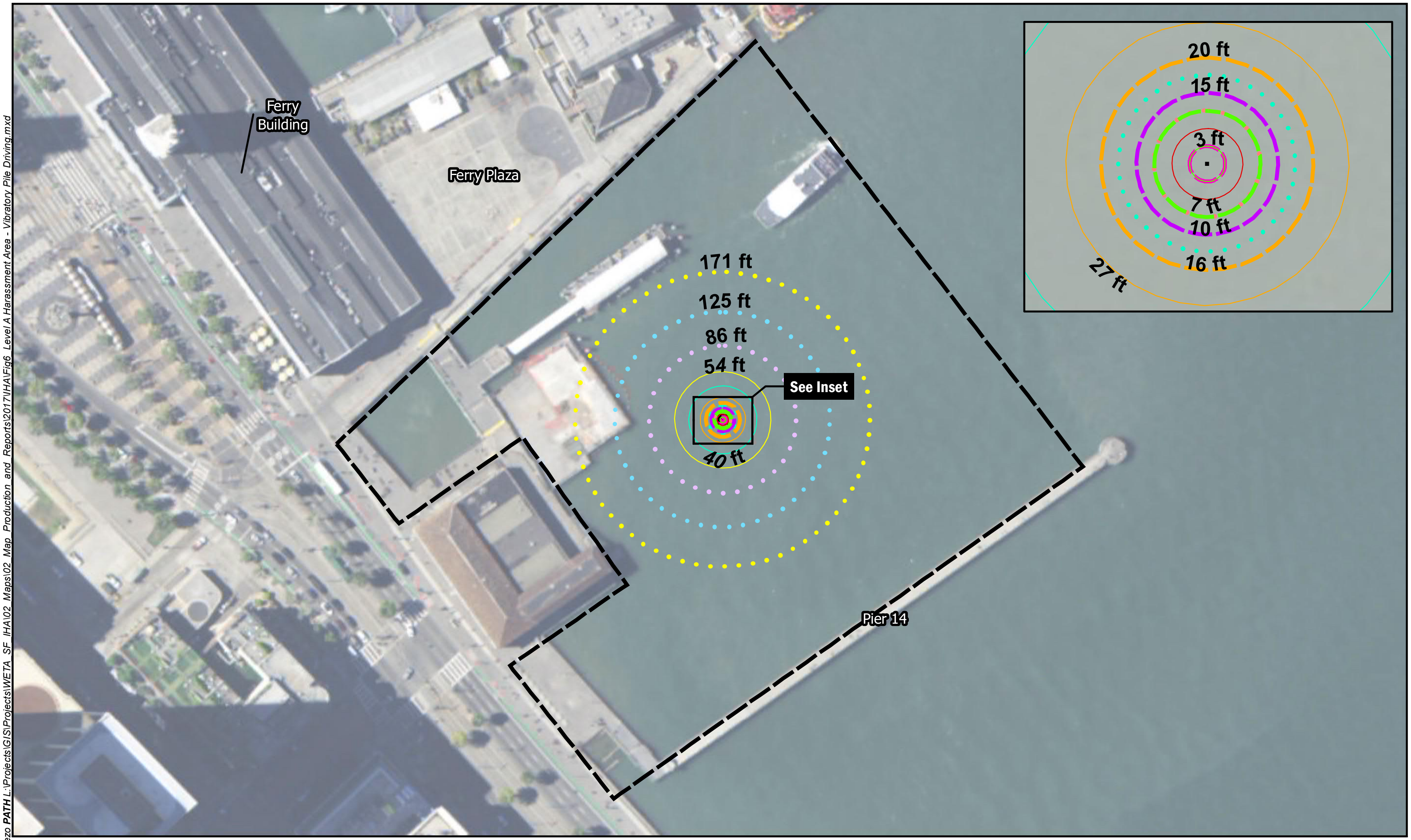
LEVEL A HARASSMENT AREA - IMPACT PILE DRIVING

Downtown San Francisco Ferry Terminal
South Basin Expansion
28067812 San Francisco Bay Area Water Emergency Transportation Authority

FIGURE 4

Source: NAIP Imagery, USDA FSA, 2014

AECOM Oakland CA 1/3/2018 USER alvarezo PATH L:\Projects\GIS\Projects\WETA_SF_IHA\02_Maps\02_Map_Production_and_Reports\2017\IHA\Fig4_Level A Harassment Area - Impact Pile Driving.mxd



	PTS Isopleth to Threshold	24-inch Steel Pile	30-inch Steel Pile	36-inch Steel Pile
	Otariid Pinnipeds	3 ft	0 ft	10 ft
	Mid-Frequency Cetaceans	7 ft	3 ft	16 ft
	Phocid Pinnipeds	27 ft	10 ft	86 ft
	Low-Frequency Cetaceans	40 ft	15 ft	125 ft
	High-Frequency Cetaceans	54 ft	20 ft	171 ft

Approximate Pile Driving Location

Project Area

N

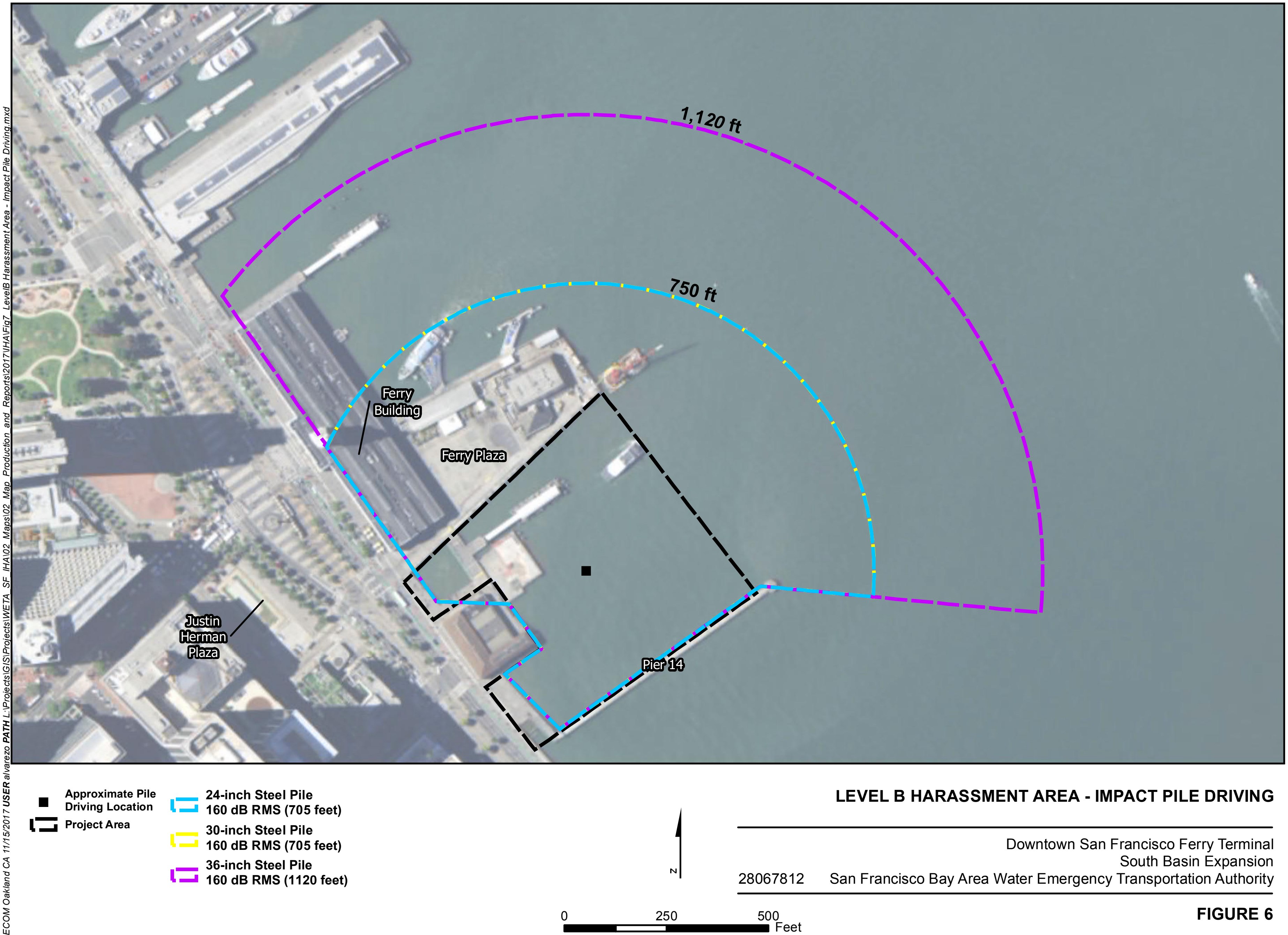
0 125 250 Feet

LEVEL A HARASSMENT AREA - VIBRATORY PILE DRIVING

Downtown San Francisco Ferry Terminal
South Basin Expansion
28067812 San Francisco Bay Area Water Emergency Transportation Authority

FIGURE 5

Source: NAIP Imagery, USDA FSA, 2014



AECOM Oakland CA 11/15/2017 **USER** alvarezo **PATH** L:\Projects\GIS\Projects\WETA_SF_IHA\02_Maps\02_Map_Production_and_Reports\2017\IHA\Fig7_LevelB Harassment Area - Impact Pile Driving.mxd

LEVEL B HARASSMENT AREA - IMPACT PILE DRIVING

Downtown San Francisco Ferry Terminal
South Basin Expansion
28067812 San Francisco Bay Area Water Emergency Transportation Authority

FIGURE 6

Source: NAIP Imagery, USDA FSA, 2014

■ Approximate Pile Driving Location

24-inch Steel Pile
120 dB RMS (8,241 feet)

30-inch Steel Pile
120 dB RMS (3,084 feet)

36-inch Steel Pile
120 dB RMS (22,011 feet)

Source: NAIP Imagery, USDA FSA, 2014

AECOM Oakland CA 1/3/2018 USER alvarezo PATH L:\Projects\GIS\Projects\WETA_SF_IHA\02_Maps\02_Map_Production_and_Reports\2017\IHA\Fig7_Level B Harassment Area - Vibratory Pile Driving.mxd

LEVEL B HARASSMENT AREA - VIBRATORY PILE DRIVING

Downtown San Francisco Ferry Terminal
South Basin Expansion
28067812 San Francisco Bay Area Water Emergency Transportation Authority

FIGURE 7

Appendix A
Proposed Hydroacoustic Monitoring Plan

DOWNTOWN SAN FRANCISCO TERMINAL EXPANSION PROJECT

HYDROACOUSTIC MONITORING PLAN

Prepared for:

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Revised January 2018

INTRODUCTION

The purpose of this Hydroacoustic Monitoring Plan is to describe the methodology proposed for measuring underwater sound levels during the installation of steel pipe piles for the development of the Downtown San Francisco Ferry Terminal Expansion Project. This monitoring plan addresses the underwater sound monitoring required to assess the project's potential effect on both fish and marine mammals. The project consists of demolishing existing deck and piles between the Ferry Building and Agriculture Building (just to the south of the Ferry Building) and constructing two new ferry gates and new deck and pile-supported structures for pedestrian circulation in San Francisco. Construction activities commenced in 2017 and included demolition activities and pile installation by vibratory driving. Pile installation is planned to be completed during the 2018 in-water construction season. Table 1 shows a summary of the piles being installed during the 2018 construction season.

Table 1
Summary of 2018 Pile Installation

Project Element	Pile Diameter	Pile Type	Method	Number of Piles/Schedule
Embarcadero Plaza, East Bayside Promenade, and Interim Access Structure	30 inches	Steel: 135 to 155 feet in length	Impact or Vibratory Driver	(18) 30-inch piles/up to 9 days
Embarcadero Plaza, East Bayside Promenade, and Interim Access Structure	24 inches	Steel: 135 to 155 feet in length	Impact or Vibratory Driver	(30) 24-inch piles/up to 15 days
Gates E, F, and G Dolphin Piles	36 inches	Steel: 145 to 155 feet in length	Impact or Vibratory Driver	10 total: two at each of the floats for protection; two between each of the floats/up to 5 days
Gate F and G Guide Piles	36 inches	Steel: 140 to 150 feet in length	Impact or Vibratory Driver	12 (6 per gate)/up to 6 days
Gate E Guide Piles	36 inches	Steel: 145 to 155 feet in length	Impact or Vibratory Driver	Six/up to 3 days
Barrier Piles near Pier 14	24 inches	Steel: 135 to 155 feet in length	Impact or Vibratory Driver	Five/up to 3 days

PILE INSTALLATION

The pile driving will consist of the piles being installed using a vibratory hammer where feasible or an impact hammer. Hydroacoustic monitoring will be conducted for ten percent of all impact pile driving of 24-, 30- and 36-inch steel shell piles. Hydroacoustic monitoring of vibratory driving was completed during the 2017 construction season.

The hydroacoustic monitoring will be conducted in accordance with the requirements of the California Department of Fish and Wildlife (CDFW) Incidental Take Permit[1] the National

[1] California Endangered Species Act Incidental Take Permit 2081-2015-013-07 Dated July 9, 2015

Marine Fisheries Service (NMFS) Biological Opinion,[2] and the NMFS Marine Mammal Incidental Harassment Authorization.[3] The monitoring will be done in accordance with the methodology outlined in this Hydroacoustic Monitoring Plan. The monitoring will be conducted to achieve the following:

- Be based on the dual metric criteria (Popper et al., 2006) and the accumulated sound exposure level (SEL);
- Establish field locations that will be used to document the extent of the area experiencing 187 decibels (dB) SEL accumulated;
- Verify the distance of the Marine Mammal Level A Exclusion zone and Level B Harassment zone thresholds;
- Describe the methods necessary to continuously assess underwater noise on a real-time basis, including details on the number, location, distance and depth of hydrophones, and associated monitoring equipment;
- Provide a means of recording the time and number of pile strikes, the peak sound energy per strike, and interval between strikes;
- Provide provisions to provide all monitoring data to the CDFW and NMFS.

Two hydrophone systems are proposed to record the sound levels at two locations and determine the extent that sound levels decrease spatially. One hydrophone will be located 10 meters (33 feet) from the pile being driven and the second hydrophone will be located 124 meters (408 feet) from the pile being driven with a clear line of sight between the pile and the hydrophones. The second hydrophone will be used to determine if the cumulative SEL is in compliance with the levels shown in the Incidental Take Permit, Biological Opinion, and Incidental Harassment Authorization. This hydrophone may be moved either further out or closer in depending on the levels measured.

CHARACTERISTICS OF UNDERWATER SOUND

Several descriptors are used to evaluate underwater noise impacts. Two common descriptors are the instantaneous peak sound pressure level (SPL) and the Root Mean Square (RMS) pressure level during the impulse, which are sometimes referred to as the SPL and RMS level respectively. The peak pressure is the instantaneous maximum or minimum overpressure observed during each pulse and can be presented in Pascals (Pa) or decibels (dB) referenced to a pressure of 1 microPascal (µPa). Since water and air are two distinctly different media, a different sound pressure level reference pressure is used for each. In water, the most commonly used reference pressure is 1 µPa, whereas the reference pressure for air is 20 µPa. For comparison, an underwater sound level of equal perceived loudness would be 62 dB higher to a comparable sound level in air.

The RMS level is the square root of the sum of the squared pressures multiplied by the time increment and divided by the impulse duration. This level, presented in dB referenced 1 µPa, is the mean square pressure level of the pulse. It has been used by NMFS in criteria for judging

[2] National Marine Fisheries Service, West Coast Region, Tracking Number SWR-2013-9595, Dated June 30, 2014
[3] Marine Mammal Protection Act, Incidental Harassment Authorization approval is pending.

impacts to marine mammals from underwater impulse and continuous -type sounds. The majority of literature uses peak sound pressures to evaluate barotrauma injuries to fish.

Sound Exposure Level (SEL), frequently used for human noise exposures, is now used as a metric to quantify impacts to fish[4] and marine mammals[5]. SEL is calculated by summing the cumulative pressure squared (p^2) over the measurement duration, integrating over time, and normalizing to 1 second. This metric accounts for both negative and positive pressures because p^2 is positive for both negative and positive pressure and thus both are treated equally in the cumulative sum of p^2. The units for SEL are dB re: 1 microPascal^2-sec. (1 μPa^2-sec).

METHODOLOGY

One hydrophone will be placed at mid water depth at the nearest distance, at approximately 10 meters (33 feet) depending on site conditions, from each pile being monitored. An additional hydrophone will be placed at mid water depth at a distance of 124 meters (408 feet) from the pile, to provide two sound level readings during ambient and pile driving recording. The 10-meter (33-foot) and the 124-meter (408-foot) locations will be monitored live to determine compliance with permit conditions. A weighted tape measure will be used to determine the depth of the water. The hydrophones will be attached to a nylon cord or a steel chain if the current is swift enough to cause strumming of the line. One end of the nylon cord or chain will be attached to an anchor that will keep the hydrophone at the specified distance from the pile. The opposite end of the nylon cord or chain will be attached to a float or tied to a static line at the surface at the specified recording distance from the pile. The distance will be measured by a tape measure, where possible, or a range finder. To the extent practicable, there will be an unobstructed path between the pile and the hydrophones.

Ambient underwater sound levels will be measured for at least one minute prior to initiation of pile driving, as well as in the absence of construction activities. Ambient levels will be reported as SEL and include a representative spectral analysis. The inspector/contractor will inform the hydroacoustics specialist when pile driving is about to start.

Underwater sound levels will be continuously monitored during the entire duration of each pile being driven. Peak levels of each strike will be monitored in real time. Sound levels will be measured in decibels.

Prior to and during the pile driving activity, environmental data will be gathered including, but not limited to, wind speed and direction, air temperature, water depth, wave height, weather conditions, and other factors (e.g., aircraft, boats, etc.) that could contribute to influencing the underwater sound levels. Start and stop time of each pile driving event will be recorded.

---

[4] Hastings, M.C., and A.N. Popper 2005. "Effects of sound on fish." Report to California Department of Transportation Contract No. 43A0139, Task order1, http://www.dot.ca.gov/hq/env/bio/files/Effects_of_Sound_on_Fish23Aug05.pdf.

[5] NMFS (National Marine Fisheries Service), 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. U.S. Department of Commerce, NOAA. NOAA Technical Memorandum NMFS-OPR-55, 178 p.

Ten percent of all impact pile driving of 24-, 30- and 36-inch steel shell and concrete piles shall be monitored to determine the efficacy of the sound attenuation system and to determine if the calculated sound pressure levels and associated distances from piles differ from the actual measurements. Verification of underwater noise levels for vibratory pile driving was completed in 2017. Table 2 details the equipment that will be used to monitor underwater sound pressure levels.

The chief construction inspector will supply the hydroacoustics specialist with the substrate composition, hammer model, and size; depth the pile is driven and blows per foot for the piles monitored. Hammer energy settings will also be recorded by the chief construction inspector, as well as any changes made to those settings during the pile monitoring period.

Table 2
Equipment for Underwater Sound Monitoring

Item	Specifications	Quantity	Usage
Hydrophone	Minimum Sensitivity – 211 dB ± 3 dB re 1 V/µPa	2	Capture underwater sound pressures and convert to voltages that can be recorded/analyzed by other equipment.
Signal Conditioning Amplifier	Amplifier Gain – 0.1 mV/pC to 10 V/pC Transducer Sensitivity Range – 10^{-12} to 10^{3} C/MU	2	Adjust signals from hydrophone to levels compatible with recording equipment.
Calibrator (pistonphone-type)	Accuracy – IEC 942 (1988) Class 1	1	Calibration check of hydrophone in the field.
SLM and Solid State Recorder	Sampling Rate – 48K Hz or greater	2	Measures and Records data.
Laptop computer	Compatible with digital analyzer	1	Store digital data on hard drive.
Post-analysis	Real time Analyzer –	1	Monitor real-time signal and post-analysis of sound signals.

Note: All have current National Institute of Standards and Technology (NIST) traceable calibration.

EQUIPMENT

Measurements will be made using hydrophones that have a flat frequency response and are omni-directional over a frequency range of at least 10 to 10,000 Hertz (Hz). For example, a G.R.A.S. CT-10 hydrophone with PCB in-line charge amplifiers (Model 422E13) and PCB Multi-Gain Signal Conditioners (Model 480M122) or equivalent systems could be used to measure sound pressures that pile driving could generate. The signals will be fed into Larson Davis Model 831 Integrating Sound Level Meters (SLM). Quality recordings using a digital audio recorder would be made during attended measurements.

The SLM will be used to establish the 187 dB cumulative SEL zone and to approximate the Level A and Level B Marine Mammal Safety and Harassment zones in the field.

The peak pressure RMS sound pressure level and SEL will be measured using an SLM. The SLM has the ability to measure the Z-weighted peak sound pressure levels over the relative short periods (e.g., time constant of 35 milliseconds). The SLM can closely approximate the unweighted SEL of each pile strike by measuring the 1-second equivalent sound energy level ($L_{eq\ (1\text{-}sec)}$) using the linear integration setting. The SLM also approximates the unweighted $RMS_{90\%}$ of each pile strike by measuring the maximum (using the L_{max} setting) with the SLM detector set to Z-weighted "impulse." Note that underwater pile strike acoustic events have durations typically between 50 and 100 milliseconds, so use of the "impulse" setting to approximate RMS sound pressure levels for impact pile strikes would likely provide a higher level.

All measurement equipment used would be required to have a frequency response of ±1 dB from 10 Hz to 10,000 Hz over the anticipated measurement range of 170 to 220 dB linear peak re: 1 μPa. Hydrophones of different sensitivities may be required depending on the acoustic environment.

CALIBRATION

Calibration of measurement systems shall be established prior to use in the field each day. An acoustical piston phone and hydrophone coupler would be used along with manufacturer calibration certificates. Calibration of measurement systems would be established as follows:

- Use an acoustically certified piston phone and hydrophone coupler that fits the hydrophone and that directly calibrates the measurement system**.** The volume correction of the hydrophone coupler using the hydrophone is known so that the piston phone produces a known signal that can be compared against the measurement system response**.** The response of the measurement system is noted in the field book and applied to all measurements.

The SLMs are calibrated to the calibration tone prior to use in the field. The tone is then measured by the SLM and is recorded on to the beginning of the digital audio recordings that will be used. The system calibration status would be checked by measuring the calibration tone and recording the tones. The recorded calibration tones are used for subsequent detailed analyses of recorded pile strike sounds.

All field notes would be recorded in water-resistant field notebooks. Such notebook entries would include operator's name, date, time, calibration notes, measurement positions, pile-driving information, system gain setting, and equipment used to make each measurement.

The equipment will be calibrated and set to properly measure sounds in the proper range; that is, pile-driving sounds will not overload the instrumentation and the noise floor of the instrumentation is not set too high that pile-driving sounds above 170 dB_{peak} cannot be properly measured.

REPORTING

In coordination with the Construction Liaison and Project Biologist, the hydroacoustic data consisting of Peak sound levels single strike SEL levels and accumulated SEL levels will be submitted to the CDFW bi-weekly or on a daily basis if requested by either CDFW or NMFS. These will be considered preliminary data and include:

- The observed typical and maximum peak pressures as recorded in field notebooks or depicted from instrument raw data output.
- The typical and maximum single strike SEL and the daily cumulative SEL as recorded from the SLM.
- The measured RMS level from the SLM and the $RMS_{90\%}$ calculated during the post processing of the recorded signals.

A Final Hydroacoustic Report will be prepared and submitted within 30 days following the completion of pile driving activities. This report will contain acoustical information (peak, RMS, and SEL) for all piles where measurements were made. The report shall include:

1. Size and type of piles.

2. A detailed description of the sound attenuation device including design specifications.

3. The impact hammer force used to drive the piles.

4. A description of the monitoring equipment and a summary of the methods used to monitor sound.

5. The distance between hydrophones and pile.

6. The depth of the hydrophone.

7. The distance from the pile to the wetted perimeter.

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. The total number of pile strikes per pile, the total number of strikes per day, and the interval between strikes.

12. The ranges and means for peak, $RMS_{90\%}$, and SELs for each pile.

13. The results of the hydroacoustic monitoring, including the frequency spectrum, peak and RMS and $RMS_{90\%}$ SPLs, and single-strike and cumulative SEL.

14. Pulse duration for RMS during impact driving.

15. A description of any observable fish, marine mammal, or bird behavior in the immediate area, as recorded by the biological monitor(s). If possible, correlation between observed fish, marine mammal, or bird behavior and underwater sound levels occurring at the time will be noted.

Appendix B
Proposed Marine Mammal Monitoring Plan

MARINE MAMMAL MONITORING PLAN
DOWNTOWN SAN FRANCISCO FERRY TERMINAL EXPANSION PROJECT – SOUTH BASIN IMPROVEMENTS

Marine mammal monitoring will be implemented during construction of the Downtown San Francisco Ferry Terminal Expansion Project – South Basin Improvements (or project), as detailed in this Marine Mammal Monitoring Plan (plan).

1.0 PURPOSE OF THE MONITORING PLAN

The purpose of this plan is to establish procedures to ensure compliance with authorization requirements, thereby avoiding slight and serious injury (Level A harassment) of marine mammals and minimizing behavioral disturbance (Level B harassment) to the extent practicable. Lethal take of marine mammals is not expected to occur as a part of this project.

The objectives of the monitoring plan are to:

- Establish parameters to monitor site locations for the disturbance of marine mammals during the construction activities;
- Avoid injury to marine mammals through visual monitoring of identified zones of influence (e.g., zones where Level A harassment criteria may be exceeded), and provide ancillary observations of marine mammals in adjacent work areas;
- Ensure that coordination with the acoustic monitoring team occurs during pile driving to modify zones of influence related to noise thresholds for fish and marine mammals, if needed; and
- Describe field operations to obtain data as follows:
  - Make daily observations and record presence or absence of marine mammals;
  - Record marine mammal behavior observations; and
  - Establish/confirm threshold distances delineated in the Incidental Harassment Authorization (IHA) request.

2.0 OVERVIEW OF PROJECT ACTIVITIES AND PROJECT LOCATION

The San Francisco Bay Area Water Emergency Transportation Authority (WETA) is expanding berthing capacity at the Downtown San Francisco Ferry Terminal, located at the San Francisco Ferry Building, to support existing and future planned water transit services operated on San Francisco Bay by WETA and WETA's emergency operations. The project area and vicinity are shown on Figure 1.

The project includes construction of two new water transit gates and associated overwater berthing facilities, in addition to supportive improvements, such as additional passenger waiting and queuing areas and circulation improvements. The project includes the following elements:

- Removal of portions of existing deck and pile construction (portions will remain as open water, and other portions will be replaced);
- Construction of two new gates (Gates F and G);
- Relocation of an existing gate (Gate E); and
- Improved passenger boarding areas, amenities, and circulation, including extending the East Bayside Promenade along Gates E, F, and G; strengthening the South Apron of the Agriculture Building; creating the Embarcadero Plaza; and installing weather protection canopies for passenger queuing.

2.1 Species that Could Be Affected

As described in detail in Section 3 of the IHA application, seven species of marine mammals could be affected by project construction activities: Pacific harbor seal, California sea lion, harbor porpoise, gray whale, northern elephant seal, northern fur seal, and bottlenose dolphin.

2.2 Description of Activities that May Result in Take

Construction of the project improvements requires pile driving. Pile driving for the project would include impact or vibratory pile driving associated with construction of the berthing structures, and the Embarcadero Plaza and East Bayside Promenade; as well as installation of a fendering "chock block" adjacent to Gates E, F, and G. Piles would be steel, concrete, or wood, depending on the application. Pile types, numbers, and sizes are described in Section 1, Table 3 of the IHA application. Underwater sound and acoustic pressure resulting from pile driving could affect marine mammals by causing behavioral avoidance of the construction area (Level B harassment) and/or injury to sensitive species (Level A harassment). Activities are not anticipated to result in lethal take or injury of marine mammals.

For pile removal and driving, distances from pile-driving activities where marine mammals could be impacted are described in Tables 1 and 2, shown on Figures 1 through 5, and summarized below; additional detail can be found in Section 7 of the of the IHA application. It is anticipated that ambient noise levels in the vicinity of the project will often exceed 120 decibels (dB), and the actual area of Level B harassment is likely much smaller than what is presented below. For those Level A zones indicated in Table 1 to be less than 33 feet (10 meters), a conservative exclusion zone of 33 feet (10 meters) will be used for monitoring purposes.

- Impact driving of steel piles could exceed the Level A threshold for the various marine mammal hearing groups over the distances provided in Table 1. Impact driving of steel piles could exceed the Level B threshold of 160 dB RMS for over the distances provided in Table 2.
- Vibratory driving and removal of 24, 30, and 36-inch piles would exceed the Level A thresholds for the various marine mammal hearing groups indicated in Table 1, and could exceed the Level B threshold of 120 dB RMS over the distances provided in Table 2.

Areas where Level A thresholds could be exceeded are considered the exclusion zones. To simplify monitoring, two sets of exclusion zones will be established for each type of pile driving, then separated based on the various hearing groups: one for otariids and mid-frequency cetaceans (i.e., California sea lion, northern fur seal, and bottlenose dolphin); one for phocids (i.e., Pacific harbor seal and northern elephant seal); and one for all other cetaceans (i.e., gray whale and harbor porpoise). Values were rounded up to the nearest hundred feet for cetaceans given the larger distances involved. See Table 3 for a summary of these exclusion zones. See Figures 1 through 3 for the exclusion zones.

Table 1
Expected Pile-Driving Noise Levels and Distances of Level A Threshold Exceedance with Impact and Vibratory Driver

	Source Levels at 33 feet (10 meters) (dB)		Distance to Level A Threshold[1], in feet[2] (meters in parentheses)				
Project Element Requiring Pile Installation	**Peak[3]**	**RMS**	**Phocids**	**Otariids**	**Low-Frequency Cetaceans**	**Mid-Frequency Cetaceans**	**High-Frequency Cetaceans**
36-Inch Steel Piles – Vibratory Driver	191	173	86 (26)	10 (3)	125 (38)	16 (5)	171 (52)

36-Inch Steel Piles – Impact Driver (BCA)	200	173	887 (270)	65 (20)	1,658 (505)	59 (18)	1,975 (602)
30-Inch Steel Piles – Vibratory Driver	181	157	10 (3)	1 (<1.0)	13 (4)	3 (<1.0)	20 (6)
30-Inch Steel Piles – Impact Driver (BCA)	200	180	463 (141)	34 (10)	865 (264)	31 (9)	1,030 (314)
24-Inch Steel Piles – Vibratory Driver	183	165	26 (8)	3 (<1.0)	39 (12)	7 (2)	56 (17)
24-Inch Steel Piles – Impact Driver (BCA)	193	180	463 (141)	34 (10)	865 (264)	31 (9)	1,030 (314)

Notes:
[1] Level A thresholds are based on the NMFS 2016 Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing; cSEL threshold distances are shown. See footnote 3 below.
[2] Where noise will not be blocked by land masses or other solid structures. Values in feet have been converted from fractional meters values, which may affect rounding during unit conversion.
[3] All distances to the peak Level A thresholds are less than 33 feet (10 meters).
Distances are rounded to the nearest foot or to "<1.0 (0)" for values less than 1 foot.
BCA will be used during impact driving of steel piles.
Peak and RMS are re: 1 µPa
BCA = Bubble curtain attenuationRMS = root mean square

dB = decibels
µPa = microPascal
NMFS = National Marine Fisheries Service

Table 2
Expected Pile-Driving Noise Levels and Distances of Level B Threshold Exceedance with Impact and Vibratory Driver

Project Element Requiring Pile Installation	Source Levels at 33 feet (10 meters) (dB)		Distance to Level B Threshold, in feet[1] (meters in parentheses)	Area of Potential Level B Threshold Exceedance Acres (Square Kilometers)
	Peak	RMS	160/120 dB RMS (Level B)[2]	
Embarcadero Plaza and East Bayside Promenade and Gates E, F, and G Dolphin and Guide Piles				
36-Inch Steel Piles – Vibratory Driver	180	175	22,011 (6,709)	8,278 (33.50)
36-Inch Steel Piles – Impact Driver (BCA)	191	173	1,120 (341)	44 (0.18)
30-Inch Steel Piles – Vibratory Driver	181	157	3,084 (940)	267 (1.08)
30-Inch Steel Piles – Impact Driver (BCA)	200	180	705 (215)	20 (0.08)
24-Inch Steel Piles – Vibratory Driver	183	165	8,241 (2,512)	1,804 (7.30)
24-Inch Steel Piles – Impact Driver (BCA)	193	180	705 (215)	267 (0.08)

Notes:
[1] Where noise will not be blocked by land masses or other solid structures. Values in feet have been converted from fractional meters values, which may affect rounding during unit conversion.
[2] For underwater noise, the Level B harassment (disturbance) threshold is 160 dB for impulsive noise and 120 dB for continuous noise.
BCA will be used during impact driving of steel piles.
Peak and RMS are re: 1 µPa.
BCA = Bubble curtain attenuation will be used during impact driving of steel piles.
dB = decibels
RMS = root mean square

Table 3
Level A Harassment - Exclusion Monitoring Zones in feet(meters)[2]

Hearing Groups	Impact Pile Driving		Vibratory Pile Driving	
	24- and 30-inch Steel Piles ft. (m)	36-inch Steel Piles ft. (m)	24- and 30-inch Steel Piles ft. (m)[1]	36-inch Steel Piles ft. (m)
Phocids	**463 (141)**	**900 (274)**	**33 (10)**	**99 (30)**
Otariids and Dolphins	**33 (10)**	**65 (20)**	**33 (10)**	**33 (10)**
Cetaceans	**1,030 (314)**	**2,000 (610)[2]**	**66 (20)**	**171 (52)**

[1] Exclusion Zone is applicable for all other pile driving and extraction activities for all marine mammal species groups. Exact distances for each hearing group for each activity type are all within 33 feet (10 meters).
[2] Some exact values have been rounded up (such as 1,975 feet [602 meters] rounded up to 2,000 feet) (610 meters)) for purposes of ease in monitoring.

ft. = feet
m = meters

3.0 MARINE MAMMAL MONITORING

One National Marine Fisheries Service (NMFS)-approved biologist or marine mammal observer (MMO) will be designated for visual monitoring, record keeping, and reporting for the project. The MMO will be present for all pile driving activities, including vibratory and impact driving activities. Underwater noise monitoring conducted during pile driving for the prior construction season has resulted in the establishment of Level B zones for vibratory driving that are substantially smaller. Since the largest Level A zone for any of the potential pile driving activities is 1,030 feet, one MMO should be sufficient to prevent Level A take and record marine mammal behavior in the Level A zone.

3.1 Baseline Monitoring

The MMO will survey the potential Level A and nearby Level B harassment zones (areas within approximately 2,000 feet of the pile-driving area observable from the shore) on 2 separate days—no earlier than 7 days before the first day of construction—to establish baseline observations. Monitoring will be timed to occur during various tides (preferably low and high tides) during daylight hours from locations that are publicly accessible (e.g., Pier 14 or the Ferry Plaza). The information collected from baseline monitoring will be used for comparison with results of monitoring during pile-driving activities.

3.2 Construction Monitoring

In several cases, the Level A thresholds would only be expected to be exceeded within a few feet of pile driving; in other cases, the Level A thresholds could be exceeded out to approximately 2,000 feet (610 meters) (see Table 1). WETA will implement a mitigation measure that requires work to cease if a marine mammal is observed in an exclusion zone (Table 3). For those Level A zones less than 33 feet (10 meters) as indicated in Table 1, a conservative exclusion zone of 33 feet (10 meters) will be used (Table 3).

As described above, for purposes of monitoring, there will be two sets of exclusion zones depending on the activity: impact pile driving and then vibratory pile driving and extraction. The exclusion zones are divided between phocids (harbor seals and northern elephant seals), otariids and dolphins (sea lions, northern fur seals and bottlenose dolphins), and then one exclusion zone is used for all other cetacean species (i.e., gray whales and harbor porpoises). See Figures 1 through 3 for the exclusion zones that will be monitored during construction activities.

The exclusion zones will be monitored for 15 minutes prior to any pile extraction and driving activities to ensure that the area is clear of any marine mammals. If marine mammals are sighted in the exclusion zone, the start of pile extraction and driving activities will be delayed to allow the animals to move out of the area. If, during pile driving or pile extraction activities, a marine mammal is seen above water and then dives below, the contractor will wait 15 minutes for pinnipeds and small cetaceans, and 30 minutes for gray whales; if no marine mammals are observed in that time, it will be assumed that the animal has moved beyond the exclusion zone and work can resume. The MMO will observe the exclusion zones from the most practicable vantage point possible (e.g., Pier 14 or the Ferry Plaza).

For the areas where the Level B threshold could be exceeded (Table 2, i.e., the area potentially exposed to underwater noise levels at or above 160 dB root mean square [RMS]) for impact driving and 120 dB RMS for vibratory driving), behavioral observations of marine mammals will be made and take would be documented. MMO observations will be made to the extent possible using binoculars from the Ferry Plaza, Pier 14, or other publicly accessible locations along the waterfront. Because no take is being authorized for Guadalupe fur seal, work must be halted if this species is detected in the Level A or Level B zones. WETA will coordinate closely with the local marine mammal rehabilitation center to share information on any sightings of this listed species. Work delays will be implemented as necessary.

3.3 Post-Construction Monitoring

The MMO will continue to observe the exclusion zone and surrounding areas for a minimum of 30 minutes after pile driving stops.

4.0 QUALIFICATIONS AND RESPONSIBILITIES FOR MMOS

4.1 Minimum Qualifications for MMOs

To be considered qualified to record observations of marine mammals for the project, observers must meet the following criteria:

- Visual acuity in both eyes (correction is permissible) sufficient for discernment of moving targets at the water’s surface, with the ability to estimate target size and distance; use of binoculars may be necessary to identify marine mammals;
- Experience in conducting field observations and collecting data according to assigned protocols (this may include academic experience), and ability to perform these tasks;
- Experience or training in the identification of marine mammal species and 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 marine mammal observations, including marine mammal species observed within the exclusion and behavioral disturbance zones; and
- Ability to communicate with project personnel orally, by radio and in person, to provide real-time information on marine mammals observed in the area, as necessary.

All monitoring personnel will be provided a copy of this monitoring plan and the IHA. Monitoring personnel must read and understand the contents of this plan—as well as the IHA—as they relate to coordination, communication, and identification and reporting of incidental harassment of marine mammals.

4.2 MMO Responsibilities

MMO tasks associated with monitoring and reporting requirements for each of the project activities are summarized below:

- Establishing exclusion zone distances from the pile to be extracted/installed, in coordination with the acoustic monitors;
- Monitoring the exclusion zone 15 minutes before pile driving is initiated to ensure that marine mammals are not present;
- Monitoring the exclusion zone for a minimum of 30 minutes after pile driving stops;
- Monitoring any marine mammal activity in the vicinity of the pile-driving activity;
- Observing marine mammal behavior and recording observations, as described in Section 3.0;
- In the event that a marine mammal is observed within the behavioral disturbance zone, recording a Level B take and documenting behaviors;
- Coordinating with WETA, construction contractor(s), and other monitors on site;
- Preparing Monitoring Data Sheets; and
- Preparing a post-construction report.

5.0 DATA COLLECTION AND REPORTING

5.1 Monitoring Data

Observations will be recorded, and will include the following, to the extent available:

- Environmental conditions (weather, sea state, tides, etc.)
- Species;
- Sex and age class;
- Number of animals;
- Description of behavior, including the location and direction of movement;
- Time of observation;
- Construction activity, including the time that pile driving begins and ends; and
- Other acoustic or visual disturbances.

The reactions of marine mammals will be recorded based on the following classifications: 1) no response; 2) head alert (e.g., looks towards the source of disturbance); 3) approaches in water (but does not leave); and 4) retreat or flush (e.g., leaves the area or flushes from the haul-out site). Attached is a Monitoring Data Sheet to be used for recording observations.

If a marine mammal carcass is found in the area, the event would be reported to NMFS according to the following schedule:

1. If a carcass is found and it is determined that it was caused by the contractor's activities, the contractor will immediately cease all activities and NMFS will be notified immediately. The MMO will gather required data and report to NMFS.

2. If a carcass is found and the cause is unknown, NMFS will be notified immediately, and the MMO will report the required data. Activities could continue while NMFS reviews the incident.

3. If a carcass is found and the cause is determined to not be associated with the contractor's activities, the MMO will report it to NMFS within 24 hours, with the required data. Construction activities would not be interrupted.

If accessible to the MMO, the carcass would be tagged; if possible, the MMO would determine and record the species, age, and sex for reporting to NMFS.

5.2 Monitoring Equipment

The following equipment will be used by the MMO:

- A rangefinder capable of achieving an accuracy of ± 5 feet at a range of 100 feet;
- Binoculars;
- Radio or cell phone; and
- Monitoring Data Sheets.

The MMO will use high-quality binoculars to monitor marine mammals at distant locations. A radio or cell phone will be used to coordinate with the construction contractor and the acoustics team, if applicable. To the extent practicable, digital video or 35 millimeter still cameras will be used to document the behavior and response of marine mammals to construction activities or other disturbances.

5.3 Reporting

The following sections detail the NMFS reporting requirements pursuant to the IHA.

5.3.1 Monitoring Data Sheets

Monitoring Data Sheets that summarize the monitoring results, construction activities, and environmental conditions would be compiled and submitted with the post-construction monitoring report. The Monitoring Data Sheets are attached.

5.3.2 Post-Construction Monitoring Report

A draft report would be submitted to NMFS within 90 days after completion of the project. The draft report would include a description of the materials and methods used in monitoring, an overall summary of the project results, a discussion of the compliance record over the course of the entire program, and a discussion of the effectiveness of monitoring methods.

A final report would be prepared and submitted to the services within 30 days following receipt of any comments on the draft report. Copies of the final report would be issued to pertinent regulatory agencies by WETA.

An acoustic data report, including data collected and summarized from all monitoring positions, would be submitted to NMFS in a similar manner, as described in the project Acoustic Monitoring Plan. The marine mammal and acoustic monitoring reports would provide useful information that would allow design of future projects to reduce incidental take of marine mammals. WETA would share field data and behavioral observations on marine mammals that occur in the project area. This information could be made available to federal, state, and local resource agencies, scientists, and other interested parties upon written request.

Date: _______________

Page ___ of ___

Daily Marine Mammal Monitoring Data Sheet

Downtown San Francisco Ferry Terminal Expansion Project – South Basin Improvements

MMO: ____

Other personnel onsite: ____

Time		**Air Temp (°F)**	**Wave Height (ft.)**	**Wind (mph)**	**Cloud Cover (%)**
Starting					
Ending					

Tidal Information* (Gauge: ______________________________________)		
Sunrise: __________		Sunset: __________
High/Low	**Tide Time**	**Height (ft.)**

Other Notes:

Date: _______________

Page ___ of ___

Comment Reference Number	Pile Number	Method of Pile Driving (Impact/ Vibratory)	Pile Driving Start/End Time	Observation Start/End Time	Mammal Species		
					Species[1]	Sex/ Age Class	Number

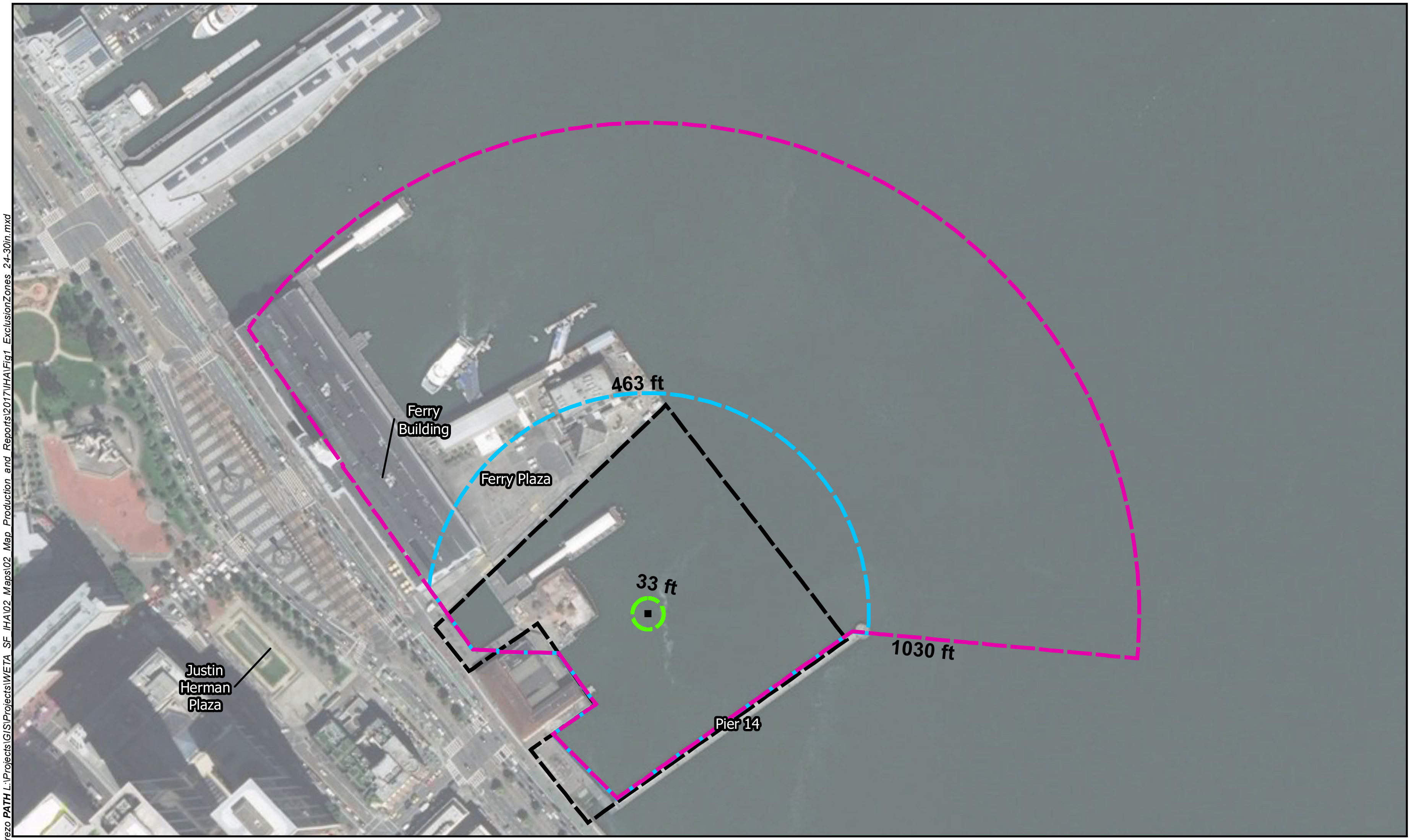
1 CL = California sea lion; PH = Pacific harbor seal; NF = northern fur seal; HP = Harbor porpoise; GW = Gray whale; BN = bottlenose dolphin; O = Other (include name); ES = northern elephant seal

Date: _______________
Page ___ of ___

Daily Marine Mammal Monitoring Data Sheet
Downtown San Francisco Ferry Terminal Expansion Project – South Basin Improvements

Behavioral Observations

Comment Reference Number	Monitor's Distance from Project Activities	Behavior of Marine Mammal	Changes in Marine Mammal Behavior (i.e., orientation, speed, diving, etc.)



■ Approximate Pile Driving Location

Project Area

24 and 30-inch Steel Pile - Exclusion Zones

Otariid Pinnipeds & Dolphins (33 ft)

Phocid Pinnipeds (463 ft)

High-Frequency Cetaceans (1030 ft)

N

0 500 1,000 Feet

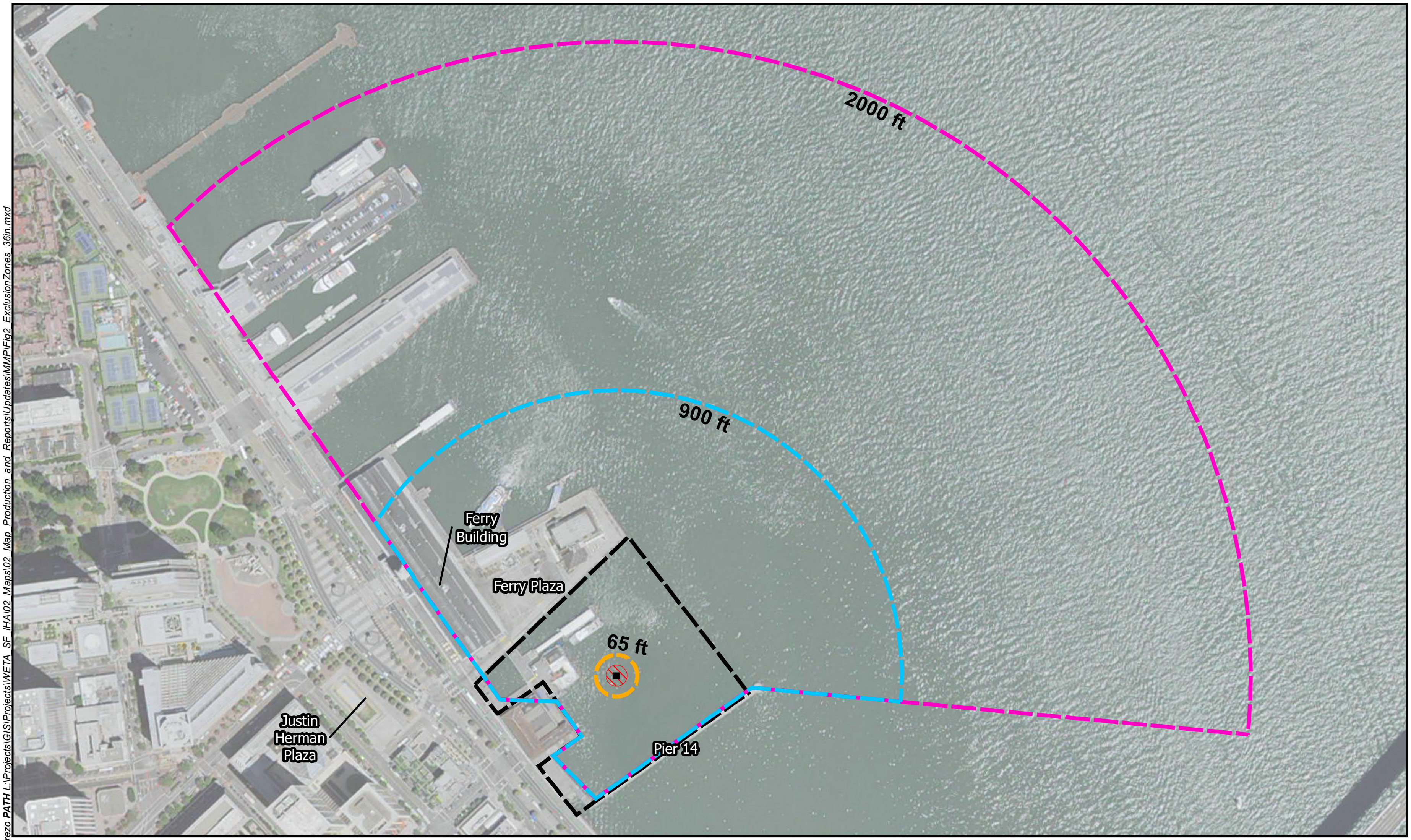
EXCLUSION ZONES FOR IMPACT PILE DRIVING 24 AND 30-INCH STEEL PILES

Downtown San Francisco Ferry Terminal
South Basin Expansion
28067812 San Francisco Bay Area Water Emergency Transportation Authority

FIGURE 1

Source: NAIP Imagery, USDA FSA, 2014

AECOM Oakland CA 1/16/2018 USER alvarezo PATH L:\Projects\GIS\Projects\WETA SF IHA\02 Maps\02 Map Production and Reports\2017\IHA\Fig1 ExclusionZones 24-30in.mxd



- Approximate Pile Driving Location
- Project Area

36-inch Steel Pile - Exclusion Zones

- Otariid Pinnipeds and Dolphins (65 ft)
- Phocid Pinnipeds (900 ft)
- Cetaceans (2000 ft)

All Other Pile Driving & Extraction

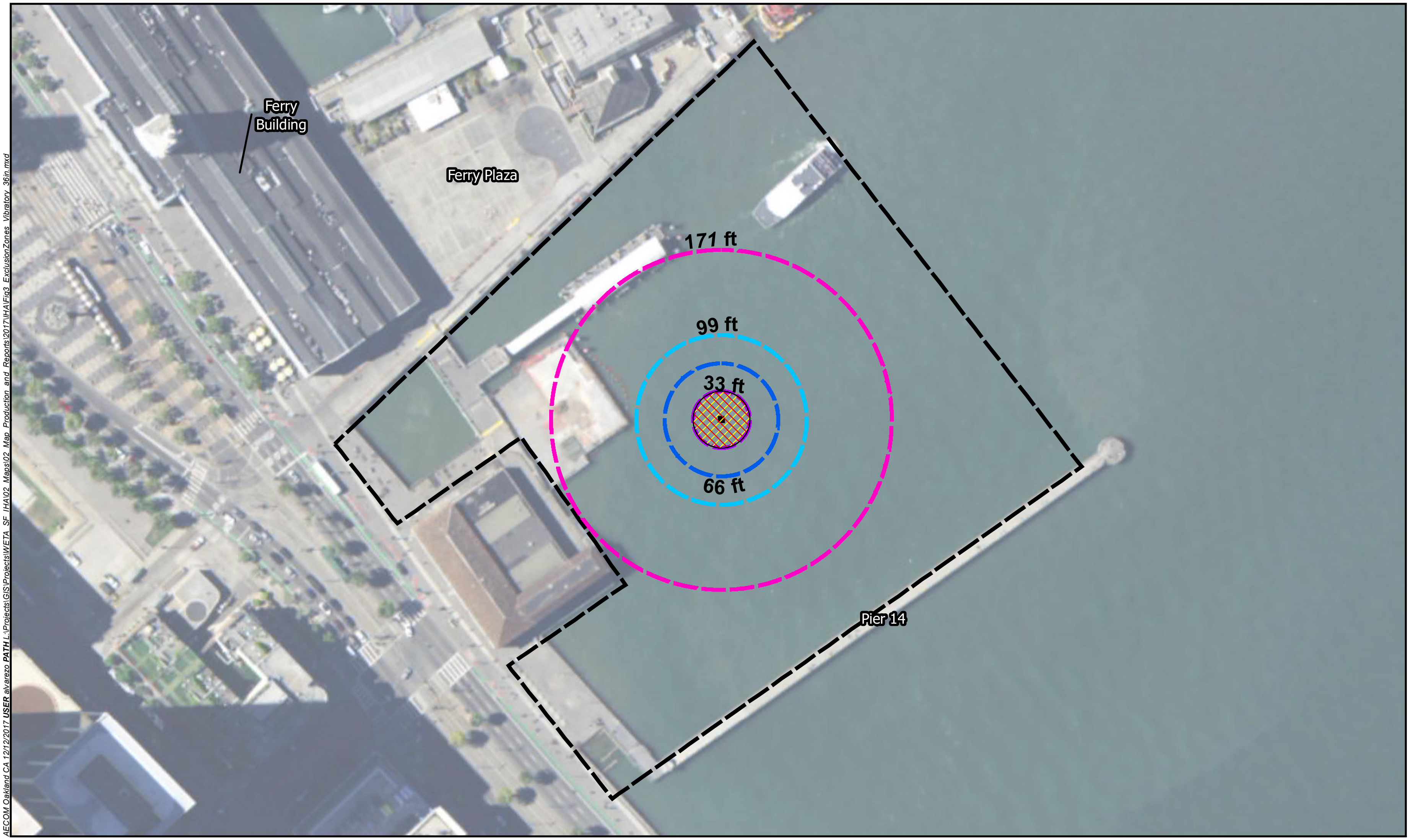
- Exclusion Zone (33 ft)

EXCLUSION ZONES FOR IMPACT PILE DRIVING 36-INCH STEEL PILES

Downtown San Francisco Ferry Terminal
South Basin Expansion
28067812 San Francisco Bay Area Water Emergency Transportation Authority

FIGURE 2

Source: NAIP Imagery, USDA FSA, 2014



Approximate Pile Driving Location
Project Area

36-inch Steel Pile - Exclusion Zones
- Otariid Pinnipeds & Dolphins (33 ft)
- Phocid Pinnipeds (99 ft)
- Cetaceans (171 ft)

24 and 30-inch Steel Pile - Exclusion Zones
- Otariid Pinnipeds & Dolphins (33 ft)
- Phocid Pinnipeds (33 ft)
- Cetaceans (66 ft)

N

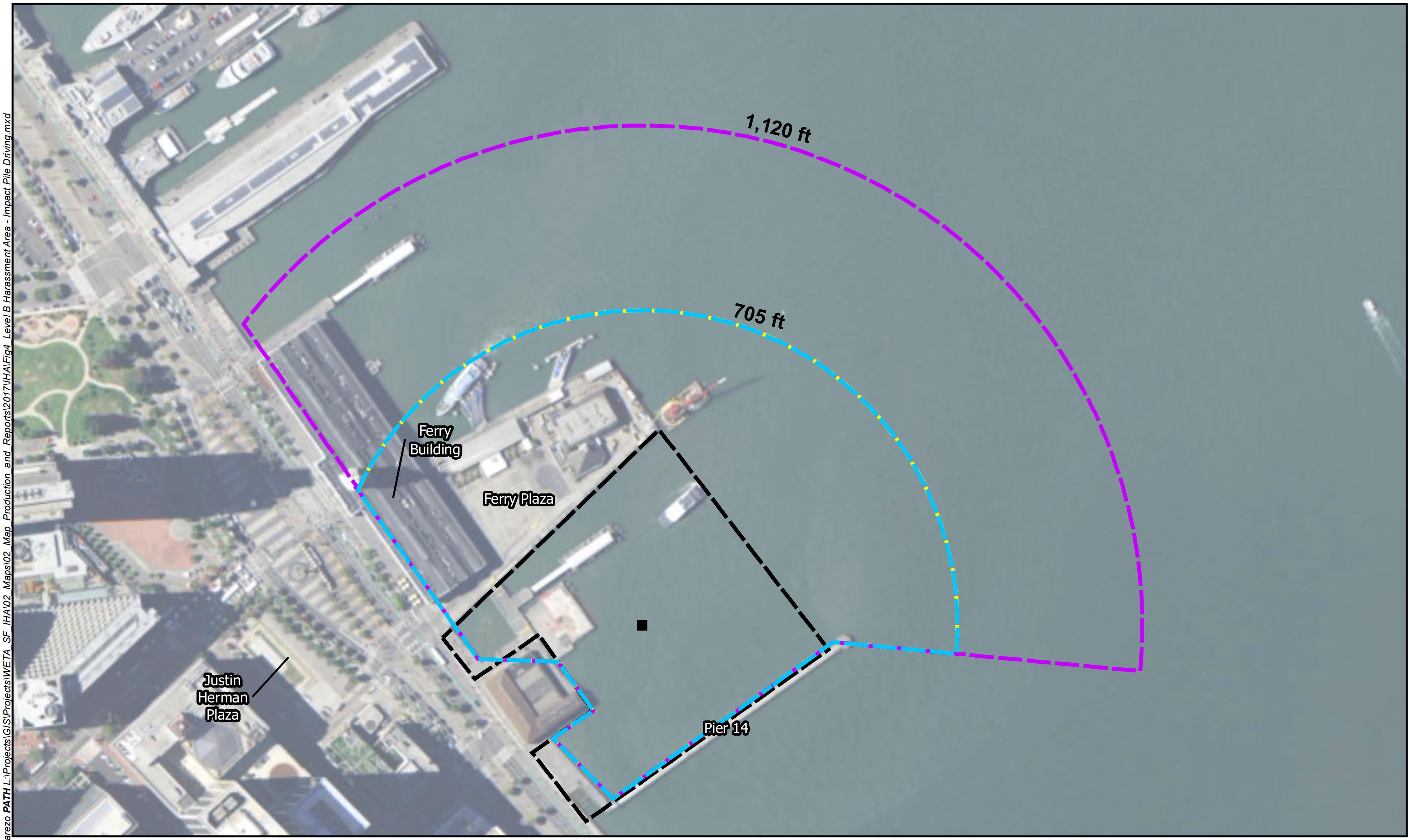
0 125 250 Feet

EXCLUSION ZONES FOR VIBRATORY DRIVING OF STEEL PILES

Downtown San Francisco Ferry Terminal
South Basin Expansion
28067812 San Francisco Bay Area Water Emergency Transportation Authority

FIGURE 3

Source: NAIP Imagery, USDA FSA, 2014



Approximate Pile Driving Location

Project Area

24-inch Steel Pile with Bubble Curtain 160 dB RMS (705 feet)

30-inch Steel Pile with Bubble Curtain 160 dB RMS (705 feet)

36-inch Steel Pile with Bubble Curtain 160 dB RMS (1120 feet)

N

0 250 500 Feet

LEVEL B HARASSMENT AREA - IMPACT PILE DRIVING

Downtown San Francisco Ferry Terminal
South Basin Expansion
28067812 San Francisco Bay Area Water Emergency Transportation Authority

FIGURE 4

Source: NAIP Imagery, USDA FSA, 2014

■ **Approximate Pile Driving Location**

24-inch Steel Pile
120 dB RMS (8,241 feet)

30-inch Steel Pile
120 dB RMS (3,084 feet)

36-inch Steel Pile
120 dB RMS (22,011 feet)

N

0 1 2 Miles

LEVEL B HARASSMENT AREA - VIBRATORY PILE DRIVING AND EXTRACTION

Downtown San Francisco Ferry Terminal
South Basin Expansion
28067812 San Francisco Bay Area Water Emergency Transportation Authority

FIGURE 5

Source: NAIP Imagery, USDA FSA, 2014

AECOM Oakland CA 12/12/2017 ***USER*** *alvarezo* ***PATH*** *L:\Projects\GIS\Projects\WETA_SF_IHA\02_Maps\02_Map_Production_and_Reports\2017\IHA\Fig5_Level B Harassment Area - Vibratory Pile Driving.mxd*