INCIDENTAL HARASSMENT AUTHORIZATION PERMIT APPLICATION

EXPLORATORIUM RELOCATION PROJECT SAN FRANCISCO, CALIFORNIA

Prepared For:
Permits, Conservation, and Education Division
National Marine Fisheries Service
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(1) A detailed description of the specific activity or class of activities that can be expected to result in incidental taking of marine mammals;

The Exploratorium is an internationally recognized museum that provides access to education about science, nature, art, human perception, and technology to over 500,000 visitors annually. After about 38 years in the Palace of Fine Arts, the Exploratorium has outgrown its current location. The fundamental objective for the Project is to construct a new home for the Exploratorium that provides ample space to accommodate substantial growth in its exhibit, education, and research programs, as well as administrative space and functions, in a single facility.

The Exploratorium proposes to relocate from the Palace of Fine Arts, at 3601 Lyon Street, to Piers 15/17, along The Embarcadero, on the waterfront of San Francisco, California (Figure 1). Piers 15/17 are located on The Embarcadero at Green Street in the northeast quadrant of the City and are bounded by The Embarcadero to the west and waters of the San Francisco Bay to the east, north, and south. Pier 9 lies south and Pier 19 lies north of the Project Site. Details of the proposed work include the installation, repair, and removal of piles at Piers 15, removal of wharf decking between Piers 15 and 17, and expansion of the southern portion of Pier 15 to accommodate increased visitors and a potential future water taxi landing (Figures 2 and 3).

There are no marine mammal haul out sites in the vicinity of the project, and deck height in the area is at elevations that are generally too high to facilitate marine mammal haul out. Deck removal and expansion will occur outside of habitat for marine mammals. Therefore, removal and expansion of the existing pier decking is not likely to result in harm or harassment of marine mammals.

Pile driving to support the repaired Pier 15, has the potential to result in harm or harassment of marine mammals through acoustic disturbance. A summary of the proposed pile work is shown below.

Summary of Pile Activities		
Activity	*Number of Piles (Maximum)*	*Location*
Install New Piles	69 steel piles (30 72-inch diameter steel piles 26 24-inch diameter steel piles 13 20-inch diameter steel piles)	Marginal Wharf, South Apron
Repair Existing Piles	Up to 1,026	Pier 15, Valley Infill Area, Marginal Wharf, North Apron
Extend Existing Piles	Up to 120	Valley Infill Area
Remove existing Piles (cut at mudline)	Up to 837	Marginal Wharf, Valley Removal Area, South Apron, Pier 15
Remove existing Piles (cut above MLLW)	Up to 306	Valley Removal Area, Marginal Wharf

Between 2 and 5 steel pipe piles will be placed daily (with the larger piles taking more time to install, and therefore fewer will be installed per day). At an average of three piles per day, the actual pile driving will be approximately 1.5 hours per day, with at least an hour break between driving. For twelve months the totals per pile would be as follows: 72" – 15hrs, 20" – 5hrs, 24" – 8 hrs. The large diameter 72-inch piles would be installed with an ICE 14122 or similar vibratory hammer. No impact hammer will be used for the larger piles. The piles to be removed will be cut off with a hydraulic shear.

Based on the sediments present and depth of pile driving needed, the contractor and geotechnical engineer do not anticipate that an impact hammer will be needed for the smaller piles (20- & 24-inch). However, if an impact hammer does need to be used for final seating, it will be either a steam-powered or a diesel-powered hammer that will deliver between 80,000 and 110,000 ft-lbs per blow.

(2) The date(s) and duration of such activity and the specific geographical region where it will occur;

The specific geographic location is depicted in Figure 1. Construction activities for the Project are expected to occur over an approximate 26-month period, with pile driving activities beginning in approximately August of 2010. If an impact hammer is needed, its use will be restricted to the period between June 1 and November 30 of a given year. Currently, use of a vibratory hammer is permitted at any time of the year for any size pile per the "Not Likely to Adversely Affect" (NLAA) consultation (Corps 2006).

(3) The species and numbers of marine mammals likely to be found within the activity area;

While incidental observations have been made of other marine mammals, such as harbor porpoise (*Phocoena phocoena*), sea otter (*Enhydra lutris*), and even humpback whale (*Megaptera noveangliae*), these species are extremely rare within San Francisco Bay. According to the revised Caltrans marine mammal monitoring program (SRS 2004) for the San Francisco/Oakland Bay Bridge (SFOBB) project, "there have been extremely rare cases of humpback straying into the Bay and occasional sightings of harbor porpoises in the Bay, including near the YBI haul-out site. Since these species are not common in the Bay, it is unlikely that these species will be present in the project vicinity during project construction." Because the scale, duration, and distance to YBI of the Exploratorium project is much less than that of the SFOBB project, incidental take authorization is not being requested for these species.

Marine mammal species commonly observed in the Bay are Pacific Harbor Seal (*Phoca vitulina richardsi*), California Sea-lion (*Zalophus californianus*) and Gray Whale (*Eschrichtius robustus*). San Francisco Bay Pacific Harbor Seal counts ranged from 524 to 641 seals from 1987 to 1999 (Goals Project 2000) and winter numbers of California Sea-lion are generally over 500 animals (Goals Project 2000). These numbers are generally thought to be stable within the Bay. The Gray Whale, though an uncommon Bay visitor, may occasionally be seen in the Central Bay. The nearest known haul out location is Pier 39 for the sea-lion and Yerba Buena Island for the harbor seal.

Only limited information exists regarding distribution of marine mammals within San Francisco Bay, primarily related to the location of haul out sites. Reconnaissance level surveys and incidental observations indicate that the activity area is not heavily utilized by marine mammals as areas to the north and west along the waterfront, closer to Pier 39. While marine mammals may occasionally forage or pass through the waters in the project area, no marine mammals have been observed in the area surrounding Piers 15 and 17 during site visits made by biologists as part of the preparation of the project Environmental Impact Report (EIR) or during the four site visits made to the area by WRA biologists between March 1 and April 6, 2010. This lack of marine mammal activity in the area may be the result of the level of human disturbance in this portion of the waterfront. Tugboat activities that occur at Piers 15 and 17, the nearby San Francisco Ferry Terminal, and other water dependant uses along this stretch of the San Francisco waterfront generate levels of noise that are likely to exceed the NMFS threshold for marine mammal disturbance under ambient conditions (120 dB). This portion of the waterfront is also high traffic for other large marine shipping and cruise vessels. The area between the project site and Angel Island is the primary route for shipping traffic into and out of the Port of San Francisco, Port of Oakland, and points south.

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

Pacific Harbor Seal

P. v. richardii ranges from Cedros Island (Baja California) along the Pacific coasts of the United States, Canada and Alaska, through the Aleutian Islands to the Pribilof Islands. Based on the most recent harbor seal counts (26,333 in May-July 2004; Lowry et al. 2005) and Hanan's revised correction factor, the harbor seal population in California is estimated to number 34,233 (Carretta et al. 2009).

In California, approximately 400-500 harbor seal haul out sites are widely distributed along the mainland and on offshore islands, including intertidal sandbars, rocky shores and beaches (Hanan 1996). The north side of Yerba Buena Island is the nearest haul out area, approximately 2 miles from the project site at Pier 15. Although seals haul out year round on Yerba Buena Island, it is not considered a pupping site for harbor seals (although pups are occasionally seen there) (Kopec and Harvey, 1995).

California Harbor Seals are not listed under the ESA or considered strategic under the MMPA. The population appears to be stabilizing at what may be their carrying capacity and the human-caused mortality is declining. There are no known habitat issues that are of particular concern for this stock (Carretta et al. 2006).

California Sea-lion

California sea lions reside in the Eastern North Pacific Ocean in shallow coastal and estuarine waters. Sandy beaches are preferred for haul out sites. In California, they haul out on marina docks as well as jetties and buoys. They are not listed as depleted under the MMPA or as endangered or threatened under the ESA. The most current NMFS stock assessment report (2007) estimates there are approximately 238,000 sea lions in

the U.S. In the Bay, sea-lions haul out primarily on floating docks at Pier 39 in the Fisherman's Wharf area and may be found on buoys elsewhere in the Bay.

Gray Whale

The Gray Whale is not listed as depleted under the MMPA and was delisted from the ESA in 1994 (59 FR 31094). NMFS's most current stock assessment report (2008) estimates this population at approximately 18,813 individuals. In the fall, Gray Whales migrate from their summer feeding grounds, heading south along the coast of North America to spend the winter in their breeding and calving areas off the coast of Baja California, Mexico. From mid-February to May, the Eastern North Pacific stock of gray whales can be seen migrating northward with newborn calves along the West Coast of the U.S. During the migration, gray whales will occasionally enter rivers and bays (such as San Francisco Bay) along the coast but not in high numbers. Individual whales may use the shallow Bay waters for foraging, or they may simply be off course. 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 (NOAA, 2009).

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

The Exploratorium project requests an authorization from the National Marine Fisheries Service for incidental take by harassment of small numbers of marine mammals, including Pacific Harbor Seal, California Sea-lion and potentially Gray Whale during construction work related to the Exploratorium relocation project at Piers 15 and 17 during 2010 and 2011.

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

Incidental harassment may occur as a result of noise and disturbance produced by pile driving. As described above, Pacific Harbor Seal and California Sea-lion are not known to haul out or pup within or near the activity area. These species may use the waters adjacent to the piers for foraging or for daily migrations between foraging and haul out locations, but are not as prevalent along this portion of the San Francisco waterfront as along others. The Gray Whale is not expected to forage in the activity area but may be affected by construction noise if it is in the Central Bay during construction activities. The type of take would be acoustic disturbance from pile driving, with between 2 and 5 piles placed daily. Because the pile driving work is anticipated to be accomplished using only a vibratory hammer, the disturbance is likely to be only due to avoidance behavior and potential reduction in foraging. Use of an impact hammer is not anticipated, but may be necessary for final seating of piles. Details regarding the pile driving is explained in question one above.

Exact numbers of each species potentially taken is difficult to ascertain given the paucity of information regarding marine mammal distribution in central San Francisco Bay and lack of any marine mammal sightings in and surrounding the project site. However, data

collected by Caltrans for the SFOBB project can be used as a surrogate to estimate density near the project area. The monitoring for the SFOBB project is just a couple miles to the north of the Exploratorium. It should be noted however, that the monitoring work thus far conducted for the Caltrans project is located in close proximity to a haul out area, where the Exploratorium project is in an area of high commercial boat activity with no haul out sites. Therefore, the numbers collected for the SFOBB project are likely higher than those for the project area.

During 22 days of monitoring from Jan-August 2006, 35 pinnipeds (33 harbor seals [94.3%] and 2 California sea lions [5.7%]) were observed during pile-driving at Piers E2 and T1 for the SFOBB project. Caltrans did not include effort hours per day into their report; however, assuming equal effort time per day, the density of harbor seals and California sea lions is 1.5 seals/day and 0.09 sea lions/day. In comparison, during the eastbound Skyway structure pile-driving, 63 pinnipeds were observed during 31 days (2.0 pinnipeds/day); however, there were two days of herring runs in late January 2004 during the eastbound monitoring resulting in 20 sea lions and 21 harbor seals observed within and outside of the marine mammal safety zone (MMSZ). There were no observed herring runs during marine mammal monitoring for Piers E2 or T1. If data for the two days herring runs were present are subtracted out, then only 22 pinnipeds (0.8 pinnipeds/day) were observed during the eastbound structure pile-driving. It appears that most pinnipeds are only transiting through the construction area and are only briefly seen 1-3 times before they move out of the area. However, herring runs could likely result in increased presence and foraging behavior. To be conservative, NMFS would estimate pinniped presence around the Exploratorium to be 2 Harbor Seals and 1 California Sea Lion/day and it should be considered that these animals could come within the Level B harassment threshold isopleth. The Exploratorium is requesting a total take request of 2 Harbor Seals, 1 California Sea Lion and 1 Grey Whale per day.

(7) The anticipated impact of the activity upon the species or stock;

Project construction at the Exploratorium may temporarily impact marine mammal species through temporary avoidance and disruption of foraging behavior as a result of pile driving, but no long term impacts to the species or stock are expected to occur as a result of the project. Federal Register Notice (Vol. 70, No. 7, pp. 1871-1875) establishes thresholds for acoustic impacts to marine mammals. These regulations set standards for behavioral harassment ("Level B" criteria) of marine mammals at 120 dB RMS for “continuous” source vibrations, and 160dB RMS for impact sources. The regulations also set the criteria for physical injury ("Level A" criteria) from an impact source at 180 dB RMS cetaceans (such as Gray Whale) and 190 dB RMS for pinnipeds, such as Pacific Harbor Seal and Sea Lion.

As part of the SFOBB project, Caltrans conducted numerous acoustic studies during vibratory pile driving within San Francisco Bay. These studies covered a range of pile types, sizes and locations. The table below summarizes typical and maximum measured sound pressure levels (root mean square values) of various pile sizes during vibratory pile-driving in and around San Francisco Bay. Measurements were taken approximately 10 meters from the source. Most of the energy during vibratory pile driving was below 600 Hz (the functional hearing range of pinnipeds in-water is 75 Hz to 75 kHz; therefore, these sounds will be detectable to pinnipeds). Water depth and other ambient conditions are expected to be comparable between the SFOBB project and

Exploratorium project. However, it is important to note that the hammer being used for the Exploratorium project is approximately 40% of the energy of the king kong hammer used for the SFOBB project. Similar size piles can be driven at this location with a smaller size hammer due to sediment conditions in the Exploratorium project area. It is reasonable to assume that pile-driving noise levels around the Exploratorium would be similar, though likely to be somewhat lower than the measurements taken below.

Pile Type/Size	Relative Water Depth	Sound Pressure Level at 10 m (RMS)
72-inch steel pipe pile-	5 meters	Average=170 dB Loudest= 180dB
34- inch steel pipe piles	5 meters	Average= 170 dB Loudest = 175 dB
24- in steel sheet piles	5 meters	Average= 160 dB Loudest= 165 dB
12-in steel pipe piles	5 meters	Average= 155 dB

In November 2003, a 1.8-meter (72-inch) diameter steel pipe pile was installed in the Richmond Inner Harbor in Richmond, California. Average and maximum SPLs are provided in Table 1 above. The pile was installed at the Castrol Oil facility dock as a breasting dolphin for large ships. The pile was installed using a vibratory driver to avoid significant underwater noise impacts. Pile installation occurred on three separate days due to unanticipated construction problems. The first two days of pile installation involved the use of an APE Model 400B Vibratory Driver/Extractor (King Kong Driver). The pile could not be installed to the specified depth using the King Kong Driver, so the larger Super Kong Driver (Model 600) was used on the third day. The larger "Super Kong" driver was not much more successful installing the pile. Measurements were made at 20 meters and 30 meters, which indicated that peak sound pressures dropped off at a rate of about 7 dB per doubling of distance. This pile-driving took place approximately 7-8 miles northeast of the Exploratorium in similar depth water. It is reasonable to assume that structure confinement and similar bathymetry in San Francisco Bay will result in similar transmission loss rates for pile-driving at the Exploratorium. Actual sound pressure levels are expected to be lower for the Exploratorium than were observed at the Castrol Oil site due to sediment differences and hammer size requirements between the two sites.

In February 2009, Caltrans measured underwater sound 16 to 1,100 m from where 3 piles were being driven with a "super king kong" vibratory hammer. Data indicated there is some variability in sound levels with respect to directionality of where the measurements were made in relation to the hammer; however, the 190 and 180dB threshold were never reached in any case. The 160dB isopleth was located approximately 150 m from the pile driver. The 120 dB isopleth varied with directionality. It occurred at a distance of approximately 1,100 m to the east but reached 130dB at this distance during driving of the 3rd pile. To the north, at 1,500m, sound levels reached 135 140dB. The report also claims that the 120-dB zone fades into ambient noise level at about 1,900 m. Therefore, it could be considered that the Level B (120 dB) isopleth is 1,900 m.

Based on this information, NMFS expects that Level A harassment thresholds would not be reached during vibratory pile driving. The Level B harassment isopleth is estimated to reach 1,900 m into the Bay from any direction of the pile hammer. This is the same Level B distance established in Caltrans' IHA during vibratory pile driving on the SFOBB.

IMPACT PILE DRIVING

Harassment threshold isopleths for impact pile driving will vary by pile and hammer size, pile type, and physical environmental features (e.g., water depth, substrate, etc.). However, due to lack of empirical data at the Exploratorium, NMFS has determined that the greatest zone set for Caltrans is appropriate for use here. Therefore, **a 500 m safety zone** will be established for all in-water impact pile driving. Marine mammal observers (MMOs) will be required during all impact hammering, to call for shut down should a marine mammal come within or approach and on a path towards the 500 m safety zone. Only after empirical data is collected and it is determined the sound attenuation devices are adequately reducing sound levels below 180 dB will MMOs be intermittent monitors for impact pile driving. This is due to the range in effectiveness of sound attenuation devices:

From the Caltrans (2005) Acoustic Monitoring Report: "Limited tests of the bubble curtain on versus the bubble curtain off were conducted to assess the performance of the bubble curtain in order to allow the caged fish tests to be conducted with unattenuated pulses. Overall, the bubble curtain on versus bubble curtain off tests showed about a 5 to 20 dB reduction at positions out to about 100 meters (330 feet). The test at Pier E6E indicated reductions of about 2 to 10 dB depending on position relative to the current. A second short test at the pier with the deepest water (Pier E3E) indicated reductions of about 11 to 18 dB in peak pressures with the least reduction on the upstream side of the pile. A third test at Pier E3W indicated only about 0 to 8 dB. All of the tests indicated that unattenuated sound pressures were about 207 to 210 dB at 50 meters (164 feet) and about 200 to 204 dB at 100 meters (328 feet). The reductions provided by the air bubble curtain were assessed at other piers where the system was never turned off by comparing measured levels to expected unattenuated levels. For the other piers, measured peak sound pressures at 50 meters (164 feet) ranged from 186 to 205 dB and from 182 to 199 dB at 100 meters (328 feet). Close-in measurements at Pier E5E indicated that maximum peak sound pressures within the air bubble curtain were about 200 to 205 dB, except on the very upstream side where they exceeded 215 dB."

Sound attenuation devices would be used during all impact pile driving. It can be assumed that, using attenuation devices, noise levels at or above 160 dB (Level B harassment isopleth for impact pile driving) would extend approximately 2,000 m into the Bay. This distance is very close to the 120 dB isopleth for pile driving. Hence, a **2,000m safety zone** will be representative of the 120 dB isopleth during vibratory pile-driving, impact pile-driving and using sound attenuation devices during impact pile-driving. The 500 and 2,000 meter isopleths are shown in Figure 4.

(8) The anticipated impact of the activity on the availability of the species or stocks of marine mammals for subsistence uses;

[12] Peak spawning activity has historically been December through February (Conner et al.). Pacific Herring, which is considered a species of special concern by CDFG, has a three month period, from

Marine mammals in San Francisco Bay are not harvested for subsistence use. Therefore no impact would occur to subsistence uses.

(9) The anticipated impact of the activity upon the habitat of the marine mammal populations, and the likelihood of restoration of the affected habitat;

No permanent impacts are expected to marine mammals. The impacts are temporary in nature and are associated with pile driving and construction noise disturbance and would not require restoration. Site conditions are anticipated to be substantively unchanged from existing conditions for marine mammals following project implementation.

(10) The anticipated impact of the loss or modification of the habitat on the marine mammal populations involved;

The impacts associated with the proposed project are temporary and are not expected to have long term affects on marine mammals or marine mammal habitat.

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

As described above, the project is not anticipated to result in Level A impacts to marine mammals, but may result in Level B harassment. Pile driving is expected to be accomplished entirely using a vibratory hammer. Based on sediment conditions, the type of hammer being utilized, and previous sound measurements, the use of a vibratory hammer is not expected to result in exceedance of the Level A threshold for marine mammals. Level B harassment would be temporary in duration, and is not expected to result in any long term effects to marine mammal stocks or habitat in the region. The use of a vibratory hammer of the size anticipated for the Exploratorium substantially minimizes potential affects to marine mammals. In addition, a “soft-start” procedure at the start of vibratory hammer activity will be used to allow animals within the area a chance to leave before full energy is reached. The soft-start requires contractors to initiate noise from vibratory hammers for 15 seconds at reduced energy followed by a 1-minute waiting period. The procedure will be repeated two additional times before full energy is achieved. This procedure will be conducted prior to driving each pile if vibratory pile-driving ceases for more than 30 minutes.

In the event that an impact hammer is necessary, a bubble curtain, wood block, or both will be used as attenuation devices to reduce hydroacoustic sound levels to below the Level A threshold. With the use of these devices, hydroacoustic levels are anticipated to be between 164 and 179 dB RMS for use of an impact hammer. In addition, if an impact hammer is necessary for use at the Exploratorium, a marine mammal monitoring program will be initiated, which will include:

1. A NMFS approved marine mammal monitor will make one baseline monitoring visit prior to initiation of impact and soft-start pile driving activities, within the Level B harassment zone (to be determined) and also within the Level A zone to

make sure no animals are taken by Level A injury/mortality. The monitor will make observations of marine mammals within 500 meters of the pile driving area, including species identification and behavior.

2. The marine mammal monitor will be required to visit the site twice per week during pile-driving and at some distance out into the 120 dB zone to make similar observations of marine mammal behavior within the monitoring distance, including notes if marine mammal behavior appears to be affected by pile driving activities.
3. Marine mammal observers will be provided with the equipment necessary to effectively monitor for marine mammals (e.g., high-quality binoculars, compass, and range-finder) in order to determine if animals have entered into the harassment isopleth and to record species, behavior, responses to pile-driving, etc.
4. During the site visits, the marine mammal monitor will also be responsible for ensuring that sound attenuation devices were being used and are reducing sound levels below established thresholds for physical injury to marine mammals (180 dB RMS).
5. If sound attenuation measures are not being implemented properly to achieve the required reduction in sound levels, the marine mammal monitor will be given authority to stop impact hammer pile driving activities and work with contractors to resolve the matter. NMFS will be notified within 48 hours if an exceedance event occurs or if take occurs that is not covered by the IHA permit.
6. The marine mammal monitor would be required to complete a report at the end of monitoring, once the use of an impact hammer use has been completed.
7. Pinniped presence during herring runs can be sporadic and unpredictable. As a result, a biological monitor will be present on site during pile installation conducted between December 1 and February 28[2]. If a Herring spawning event is observed, work will cease for a period of two weeks following the spawning event. The area will be surveyed by the biological monitor prior to resumption of work to ensure that further work will not impact spawning or newly hatched Herring in addition to marine mammals.

Boat based monitoring of marine mammals at Yerba Buena Island will be unnecessary as: 1) the known haul out is on the other side of the island; 2) the island is approximately 2,300 meters from Piers 15 and 17, outside of the 1,900 meter isopleth; 3) Yerba Buena Island effects should be visible by land based observation with a spotting scope and 4) boat based monitoring could influence monitoring results given that most boat based activities exceed the threshold for Level B harassment.

(12) Where the proposed activity would take place in or near a traditional Arctic subsistence hunting area and/or may affect the availability of a species or stock of marine mammal for Arctic subsistence uses, the applicant must submit either a plan of cooperation[9] or information that identifies what measures have been taken and/or will be taken to minimize any adverse effects on the availability of marine mammals for subsistence uses.

Not applicable. Activity would not take place in or near a traditional Arctic subsistence hunting area.

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

Proposed monitoring recommendations are listed in Section 11 above. Previous efforts at hydroacoustic monitoring are referenced to establish anticipated levels of effect. Use of a vibratory hammer of the size proposed for the Exploratorium is not anticipated to result in exceedance of Level A thresholds for marine mammals. In the even that an impact hammer will be used, the monitoring plan described above in Section 11 will be implemented.

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

All marine mammal data gathered during construction will be made available to NMFS, researchers and other interested parties as specified in Section 11 above.

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Figures

Figure 1. Project Area Location Map

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S

Exploratorium Relocation Project
Piers 15 and 17
San Francisco, California

0 1,000 2,000 Feet

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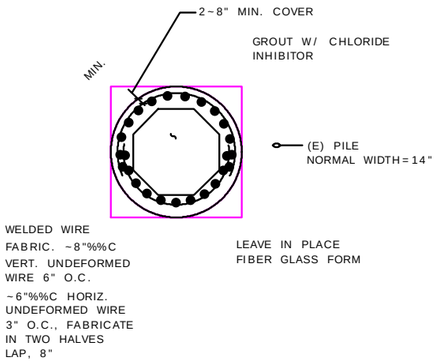
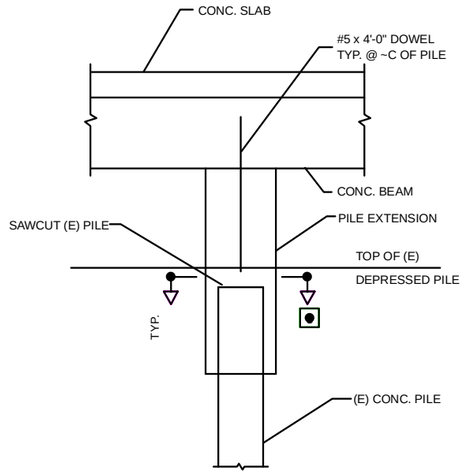
Map Date: September 2009
Map By: Derek Chan
Base Source: USGS
Filepath: L:\ACAD2000\19000\19121\GIS\ArcMap\Figure1.mxd

Pile Extension Details

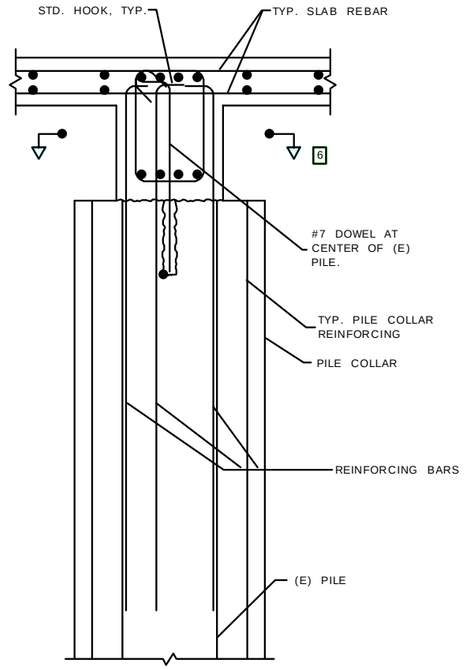


INFILL PILE EXTENSION

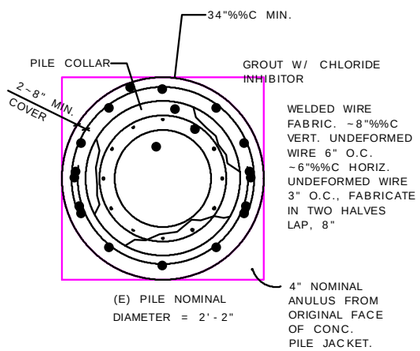


TYPICAL PILE EXTENSION

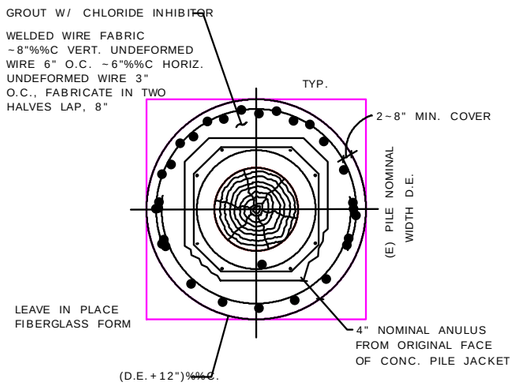
Pile Repair and Reinforcement Details



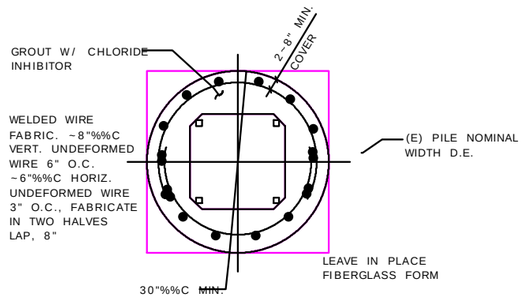
TYPICAL PIER REINFORCEMENT



PIER 17 PILE



PIER 15 PILE



WHARF PILE

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Exploratorium Relocation Project

Piers 15 and 17
San Francisco,
California

Figure 2.
Pile Reinforcement Detail

This map is representational only, and not meant for use in detailed design.

Map Date: Sept 09
Source Data: EHDD and Rumsey Engineers
Map By: Sundaran Gillespie
Filepath: I:\ACAD2000\19000\19121\GIS\ArcMap\Figure 4.mxd

Legend

Areas of Decking Removal or Expansion

South Apron

Expanded South Apron: (0.18 acres)
- Install 13 new 20-inch piles
- Cut 42 piles at mudline

Valley

Open Water Area: (1.26 acres of new open water)
- Cut 730 piles at mudline
- Cut 298 piles above mudline for pile garden

Rehabilitated Decking: (1.51 acres)
- Remove and replace existing decking
- Extend 120 piles
- Repair 22 existing piles

Floating Dock: (0.05 acres)
- Install 3 piles

Areas of Pile Work Only (No Decking Removal or Expansion)

Pier 15
- Repair 765 piles
- Cut 8 piles

Pier 17: No work being done

Marginal Wharf: No work being done

Marginal Wharf Repair
- Install 30 new 72-inch piles
- Install 26 new 24-inch piles
- Repair 95 existing piles
- Cut 65 piles at mudline

North Apron
- Repair 144 piles

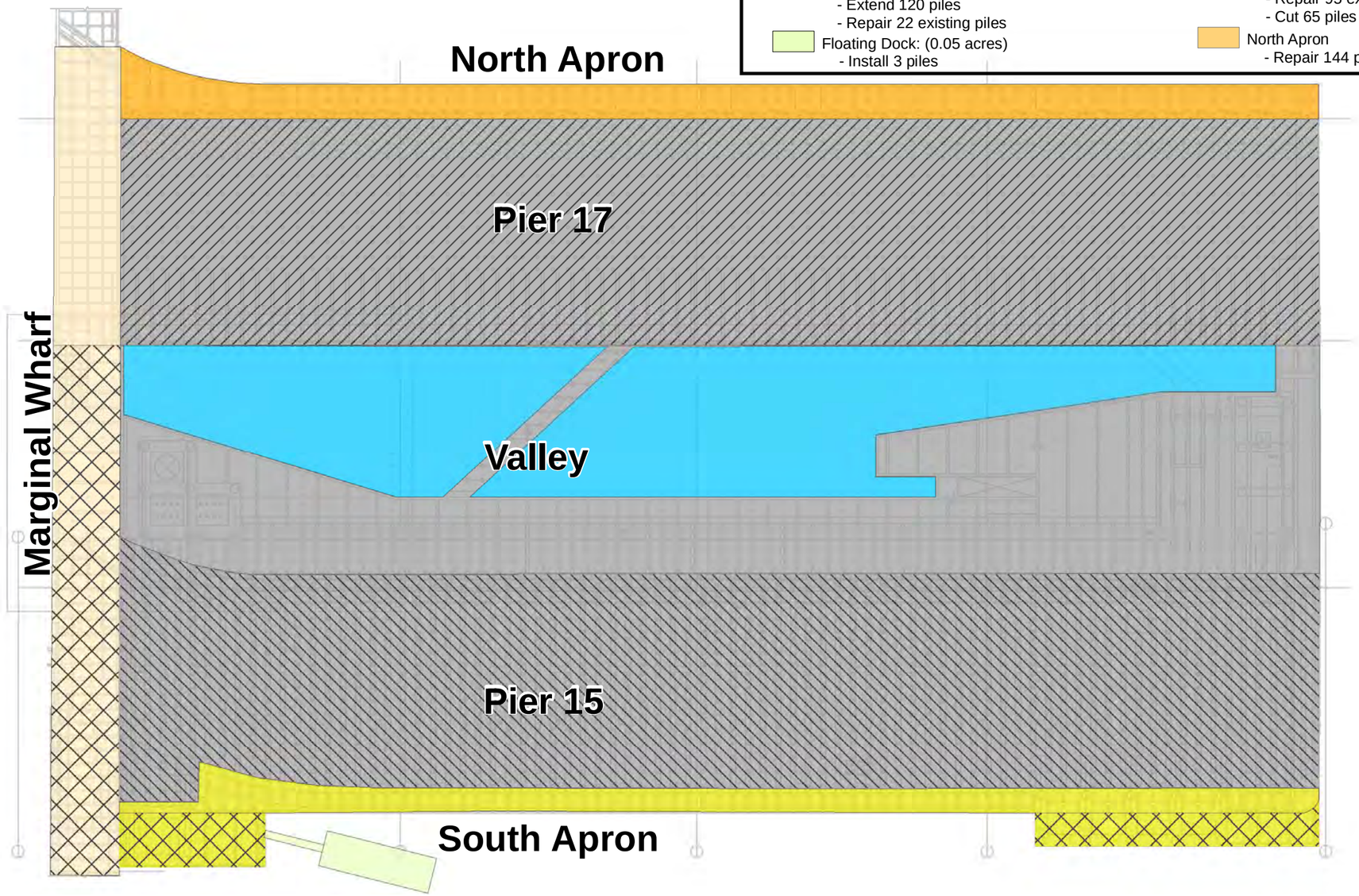

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Figure 3.
Project Construction and Demolition Overview

This map is representational only, and not meant for use in detailed design.

N
W E
S

0 50 100
Feet

Map Date: Sept 09
Source Data: EHDD and Rumsey Engineers
Map By: Sundaran Gillespie
Filepath: I:\ACAD2000\19000\19121\GIS\ArcMap\Figure 3.mxd

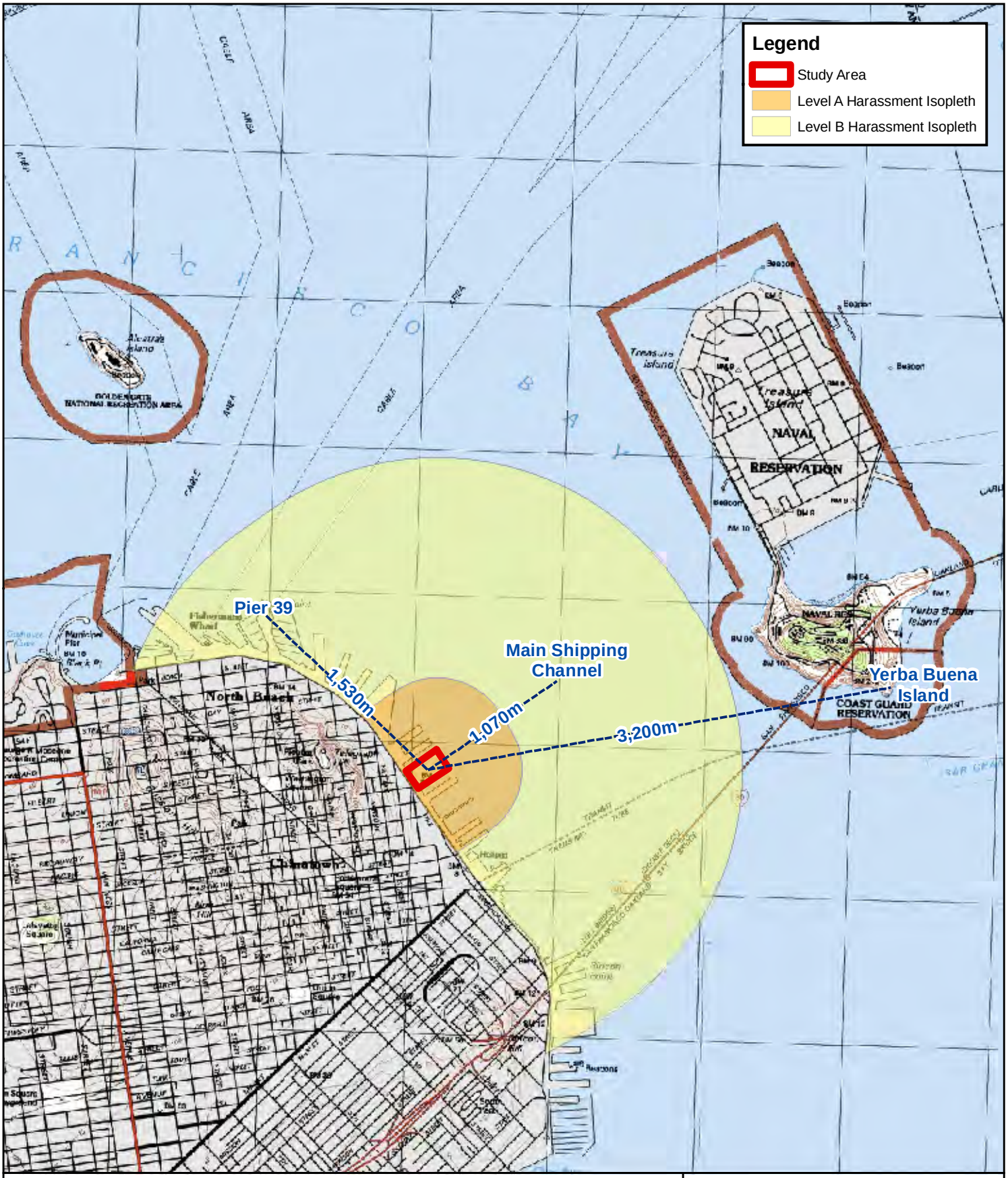

Figure 4: Level A and Level B Harassment Isopleths

N
W E
S

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Piers 15 and 17
San Francisco, California

0 2,000 4,000 Feet

wra
ENVIRONMENTAL CONSULTANTS

Map Date: May 2010
Map By: Derek Chan
Base Source: USGS
Filepath: L:\Acad 2000 Files\19000\19121\gis\arcmap\FigX_HarassmentIsopleths.mxd