APPENDIX B

Biological Resources

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, LOS ANGELES DISTRICT
915 WILSHIRE BOULEVARD, SUITE 930
LOS ANGELES, CALIFORNIA 90017-3489

March 13, 2020

Jolie Harrison
Division Chief,
Permits and Conservation Division
Office of Protected Resources
1315 East-West Highway, F/PR1 Room 13805
Silver Spring, Maryland 20910

Dear Ms. Harrison:

Please find the attached request for an incidental take authorization under section 101(a)(5) of the Marine Mammal Protection Act of 1972, as amended, for the take of marine mammals incidental to conducting breakwater repairs by the U.S. Army Corps of Engineers, Los Angeles District.

The U.S. Army Corps of Engineers plans to conduct breakwater repairs in Port San Luis, San Luis Obispo County, CA from April 2021-November 2021. Because the USACE activities have the potential to cause Level B Take of marine mammals, we are requesting an Incidental Harassment Authorization.

We look forward to working with you and your staff to answer any questions you may have about this application. Please feel free to contact Mrs. Natalie Martinez-Takeshita at 213-452-3306 or via email at Natalie.M.Martinez-Takeshita@usace.army.mil with additional questions.

Sincerely,

Eduardo T. De Mesa
Chief, Planning Division

US Army Corps of Engineers

INCIDENTAL HARASSMENT AUTHORIZATION (IHA) APPLICATION FOR

OPERATIONS AND MAINTENANCE (O&M)
PORT SAN LUIS HARBOR BREAKWATER REPAIRS

SAN LUIS OBISPO COUNTY, CALIFORNIA

Submitted by:
U.S. Army Corps of Engineers
South Pacific Division
Los Angeles District
915 Wilshire Blvd.
Los Angeles, California 90017

Submitted to:

National Oceanic and Atmospheric Administration (NOAA) Fisheries
Permits and Conservation Division, Office of Protected Resources
1315 East-West Highway, F/PR1 Room 13805
Silver Spring, MD 20910

February 2021

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I. **Description of Specified Activity:** *A detailed description of the specific activity or class of activities that can be expected to result in incidental taking of marine mammals.*

The Los Angeles District (LAD) of the U.S. Army Corps of Engineers (Corps), as part of its Operations and Maintenance (O&M) program, is proposing to perform O&M repairs to the Port San Luis Breakwater, Port San Luis Harbor, San Luis Obispo County, to maintain the breakwater's integrity. Port San Luis Harbor is located within San Luis Obispo Bay. The proposed project would perform O&M repair on the breakwater by resetting and replacing stone along the approximately 2,400 foot long and 20 foot wide breakwater. O&M repair work would focus on the most heavily damaged 1,420 feet of the structure located on the distal end between Stations 4+00 and 18+20 (Figure 4). O&M repair work would be conducted from the leeward side of the breakwater, due to the nature of the repairs and safety constraints due to adverse open ocean sea state conditions on the seaward side of the breakwater. The footprint of the breakwater would not be changed, but the crest elevation would be raised from +13 feet Mean Lower Low Water (MLLW) to +16 feet MLLW as a consequence of the armor stone size required for hydraulic stability and the breakwater prism. It is estimated that approximately 29,000 tons of existing stone would need to be reset, and 60,000 tons of new stone (individual stone sizes range from 5 to 20 tons) would be placed to restore the most heavily damaged portion of the breakwater to its original design. Repair work elevation changes could potentially extent to the seabed to ensure a stable slope is maintained ensuring structure stability. Repair work construction activities would be limited to day light hours (approximately 11 hours a day). Minor excavation of shoaled sediment (approximately 15,000 cubic yards) adjacent to the leeward side of the breakwater would be necessary to create adequate depths for barges and other vessels to access the breakwater for the O&M repair. The excavated material will be relocated approximately 1,000 feet north of the breakwater to minimize additional impacts to the existing eelgrass bed in the lee of the breakwater. The excavated and relocated sediment will be utilized to create an engineered eelgrass mitigation site in shallow waters. Mitigation to minimize resuspension and movement of these relocated sediments will minimize disturbance to marine mammals and their prey. Excavation of shoaled sediment could potentially occur during day and night hours (approximately 22 hours a day). In the event of adverse weather, the contractor will relocate the equipment from the lee of the breakwater and seek shelter, mooring within the established Port San Luis Harbor District designated anchorage or within Morro Bay Harbor. The proposed project is required to protect Port San Luis Harbor and maintain safe navigability within the port.

Construction would be sea-based, conducted by a crane-equipped barge (1), barges carrying rock (2), tug boats (3), and small craft support vessels (3), possibly a clamshell dredge (1), and possibly a scow (1); quantities of equipment are worst case estimates and may differ slightly depending on the individual contractor awarded the construction contract. The first phase of construction will be the excavation of shoaled sediment adjacent to the breakwater to allow for access of the equipment required to repair the breakwater. The excavation of shoaled sediment will require a crane-equipped barge (possibly the same crane-equipped barge utilized for the repair work) or a clamshell dredge, possibly a scow, tugboats, and small craft support vessels. While it is anticipated the excavation of the entire shoaled area requiring excavation by the contractor for repair equipment access will take place prior to the repair rock work commencing, additional excavation throughout the duration of the construction may be required to maintain adequate working depths if unforeseen shoaling of the excavated area occurs. The second phase of construction will consist of the repair work to the breakwater structure, requiring a crane-equipped barge, barges carrying rock, tugboats, and small craft support vessels. Repair work will consist of resetting of existing stone and placement of new stone on the breakwater structure. Dropping of armor stone is not permitted, but it should be expected that some stones may be accidentally dropped during placement. Stones would be carefully placed and interlocked with existing stones to maximize stability and minimize the intensity of sound due to stone placement. The crane-equipped barge and attached storage barge will pull approximately a couple hundred feet away from the breakwater at the end of the work day for overnight mooring for safety purposes and pull back into working position in the morning, unless adverse weather is expected. Construction activities are expected to take no more than 174 work days.

The following is a description of each type of equipment and how it will be utilized.
Crane-equipped Barge(s). The crane-equipped barge (estimated to be as large as 260 ft by 80 ft) is a barge with an attached crane that will be utilized for the breakwater repair work (Figure 8) and may be utilized for the excavation of shoaled sediment. Should the crane-equipped barge be utilized for the excavation of shoaled sediment the crane will be outfitted with a clamshell bucket. The contractor may opt to utilize a separate clamshell dredge (a crane-equipped barge outfitted with a clamshell bucket, estimated to be approximately 120 ft by 60 ft) to excavate the shoaled sediment. During excavation the clamshell bucket will be lowered by the crane operator to the sea floor to excavate sediment. The crane will place material on an adjacent storage barge or into a scow for placement at a designated placement site within the vicinity. During breakwater repair construction a barge with an attached crane will be outfitted with lifting tongs to reset existing stone and retrieve stones from an adjacent storage barge tied up to the crane-equipped barge, and then place those stones on damaged sections of the jetties. A boat operator in a skiff, and spotter on the jetty, would direct the operation of the crane in order to pick and place the stones. The picked stone must be able to match the dimensions of the voids along the jetty. Approximately 30 to 35 stones can be picked and placed per day using this vessel (Roughly three to four stones per hour on average). On average the crane-equipped barge and attached storage barge would move once a week along the breakwater, approximately repairing 75-100 ft linear feet per week. The movement of the barges along the breakwater would take approximately 30 minutes to 6 hours dependent on whether the main anchors require resetting. The crane-equipped barge and attached storage barge will pull approximately a couple hundred feet away from the breakwater at the end of the work day for overnight mooring for safety purposes and pull back into working position in the morning, unless adverse weather is expected. The movement of the barges at night to pull away from the breakwater will not require the main anchors to be reset, taking approximately 30 minutes.

Support Vessels. Self-propelled vessels that serve as tenders, tugs, and spotting craft. The main purpose of a support vessel is to assist the crane operator as well as to ferry equipment and crew back and forth from the shore, jetties, staging areas, and the crane and storage barges. On average every two to three weeks new stone will be brought to the site on a storage barge to be exchanged with the empty storage barge; when this occurs the maximum anticipated number of support vessels on site is six. During the majority of the construction duration the daily norm would be two support vessels on site, one skiff and one tug. The complement of these vessels is usually just one operator unless ferrying other crew.

Storage/Rock Barge. Another floating barge which serves as the stockpile of stone for repair work will be utilized. This barge is typically towed in from an offsite quarry location (likely Pebbly Beach Quarry on Santa Catalina Island) and is then tied up to the crane-equipped barge. The complement of this vessel is usually a spotter/oiler who works with the crane operator to select stones. The rock barge is expected to carry approximately 2,000 to 4,000 tons of stone per trip. On average every two to three weeks new stone will be brought on a storage barge to be exchanged with the existing empty storage barge, the exchange of storage barges will take approximately two to three hours each time. The unused/awaiting barges will be stored within a designated existing mooring within the established Port San Luis Harbor District designated anchorage or within Morro Bay Harbor.

The Corps is seeking an IHA for the O&M Port San Luis (PSL) Breakwater Repair project, components of the project may result in Level B harassment take of pinnipeds that are hauled-out on the breakwater structure or in the water nearby. Level B harassment may also occur due to visual disturbance during the excavation of shoaled sediment adjacent to the breakwater and in transit to the mitigation area. Level B harassment will likely occur due to visual and auditory disturbances during the repair work of the breakwater that will consist of resetting existing stone and setting new stone.

On 25 Feb 2019 a team of researchers from the U.S. Army Corps of Engineers Los Angeles District and Engineer Research and Development Center traveled to the Breakwater Repair Project at the Port of Long Beach, CA to collect representative sound files. Maintenance activities on the Long Beach, CA breakwater provided near identical conditions to the proposed work activities of the PSL breakwater repair. The sound files were collected based on guidance documents set in NMFS 2011 a/b and NOAA OPR-55. The sound files were analyzed to determine whether the anthropogenic noise exceeded the thresholds for underwater acoustic activities set by the National Oceanic and Atmospheric Administration. On 27 Feb 2019 ambient sound files were collected at San Luis Obispo, CA near the breakwater to be used as a baseline measurement for proposed repair work. The complete hydroacoustic and acoustic summary report can be found in the appendix.

Table 1. Hydroacoustic Data from LS-1 Recorder during Rock Resetting at the USACE 2019 O&M Port of Los Angeles and Port of Long Beach Breakwater Repair Project analyzed for a 60 second window.

	Low F.	Mid F.	High F.	Pinniped F.	Otariddae F.
Weighted Broadband Source Levels (dB re 1 μPa/m)	132.09	122.57	119.67	129.53	129.63
Unweighted Broadband RMS source level (dB re 1 μPa/m) at 100% of energy	140.35				

Table 2. Hydroacoustic Data from Snap recorder for ambient noise in Port San Luis, CA.

	Low F.	Mid F.	High F.	Pinniped F.	Otariddae F.
Weighted Broadband Source Levels (dB re 1 µPa/m)	107.39	94.13	91.90	100.98	100.98
Unweighted Broadband RMS source level (dB re 1 µPa/m)	131.55				

Table 3. Acoustic Data from Galaxy CM-170 Sound Pressure Meter (dB Peak).

	Port of Long Beach, CA	Port San Luis, CA
Maximum decibels during Crane Operation	82.9*	n/a
Average decibels over 8-minute recording	66.7*	62.6**

*Data was recorded at a 30-meter standoff from the crane during construction activities.

**The average ambient noise level from the breakwater at Port San Luis was due to heavy wave action on the breakwater structure.

II. Dates, Duration, and Specified Geographic Region: *The date(s) and duration of such activity and the specified geographical region where it will occur.*

Port San Luis is located on the central California Coast, approximately midway between Los Angeles and San Francisco, in San Luis Obispo County (Figures 1 & 2). Breakwater repairs are tentatively scheduled to occur from April 2022 to October 2022, thus the Corps requests the IHA issuance by May 2021 in order to secure contracts and IHA effective dates to be April 1, 2022 to March 31, 2023. O&M PSL breakwater proposed repair schedule is time dependent on weather conditions, equipment availability, working performance of the equipment, contractual commitments, and availability of funds. Due to the location of the PSL breakwater, the contractor would be fully or partially exposed to open ocean wave conditions. Adverse wave and inclement winter weather conditions at PSL preclude safe working conditions during the months of November to March when PSL experiences consistently high and/or rough sea conditions. Therefore, the work season *generally* extends from April through October, with extensions, contractions, and additional work windows outside of the summer season varying by weather patterns.

The breakwater structure is an approximately 2,400-foot long large armor stone revetment that extends from the rocky headlands of Point San Luis towards the southeast. The breakwater has approximately 2,700 feet (ft) of shoreline on each side of the breakwater due to bulges in the shoreline along the breakwater resulting from native terraces of Point San Luis and Whaler's Island that are integrated into the breakwater. Water depths along the leeward and seaward interfaces of the seafloor and the PSL breakwater structure range from approximately 0 ft MLLW to -40 ft MLLW, reaching the deepest depths at the head of the breakwater. Water depths within 1,000 feet of the immediate area surrounding the leeward and seaward sides of the PSL breakwater range from 0 ft MLLW to -50 ft MLLW. Water depths are deepest at the centerline of the head section of the structure dropping off into deeper waters, reaching -50 ft MLLW approximately 350 ft from the terminal end of the head section.

The following is summary excerpt from the May 2019 Biological Investigations of the Port San Luis Breakwater Report and January 2021 PSL Eelgrass Mitigation and Monitoring Plan (Merkel & Associates 2019 & 2021). On the leeward east facing portion of the breakwater extending out to sea from Whaler's Rock the rock structure is similar to that on the seaward side but is less impacted by wave energy. As a result, the breakwater supports a differing algal and invertebrate community with a more restricted tidal zone at the upper margins of the rock due to reduced wave, swell, and spray influence. In February 2019, eelgrass (*Zostera pacifica*) was mapped as a continuous bed extending for approximately half a mile along the protected shore in the lee of the breakwater. The bed extends southeasterly along the breakwater out to just short of Station 12+00 (Figure 10). Along the shoreline the bed extends past Smith Island where the bed diminishes. Torrey's surfgrass (*Phyllospadix torreyi*) was found to occur extensively on the native bedrock of Point San Luis and Whaler's Island, and to a much lesser degree on the low-lying boulder rock on the leeward side of the breakwater (Figure 10). Although *P. torreyi* was specifically observed, Scouler's surfgrass (*P. scouleri*) is also present in the area with records existing from Diablo Canyon and Pismo Beach, and it would not be unexpected for both species to be represented in the study area. On the seaward side of the breakwater, surfgrass is found only within the partially sheltered areas near Point San Luis. On the lee side of the breakwater, surfgrass was most abundant on small areas of bedrock outcrops extending above the sand or adjacent to the breakwater boulder. However, surfgrass was also found on the lower intertidal imported boulder rubble that extended outward from the breakwater. The canopy kelp in Port San Luis is dominated by giant kelp (*Macrocystis pyrifera*) which is present within scattered beds on rocky bottom habitats within Port San Luis. Historically, beds have been found both inside the breakwater protection and outside of the breakwater. Over at least the past couple of years during which time surveys have been completed for the breakwater repairs project, little to no kelp has been noted outside of the breakwater within the project study area (Figure 10). In June-July 2018 no kelp was noted on the breakwater. Additional kelp surveys were conducted in January-February 2019 and kelp was not noted at this time. Because of the absence of kelp in 2018 and the absence of kelp in winter 2019, a kelp frequency analysis was undertaken to identify how often kelp occurred in the project area and along the breakwater using data from CDFW kelp canopy surveys. This analyses revealed kelp at a low frequency of occurrence (14 percent of the surveys) with presence of narrow fringes of kelp being observed, principally on the lee of the breakwater. The distribution showed kelp at the tip of the breakwater and, erroneously, on intertidal and very shallow subtidal rock not suited to supporting giant kelp or bull kelp (*Nereocystis luetkeana*). Rather it is believed that the CDFW mapping likely included the understory feather boa kelp (*Egregia menzieii*) that is present in these areas. In spring 2020, kelp was more expansive in the project study area, but canopy kelp remained absent from the inside margin of the breakwater. A small amount of kelp canopy was present in small stands near the toe of the outer portions of the breakwater and was fairly extensive in the harbor (Figure 10). Based on the frequency distribution analyses of CDFW data and observations from 2018-2020, canopy kelp is not believed to be a significant habitat resource within the work area.

Table 4. Breakwater Repair Area Stationing Coordinates.

Breakwater Repair Stationing	Latitude	Longitude
Station 4+00	35° 09' 30.96" N	120° 45' 12.39" W
Station 18 +00	35° 09' 21.43" N	120° 44' 59.06" W

Table 5. Tentative Construction Schedule.

Construction Activity	Duration (days)*	Frequency (hours/day)	Dates (2022)
Excavation of Shoaled Sediment	6 to 18	11 to 22	April
Breakwater Repair	156	11	April - October

*Assumes a 6 day work week.

III. Species and Numbers of Marine Mammals: *The species and numbers of marine mammals likely to be found within the activity area.*

Breakwater repair activities will be limited to the immediate area surrounding the PSL breakwater (extending approximately 300 feet into the leeward waters immediately adjacent to the breakwater) and the eelgrass mitigation area. Three pinniped species (seals and sea lions) may be present in the area impacted by the construction. Table 6 summarizes the population status and abundance of each of these species.

Other marine mammal species that have the potential to occur within the waters surrounding San Luis Obispo County are the: Guadalupe fur seal (*Arctocephalus townsendi*), Northern elephant seal (*Mirounga angustirostris*), Humpback whale (*Megaptera novaeangliae*), Blue whale (*Balaenoptera musculus*), Fin whale (*Balaenoptera physalus*), Killer whale (*Orcinus orca*), Eastern North Pacific Gray whale (*Eschrichtius robustus*), Pacific whitesided dolphin (*Lagenorhynchus obliquidens*), Risso's dolphin (*Grampus griseus*), Northern right whale dolphin (*Lissodelphis borealis*), Long-beaked common dolphin (*Delphinus capensis*), Short-beaked common dolphin (*Delphinus delphis*), Dall's porpoise (*Phocoenoides dalli*), and Bottlenose dolphin (*Tursiops truncatus*). Occurrences within the vicinity of the project area of the species listed above are considered uncommon and would be not be expected in the limited project area within the lee of the breakwater. Generally, these species would be observed seaward of the breakwater and within the open waters of Port San Luis Bay and at a distance from the work area where thresholds for the onset of temporary threshold shifts in marine mammal hearing would not be triggered. The above listed species do not have the potential to be harassed thus the Corps is not requesting take for these species and the species have been excluded from subsequent analysis and will not be considered further in this application.

The federally threatened Southern sea otter (*Enhydra lutris nereis*) has the potential to infrequently occur within the project area. Infrequent occurrences, more transient in nature have been observed of solitary individuals within the vicinity of the project area. One mile east of the project area within Port San Luis Bay, in the kelp beds a raft(s) of Southern sea otters were consistently observed during marine mammal surveys conducted in 2018 and monthly throughout 2019. An on-site marine mammal monitor will implement a shutdown of work should any Southern sea otters be observed within an area that would pose risk to the animal. Pursuant to Section 7 of the Endangered Species Act the Corps will initiate informal consultation for the Southern sea otter with the US Fish and Wildlife, the agency responsible for managing Southern sea otters.

Table 6. Marine Mammal Stock Assessment.

Species	Stock	ESA Status	MMPA Status	Stock Abundance (N^{MIN})	PBR	Annual M/SI
California Sea Lion (*Zalophus californianus*)[1]	U.S.	Not Listed	Non-depleted	257,606	14,011	≥321
Steller Sea Lion (*Eumetopias jubatus*)[2]	Eastern U.S.	Delisted (2013)	Non-strategic	43,201	2,592	112
Harbor Seal (*Phoca vitulina richardii*)[3]	California	Not Listed	Non-depleted	27,348	1,641	42.8

[1] NMFS Marine Mammal Stock Assessment Report: CA Sea Lion, revised 3/18/2019
[2] NMFS Marine Mammal Stock Assessment Report: Steller Sea Lion, revised 12/30/2019
[3] NMFS Marine Mammal Stock Assessment Report: Harbor Seal, revised 7/31/2015

IV. **Affected Species Status and Distribution:** *A description of the status and distribution, including seasonal distribution (when applicable), of the affected species or stocks of marine mammals likely to be affected by such activities.*

The following three pinniped species may be present in the affected area during breakwater repair construction. Two species of pinnipeds were observed utilizing the PSL breakwater as a consistent haul-out site when weather permitted, the California sea lion and Steller sea lion. PSL abundance estimates reported below are from monthly marine mammal surveys conducted by the US Army Corps of Engineers Biologist in 2019, survey efforts on average were two hours per survey event (Table 8).

Surveys conducted by the Corps Biologist and Merkel and Associates (M&A) (see appendix for M&A Biological Marine Mammals Survey Report) between 2018 and 2019 observed the general distribution of marine mammals along the PSL breakwater is influenced by direct wave energy against exposed breakwater segments. An offshore rock formation on the seaward side of the breakwater's southern end absorbs direct wave energy and reduces the intensity of waves reaching the breakwater. This allows for manageable haul out locations on both the seaward and leeward sides of the breakwater in proximity to this rock. As Figure 5 shows, the most densely populated haul out areas for California sea lions and Steller sea lions occur on the leeward side of the south eastern end of the breakwater and spread around the revetment stone to the protected segment of the seaward side of the breakwater. Pinniped density increased at the south eastern end of the breakwater, reaching highest densities at the head section of the breakwater. The head section will refer to station 17+00 to 18+20 for the purposes of this document. Pinniped haul out utilization of the breakwater extended from station 9+00 to 18+20 of the breakwater. Pinniped density remained consistently concentrated at the head section, with over half of the pinnipeds present on any given survey occupying the south eastern end of the breakwater. Decreased pinniped density was documented as one moved away from the head section towards station 9+00. Breakwater repair construction would be sequenced to commence at the farthest station (station 4+00) from the head section of the breakwater, work would progress slowly (approximately 75-100 feet per week), thus at times work would be 1,000 feet from the head section of the breakwater most commonly utilized by the pinnipeds. As the breakwater repair work progresses the barges will move slowly along the breakwater towards the head section, at times overlapping with the sections of the breakwater utilized as a haul-out by both pinniped species, resulting in the displacement of pinnipeds from these sections while work is being conducted. Therefore, it is anticipated that pinnipeds may not be impacted throughout the entire duration of the construction period as animals become habituated to the presence and noise of the barges and vessels.

California Sea Lion (*Zalophus californianus*)

California sea lions (CSL) range along the west coast of North America from British Columbia to Baja California and throughout the Gulf of California. Breeding occurs on islands along the coast of western Baja California, Gulf of California, and southern California (Channel Islands) (Barlow et al. 1995). Pupping season in Southern California is generally recognized as May through August, although some pupping has been observed outside of these months. There are three recognized CSL stocks (U.S. stock, Western Baja stock, and the Gulf of California stock) with the U.S. stock ranging from the U.S./Mexico border into Canada. CSLs in the U.S. are not listed as "endangered" or "threatened" under the Endangered Species Act or as "depleted" under the MMPA. The stock is estimated to be approximately 40% above its maximum net productivity level (MNPL = 183,481 animals), and is considered within the range of its optimum sustainable population (OSP) size (Laake *et al*. 2018).

El Niño events are known to negatively influence pup production, although pup counts have generally increased since the mid-1970s (NOAA 2014). Current contributors of CSL mortality include gill netting, trawl fisheries and related entanglement. Other mortality threats include boat and car collisions, shootings, entanglement and ingestion of marine debris, toxic algal blooms, predation control, and entrainment in power plants (NOAA 2014). Increasing sea-surface temperatures in the California Current negatively impact prey species availability and reduce survival rates of CSLs (DeLong *et al*. 2017, Laake *et al*. 2018, Lowry *et al*. 1991, Melin *et al*. 2008, 2010). Thus, increasing ocean temperatures may continue to limit the population size of the CSL stock within the California Current (Cavole *et al*. 2016, DeLong *et al*. 2017, Laake *et al*. 2018).

California sea lions are common in PSL year round where they are often hauled out on the PSL breakwater structure and within San Luis Obispo Bay on buoys and work docks (Figures 7 & 9). The general distribution of CSLs along the breakwater is influenced by direct wave energy against exposed breakwater segments. The distribution of CSLs on the breakwater is greatly influenced by the season and day to day sea state conditions. Four dead young pup carcasses were observed on the breakwater during the June 2018 survey conducted by M&A, no very young live pups were noted during either the on-water surveys or within the aerial survey photographs. During the contractor's marine mammal surveys (Table 9) and the Corps' monthly 2019 marine mammal surveys (Table 8) there was no observed nursing occurring by any of the CSLs in PSL and the majority of the animals in the pup-yearling size class (Table 9) were in the higher end of the size class, suggesting the smaller live pup-yearlings observed on the PSL breakwater may have been born elsewhere and not on the breakwater. It is believed based on observations that the pupping activities on the breakwater rock are not highly successful due to large voids between rocks that allow young pups to fall and become trapped inside the breakwater (per communication with M&A, see appendix). The PSL breakwater site is not as suitable of a pupping area as the natural rock formations found in the natural pupping grounds off the Channel Islands. Generally, the breakwater is utilized by CSLs beginning in April extending through December, with greater densities observed hauled out at the south eastern end of the breakwater, and the greatest densities consistently observed at the head section of the breakwater. In addition, greater densities were observed on the leeward side as opposed to the seaward side. Based on the Corps' 2019 surveys the abundance of pinnipeds on the PSL breakwater was highest June through November (Table 8). Although surveys were conducted monthly by the Corps biologist in 2019, adverse open ocean sea state conditions prevented surveys of the seaward side of the breakwater every month, but CSLs are not expected to haul out there during these high sea state conditions. For the purposes of the analyses for pinniped abundance estimates, the months with the highest abundance and where complete surveys of the leeward and seaward sides of the breakwater were conducted (June, July and September 2018) were used to be conservative. The monthly surveys by the Army Corps biologist could not distinguish between pinniped species. Therefore, pinniped species ratios were calculated from the more detailed M&A June 2018 surveys to estimate the ratio of CSLs to SSLs. This ratio was applied to other survey months to estimate the numbers of each species present at other times. Merkel & Associates June 2018 survey identified pinnipeds to species level (CSL and SSL); approximately 94% of pinnipeds hauled out on the breakwater were CSLs and 6% SSLs. This ratios of CSL:SSL were used to calculate the average abundance of CSLs and SSLs (Table 7) hauled out on the PSL breakwater from the calculated averaged abundance of pinnipeds hauled out on the PSL breakwater during the June, July, and September 2019 USACE surveys. As a result we estimate approximately 302 individual CSLs per day are on the breakwater. Age class and sex classifications from the M&A June 2018 survey are summarized in Table 9.

Due to adverse wave and inclement winter weather conditions at PSL it is generally not possible to safely work outside of CSL pupping season (May to August) or outside of the months the breakwater is utilized by CSLs. Therefore, breakwater repair activities will likely affect hauling out behavior, and may affect nursing behaviors due to visual and auditory disturbance. The acoustic data collected on similar breakwater repair activities did not exceed the NOAA acoustic thresholds established for the CSL (Table 3). The hydroacoustic data (Table 1) slightly exceeds the NOAA acoustic thresholds established for the CSL at 10 meters from the noise source, although it is not anticipated that CSLs would be within a minimum 20 meter radius of equipment and personnel due to the visual disturbance caused by the presence of the equipment, personnel, and construction activities.

<u>Steller Sea Lion (*Eumetopias jubatus*)</u>

Steller sea lions (SSL) range along the North Pacific Rim from northern Japan to central California (Loughlin et al. 1984), with regions of abundance and distribution in the Gulf of Alaska and Aleutian Islands. Individual SSLs travel extensive distances outside of the breeding season (late May to early July), likely correlating to locations of seasonally important prey resources. Based on distribution, population dynamics, and genotypic data, the species occurring in United States waters has been divided into two stocks, the eastern U.S. stock (east of Cape Suckling, AK) and the western U.S. stock (west of Cape Sucking, AK) (Loughlin 1997). The eastern stock rookeries occur in Alaska, British Columbia, Oregon, and California. Pitcher et al. (2007) documented a northward shift in the overall breeding distribution has occurred, with a contraction of the range in southern California and new rookeries established in Southeast Alaska. The Eastern U.S. stock of SSLs was delisted under the ESA in 2013 and is not considered depleted (classified as a non-strategic stock) under the MMPA. The counts of eastern SSLs have steadily increased over a 30+ year period, the Eastern U.S. stock is likely within its Optimum Sustainable Population (OSP); however, no determination of its status relative to OSP has been made (NMFS Marine Mammal Stock Assessment Report: Steller Sea Lion, revised 12/30/2016).

The Eastern U.S. stock has experienced a sustained increase throughout its breeding range. Although, in the southern end of its range (Channel Islands in southern California), it has declined considerably since the late 1930s and several rookeries and haulouts south of Año Nuevo Island have been abandoned (NMFS Marine Mammal Stock Assessment Report: Steller Sea Lion, revised 12/30/2016). Changes in the ocean environment, particularly warmer temperatures, may be factors that have favored CSLs over SSLs in the southern portion of the SSL's range (NMFS 2008). The risk of oil spills to this stock may increase in the next several decades due to increased shipping, including tanker traffic, from ports in British Columbia and possibly Washington State (COSEWIC 2013, NMFS 2013, Wiles 2014) and LNG facility and pipeline construction (COSEWIC 2013).

Steller sea lions have been observed intermittently hauling out on the PSL breakwater and work docks within San Luis Obispo Bay. Like the CSLs, the general distribution of SSLs when present along the breakwater is influenced by direct wave energy against exposed breakwater segments, the season, and day to day sea state conditions. Greater densities of SSLs were observed at the south eastern end of the breakwater (especially concentrated at the head section of the breakwater) during a June 2018 survey performed by Merkel & Associates (2019). Data has not been collected to support a fine scale analysis investigating frequencies at which SSLs are present on the PSL breakwater, however, surveys did confirm SSLs were not utilizing the breakwater as a haul-out site in the months of December, and January through April (Table 8). Based on the Corps' 2019 surveys the abundance of pinnipeds on the PSL breakwater was highest June through November (Table 8). Although surveys were conducted monthly by the Corps biologist in 2019, adverse open ocean sea state conditions prevented surveys of the seaward side of the breakwater every month, but SSLs are not likely to be hauled out during rough conditions. The pinniped species ratios calculated from the M&A June 2018 surveys were used to determine the average abundance of SSLs on the PSL breakwater; the result was approximately 19 individual SSLs per day. Age class and sex classifications from the M&A June 2018 survey are summarized in table 9. This estimate is based on peak season survey data, although, based on observational data it is believed that SSLs are not present every day, thus this is likely an over estimation of SSL abundance per day on the PSL breakwater.

Breakwater repair activities will likely affect hauling out behavior, due to visual and auditory disturbance. The acoustic data collected on similar breakwater repair activities did not exceed the NOAA acoustic thresholds established for the SSL (Table 3). The hydroacoustic data (Table 1) slightly exceeds the NOAA acoustic thresholds established for the SSL at 10 meters from the noise source, although it is not anticipated that SSLs would be within a minimum 20 meter radius of equipment and personnel due to the visual disturbance caused by the presence of the equipment, personnel, and construction activities.

Harbor Seal (*Phoca vitulina richardii*)

Harbor seals (*Phoca vitulina*) are widely distributed along coastal areas of the North Atlantic and North Pacific. Two subspecies exist in the Pacific: *P. v. stejnegeri* in the western North Pacific, near Japan, and *P. v. richardii* in the eastern North Pacific. *P. v. richardii* inhabits coastal and estuarine areas from Mexico to Alaska. While these seals do not make extensive pelagic migrations, they do travel 300-500 km to find food or suitable breeding areas (Herder 1986; Harvey and Goley 2011). In California, approximately 400-600 harbor seal haulout sites are widely distributed along the mainland and on offshore islands, including intertidal sandbars, rocky shores and beaches (Hanan 1996; Lowry *et al*. 2008). Harbor seals breed and pup throughout their range.

A review of harbor seal dynamics through 1991 concluded that their status relative to OSP could not be determined with certainty (Hanan 1996). The California stock of harbor seals are not listed as "endangered" or "threatened" under the Endangered Species Act nor designated as "depleted" under the MMPA. (NMFS Marine Mammal Stock Assessment Report: Harbor Seal, revised 7/31/2015)

Since statewide censuses were first conducted in the 1980s, population size has increased, peaking in 2004. Although, subsequent counts in 2009 and 2012 have been lower. Expanding pinniped populations in general have resulted in increased human-caused serious injury and mortality, due to shootings, entrainment in power plants, interactions with recreational hook and line fisheries, separation of mothers and pups due to human disturbance, dog bites, and vessel and vehicle strikes (Carretta et al. 2014). All west-coast harbor seals that have been tested for morbilliviruses were found to be seronegative, indicating that this disease is not endemic in the population and that this population is extremely susceptible to an epidemic of this disease (Ham-Lammé *et al*. 1999).

Harbor seals have not been observed hauling out on the PSL breakwater or work docks within the San Luis Obispo Bay. However, 2019 monthly marine mammal surveys documented harbor seals hauled out on the low lying bedrock benches of nearby Smith Island (Figure 3) from January to May and again in December. The greatest number of individuals observed on a day was 25, observed during the December 2019 survey. During the Corps' monthly 2019 surveys only one individual was observed swimming within the immediate vicinity of the breakwater, 15 feet off the head of the breakwater (March 2019 survey). Merkel & Associates (during June 2018 invertebrate surveys) observed harbor seals swimming in proximity to the breakwater in low abundance and intermittently, less than a dozen observations of likely fewer individuals. The distance between the nearest work area (station 4+00) and Smith Island is approximately

1,300 feet (Figure 3). The greatest density of harbor seals was observed on low lying bedrock benches located near Cal Poly Pier, approximately 1.5 miles from the PSL breakwater. During the 2019 surveys low numbers of individuals (no more than eight on any given survey, not clustered together in one area) were observed foraging and resting in various small patch kelp beds throughout the inner harbor, ranging from 0.5 to 1.5 miles from the breakwater.

While harbor seals were not observed hauled out on the PSL breakwater during the Corps' 2019 monthly marine mammal surveys, they were observed hauled out at the low lying rocky benches of Smith Island (approximately 1,300 feet from the nearest repair area (Station 4+00) (Table 10). The potential for the harbor seals to transit the waters near or within the project area exists. The average abundance for harbor seals within the project area (Table 7) was calculated using the Corps' monthly 2019 marine mammal survey data, for the purposes of the analysis the surveys with the highest abundances within the potential work window period were used to be conservative, note all three observation locations were included (swimming near breakwater, hauled out at Smith Island and swimming near Smith Island). The average abundance, which was approximately 10 SSLs per day, was calculated as to capture any individuals that may swim within the vicinity of the repair area during construction while transiting to and from the open sea to Smith Island. The calculated take estimates took a conservative approach, likely these take estimates are an overestimation given that harbor seals were not present throughout the year, infrequently observed swimming within the immediate vicinity of the breakwater, Smith Island is located at a distance that one would not anticipate impacts to harbor seals from the breakwater repair activities, the open lay out of Port San Luis gives harbor seals adequate area to transit in and out of PSL without requiring them to transit through the project area, and harbor seals would likely avoid the project area due to the visual disturbance of the construction associated equipment and personnel.

Breakwater repair activities are not expected to affect hauling out behavior, due to the distance from the construction activities. Auditory disturbance is also not expected due to the distances of haul out and foraging areas from the noise sources. The work footprint is confined to a small area and it is not anticipated that harbor seals would be within a minimum 20 meter radius of the crane mounted barge due to the visual disturbance caused by the presence of the equipment, personnel, and construction activities. Port San Luis is an open bay and the small work footprint would not limit the movements of harbor seals in the area or exclude/prevent them from accessing established harbor seal haul out or foraging sites.

V. **Type of Incidental Taking Authorization Requested:** *The type of incidental taking authorization that is being requested (i.e., takes by harassment only; takes by harassment, injury, and/or death) and the method of incidental taking.*

In this application, the Corps requests an IHA for the take of marine mammals incidental to the proposed action, the PSL breakwater repair construction activities, effective April 1, 2022 to March 31, 2023. The term "take" as defined in Section 3 [16 U.S.C. § 1362 (13)] of the MMPA means, "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal." "Harassment" was further defined in the 1994 amendments to the MMPA, which provided two levels of harassment: Level A— potential injury, and Level B— potential behavioral disruption.

Under the MMPA, NMFS has defined levels of harassment for marine mammals. Level B harassment is defined as, "Any act of pursuit, torment, or annoyance which has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering." The Incidental Take Authorization requested herein is for the authorization of Level B harassment to marine mammals protected under the MMPA that are identified in Chapter 6 as a result of visual and auditory disturbances associated with the breakwater repair construction activities. Incidental take would be a temporary and localized disturbance of animals from elevated sound levels, construction and barge traffic, and visual stimulus from construction activities on the breakwater.

Therefore, the Corps requests the issuance of an IHA pursuant to Section 101(a)(5) of the MMPA for incidental take of three pinniped species listed in Section 4 by Level B harassment during the PSL breakwater repair construction activities.

VI. **Take Estimates for Marine Mammals:** *By age, sex, and reproductive condition (if possible), the number of marine mammals (by species) that may be taken by each type of taking identified in Section 5, and the number of times such takings by each type of taking are likely to occur.*

This section provides an estimate of the number of incidental takes proposed for authorization through this IHA, which will inform both NMFS' consideration of "small numbers" and the negligible impact determination. Authorized takes would be by Level B harassment, as use of the acoustic source (i.e., rock laying) and construction has the potential to result in disruption of behavioral patterns for individual marine mammals.

Using the best available science, NMFS has developed acoustic thresholds that identify the received level of underwater sound above which exposed marine mammals would be reasonably expected to be behaviorally harassed (equated to Level B harassment) or to incur PTS of some degree (equated to Level A harassment).

Level B Harassment for non-explosive sources – Though significantly driven by received level, the onset of behavioral disturbance from anthropogenic noise exposure is also informed to varying degrees by other factors related to the source (*e.g.*, frequency, predictability, duty cycle), the environment (*e.g.*, bathymetry), and the receiving animals (hearing, motivation, experience, demography, behavioral context) and can be difficult to predict (Southall *et al.,* 2007, Ellison *et al.*, 2012). Based on what the available science indicates and the practical need to use a threshold based on a factor that is both predictable and measurable for most activities, NMFS uses a generalized acoustic threshold based on received level to estimate the onset of behavioral harassment. NMFS predicts that marine mammals are likely to be behaviorally harassed in a manner we consider Level B harassment when exposed to underwater anthropogenic noise above received levels of 120 dB re 1 microPascal (μPa) (root mean square (rms)) for continuous (*e.g.,* vibratory pile-driving) and above 160 dB re 1 μPa (rms) for non-explosive impulsive (*e.g.*, impact pile driving, or rock setting) sources.

Based on the sound source measurement study discussed above, underwater sound levels are not expected to exceed the Level B harassment acoustic thresholds underwater outside of the required 10 m shutdown zone for all construction equipment and vessels (see above).
Airborne Acoustic Effects - Pinnipeds that occur near the project site could be exposed to airborne sounds associated with rock setting that have the potential to cause behavioral harassment, depending on their distance from rock setting activities. Cetaceans are not expected to be exposed to airborne sounds that would result in harassment as defined under the MMPA. For in-air sounds, NMFS has established Level B harassment acoustic thresholds that harbor seals exposed above received levels of 90 dB re 20 μPa (rms) will be behaviorally harassed, and other pinnipeds will be harassed when exposed above 100 dB re 20 μPa (rms). Based on the sound source measurement study discussed above, airborne sound levels are expected to exceed the Level B harassment acoustic thresholds for a distance no-greater than 100 m for rock setting activities (Dr. Shane Guan, NMFS, personal communication).

The construction activity and movement of the barges is expected to cause visual disturbance to hauled-out pinnipeds on the breakwater, especially as the construction work moves toward the head of the breakwater where the most pinnipeds haul out. It is expected that the visual disturbance of the construction equipment and personnel will result in the take of hauled out pinnipeds within the immediate work area, based on observational data from similar construction activities pinnipeds maintained a minimum approximate 150 foot distance from construction equipment and personnel once flushed from the area (personal communication with Marine Construction Contractors and Merkel & Associates). Based on discussions with our consultant and contractors we decided it was reasonable to assume animals within 300 feet of the immediate work area would be disturbed (due to visual disturbance) and possibly flushed from the area each day. Therefore, the anticipated area of take would be 300 feet extending from each direction of the crane-equipped barge and the barge itself (approximately 100 ft), for a total of 700 feet, rather than the entire length of the breakwater daily. The repair area is approximately 1,420 feet, therefore approximately half of the repair area would be considered an area of take on any given day.

While our baseline studies discussed above indicate most pinnipeds are hauled out at the head of the breakwater and may not be disturbed during the early phases of work when the activity is focused on the base end of the breakwater, and the project is likely to occur at least partly during times of the year when less pinnipeds may be present, we conservatively request take for our estimate of daily pinniped presence during the most abundant season for all days of project work. The summary presented in Table 7 indicates the total number of calculated Level B take estimates that may result from the Proposed Action at the PSL Breakwater. Level B take request estimates for marine mammals were based on the estimated abundance of animals per day on the PSL breakwater and in waters within a 300 foot radius of the breakwater. Construction duration was estimated to be 174 days (based on a seven month construction duration and 6 day work week). It is assumed that the majority of the animals taken each day will likely be the same individuals taken throughout the duration of the construction period, thus the take estimate is reflecting a high frequency of takes of a smaller number of individuals (Estimated Density in Table 7) taken multiple times throughout the duration of the construction period.

The calculated Level B take estimates that may result from the Proposed Action at the PSL Breakwater in Table 7 are conservative take estimates and reflect a worst case scenario of take, assuming that every animal is flushed and displaced from the entire PSL breakwater everyday throughout the duration of the construction period. It is expected that an initial startle response will be elicited from the pinniped species present when equipment is mobilized to the project area. Once equipment and personnel are present it is expected that the pinnipeds within the vicinity of PSL breakwater will become habituated to the construction activities, and presence of equipment and personnel. The nature of breakwater repair construction is a very slow progression, approximately 75 to 100 feet of the breakwater would be repaired per week. The slow progression of the work would further allow for habituation to the construction equipment, personnel, and activities by the pinniped species hauled out on the PSL breakwater. Furthermore the construction would be sequenced to begin at station 4+00 to minimize disturbance to the pinnipeds at the south eastern end of the breakwater, where the greatest densities and utilization of the breakwater occur. Thus, one could estimate that the actual take could potentially be half or less than that of the take estimated in Table 7. However, due to the unpredictable nature of animals in the wild, the Corps took the most conservative approach when calculating the Level B take estimates that may result from the PSL breakwater repair construction activities, assuming that every animal is flushed and displaced from the entire PSL breakwater everyday throughout the duration of the construction period.

Table 7. Level B Take Estimates requested by species at the PSL Breakwater Project Area.

Species	**Averaged Daily Abundance***	**Level B Harassment Per Day**	**Total Take****	**Stock Abundance (N^{MIN})**	**% of Stock (take/abundance * 100)**
California Sea Lion (*Z. californianus*)	302.05	302.05	52,557	257,606	20.4%
Steller Sea Lion (*E. jubatus*)	19.28	19.28	3,355	43,201	7.8%
Harbor Seal (*P. vitulina richardii*)	10.33	10.33	1,797	27,348	6.6%

*Average abundance of pinnipeds present on the PSL Breakwater and in waters within a 300 ft radius of the breakwater per day.
**Total Take estimation based on seven month construction period (6 working days/week) = 174 total days.

Table 8. USACE 2019 PSL Breakwater Pinniped Survey Data.

Survey Date	**Leeward**	**Seaward**	**Total**
1/30/2019	0	0	0
1/31/2019	0	0	0
2/1/2019	0	0	0
3/1/2019	0	*	0*
3/24/2019	0	*	0*
3/30/2019	0	*	0*
3/31/2019	0	*	0*
4/1/2019	0	*	0*
5/1/2019	0	+	18+
5/28/2019	188	*	188
6/3/2019	**182**	**115**	**297**
7/29/2019	**166**	**25**	**191**
8/27/2019	0	1	1
9/25/2019	**326**	**150**	**476**
11/6/2019	398	*	398*
12/5/2019	113	*	113*
12/28/2019	0	0	0**

*Seaward side of breakwater not surveyed because of sea state conditions, no pinnipeds expected to be hauled out during these times.
**No pinnipeds hauled out on breakwater, 3 observed swimming near head of breakwater.
+Pinnipeds distributed at head section along centerline to seaward side of the breakwater structure.
Bold indicates months survey data was used to calculate the average abundance of pinnipeds on the PSL Breakwater per day.

Table 9. PSL Breakwater Marine Mammal Survey, June 30, 2018, Merkel & Associates.

CA Sea Lion	Adult female	30
	Adult Male	31
	Pup-yearling*	57
	Sub-adult-juvenile	164
CA Sea Lion Total		**282**
Steller Sea Lion	Adult Female	5
	Adult Male	5
	Sub-adult-juvenile	9
Steller Sea Lion Total		**19**
Pinniped Total		**301**

*Pup-yearling age class defined as birth to 1 year old, note the majority of the individuals in this age class were at the higher end of the size class.

Table 10. USACE 2019 PSL Breakwater and Smith Island Harbor Seal Survey Data.

Survey Date	Swimming Near PSL Breakwater (Leeward Side)	Hauled Out at Smith Is.	Swimming near Smith Is.
1/30/19-2/1/19	0	13	Several
3/1/2019	0	15	0
3/24/2019	**1 Individual, 15 ft off head**	**14**	**3**
5/1/2019	**0**	**10**	**0**
5/28/2019	**0**	**2**	**1**
6/3/2019	0	0	0
7/29/2019	0	0	0
8/27/2019	0	0	0
9/25/2019	0	0	0
11/6/2019	0	0	0
12/5/2019	0	25	0
12/28/2019	0	1	1

Bold indicates months survey data was used to calculate the average abundance of pinnipeds on the PSL Breakwater per day.

VII. Anticipated Impact of the Activity: *The anticipated impact of the activity to the species or stock of marine mammal.*

Due to adverse wave and inclement winter weather conditions at PSL it is generally not possible to safely work outside of CSL pupping season (May to August) or outside of the months the breakwater is utilized by CSLs. Therefore, breakwater repair and shoal excavation activities will likely effect hauling out behavior, and may affect pupping and nursing behaviors due to visual and auditory disturbances. It is anticipated that individuals will utilize other areas of the breakwater or possibly relocate to a haul out site other than the PSL breakwater, such as the buoys, work docks, or jetties at neighboring harbors/bays. The proposed action is not expected to have a consequential impact to foraging or feeding of California sea lions because the small footprint of the project area accounts for only a small fraction (less than 1%) of the available foraging area within San Luis Obispo Bay.

Breakwater repair and shoal excavation activities will likely effect hauling out behaviors of SSLs due to visual and auditory disturbances. It is anticipated that individuals will utilize other areas of the breakwater or relocate to a haul out site other than the PSL breakwater, such as the buoys, work docks, or jetties at neighboring harbors/bays. The proposed action is not expected to have a consequential impact to foraging or feeding of Steller sea lions because the small footprint of the project area accounts for only a small fraction (less than 1%) of the available foraging area within San Luis Obispo Bay. The proposed action is not expected to impact the reproduction of Steller sea lions.

The open lay out of PSL gives harbor seals adequate area to transit in and out of PSL without requiring them to transit through the project area, and harbor seals would likely avoid the project area due to the visual disturbance of the construction associated equipment and personnel. The conservative take estimate requested by the corps represents a worst case scenario for Level B take, accounting for 6.6% of the California stock (based on the minimum population estimate). Although, one should take into consideration that this would not imply 6.6% of the California stock would be impacted, as this number likely accounts for a majority of the same individuals being taken multiple times throughout the duration of construction. The proposed action is not expected to have a consequential impact to foraging or feeding of Pacific harbor seal because the small footprint of the project area accounts for only a small fraction (less than 1%) of the available foraging area within San Luis Obispo Bay. The proposed action is not expected to impact hauling out behaviors or the reproduction of harbor seals.

Behavioral responses to audio and visual disturbance can be highly variable and context-specific. A number of factors may influence an animal's response to noise, including its previous experience, its auditory sensitivity, its biological and social status (including age and sex), and its behavioral state and activity at the time of exposure. Behavioral state or differences in individual tolerance levels may affect the type of response. For example, animals that are resting may show greater behavioral change in response to disturbing noise levels than animals that are highly motivated to remain in an area for feeding (Richardson et al., 1995; National Research Council, 2003; Wartzok et al., 2004). Indicators of disturbance may include sudden changes in the animal's behavior or avoidance of the affected area. A marine mammal may show signs that it is startled by the noise or visual disturbance and/or it may swim away from the sound source and avoid the area. Types of responses during the shoal excavation and breakwater repair activities may range from; no response, avoidance of the project area, NOAA's three-point pinniped disturbance scale responses (alert, movement, flushing), reduced haul-out time on the PSL breakwater, to relocation from the PSL breakwater to another area for the duration of construction.

Based on communication with a contractor and their experience at Redondo Harbor many years ago where the head section of the breakwater there was utilized as a haul-out and common knowledge of behavior of pinnipeds due to visual disturbance, the response of CSLs to the proposed rock placement may include alert behavior, approaches to the water, and flushes into the water. The contractor observed animals often relocated and hauled out on nearby trunk sections of the breakwater where construction activities were not taking place. These potential disturbances could be caused by the visual disturbance caused by the presence or movement of construction equipment and/or the noise produced by the equipment. Behaviorally, pinnipeds may respond to rock placement and shoal excavation activities by vacating the surrounding area. Some may redistribute themselves along portions of the breakwater away from construction activities and potentially to other haul out sites within PSL Harbor or along the coast to the south and north.

Based on past responses to similar activities, it is likely that pinniped exposure to rock placement and shoal excavation activities would change their use of the PSL breakwater and the amount of time they would otherwise spend hauled out in the immediate vicinity of the work areas on the PSL breakwater. The changes in pinniped use of the breakwater may potentially be nominal should the pinnipeds become habituated to the presence of the construction equipment and personnel. Repetitive, short-term displacement is likely to cause repetitive, short-term disruptions in their normal behavioral patterns at the PSL breakwater. Disruption from visual or auditory disturbance would be limited to working hours during the predicted construction season. In addition, the background acoustic levels at the breakwater are likely elevated at times given the strong tides, high winds, and breaking surf conditions.

The anticipated impact upon the CSLs and SSLs includes temporary disturbance (alert and flushing behaviors) and temporary displacement of animals to other parts of the breakwater or other nearby haul out sites until work is discontinued. Other limited and likely less desirable haul out availability for pinnipeds exists throughout other parts of the breakwater and within the PSL inner harbor regions. Potential alternative haul out sites exist to the north and south of PSL, although, it is not known whether pinnipeds would relocate to these areas. Observations on a past breakwater repair project in Redondo Harbor, California by the construction contractor (Connolly-Pacific) observed that pinnipeds that were flushed from the breakwater repair areas did not leave the surrounding area but rather relocated and hauled out on other sections of the breakwater. Animals that flush from the breakwater would be expected to move to other parts of the breakwater, likely resulting in increased haul out densities in some areas. It is not expected that there would be a reduction in prey resources as a result of the Proposed Action.

There are no current threats to the species that are either part of the environmental baseline or cumulative effects in the action area that are anticipated to affect pinnipeds in addition to the activities of the Proposed Action described above. Effects of the action are not anticipated to appreciably reduce the species' ability to survive and recover.

VIII. Anticipated Impacts on Subsistence Uses: *The anticipated impact of the activity on the availability of the species or stocks of marine mammals for subsistence uses.*

Not applicable, project site is located in California. Project activities are not in or near a subsistence hunting area and will not affect the availability of a species or stock of marine mammal for subsistence uses. There are no relevant subsistence uses of marine mammals implicated by this action.

IX. Anticipated Impacts on Habitat: *The anticipated impact of the activity upon the habitat of the marine mammal populations and the likelihood of restoration of the affected habitat.*

The Proposed Action would not result in in-water acoustic sound that would cause significant injury or mortality to prey species and would not create barriers to movement of marine mammals or prey. Behavioral disturbance caused by in-air acoustic impacts (Table 3) may result in marine mammals temporarily moving away from or avoiding the exposure area but are not expected to have long term permanent impacts.

Impacts to habitat from the Proposed Action are expected to include increased human activity and noise levels, minimal impacts to water quality, and negligible changes in prey availability near the individual project site.

The Corps does not anticipate any measureable long-term impact to the marine mammal habitat. Repairing the PSL breakwater by resetting and adding additional stone would not reduce the availability, quality, or accessibility of habitat for pinniped species. Pinnipeds haul out on the existing breakwater structure, and are easily able to climb up several vertical feet. They use sections of the breakwater composed of angular breakwater stone in areas of differing slope and commonly use side slopes and the top of the breakwater. They have excellent climbing abilities on breakwater stone and therefore are expected to easily make use of the repaired breakwater. In addition, repair of the breakwater will minimize large voids that exist in the current breakwater structure that young CSL pups are thought to be falling into and becoming trapped inside the breakwater.

Transport of stone via barges would nominally increase vessel traffic along major navigation routes in existing harbors and navigation channels during the project duration, but impacts are not likely to be permanent. The number of additional barge trips per year attributable to the Proposed Action is expected to be approximately 40 trips. This is small (< 1%) annual percentage increase relative to the current number of other commercial and recreational vessels already using any of these potential routes. Additional noise could be generated by barge-mounted equipment, such as cranes and generators, but this noise would typically not exceed existing background underwater noise levels. Impacts to marine mammals from these noise sources are expected to be negligible.

Some degree of localized reduction in water quality would occur as a result of in-water construction activities. Most of this effect would occur during the excavation of shoaled sediment adjacent to the breakwater. Any effects to turbidity are expected to be short-term and minimal. Turbidity would return to normal levels within a short time after completion of the Proposed Action.

Chemical properties such as dissolved oxygen (DO), temperature, pH, salinity, and nutrients are not expected to be substantially altered by the excavation of shoaled sediment; water quality monitoring would be conducted during the excavation of shoaled sediment to ensure these chemical properties are not substantially altered outside of the immediate work area and 500’ buffer zone, and that any alteration due to the project is temporary. Excavation of organically enriched or anaerobic sediments and suspension of these sediments could cause direct temporary impacts to DO. Excavation and discharge activities would also cause direct temporary water quality impacts due to turbidity and reduced light transmissivity. Increases in turbidity detectable above background levels are usually confined from 100 to 500 feet from the crane- equipped barge depending on sediment character and tidal current conditions. Sediment adjacent to the PSL breakwater is expected to be characterized as sands, which fall out of the water column quicker decreasing the turbidity plume. A clamshell bucket has impacts across the entire water column as sediments are carried up to the surface in the clamshell. It is expected that plumes would remain in the harbor area and not migrate into the open ocean environment. The duration of the plume is expected to be short; suspended solid concentrations would likely return to background levels within an hour to 24 hours after excavation ceases, dependent on sediment character and tidal current conditions. Monitoring would be conducted during excavation of sediment for salinity, pH, temperature, DO, turbidity and light transmissivity. Excavation of sediments would be controlled to keep turbidity impacts to acceptable levels.

It is not anticipated that the environment within the vicinity of the breakwater would be significantly affected by sediments being stirred up into the water column due to construction involving the resetting and placement of new stones. Dropping of armor stone is not permitted, but it should be expected that some stones may be accidentally dropped during placement. Stones would be carefully placed and interlocked with existing stones to maximize stability, the careful placement should minimize stirring up of sediment. Small amounts of soil adhering to the stone may become temporarily suspended in the water column, causing a slight increase in turbidity. Due to the small amounts of turbidity involved, the project will not cause water quality conditions to change. Impacts are expected to be less than significant in terms of increased turbidity. No direct effects to marine mammals are expected from turbidity impacts.

Direct impacts (habitat loss/degradation or reduction in population size) to marine resources would be extremely limited due to resetting and placement of stone on the breakwater. Resetting and placement of stone could smother and/or crush sessile organisms currently attached to the currently exposed rock. However, following their replacement, these rocks would be recolonized, making any impact temporary in nature.

Excavation of shoaled sediment adjacent to the breakwater will directly affect approximately 3.6 acres of the benthic community. Extensive Pacific eelgrass (*Zostera pacifica*) beds are located throughout PSL, some degree of impact is expected and will be addressed through the Essential Fish Habitat (EFH) consultation process with the NMFS, Long Beach office. Direct estimated impacts to Pacific eelgrass due to the shoal excavation are 1.8 acres. A worst case full area of potential effects estimate to Pacific eelgrass is 4.39 acres. To minimize additional impacts to the eelgrass beds the excavated material will be relocated approximately 1,000 ft north of the breakwater, where it will be utilized to create an engineered eelgrass mitigation site. Mobile species are expected to relocate out of the area until dredging activities are finished. Some marine populations, particularly benthic organisms, would be destroyed by the excavation of sediment, but are expected to recolonize the area once excavation of sediment has ceased. Effects of a clamshell dredge project in San Diego Bay on demersal fish, epibenthic invertebrate, and benthic infaunal invertebrate communities have previously been studied. Results indicated that demersal fish took between 14 and 22 months to recover. Benthic infauna recovered within 5 months relative to density and biomass, but examination of community indices indicated that full recovery of community structure may have taken 17 to 24 months. Epibenthic invertebrates recovered within 29 to 35 months in terms of density and biomass. However, the epibenthic invertebrate community composition was still changing or had achieved an alternate stable state near the end of the study (Merkel & Associates 2010).

Recovery rates of some of the PSL benthic communities may be decreased in relation to the Merkel & Associates 2010 study of San Diego Bay due to the shallow excavation of sediment and small area of excavation compared to the San Diego Bay study. Turbidity caused by the excavation of sediment can impact plankton populations by lowering the light available for phytoplankton photosynthesis and by clogging the filter feeding mechanisms of zooplankton. Turbidity would be expected to be mostly confined to the local disturbance area. Because turbidity effects would be localized and short-term, with respect to ambient conditions, and the marine plankton are transitory in nature, impacts on phytoplankton and zooplankton would not be significant. Environmental effects from turbidity and sediment fallout would primarily impact intertidal and subtidal macroalgae and directly and potentially indirectly impact eelgrass species. Prolonged light limitation negatively effects photosynthesis, growth, and recruitment of algal and eelgrass species. Any benthic flora within the immediate project area would be eliminated by the sediment excavation activities because of site excavation and substrate removal. The most direct impact of sediment excavation would be the elimination of benthic organisms from the immediate area. A secondary impact would be the redisposition of suspended sediments on adjacent areas. Benthic organisms are more susceptible to turbidity. Mechanical or abrasive action of suspended silt and detritus can negatively impact filter-feeding organisms by clogging their gills and impairing proper respiratory and excretory functioning and feeding activity. After excavation terminates, the affected area would be recolonized. Field studies indicate that recolonization initiates immediately and lost productivity rates are re-established in 2 to 3 years. Local fishes would likely avoid disturbance areas, thus lethal effects of suspended sediment on fishes are not anticipated to be great. Turbidity would likely be localized in time and space. As construction occurs, it is expected that demersal and pelagic fishes would temporarily relocate to avoid potential water quality impacts (i.e., turbidity plumes). While colonization of fishes may occur quickly in the excavated areas by local fishes temporarily displaced due to construction activities, complete recovery of the demersal fish community could take 1 to 2 years. Although, the demersal fish community may not experience significant direct mortality due to dredging there is likely a dependent correlation between the recovery of the benthic infauna and epibenthic invertebrate community recovery rates and that of the fish communities. Adverse impacts to EFH are expected to occur in the area requiring excavation of shoaled sediment, although, this area is small (less than 1%) relative to the available benthic, sandy bottom habitat in PSL harbor and excavation of shoaled sediments will be short term (possibly less than one week, maximum three weeks).

No permanent adverse effects are anticipated for critical habitat of prey species for marine mammals. Prey resources in the vicinity are not expected to be reduced.

X. Anticipated Effects of Habitat Impacts on Marine Mammals: *The anticipated impact of the loss or modification of the habitat on the marine mammal populations involved.*

The Corps does not anticipate repairs to the PSL breakwater would result in any measurable loss or habitat modification affecting marine mammal populations. The Corps does not expect loss of marine mammal prey or foraging resources. Temporary, seasonal disturbance at the PSL breakwater haul out site during breakwater repair construction activities is not expected to reduce post-construction use of the area by the pinnipeds species. The PSL breakwater is not designated critical habitat under the ESA for any listed marine mammal.

XI. Mitigation Measures to Protect Marine Mammals and Their Habitat: *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 their availability for subsistence uses, paying particular attention to rookeries, mating grounds, and areas of similar significance.*

Provided below is a summary of the avoidance and minimization measures and best management practices (BMPs) that will be implemented.

- A marine mammal monitor (a trained biologist with experience identifying and monitoring marine mammal species expected to be present in PSL) pre-approved by the Corps and NMFS will monitor for marine mammals 30 minutes prior to the start of construction activities (including prior to construction related vessels and barges mobilizing/starting up for the day), during construction activities, and 30 minutes after the completion of construction activities. A monitoring plan will be implemented as described in Section 13. This plan includes specific procedures in the event a mammal is encountered and reporting requirements.

- The Corps will conduct Marine Mammal Training for all construction personnel and the marine mammal monitors that will cover the following: marine mammal identification, clear explanation of responsibilities, communication procedures, marine mammal monitoring protocol, and operational procedures.
- The Corps will implement a soft-start procedure at the beginning of the work day. The objective of a soft-start is to provide a warning and/or give animals in close proximity to construction activities a chance to leave the area prior to operating at full capacity thereby, exposing fewer animals to visual disturbances, and underwater and airborne sounds that may elicit a startle response. A soft start procedure will be used at the beginning of each day, crews will slowly approach the work site creating a visual disturbance allowing animals in close proximity to construction activities a chance to leave the area prior to stone resetting or new stone placement.
- The marine mammal monitor will scan the waters for 30 minutes before and during all construction activities. If any species for which take is not authorized are observed within the immediate work area during or 30 minutes before work commences, the observer(s) will immediately notify the on-site supervisor, and require that work either not initiate or temporarily cease until the animals have moved outside of the area of potential effect (breakwater area immediately adjacent to crane-equipped barge and buffer area 300 feet along breakwater on either side of the crane-equipped barge).
- Direct physical interaction with marine mammals will be avoided during construction activities. If a marine mammal comes within 10 meters of such activity, operations must cease and vessels must reduce speed to the minimum level required to maintain steerage and safe working conditions, as necessary to avoid direct physical interaction.
- If rock setting is delayed or halted due to the presence of a marine mammal, the activity may not commence or resume until either the animal has voluntarily exited and been visually confirmed beyond the shutdown zone or 15 minutes have passed without re-detection of the animal.
- Breakwater construction associated equipment and vessels will not travel at speeds greater than 8 knots within PSL Harbor.
- A Water Quality Protection and Monitoring Plan will be implemented in coordination with the California Regional Water Quality Control Board per Clean Water Act conditions during the excavation of shoaled sediment.
- A spill prevention and response plan will also be developed and kept onsite with appropriate supplies.
- An Environmental Protection Plan will be developed and implemented prior to the commencement of any construction activities. The plan will identify biological resources within the project vicinity and outline avoidance and minimization measures and BMPs to be implemented throughout the project duration. The plan also identifies construction elements and recognizes spill sources at the site. The plan outlines BMPs, response actions in the event of a spill or release, and notification and reporting procedures. The plan also outlines contractor management elements such as personnel responsibilities,

project site security, site inspections, and training.

- No petroleum products, chemicals, or other toxic or harmful materials will be allowed to enter surface waters.
- Equipment that enters surface waters will be maintained to prevent any visible sheen from petroleum products.
- No oil, fuels, or chemicals will be discharged to surface waters, or onto land where there is a potential for re-entry into surface waters to occur. Fuel hoses, oil drums, oil or fuel transfer valves, fittings, etc. will be checked regularly for leaks and will be maintained and stored properly to prevent spills.
- No cleaning solvents or chemicals used for tools or equipment cleaning will be discharged to ground or surface waters.

XII. **Mitigation Measures to Protect Subsistence Uses:** *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, you must submit either a plan of cooperation (POC) 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.*

There are no relevant subsistence uses of marine mammals impacted by this action, see Section VIII. There will be no impact on subsistence uses because the project activities will not take place in or near Arctic subsistence hunting areas, nor will they affect the availability of species or stocks for subsistence uses.

XIII. **Monitoring and Reporting:** *The suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species, the level of taking or impacts on populations of marine mammals that are expected to be present while conducting activities and suggested means of minimizing burdens by coordinating such reporting requirements with other schemes already applicable to persons conducting such activity. Monitoring plans should include a description of the survey techniques that would be used to determine the movement and activity of marine mammals near the activity site(s) including migration and other habitat uses, such as feeding.*

- The Corps will designate a NMFs-approved biologically trained on-site marine mammal monitor to carry out the monitoring and reporting. The Corps will include the following minimum qualifications for marine mammal monitors:
  - Advanced education in biological science, wildlife management, mammalogy or related fields (Bachelor’s degree or higher is preferred).
  - Visual acuity in both eyes (correction is permissible) sufficient to discern moving targets at the water's surface with ability to estimate target size and distance. Use of binoculars or spotting scope may be necessary to correctly identify the target.
  - Experience and ability to conduct field observations and collect data according to assigned protocols (this may include academic experience).
  - Experience or training in the field identification of marine mammal species

expected to occur in PSL and identification of behaviors.
    - Writing skills sufficient to prepare a report of observations. Reports should include such information as number, type, and location of marine mammals observed; their behavior in the area of potential sound effects during construction; dates and times when observations and in-water construction activities were conducted; dates and times when in-water construction activities were suspended because of marine mammals, etc.
    - Ability to communicate orally, by radio, or in-person with project personnel to provide real time information on marine mammals observed in the area, as needed.
- A marine mammal monitor will be placed at the best vantage points practicable (from the construction barges, breakwater, or independent monitoring vessel).
- The Corps will conduct one pinniped monitoring survey, and any other observed marine mammal species (by species and age class if possible) present on the PSL breakwater and immediate surrounding area within 1 week prior to commencing work (including mobilization activities) at the PSL breakwater (see below for minimum requirements and data to be collected during survey and monitoring efforts).
- During construction the marine mammal monitor will scan the waters for 30 minutes prior, during, and 30 minutes after construction activities (excavation of sediment, stone resetting and placement of new stone) have completed.
- If weather or sea conditions restrict the marine mammal monitor's ability to observe, or become unsafe for monitoring, construction will cease until conditions allow for monitoring to resume.
- Stone resetting and new stone placement will only occur during daylight hours from sunrise to sunset when it is possible to visually monitor marine mammals.
- If the Corps or its contractors discover an injured or dead marine mammal species in the action area, regardless of known cause:
    - The Corps will immediate report the incident to the Office of Protected Resources (OPR) (PR.ITP.MonitoringReports@noaa.gov), NMFS and to the NMFS West Coast California Regional Stranding Network (Justin Viezbicke/Justin Greenman) as soon as feasible. If the death or injury was clearly caused by the specified activity, the Corps must immediately cease the specified activities until NMFS OPR is able to review the circumstances of the incident and determine what, if any, additional measures are appropriate to ensure compliance with the terms of this IHA. The Corps must not resume their activities until notified by NMFS.
    - Reporting of the incident must include the following:
        - Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable)
        - Species identification (if known) or description of the animal(s) involved
        - Condition of the animal(s) (including carcass condition if the animal is dead)
        - Observed behaviors of the animal(s), if alive
        - If available, photographs or video footage of the animal(s)
        - General circumstances under which the animal was discovered
- If any species for which take is not authorized are observed within the area of potential effects during or 30 minutes prior to excavation of sediment, stone resetting, or new stone placement, the marine mammal monitor will immediately notify the on-site supervisor,

and require that these construction activities either not initiate or temporarily cease until the animals for which take is not authorized have moved outside of the area of potential effect.

- The marine mammal monitor will monitor for marine mammals and have the authority to implement shutdown/delay procedures when applicable (in the unlikely and unexpected event an animal is in a location that would result in a Level A take, or a species not covered for Level B incidental take under this IHA is present within the vicinity that could result in take).
- During construction at the PSL breakwater, a final report will be provided to the NMFS.
  - These reports will provide dates, time, tidal height, maximum number of pinnipeds on the breakwater and any observed disturbances (detailing marine mammal species and behavior(s)). The Corps also will provide a description of construction activities at the time of observation, any mitigation actions that were implemented, and an assessment of the implementation and effectiveness of the mitigation measures.
- At a minimum, the following information will be collected on the marine mammal monitor's observation forms during all survey and monitoring events.
  - Monitor's name performing the survey/monitoring
  - Date and time that survey and construction activities begin and end.
  - Construction activities occurring during each observation period.
  - Weather parameters (e.g., percent cover, visibility).
  - Sea state/tidal conditions [e.g., sea state, tidal state (incoming, outgoing, slack, low, and high)].
  - Upon observation of a marine mammal the following information will be recorded:
    - Monitor who sighted animal and monitor's location
    - Activity at time of sighting
    - Time of sighting
    - Identification of the animal (e.g., genus/species, lowest possible taxonomic level, or unidentified), monitor's confidence in identification, and the composition of the group if there is a mix of species
    - Distance and bearing of each marine mammal observed to the construction activity for each sighting
    - Estimated number of animals (min/max/best)
    - Estimated number of animals by cohort (adults, juveniles, neonates, group composition, etc.)
    - Animal's closest point of approach and estimated time spent within the harassment zone
    - Description of any marine mammal behavioral observations (e.g., observed behaviors such as feeding or traveling), including an assessment of behavioral responses to the activity (e.g., no response or changes in behavioral state such as ceasing feeding, changing direction, flushing, or breaching)
    - Disturbance must be recorded according to NMFS' three-point pinniped disturbance scale

    - Note other human activity in the area not associated with the project activities.
    - Note in behavioral observations, to the extent practicable, if an animal has remained in the area during construction activities. Therefore, it may be possible to identify if the same animal or different individuals are being taken.
    - Monitor will note observation of tagged animals and pertinent information regarding species, age class, and sex to the maximum extent possible.
- Collected data will be compiled following the completion of construction and submitted to the NMFS within 90 days of completion of construction at the PSL breakwater.
- Post-construction surveys will document the pinniped use of the PSL breakwater.

XIV. **Suggested Means of Coordination:** *Suggested means of learning of, encouraging, and coordinating research opportunities, plans, and activities relating to reducing such incidental taking and evaluating its effects.*

Besides NMFS, the USFW and CDFW, will be apprised of the Corps work and results of the monitoring efforts. The data will be made publicly available, will be made available upon request, and will be provided to the local citizen science and non-profit marine mammal groups within San Luis Obispo and Morro Bay.

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Figure 1. Regional Vicinity Map & Figure 2. Local Vicinity Map

Figure 1 Regional Vicinity Map

Figure 2 Local Vicinity Map

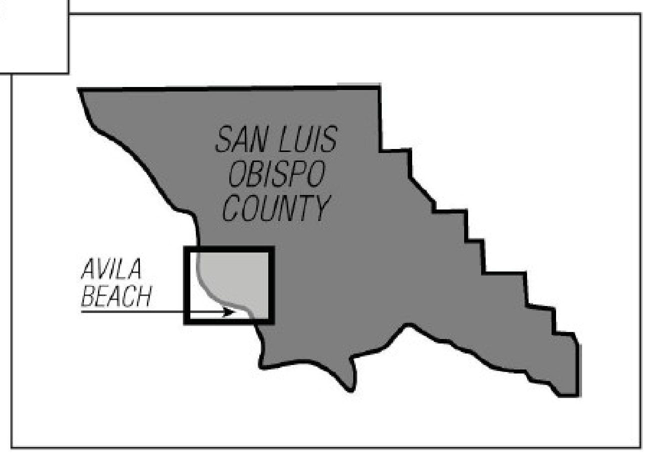


Figure 3. Port San Luis Harbor Site Map

Figure 4. Breakwater Repair Areas

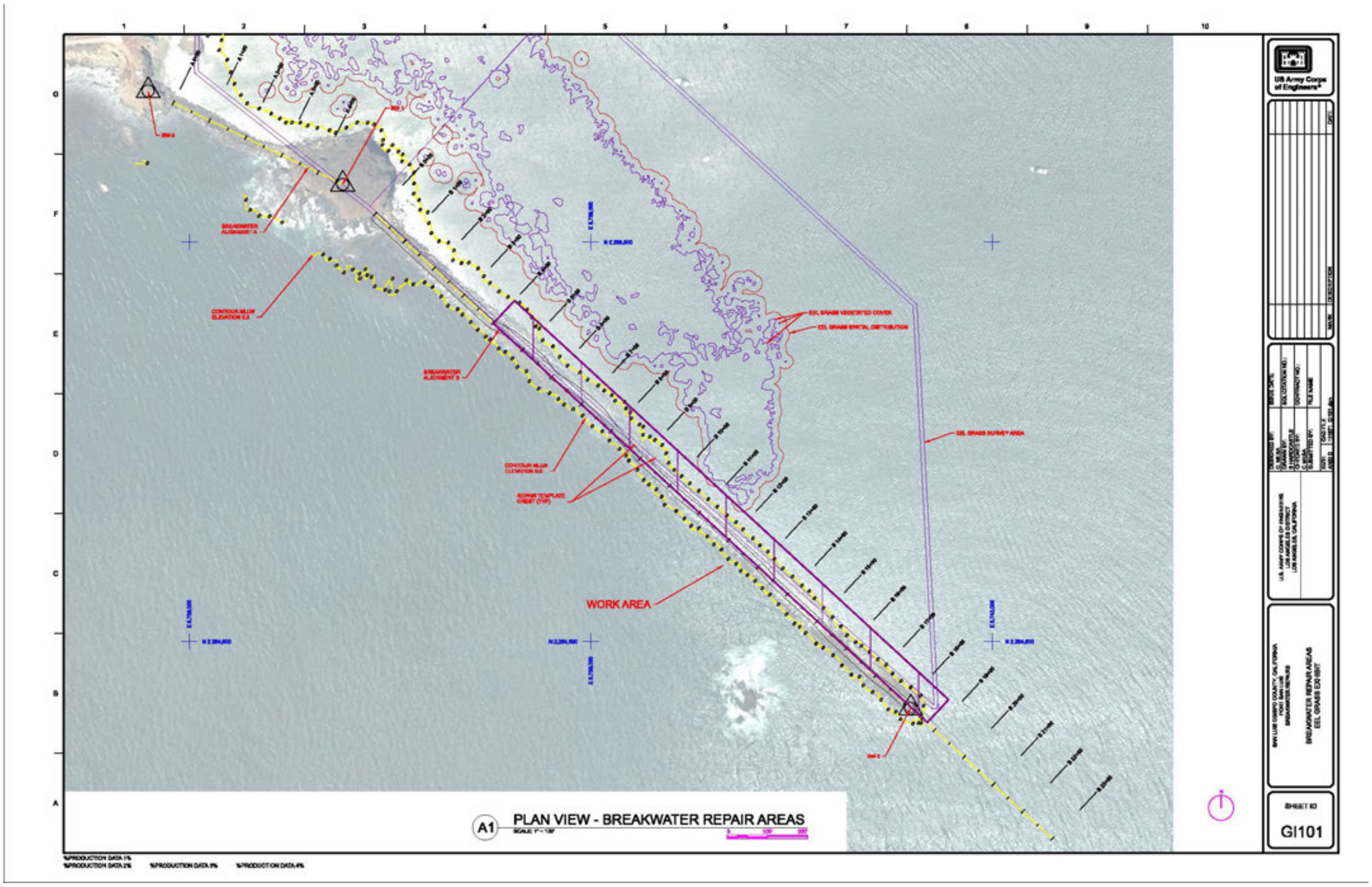


Figure 5. Breakwater Pinniped Haul Out Site June 2018 Merkel & Associates

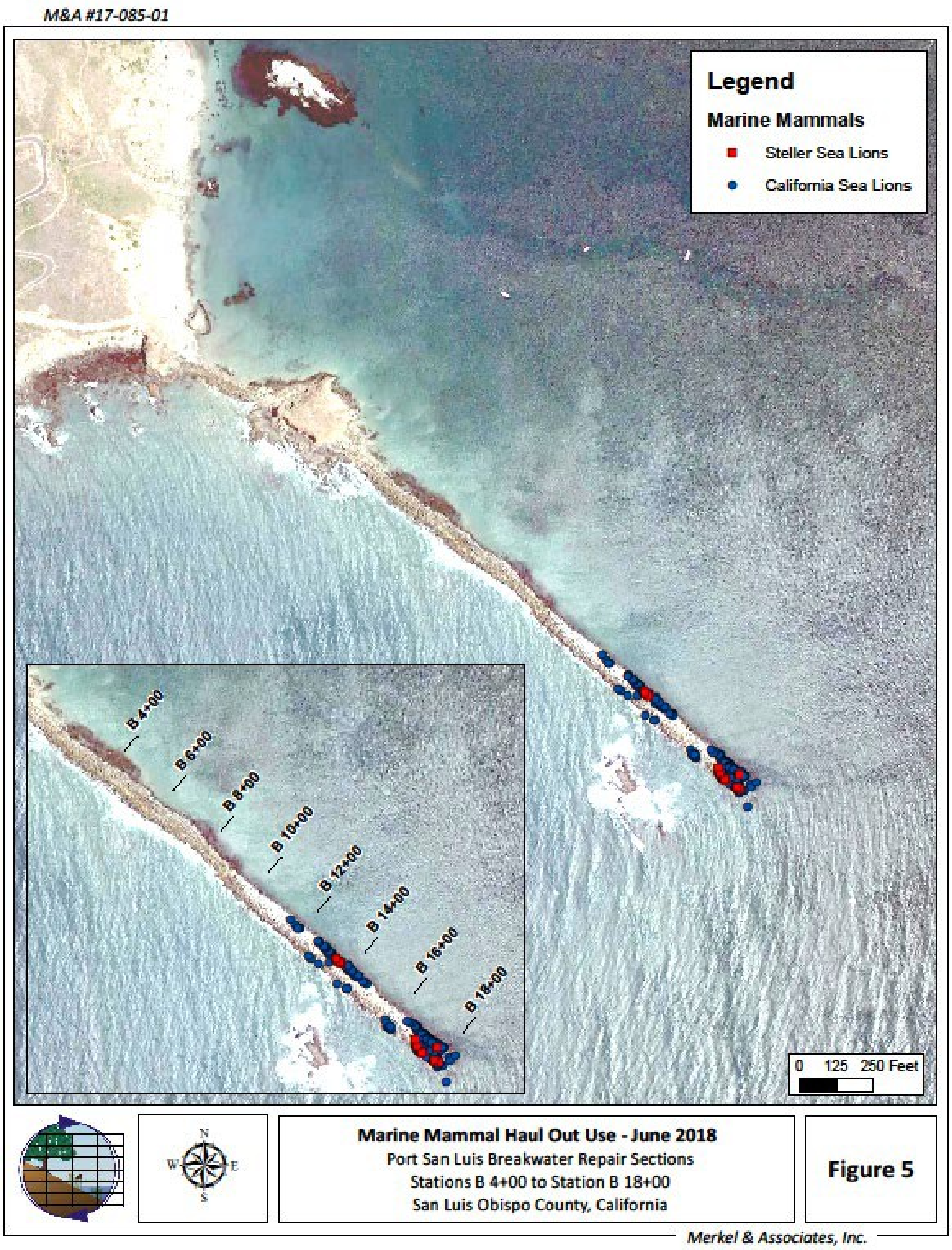


Figure 6. Breakwater Pinniped Haul Out Site & Project Footprint

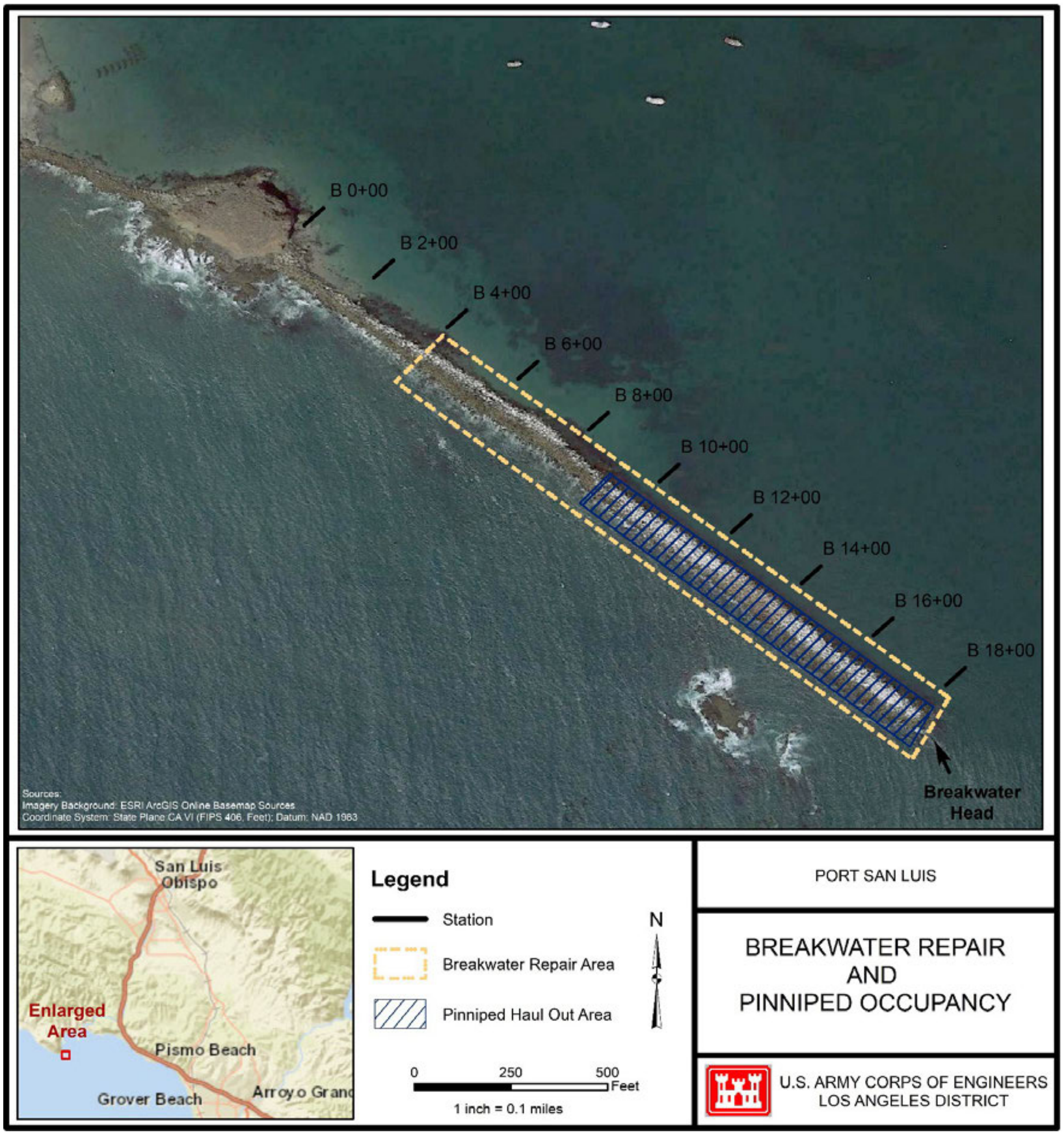


Figure 7. Pinniped Breakwater Images

PSL Breakwater: Head Section, Leeward. 6NOV2019

PSL Breakwater: South Eastern Section looking north towards Whaler's Rock, Leeward. 6NOV2019

PSL Breakwater: South Eastern Section, Seaward. 3JUNE2019

Figure 8. Crane-equipped Barge & Rock Barge at LA/LB Harbor Breakwater Repair Site

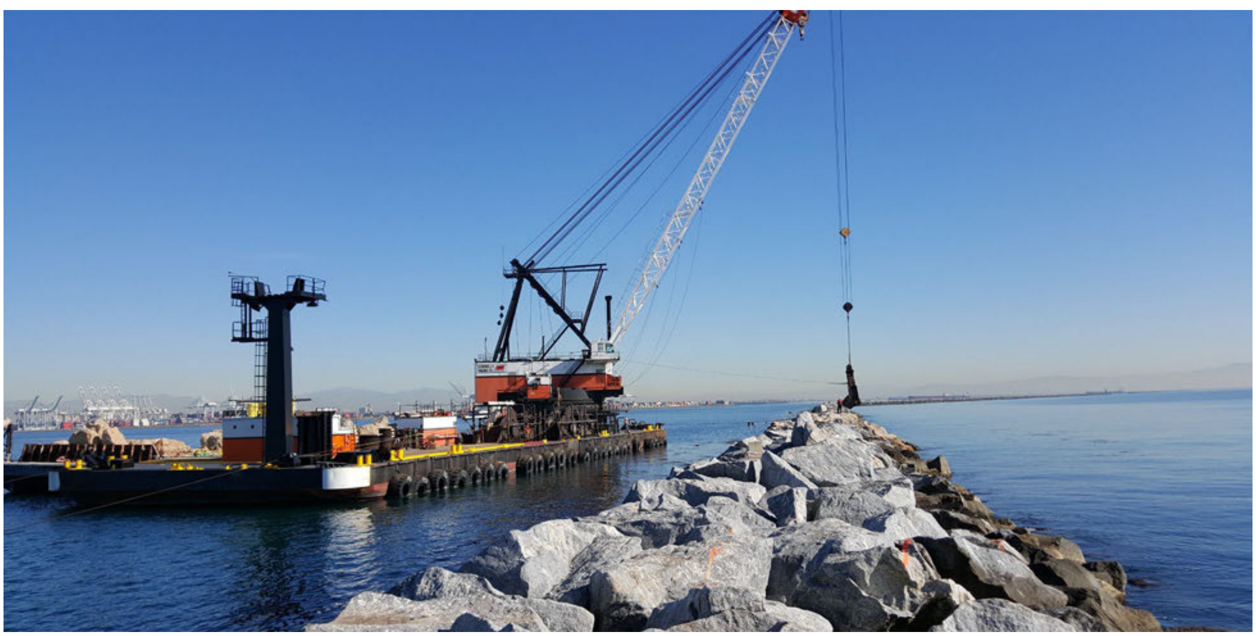
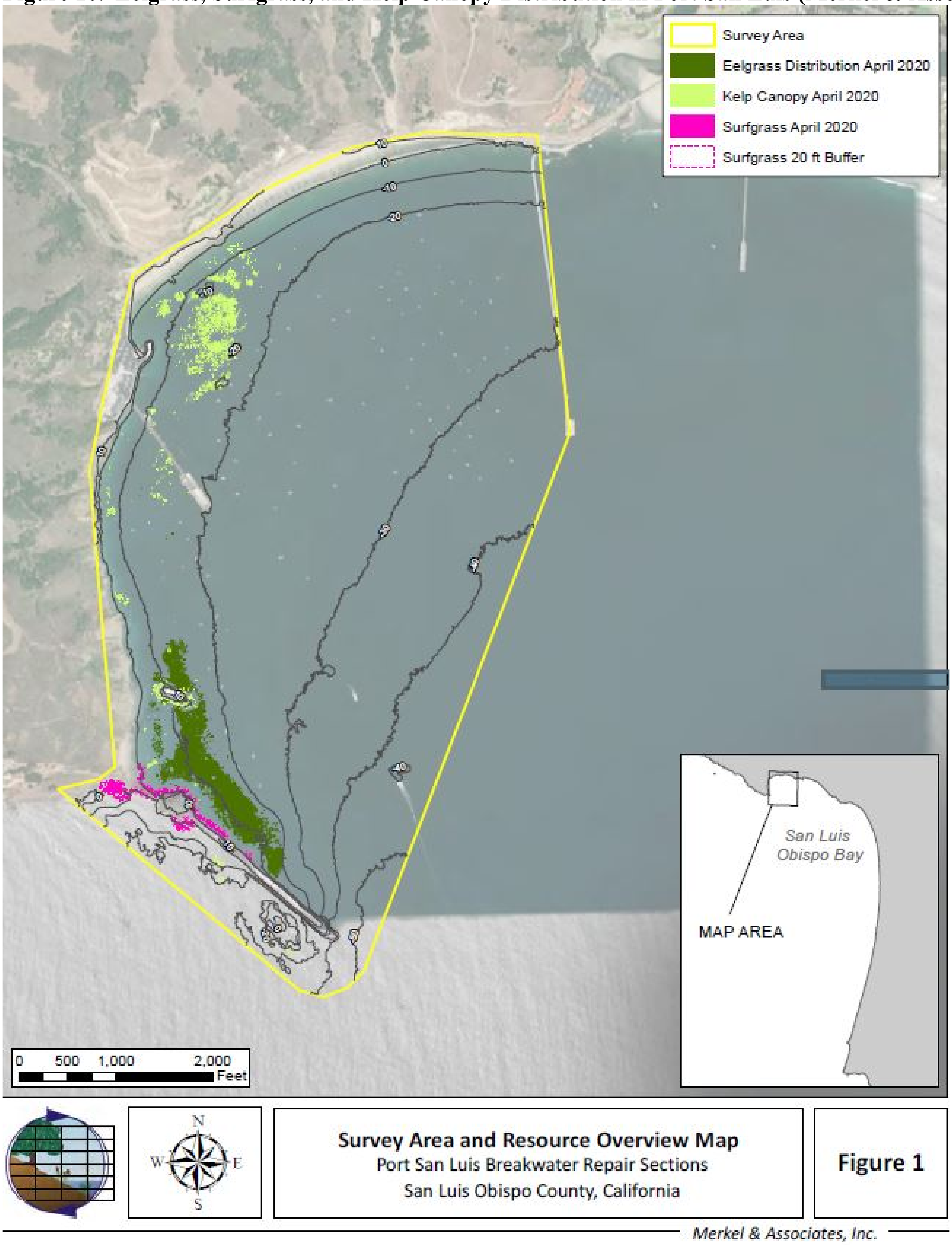


Image Source: Connolly-Pacific Co.

Figure 9. PSL Work Dock along Harford Pier (0.75 miles from the PSL Breakwater).

Figure 10. Eelgrass, Surfgrass, and Kelp Canopy Distribution in Port San Luis (Merkel & Associates)



APPENDIX

USACE Hydroacoustic & Acoustic Summary Report

On 25Feb2019 a team of researchers from the U.S. Army Corps of Engineers Los Angeles District and Engineer Research and Development Center traveled to the Breakwater Repair Project at the Port of Long Beach, CA to collect representative sound files. The sound files were collected based on guidance documents set in NMFS 2011 a/b and NOAA OPR-55. The sound files were analyzed to determine whether the anthropogenic noise exceeded the thresholds for underwater acoustic activities set by the National Oceanic and Atmospheric Administration. 27Feb2019 ambient sound files were collected at San Luis Obispo, CA near the breakwater to be used as a baseline measurement for proposed repair work.

Site Selection & Hydrophone Placement

Maintenance activities on the Long Beach, CA breakwater provided near identical conditions to the proposed work activities of the Port San Luis breakwater repair. Sound files were collected during rock placement and scraping. Sound measurements occurred at 10, 50, 100, and 250 meters from the rock placement site. Distance was measured from the placement of the rock to the location of the hydrophone. Hydrophones were placed at 25% and 75% of the water column height from the seafloor. The project was conducted in shallow water with sound energy coming from the surface reflection path, bottom directed path, and direct path (Richardson *et al.* 1995). All terminology used for reporting are defined in NMFS-OPR-55. Terrestrial measurements were made by personnel standing on the breakwater and recording at 50, 75, 100, and 150 meters.

Temporal Consideration

Sounds were recorded at each distance/depth for 30 minutes. The lifting, moving, and placing of the material was treated as one sample period. Non-construction activities in the vicinity, such as shipping traffic and recreational boat noise, were excluded from the dataset. Samples that captured construction equipment failure or an anomalous placement event (e.g., rock falls out of the grapple when the crane is moving) were also excluded. Rocks were only placed on the surface of the breakwater while we were onsite.

Equipment Selection

A Loggerhead LS-1 and SNAP data logger equipped with a HTI-96-min hydrophone were moored to an anchor. The HTI-96-MIN 3V/ LED hydrophones were connected with a Seacon MCIL3M & MCDLSF connector. The hydrophones were calibrated by a NIST approved ISO 9001 compliant third party lab, as required by USACE regulations. The hydrophone sensitivities were -169.5 and -170 dBV re: 1 µPa, respectively. Sampling rates were set to 44.1 kHZ. Data were recorded in uncompressed .WAV file format. A copy of all data is available in uncompressed WAV format for independent analysis. Recording equipment was selected based on criteria in NMFS 2011a,b. A Galaxy Audio CM-170 type 2 SPL meter was used to measure in air sound pressure levels. The galaxy meter sound files were set to record in dBA at a slow time weighting.

Mooring Design

A concrete anchor was used. Nylon rope connected the rubber buoy to the anchor with no metal to eliminate possible sound contamination. Recording equipment was fastened to the rope with a zip tie and allowed to suspend from the bailer connector perpendicular to the sea floor. Flow shields were not placed around the hydrophone due to low wave activity (> 1.5m/s) present at the fieldsite. The data was collected inside the breakwater with a direct noise path to the barge to represent the worst case scenario.

Project Information

The contractor Connolly-Pacific Co. used a 350 ton crane to move approximately 16-ton stones from a staging barge to the damaged section of the breakwater structure. Boulders were placed above the surface of the water and fully came to rest before the clamp could be released from the boulder.

Results

Underwater acoustics

The data files selected represented the most intense activities of the crane. The crane was "resetting" the rocks that were being placed by actively picking up individual rocks on the breakwater and quickly placing them back on the structure. This created a sound file with the largest signature due to the crane being fully throttled to lift the rocks in quick succession (<30 seconds). A 60 second sub-file was pulled from each recording device and used as the dataset. The recorded files were collected at the same time. The snap logger was deployed at 25% depth and the LS-1 logger was deployed at 75% depth from surface. Data were first filtered in Audacity to remove clicks/ distortion in the .wav file using high pass/ low pass filters. Data was then checked for clipping and anomalies that were not representative of the signal generated by the rock placement event. The data was then analyzed for individual events (impulse- i.e. rock placement) or broadband acoustic. The noise generated by the crane masked the sound of the rock placement therefore broadband event calculations were used. Broad band acoustic noise measurements were made using the equations set by OPR-55. All python script is available upon request.

Los Angeles Breakwater Repair Bioacoustic Monitoring

Table 1. Calculation variables for the Field sites are listed below:

	Long Beach, CA	San Luis Obispo, CA
Temperature (C)	13.2	12.4
Salinity (ppt)	33.51	31.19
pH	7.89	7.84
Distance from source (m)	15	n/a
Depth of source (m)	0	n/a
Number of source events per 24 hours	480	n/a
Duration of event (minutes)	60	n/a
Transmission loss coefficient	Near shore	Near shore

Table 2. Data from LS-1 Recorder during Rock Resetting analyzed for a 60 second window.

	Low F.	Mid F.	High F.	Pinniped F.	Otariddae F.
Distance to Permanent Threshold Shift (m)	10	10	10	10	10
Distance to Temporary Threshold Shift (m)	10	10	10	10	10
Weighted Broadband Source Levels (dB re 1 µPa/m)	132.09	122.57	119.67	129.53	129.63
Unweighted Broadband RMS source level (dB re 1 µPa/m)	140.35				

Table 3. Data from Snap recorder for ambient noise in Port San Luis Obispo, CA.

	Low F.	Mid F.	High F.	Pinniped F.	Otariddae F.
Distance to Permanent Threshold Shift (m)	10	10	10	10	10
Distance to Temporary Threshold Shift (m)	10	10	10	10	10
Weighted Broadband Source Levels (dB re 1 μPa/m)	107.39	94.13	91.90	100.98	100.98
Unweighted Broadband RMS source level (dB re 1 μPa/m)	131.55				

Data show no significant effect on 24-hour weighted duration Sound exposure level measurement. The number of source events per 24 hours were considered 480 based on an 8-hour work day. This is not a true reflection based on crew breaks and equipment repair, representing a maximum level of exposure.

Los Angeles Breakwater Repair Bioacoustic Monitoring

Table 4. Data from Galaxy CM-170 Sound Pressure Meter

	Long Beach, CA	San Luis Obispo, CA
Maximum decibels during Crane Operation	82.9	n/a
Average decibels over 8-minute recording	66.7	62.6

The data was recorded at a 30-meter standoff from the crane during construction activities. The average noise from the breakwater at San Luis Obispo was due to heavy wave action on the breakwater structure.

References

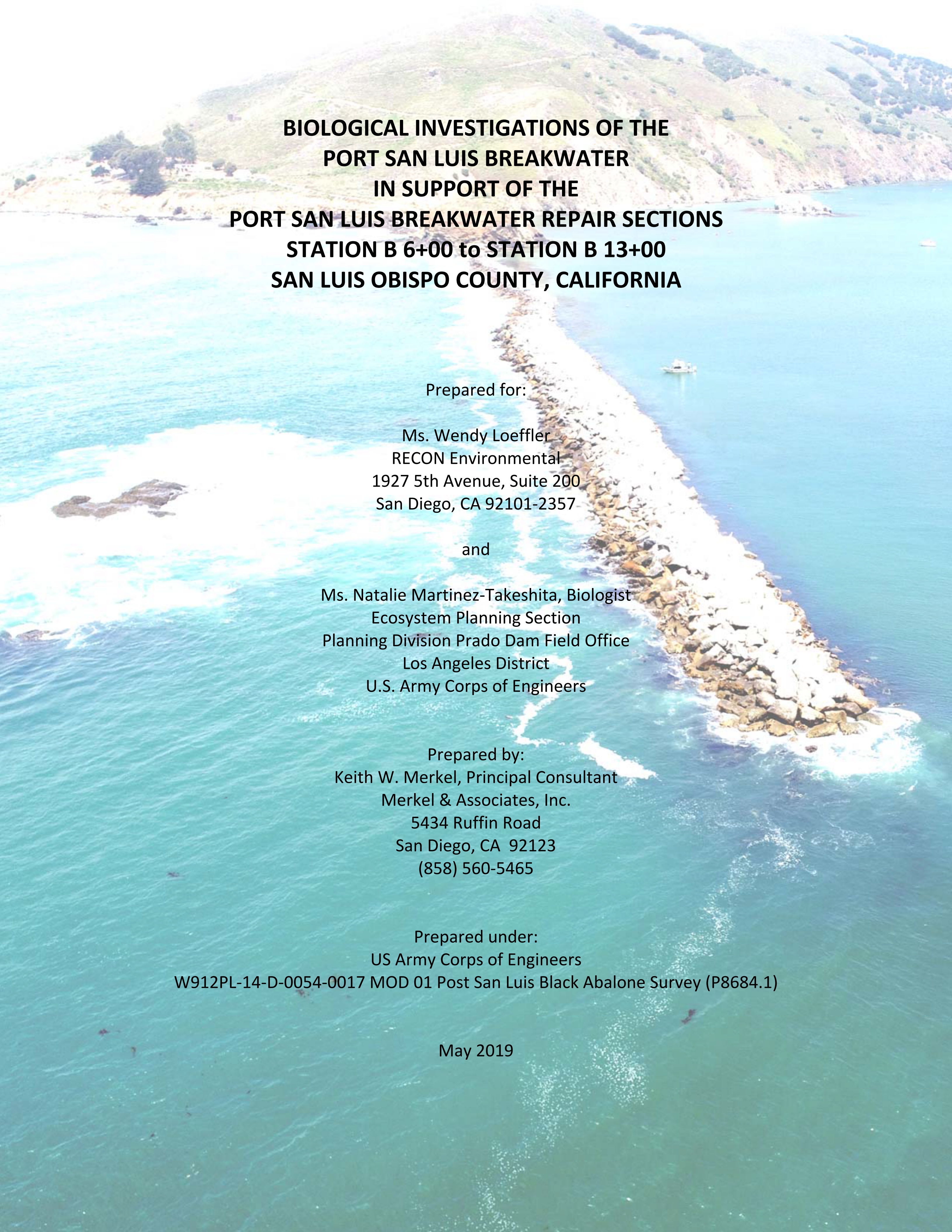
NMFS. 2011a. Guidance Document: Data Collection Methods to Characterize Underwater Background Sound Relevant to Marine Mammals in Coastal Nearshore Waters and Rivers of Washington and Oregon. Memorandum from NMFS Northwest Region and Northwest Fisheries Science Center to Interested Parties.

NMFS. 2011b. Guidance Document: Data Collection Methods to Characterize Impact and Vibratory Pile Driving Source Levels Relevant to Marine Mammals. Memorandum from NMFS Northwest Region and Northwest Fisheries Science Center to Interested Parties.

Richardson, J. W., C. R. Greene, C. I. Malme, and D. H. Thomson. 1995. Marine Mammals and Noise. Academic Press, San Diego, CA.

APPENDIX

Merkel & Associates May 2019 Biological Investigations of the Port San Luis Breakwater Report: Marine Mammals Survey



BIOLOGICAL INVESTIGATIONS OF THE PORT SAN LUIS BREAKWATER IN SUPPORT OF THE PORT SAN LUIS BREAKWATER REPAIR SECTIONS STATION B 6+00 to STATION B 13+00 SAN LUIS OBISPO COUNTY, CALIFORNIA

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Prepared under:
US Army Corps of Engineers
W912PL-14-D-0054-0017 MOD 01 Post San Luis Black Abalone Survey (P8684.1)

May 2019

3.5 Marine Mammals Survey

3.5.1 Methods

Marine mammal surveys were conducted in order to identify hauled out mammals along the Port San Luis breakwater and in proximity to the breakwater. Investigations were completed by two methods. The first was visual surveys conducted from a vessel navigated slowly along the breakwater and adjacent rocks to identify marine mammals hauled out. In addition, anecdotal observations were made of marine mammal in the project area during completion of various biological investigations in June-July 2018 and January-February 2019.

The second method of survey was a quantitative assessment of marine mammals on the breakwater and adjacent rock islands completed by completion of multiple UAV overflights. The marine mammal surveys were conducted during two different seasons with varying weather, sea state, and environmental conditions. Surveys were completed on June 30, 2018 and again on January 30 during high and low tides, January 31 during low tide, and February 1, 2019 during high tide and low tides. Aerial flights were conducted at elevations of 250 meters with true vertical overflights and offset oblique photographs of the breakwater and nearby rock islands. Using the collected photographs, marine mammals were identified, counted, and mapped on the breakwater using ESRI ArcGIS spatial mapping software.

The first surveys conducted by M&A biologists for the Port San Luis breakwater repair were completed between June 29–July 1, 2018 and were ancillary to focused surveys for black abalone. During the first survey, biologists noted the presence of marine mammals in the water and on the breakwater, as well as within the protected waters of Port San Luis. During the surveys a UAV was flown over the breakwater to produce an orthomosaic image of the survey area. The field observations and the photomosaic were subsequently used to inventory mammals on the breakwater. During the survey period, the cloud cover was typically overcast in the morning and approximately 20 percent cover in the afternoon. Winds were 0-1 Beaufort Scale (BS), and calm sea state with waves in the range of 1-2 feet on the lee of the breakwater and 3-6 feet on the windward side of the breakwater.

The second set of marine mammal surveys was conducted between January 29 and February 1, 2019. During this time, the Port of San Luis area was experiencing several days of stormy weather conditions and high surf just prior to the commencement of the survey. The weather was generally misty or rainy during the period. The conditions were wet and windy with surf between 4 and 6 feet outside of the breakwater. Breaks in the weather allowed the completion of all necessary aerial survey flights. Conditions during the surveys were between 53 ˚F to 63˚F. Cloud cover ranged from 100 to 30 percent, winds ranged between 0 and 3 BS. Surveys were initially intended to be completed twice, one day apart, but due to an absence of any marine mammals hauled out on the breakwater on the first day, January 29, surveys were conducted on all three days.

Sea lions photographed in June 2018 using high resolution low altitude UAV aerial photography. Overflights provided an opportunity to map individual animals hauled out by species, gender, and age class.

January-February 2019 visual surveys and UAV surveys of the breakwater did not identify any marine mammals. However, during this period Smith's Island supported hauled out Pacific harbor seals.

3.5.2 Results

There were four marine mammal species observed during both surveys. *Species present in the area included Steller sea lion (Eumetopias jubatus), California sea lion (Zalophus californianus*), Southern sea otter (*Enhydra lutris nereis*), and Pacific harbor seal (*Phoca vitulina*). Other marine mammals are known to be sighted within San Luis Obispo County, but are more transient and not likely to utilize the Port San Luis Breakwater repair sections project area as a substantial habitat area.

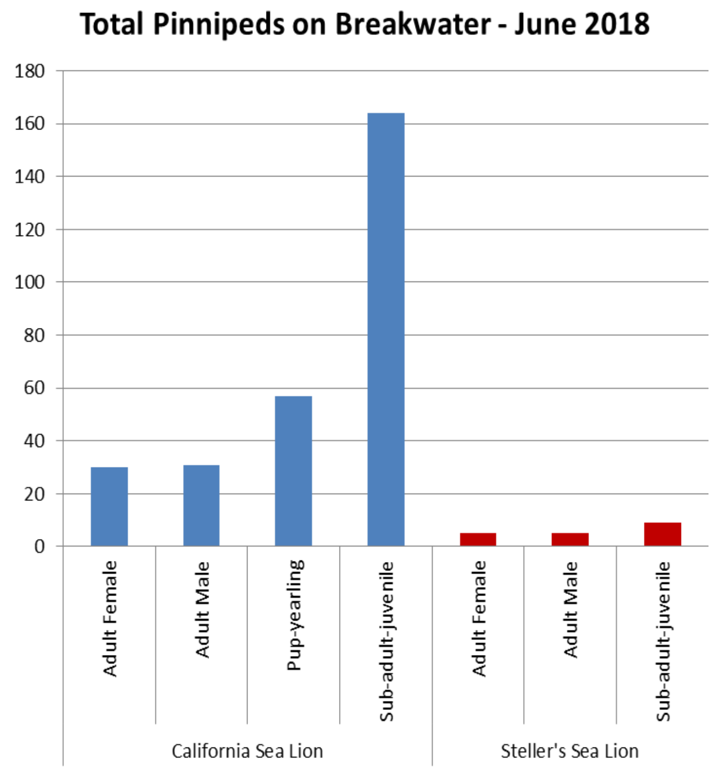
Mammals known in the San Luis Obispo County waters but not observed during the current surveys include: Guadalupe fur seal (*Arctocephalus townsendi*), Northern elephant seal (*Mirounga angustirostris*), Humpback whale (*Megaptera novaeangliae*), Blue whale (*Balaenoptera musculus*), Fin whale (*Balaenoptera physalus*), Killer whale (*Orcinus orca*), Eastern North Pacific Gray whale (*Eschrichtius robustus*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), Risso's dolphin (*Grampus griseus*), Northern right whale dolphin (*Lissodelphis borealis*), Long-beaked common dolphin (*Delphinus capensis*), Short-beaked common dolphin (*Delphinus delphis*), Dall's porpoise (*Phocoenoides dalli*), and Bottlenose dolphin (*Tursiops truncatus*). While not observed during the present survey, whale vertebrae, probably from gray whale, were observed at multiple locations on the breakwater during both the 2018 and 2019 surveys.

One of two whale vertebrae observed on breakwater June 30, 2018

The marine mammal species observed within the project location during the 2018 survey include Southern sea otter, Pacific harbor seal, Steller sea lion. and California sea lion. During the 2018 black abalone survey work Southern sea otters and Pacific harbor seal were observed in proximity to the breakwater in low abundance and intermittently, and were more common within the inner harbor where they were observed foraging and resting in small patch kelp beds. During the course of the surveys, only two to three otters were observed and observations of seals were likely less than a dozen observations of likely fewer individuals. While not observed, it is believed that the otters were likely foraging on the breakwater as it appears that there are abundant crabs, shellfish, and octopus available on the subtidal and intertidal rocks. Also observed in abundance in the water along the breakwater were otariid pinnipeds including Steller sea lion and California sea lion. No attempt was made to count pinnipeds in the water during the surveys.

High resolution aerial imagery collected on June 30, 2018 allowed counting of hauled out pinnipeds on the breakwater. A total of 282 California sea lions and 19 Steller sea lions were observed occupying areas on the breakwater. The survey divided observed marine mammals first by species then by age class. The most abundant age class was the sub-adult-juvenile class followed by pup-yearling and leaving an almost equal amount of both the adult male and adult female classes in both California sea lion and Steller sea lion. Also notable during the surveys were four dead young pup carcasses on the breakwater rocks. No very young live pups were noted during either the on-water surveys or within the aerial survey photographs.

The general distribution of marine mammals along the breakwater is influenced by direct wave energy against exposed breakwater segments. An offshore rock formation on the seaward side of the breakwater's southern end absorbs direct wave energy and reduces the intensity of waves reaching the breakwater. This allows for manageable haul out locations on both the seaward and leeward sides of the breakwater in proximity to this rock. As Figure 7 shows, the most densely populated haul out areas occur on the leeward side of the south eastern end of the breakwater and spread around the revetment stone to the protected segment of the seaward side of the breakwater. In the open water, near the breakwater shoreline, sea lion were noted to be abundant, but it was not possible to count animals, or positively identify species or demographic metrics. As such, they were noted but not enumerated.

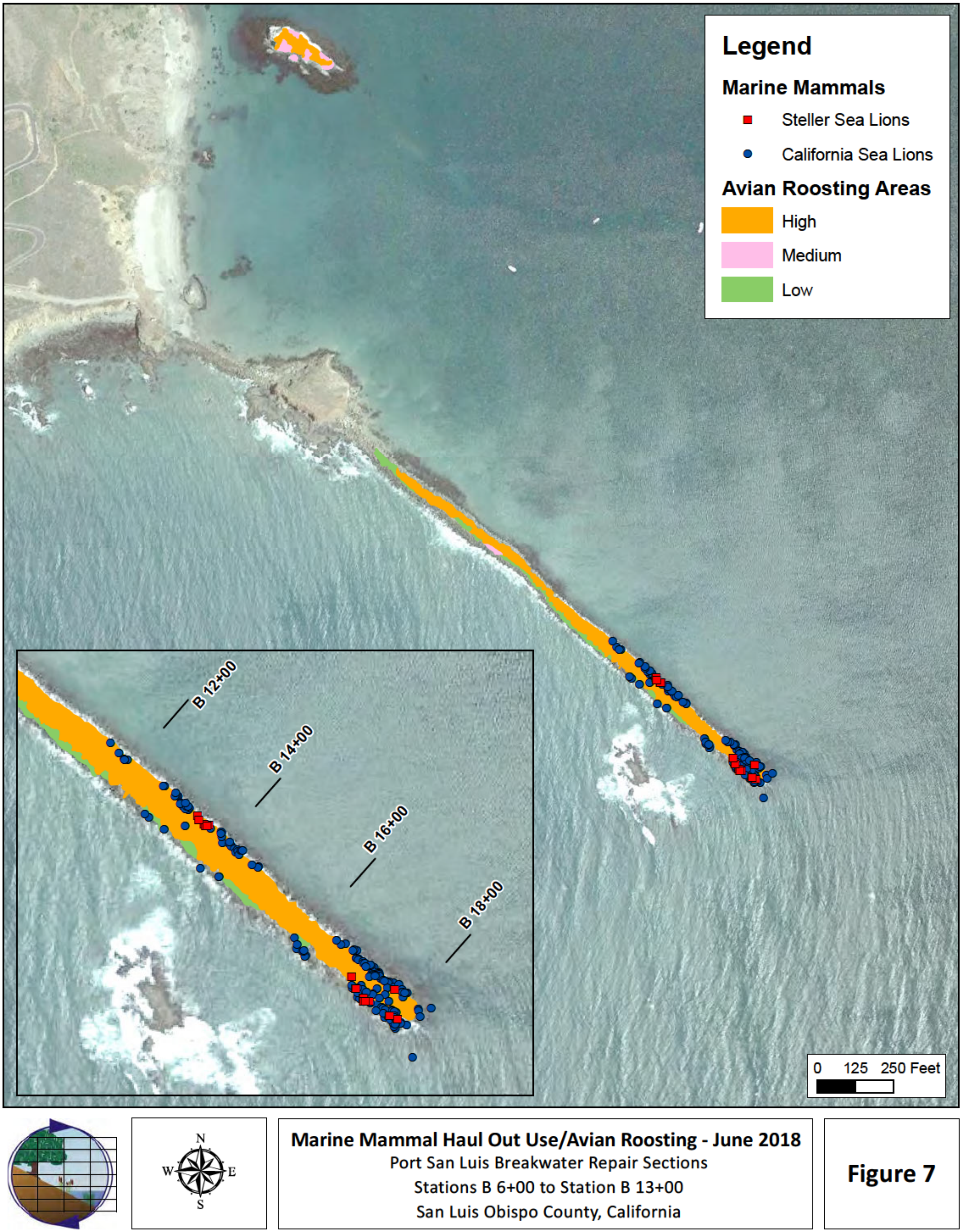


Population demographics of sea lions hauled out on Port San Luis Breakwater June 30, 2018

Further from the breakwater, California sea lions were also observed resting on a floating barge just east of the fishing pier. California sea lions, sea otters, and harbor seals were observed transiting / foraging and resting in the water around the fishing pier and boat moorings in the harbor and were even noted to enter the boat hoist launch basin.

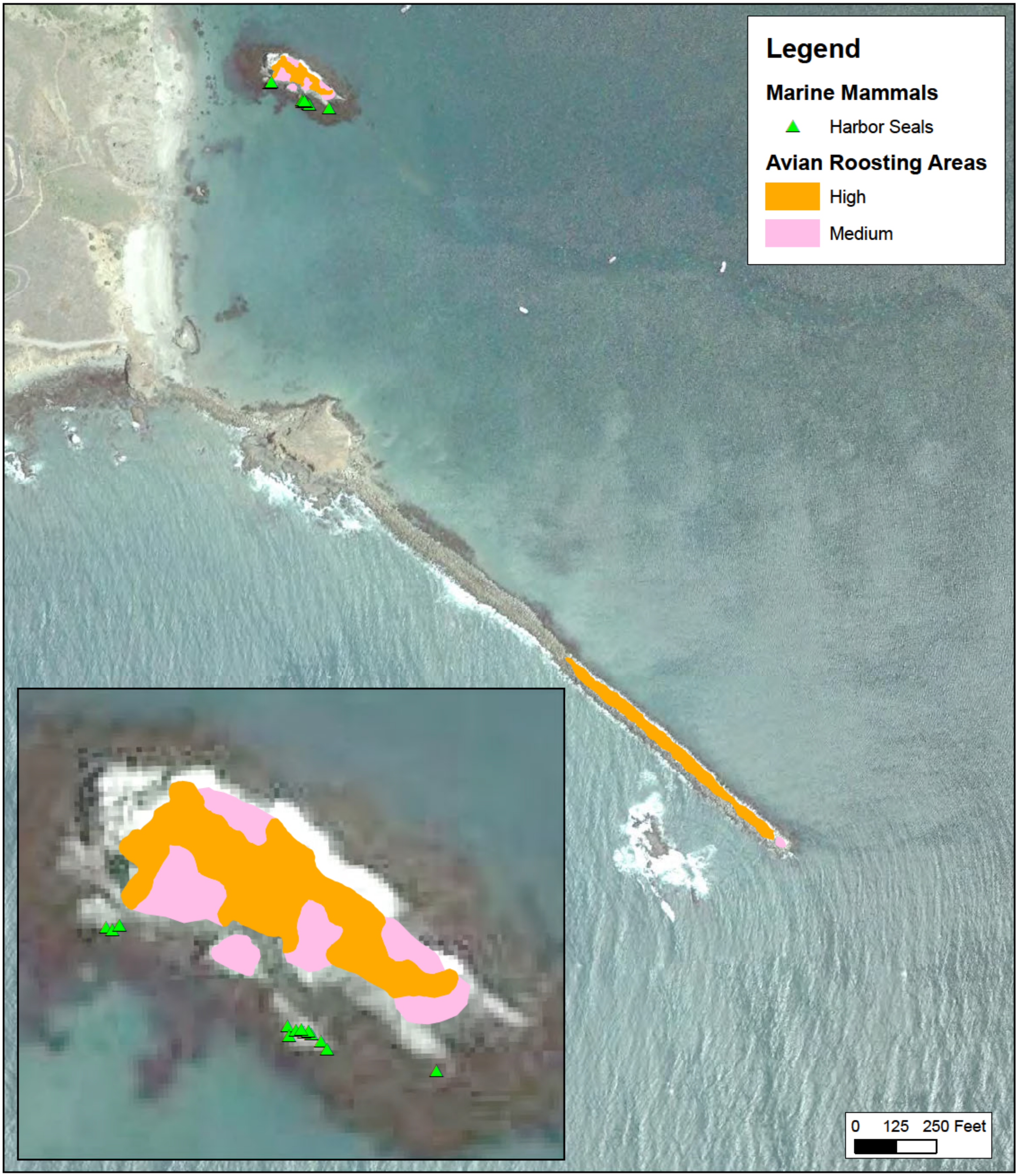
During the January and February 2019 surveys, there were no marine mammals observed on the breakwater or within the immediate project area. A total of 13 Pacific harbor seal were found hauled out on and nearby Smith Island (Figure 8). As was the prior case with sea lions, several additional harbor seals were noted in the water around Smith Island, but were not counted. Smith Island has low lying bedrock benches that are better suited as haul-outs for seals than is the steep boulder rock of the breakwater. Noting that seals haul out on Smith Island, it would not be unexpected to see seals similarly haul out on the sand beach near Point San Luis in the lee of the breakwater, or under calm sea states, on the rocky terraces of Whaler's Island or Point San Luis on the seaward side of the breakwater.

While sea lions were notably absent from the breakwater during the winter months, a small number of California sea lions were noted hauled out on the purpose placed sea lion float near the fishing pier. Other sea lions as well as sea otters and harbor seals were noted in the protected waters of Port San Luis during transiting trips back and forth from moorings and launch facilities to the breakwater.



Marine Mammal Haul Out Use/Avian Roosting - June 2018
Port San Luis Breakwater Repair Sections
Stations B 6+00 to Station B 13+00
San Luis Obispo County, California

Figure 7



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Marine Mammal Haul Out Use/Avian Roosting - February 2019
Port San Luis Breakwater Repair Sections
Stations B 6+00 to Station B 13+00
San Luis Obispo County, California

Figure 8

From: Keith Merkel
To: [redacted]
Subject: [Non-DoD Source] California sea lion pupping at Port San Luis Breakwater
Date: Monday, November 30, 2020 10:16:54 AM

Hi Natalie,
Thanks for your inquiry a week or so ago regarding the survey results of our June 2018 marine mammal surveys on the Port San Luis breakwater. You had asked about the breakdown of our pup-yearling classification for sea lions. Specifically, how many pups and how many yearlings There were no pup-yearlings of Steller sea lions and a total of 57 pup-yearlings of California sea lions observed.

We did not split this class to pups and yearlings due to the fact that there were many small yearlings that could be confused with young pups. However, we understand the context of the question to be whether the area is a pupping area or just a haul out. In our report (Merkel & Associates 2019. Biological Investigations of the Port San Luis Breakwater In Support of the Port San Luis Breakwater Repair Sections Station B 6+00 to Station B 13+00, San Luis Obispo County, California) we noted the following:

"A total of 282 California sea lions and 19 Steller sea lions were observed occupying areas on the breakwater. The survey divided observed marine mammals first by species then by age class. The most abundant age class was the sub-adult-juvenile class followed by pup-yearling and leaving an almost equal amount of both the adult male and adult female classes in both California sea lion and Steller sea lion. Also notable during the surveys were four dead young pup carcasses on the breakwater rocks. No very young live pups were noted during either the on-water surveys or within the aerial survey photographs."

Note that we opted not to consider the area a pupping site or rookery as we believe that pupping on the site has been incidental, if not accidental. The four dead pup carcasses were located on high rocks of the breakwater and the chances for these pups to make it to the water would have been extremely low given the large voids between breakwater rocks and the expectation that pups would fall into the interior of the breakwater rather than reaching the water. It is not a suitable pupping area and it is possible that the pups expired on the rocks rather than attempting to traverse the distance to the water. As noted, no very young live pups were noted. This suggests that smaller pup-yearlings may have been born elsewhere and not on the breakwater.

It should be noted that over the past decade shortages of food and crowding at established Channel Island rookeries have resulted an expansion of occurrence of births of sea lions on mainland habitual haul out sites. These have rarely ended well with high incidents of pup mortality. We believe the observed pupping at Port San Luis breakwater to be a similar condition and not evidence of a rookery or even early establishment of pupping location.

Please let me know if you need further clarification.

Thanks,
Keith

Keith Merkel
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(858) 560-5465

M&A # 05-024-42

EELGRASS MITIGATION AND MONITORING PLAN
IN SUPPORT OF THE PORT SAN LUIS BREAKWATER REPAIRS
PORT SAN LUIS, SAN LUIS OBISPO COUNTY, CALIFORNIA

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March 2021

Keith Merkel, Principal Consultant

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Appendix A. California Eelgrass Mitigation Policy and Implementing Guidelines

Eelgrass and Surfgrass Mitigation and Monitoring Plan in Support of the Port San Luis Breakwater Repairs Project Port San Luis, San Luis Obispo County, California

INTRODUCTION

The Port San Luis breakwater is a federally maintained structure providing wave protection to Port San Luis. The breakwater is maintained by the U.S. Army Corps of Engineers, Los Angeles District (Corps). The breakwater structure is an approximately 2,400-foot long large armor stone revetment that extends from the rocky headlands of Point San Luis towards the southeast. The breakwater has approximately 2,700 feet (ft) of shoreline on each side of the breakwater due to bulges in the shoreline along the breakwater resulting from native terraces of Point San Luis and Whaler's Island that is integrated into the breakwater. The breakwater is described in two alignment sections. Alignment A extends between Point San Luis and Whaler's Island, an approximately 2-acre natural rock island located approximately 300 ft offshore from Point San Luis. Alignment B extends from Whaler's Island to the southeast for a distance of approximately 1,850 ft. Portions of Alignment B, located 600 to 1,300 ft to the southeast of Whalers' Island, are in need of crest heightening. A loss in crest height is due to displacement of armor stone that has been toppled off the breakwater, which now principally resides on the leeward side of the breakwater.

As a result of the degradation of the breakwater, the Corps has initiated a project to repair the breakwater. The breakwater repairs in this section will be made by replacing crest height with the import of new armor stone, salvaging and reusing existing displaced armor stone or a combination of import and salvage reuse. Details of construction methods are not yet known. However, in order to commence environmental review and interagency coordination, the Corps has contracted for the completion of focused marine biological investigations within the project area. Merkel & Associates Inc. (M&A) was retained by the Corps to prepare a Pacific eelgrass (*Zostera pacifica*) mitigation plan in support of rock repairs to be conducted on the Port San Luis Breakwater at Port San Luis, California. In completing eelgrass impact analysis for this plan preparation, it was also noted that, in addition to eelgrass, the defined Area of Potential Effect (APE) supports a limited amount of Torrey's surfgrass (*Phyllospadix torreyi*). As such, some portion of the surfgrass may be impacted by the construction activities. For this reason, surfgrass has also been addressed within this plan. Kelp canopy is not expected to be significantly affected by the work and thus is not proposed for mitigation under this plan.

Enacting measures to avoid and minimize impacts to seagrass would lessen the compensatory mitigation area required to be met. For this reason, the mitigation plan includes recommended measures to avoid and minimize impacts during construction with the goal of lowering the area of the mitigation that must achieve success standards. However, it is not certain that all recommended measures can be implemented by the Corps and the selected contractor, and it is not guaranteed that the full implementation of measures will lead to fully predictable levels of reduction in overall impacts. For this reason, the mitigation plan proposed targets the maximum anticipated impacts to seagrass, and seeks to have the avoidance and minimization measures reduce the ultimate impact in a manner that reduces the area of mitigation required to be successful to compensate for unavoidable losses. This is different from assuming successful avoidance and minimization and thus curtailing the scale of the mitigation area, *a priori*.

SPECIES CONSIDERED IN THIS PLAN

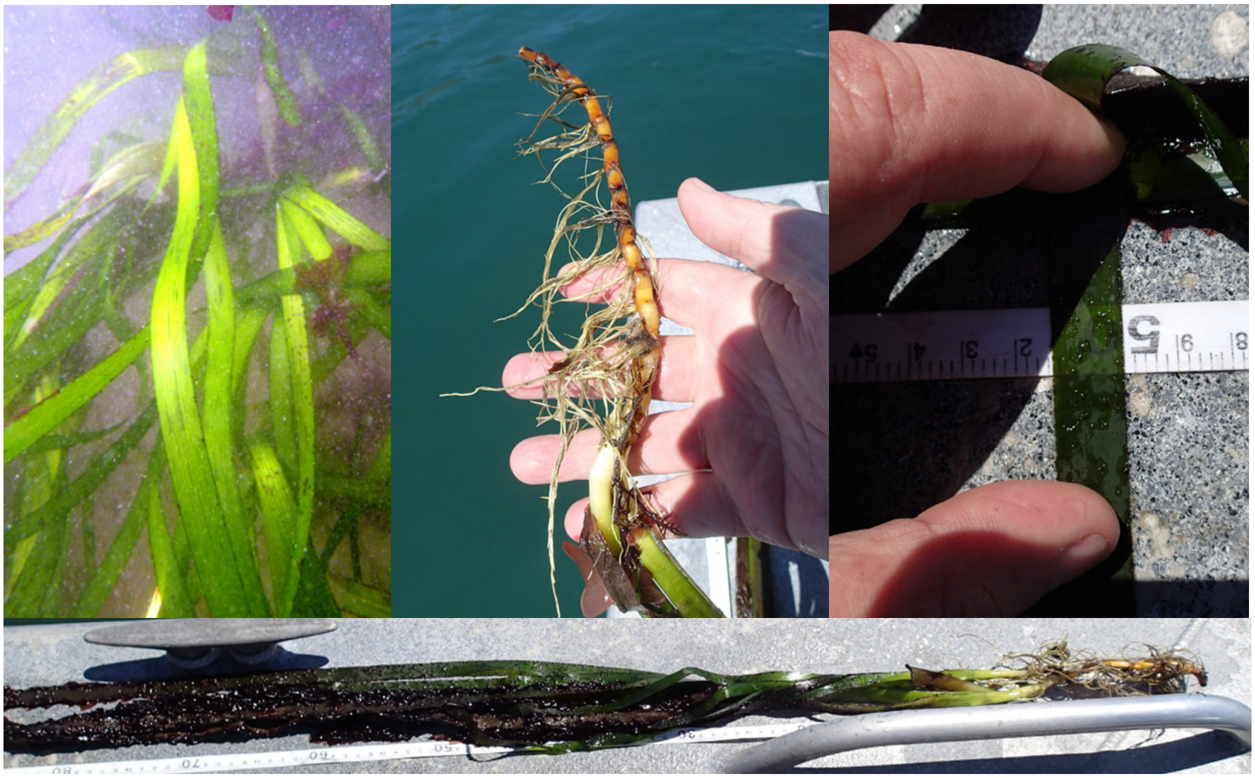
Pacific Eelgrass

Eelgrass is an important habitat structuring organism found in shallow unconsolidated soft bottom, tidally influenced, protected waters of temperate latitudes. Eelgrass is recognized for its significant contributions to multiple, physical, chemical, and biological ecosystem functions. Eelgrass is a highly productive marine angiosperm (flowering plant) in the family Zosteraceae and is considered a "foundation" or habitat forming species.

Vegetated shallows, including eelgrass habitats are considered special aquatic sites under the 404(b)(1) guidelines of the Clean Water Act (40 C.F.R. § 230.43). Under the Magnuson-Stevens Fishery Conservation and Management Act (MSA) eelgrass is found within Essential Fish Habitat (EFH) and is designated as a Habitat Area of Particular Concern (HAPC) for various federally-managed fish species within the Pacific Coast Groundfish Fishery Management Plan (FMP) (PFMC 2008). An HAPC is a subset of EFH that is considered rare, particularly susceptible to human-induced degradation, especially ecologically important, and/or located in an environmentally stressed area. HAPC designations are used to identify areas where additional focus for conservation efforts is warranted.

Three species of eelgrass occur in California and occupy only about 15,000 acres statewide (Merkel & Associates 2017). Of this total, most of the known eelgrass in the state is comprised of common eelgrass (*Zostera marina*) that is widely distributed in the bays and estuaries of the northern hemisphere and is commonly encountered in fully tidal marine systems, and some partially muted systems in California. Also present in California are two other species for which abundance and distribution are dwarfed by that of *Z. marina*. In northern California, the introduced Japanese eelgrass (*Z. japonica*) occurs in scattered locales within principally a low intertidal range. This species likely occupies much less than a dozen acres within only a handful of locations. The second most abundant species is the rather rare Pacific eelgrass (*Zostera pacifica*), native to waters of southern and central California. It is likely that *Z. pacifica* occurs over less than a few hundred acres within California, but may be more common in northern Baja Mexico. The full extent of the known *Zostera pacifica* is estimated at under 300 acres; however, substantially less is known about the distribution of this species than its congener, *Z. marina*, and it may be one of the rarest marine habitats in California.

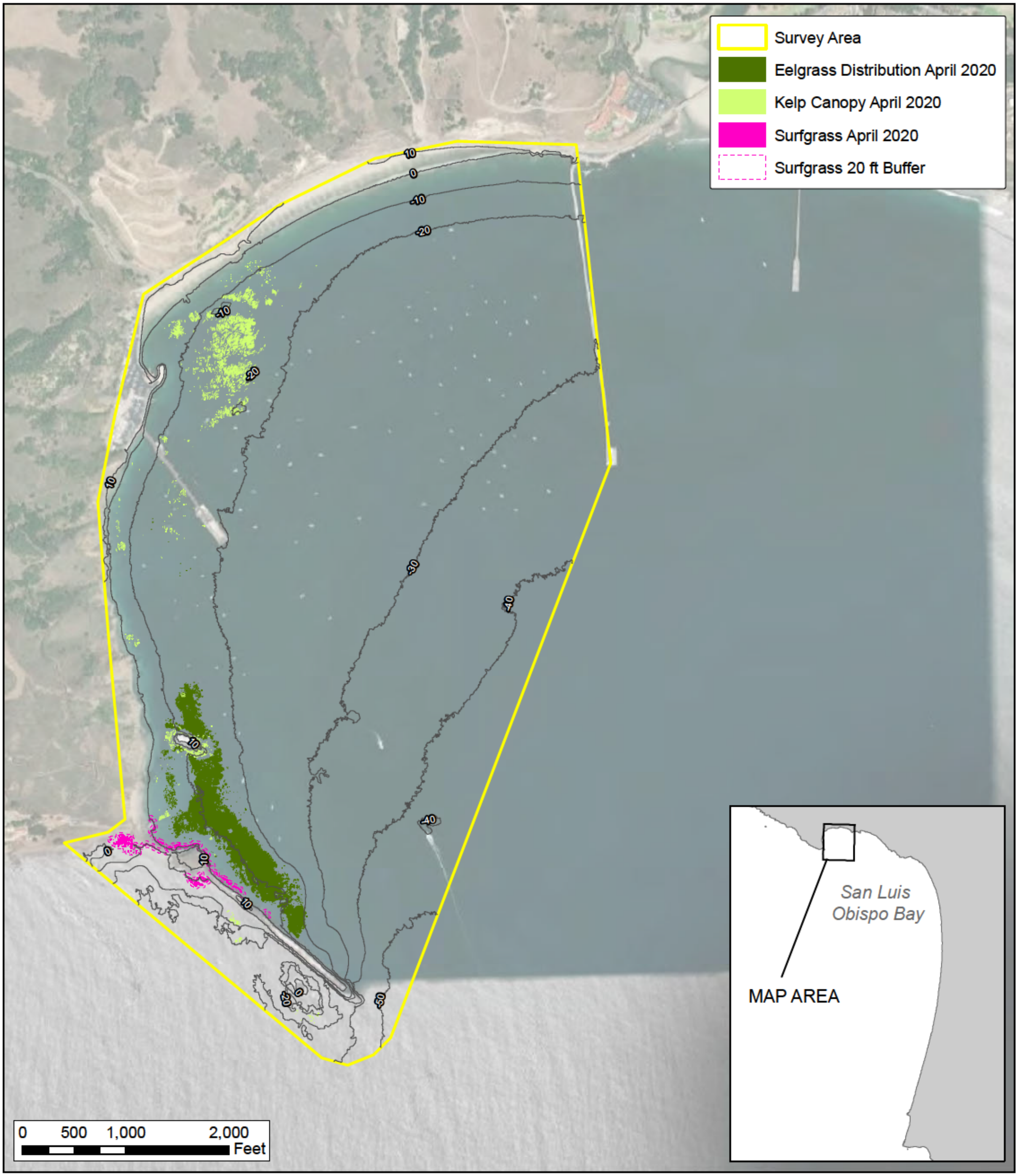
Pacific eelgrass is a robust eelgrass with broad leaves and thick, nearly woody rhizomes. The species is restricted to open coastal nearshore environments in southern and central California and extends into Baja Mexico. Pacific eelgrass is found in sheltered embayments in the lee of prominent points and capes on the Channel Islands and the mainland coast. The depth range occupied by *Z. pacifica* is typically substantially deeper than that of *Z. marina*. Further the depth range is typically broader than for common eelgrass. However, it is likely that the light requirements for *Z. pacifica* are not substantially different from those of *Z. marina.* Rather the broader and deeper range is reflective of the clearer water of open coastal environments and higher energy within the shallows such that the upper margin is restricted by energy levels rather than desiccation stress as is often the case for common eelgrass.



*Pacific eelgrass (*Zostera pacifica*) is a robust heavy bodied eelgrass with large nearly woody rhizomes, broad leaves, and a relatively open growth form. It occurs exclusively in sandy to small gravelly habitats with strong open marine influences and rarely extends into the mouths of enclosed bays and estuaries such as San Diego Bay, Mission Bay, and Newport Bay in southern California.*

Unlike common eelgrass, Pacific eelgrass grows in a nutrient-poor sediment environment of clean sands in open coastal waters. This means that unlike the fast growing common eelgrass, Pacific eelgrass is slow growing and invests greater energy in sustaining its more vigorous tissues than it does in plant expansion. It is not known how important seedling recruitment is to sustaining Pacific eelgrass beds, or how commonly beds are established by seeding. However, it is likely that predictable bed reestablishment by seed is rare following extirpation events. This is based on the limited distribution of the species, the rarity of suitable habitat to support the species, and a belief that flowering in *Z. pacifica* is fairly limited, based on observation, but no focused study.

Within Port San Luis, eelgrass surveys were completed within the approximately 700-acre sheltered embayment between the Port San Luis Breakwater and the Cal Poly Pier in April-May 2020 (Figure 1). The surveys revealed the presence of 15.16 acres of Pacific eelgrass. In June 2018 Pacific eelgrass within the immediate proximity of the breakwater between Smith Island and the lee of the breakwater was surveyed and determined to total 14.19 acres. In February 2019, the same survey extent supported 13.90 acres with approximately 2 percent difference in total area between the surveys and 92 percent of the bed being stable between the survey intervals (Merkel & Associates 2019). Similar stability from spring 2018 through spring 2020 has been observed for this bed segment. Notably, approximately 94 percent of the entirety of the eelgrass present within the Port San Luis area occurs between Smith Island and the breakwater with well over 99 percent of the eelgrass occurring at the western margin of the bay with only a handful of scattered small plants extending from the consolidated larger beds eastward towards Hartford Pier.



Survey Area and Resource Overview Map
Port San Luis Breakwater Repair Sections
San Luis Obispo County, California

Figure 1

SURFGRASS

Surfgrasses are perennial dioecious marine plants in the family Zosteraceae. Torrey's surfgrass (*Phyllospadix torreyi*) and Scouler's surfgrass (*P. scouleri*) both occur at Port San Luis and both occur on the Port San Luis breakwater. Torrey's surfgrass ranges from Vancouver Island in British Columbia into Baja California. *P. torreyi* has wiry and long leaf blades that sometimes reach 3 meters in length. The leaves have a narrow round cross section that is typically less than 2 mm in diameter. It is typically found within environments subject to sand scour and intermittent sand burial. Scouler's surfgrass ranges from Sitka Sound, Alaska into Baja California. *P. scouleri* leaves are generally flat and wide (2-4 mm). The leaves are shorter than *P. torreyi*, typically reaching less than 1 meter in length. Both surfgrasses grow on rock making use of hypha-like rhizomes to anchor the plant and dense leaves arise from woody rhizomatous bundles near the plant base.

*Torrey's surfgrass (*Phyllospadix torreyi*) (left) and Scouler's surfgrass (*P. scouleri*) (right). Surfgrass is attached to the rock by holdfast like roots, but generally its colonization is facilitated by compact turf like algae.*

Surfgrass is susceptible to desiccation and heat stress and it is common to see plants that have been burned by exposure during daytime low tides. The plants are relatively robust and can recover fairly rapidly after leaf damage; however, when rhizomes are lost, the recovery may be extremely slow or non-existent. Surfgrass is resistant to sand scour and intermittent burial. Surfgrass is a climax species that recruits into areas that have already been colonized by other species. Typically, surfgrass recruitment is facilitated by turf algae that tends to effectively capture the hairy horned surfgrass seed that is adapted to catching in the tight algal turfs for establishment of new plants.

While surfgrass extends new leaves relatively rapidly when plants are damaged, the basal expansion is moderately slow and new plant establishment is similarly slow to occur. It is typical for the establishment and loss of surfgrass patches to go un-noticed and thus the general spatial dynamics of this seagrass are not well documented. However, in Morro Bay a focused effort to document marine communities in association with the Corps' annual maintenance excavating has allowed for a long-term annual tracking of the expansion of surfgrass on the breakwaters of Morro Bay. This monitoring has documented establishment of new surfgrass patches and expansion in coverage of established patches over many years since the first patch of surfgrass was detected on the north jetty in 2013. Over the subsequent 7 years surfgrass has expanded to both outer rock jetties and occurs in many tens of patches with some reaching multiple square meters in area. This recent observed spread on jetties that have been present since 1942-43 might suggest slow development of conditions suitable for surfgrass recruitment, recent extirpation and recolonization events, or relatively rapid localized recruitment of surfgrass following much less common colonization events.

Aerial view of surfgrass on the lee side of the Port San Luis breakwater is principally found on the displaced rock that persists interspersed with sand at the lower intertidal margins of the breakwater.

Surfgrass at Port San Luis has been documented both on the outside and inside of the breakwater. The majority of the surfgrass occurs on the natural rock of Point San Luis and Whaler's Island; however, additional surfgrass extends along the breakwater within area where the breakwater rock is exposed to sand scour and burial. It does not occur on the rock in cleaner water, where it likely is precluded by competition with macroalgae. As a result of its presence in areas that are influenced by sanding, the presence of surfgrass on the breakwater is predominantly focused on the inner portions of the breakwater where intertidal and shallow subtidal sand deposits occur. On the outer segment B of the breakwater where proposed repairs are to occur, surfgrass is most substantively found on the boulders that have been displaced from the breakwater and now persist on two low intertidal zone terraces comprised of a mosaic of displaced jetty rock and interstitial sand.

GIANT KELP

Giant kelp (*Macrocystis pyrifera*) is present within scattered beds on rocky bottom habitats within Port San Luis. Historically, beds have been found both inside the breakwater protection and outside of the breakwater. Over at least the past couple of years during which time surveys have been completed for the breakwater repairs project, little to no kelp has been noted outside of the breakwater within the project study area (Figure 1). In June-July 2018 no kelp was noted on the breakwater. Additional kelp surveys were conducted in January-February 2019 and kelp was not noted at this time. Because of the absence of kelp in 2018 and the absence of kelp in winter 2019, a kelp frequency analysis was undertaken to identify how often kelp occurred in the project area and along the breakwater using data from CDFW kelp canopy surveys (Merkel & Associates 2019). This analyses revealed kelp at a low frequency of occurrence (14 percent of the surveys) with presence of narrow fringes of kelp being observed, principally on the lee of the breakwater. The distribution showed kelp at the tip of the breakwater and, erroneously, on intertidal and very shallow subtidal rock not suited to supporting giant kelp or bull kelp (*Nereocystis luetkeana*). Rather it is believed that the CDFW mapping likely included the understory feather boa kelp (*Egregia menzieii*) that is present in these areas. In spring 2020, kelp was more expansive in the project study area, but canopy kelp remained absent from the inside margin of the breakwater. A small amount of kelp canopy was present in small stands near the toe of the outer portions of the breakwater and was fairly extensive in the harbor (Figure 1). Based on the frequency distribution analyses of CDFW data and observations from 2018-2020, canopy kelp is not believed to be a significant habitat resource within the work area and thus is not further addressed in this mitigation and monitoring plan.

EELGRASS AND SURFGRASS IMPACTS

PROJECT ACTIVITIES

The Corps is proposing to perform Operations and Maintenance (O&M) repairs to the Port San Luis breakwater to maintain the breakwater's integrity. The proposed work would involve repair of the breakwater by resetting and augmenting quarried jetty stone along the breakwater. The repair work would occur on the outer segment B of the breakwater that extends seaward from Whaler's Island. The repair is to be focused on the most heavily damaged 1,420 feet of the structure located between station 4+00 and the head of the breakwater at station 18+20. The footprint of the breakwater would not be changed, but the crest elevation would be raised from +13 feet Mean Lower Low Water (MLLW) to +16 feet MLLW for hydraulic stability, to accommodate larger armor stone, to meet design criteria, and to account for sea level rise. It is estimated that approximately 29,000 tons of existing stone would be required to be reset and 60,000 tons of new stone would be placed to restore the most heavily damaged portion of the breakwater.

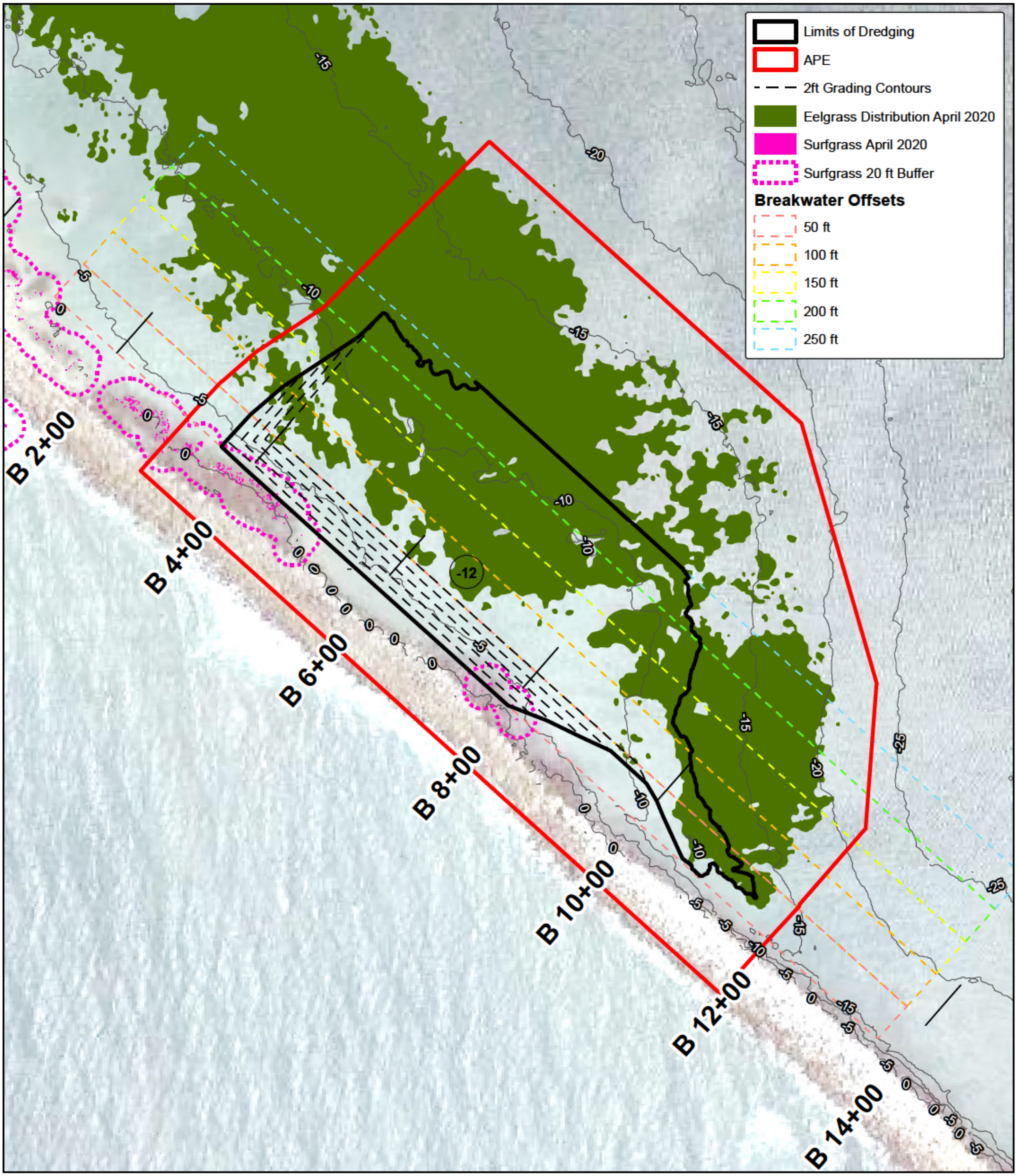
Repair work would occur from the lee of the breakwater and would extend from a low elevation at 0 feet MLLW to the breakwater crest with no work being performed on the outside face of the breakwater. All work is anticipated to be from waterside equipment, including a large crane barge, one or more rock barges, a scow, tug boats, and small crew boats, survey boats and other support vessels. The work is anticipated to require a 6-month construction window focused on the lower wave climate summer and fall months of the year.

In order to perform the work, it is necessary for the crane barge and supporting rock barge to be positioned adjacent to the east side of the breakwater such that jetty stone may be individually grappled off the rock barge and placed on the breakwater. Vessel positioning will be maintained by using multi-point anchoring or spuds or a combination. The anchor spread would need to be repositioned as the equipment is moved along the work area. The drafts of the crane barge and loaded rock barges are generally 8-10 feet and a significant portion of the leeward side of the breakwater supports an accreted sand shoal that is shallower than that necessary to accommodate access. To accommodate equipment access without vessel grounding at low tide or during periods of heavy swell would require excavating of an access channel to -12 feet MLLW.

The side-by-side width of the crane barge and rock barge is approximately 150 feet. The width of the access channel, including required breakwater toe setbacks, channel slopes, and maneuvering and positioning area for the crane barge and rock barges are estimated to be approximately 250 feet. Excavation of the access channel for breakwater repair is considered the first phase of construction activities. During this phase of work, excavation of approximately 13,500 to 15,000 cubic yards of sand would occur to cut a channel adjacent to the east side of the breakwater from approximately Station 12+00 northward to approximately Station 4+00 (Figure 2). The subsequent second phase of work would involve repositioning unstable armor stone and placing new armor stone to restore the integrity of the breakwater.

SEAGRASS IMPACTS

The excavating of the access channel is expected to result in direct impacts to eelgrass from excavating. In addition, secondary impacts around the excavating footprint may be expected to occur as a result of both controllable and uncontrollable factors. As such, quantification of potential impact extends beyond the direct footprint of work to define an Area of Potential Effect (APE) (Figure 2).



Project Impact Area Seagrass
Port San Luis Breakwater Repair Sections
San Luis Obispo County, California

Figure 2

Potential impacts to seagrasses from excavating of the access channel would occur to Pacific eelgrass. No direct excavating impacts to surfgrass are anticipated as a result of excavating. Outside of the excavation impacts, the impacts to eelgrass and surfgrass become less certain and may be substantively controlled by implementation of construction period best practices targeted at reducing potential for secondary impacts. The recommended measures to avoid and minimize secondary impacts are discussed later in this plan. However, for purposes of appropriately scaling the seagrass mitigation to avoid risks of shortfall it is best to assume a high estimate of potential impact and then work to both minimize the impact and plan mitigation for the higher level of effect.

The impacts to seagrasses that are anticipated from the project are identified in Table 1. Controllable impacts potentially occurring to eelgrass beyond the direct excavating may occur as a result of elevated turbidity from excavating, propeller thrust damage by tug boats, dragging tow lines or positioning anchor rode and spudding outside of the excavation channel, or positioning of equipment over eelgrass for a period of time resulting in shading impacts to eelgrass. Less controllable impacts may include cut bank relaxation near the upper end of the channel cut at Station 4+00 or elevated turbidity from post-excavating sediment stabilization and winnowing of fine sediments from the exposed cut areas. While the APE has been defined broadly to include proximate areas that may be affected by secondary damage, it is anticipated that little of this area will actually be impacted if construction controll measures are effectively implemented.

Surfgrass occurs within the APE, but not within the access channel excavation area. This resource is scattered in small patches right at and slightly below 0 feet MLLW and may be impacted by rock repositioning near the lower limit of work and may suffer from unplanned rock drops during work or disturbance of sediment and burial by sand as a result of changing sediment accretion patterns during the time equipment is positioned in the adjacent channel area. Conversely, the reduction of sand in the adjacent areas to the surfgrass may be expected to result in a migration of sand out of the boulder field area resulting in either a shifting of the boulders, or a reduction in sand scour and burial stress in surfgrass locations and a loss of surfgrass due to increased competitive advantage by macroalgae that is dominant to the exclusion of surfgrass within the areas of the breakwater that are not heavily influenced by sand. At present, it is anticipated that all impacts to surfgrass may be avoidable. However, potential for limited losses of this species within the APE cannot be ruled out given the very close proximity of heavy rock work and the relative unpredictability of how the rock on the sand shoals may shift in response to a combination of the adjacent excavating and the change in scouring hydrodynamics with the prolonged presence of the construction barges in close proximity. As such it is appropriate to assume some degree of impact to this resource may occur although it is very unlikely that it would be more than a small fraction of the total extent present in the APE.

Table 1. Anticipated impact to seagrasses from Port San Luis breakwater repairs

Seagrass Habitat Impacted	Estimated Impact Excavation Area	Estimated Impact Full APE
Pacific Eelgrass	7,286 m^2 (1.80 ac)	17,758 m^2 (4.39 ac)
Surfgrass	0 m^2 (0 ac)	31 m^2 (0.008 ac)

EELGRASS MITIGATION

EELGRASS MITIGATION REQUIREMENTS

Impacts to eelgrass are anticipated to range from 1.80 to 4.39 acres based on spring 2020 eelgrass surveys (Table 1). The actual impact requiring mitigation is to be determined based on pre-construction and post-construction surveys conducted under the guidance of the California Eelgrass Mitigation Policy (CEMP) (NMFS 2014). However, for purposes of mitigation planning, it has been assumed that impacts would occur to the higher 4.39 acres of Pacific eelgrass. Under the CEMP, eelgrass impacts are to be offset by restoration of eelgrass at a 1.2:1 ratio (mitigation to impact). The required initial restoration size is scaled by a regional success history factor that has been established in the CEMP and which is adjusted over time during policy review periods. At present, the minimum restoration sizing required for central California is equal to the ultimate success requirement (1.2:1) due to a 100 percent success rate for eelgrass restoration in the region. Based on the minimum requirements of the CEMP and the assumed maximum extent of impact within the APE, an eelgrass restoration project of 5.27 acres would be required to be implemented and 5.27 acres of the restoration would be required to be successful. However, it is important to note that this level of restoration success is not a good indicator for the present project in that it is based on only four projects all involving the restoration of *Zostera marina* within the protected waters of Morro Bay (NMFS 2014). Further, eelgrass restoration projects are almost never fully successful and some degree of shortage in eelgrass cover or density should be factored into the mitigation planning. In addition, the restoration of *Z. pacifica* in an open coastal system should be considered to be much less certain than restoration of *Z. marina* within a bay setting. The history of eelgrass restoration in *Z. pacifica* is much more limited with only a small handful of projects involving this species. Further, the restoration environment is more variable and unpredictable with respect to factors that may affect the restoration success such as wave environments, nutrient availability, and sediment stability.

As a result of the concerns relative to restoration of Pacific eelgrass, it is recommended that the risks in the mitigation be managed by a multipronged strategy as follows:

1) Plan mitigation needs based on an assumed high impact level;
2) Minimize impacts where practical based on construction period best practices environmental controls;
3) Aim high on the eelgrass restoration target to meet a lower mitigation requirement, and;
4) Diversify the mitigation approach to minimize the potential for a particular type of stressor impacting the mitigation areas resulting in catastrophic losses.

This approach to enhancing potential for successful mitigation has been taken within this plan.

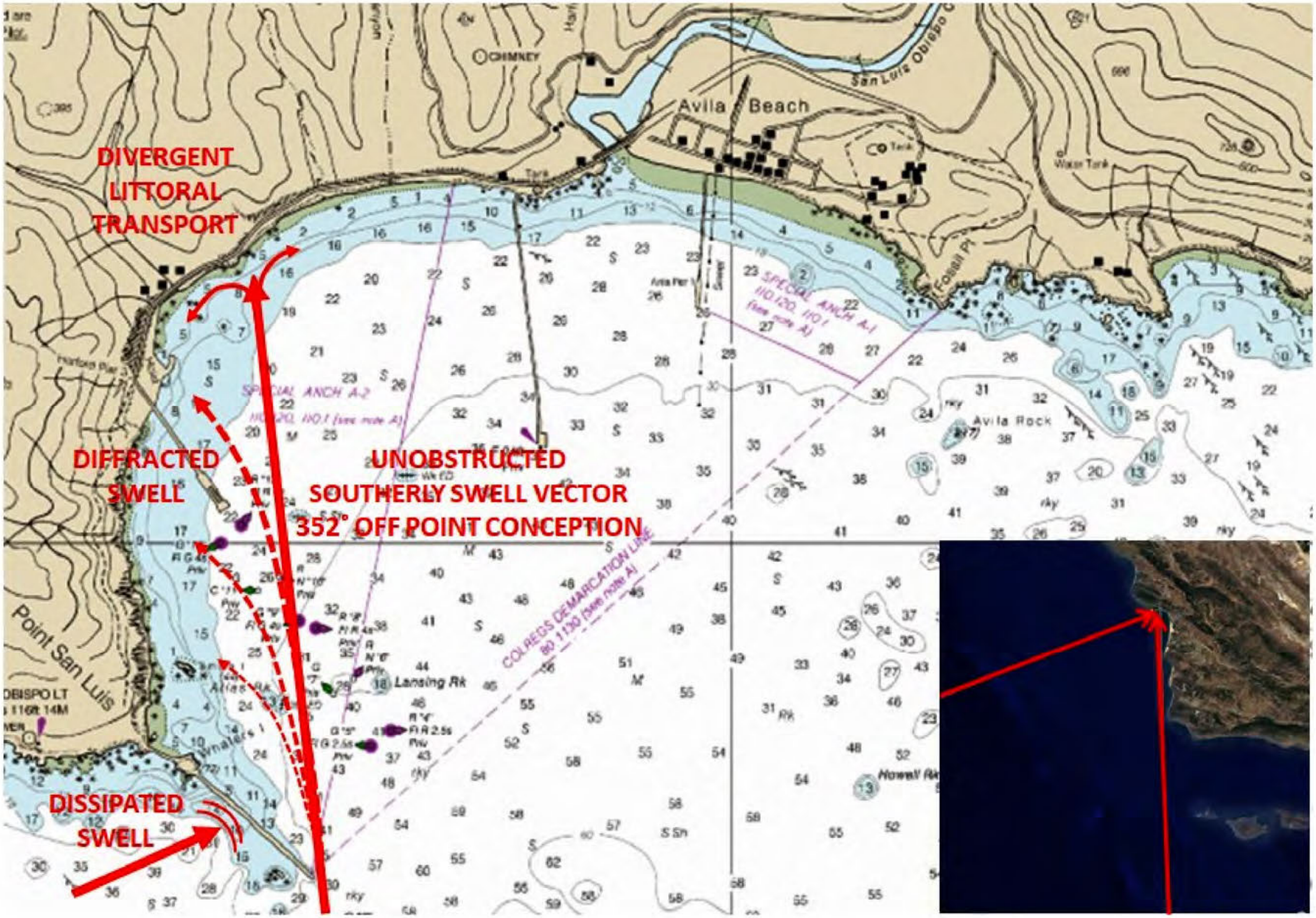
EELGRASS HABITAT ENVIRONMENTAL DESIGN FACTORS

Wave Climate

The wave climate of San Luis Obispo Bay and more specifically around Port San Luis has a considerable amount to do with the distribution of eelgrass within the bay. San Luis Obispo Bay is a typical hook shaped open coastal embayment defined by the up coast rocky headland of Point San Luis that provides a natural protection of the embayment from northerly swell (Figure 3). This protection is naturally augmented by the presence of Whaler's Island and smaller rocks further from the point that are elements of the continuing headland geology. With the construction of the Port San Luis breakwater along the natural headland rock formation axis of approximately 130˚ the wave sheltering effects within the harbor from northern and western swell conditions has been further expanded with westerly swell being dissipated on the breakwater rock and northerly swell being trained further to the south. Inner Port San Luis is exposed to wave penetration from southerly swell conditions; however the influence of the prominent Point Conception located 40 miles to the south, limits the fetch of waves approaching from the southeast, while waves approaching from the southwest are partially blocked by the Port San Luis breakwater such that the energy level in San Luis Obispo Bay diminishes to the northern and western extent of the bay towards the lee of the Port San Luis Breakwater and energy increases to the east and south within the bay towards Avila Beach with even greater exposure being seen at Pismo Beach. While the breakwater provides protection of the bay from northern and western swell, the alignment's prominent point and angle toward shore create a point of wave interference that results in diffraction of southerly swell such that a portion of the wave energy spreads to the protected waters behind the breakwater. This spread creates a moderate amount of wave energy within the waters that are otherwise protected from direct wave attack.

To better visualize the distribution of the wave climate within the project area relative to the existing distribution of eelgrass, the Coastal Storm Modeling System (CoSMoS) wave modeling developed by the United States Geological Survey (USGS) for predictions of coastal flooding was accessed and a 20-year storm scenario was run to obtain an output of significant wave height (USGS 2020). From this output, the existing eelgrass beds were used as a mask to extract a section of the model in order to determine the significant wave climate at a 20-year event within eelgrass habitat. The modeled wave climate within the eelgrass beds was then overlain on the overall wave climate plot to explore eelgrass distribution relative to the modeled wave environment (Figure 4).

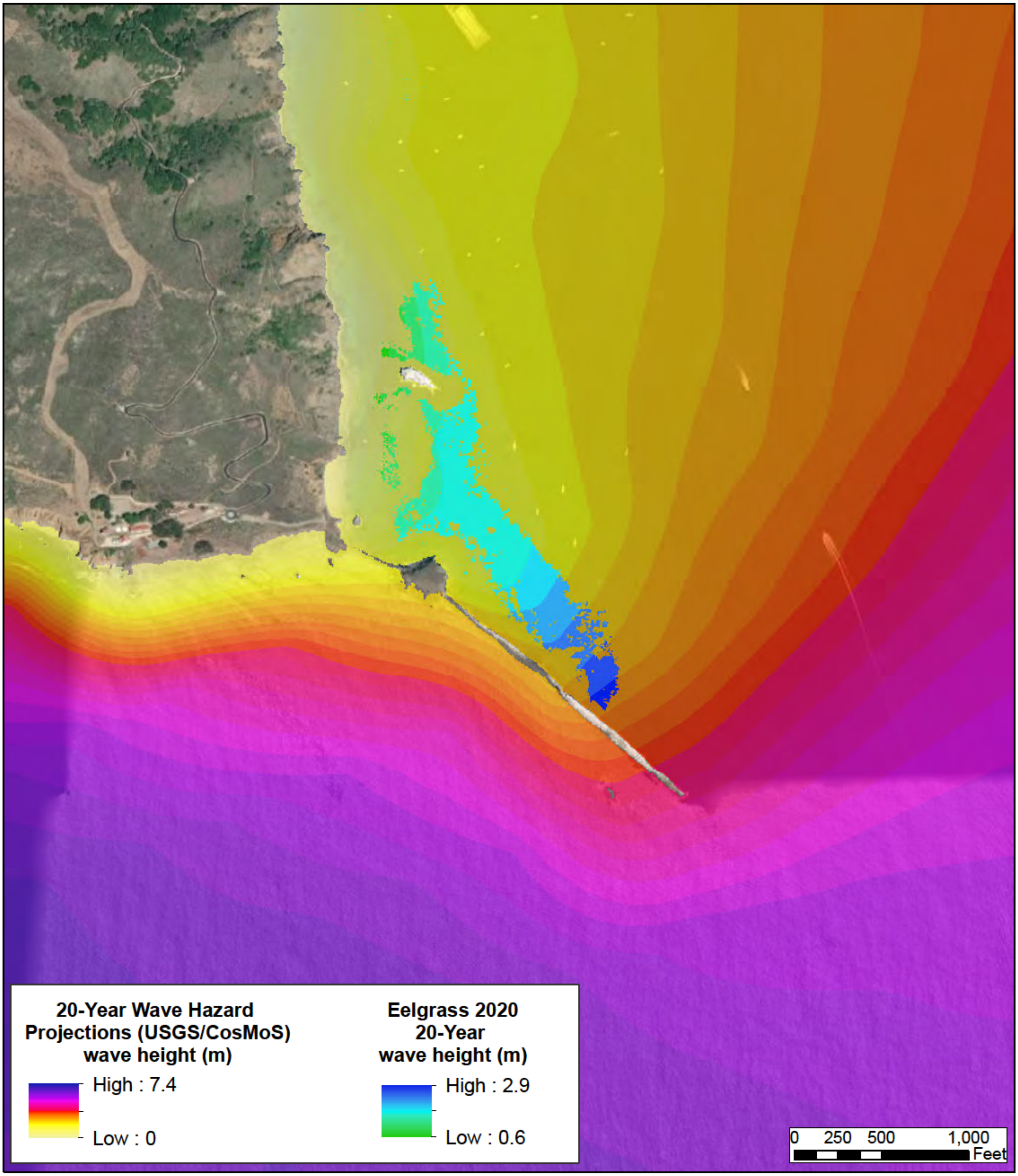
The output from the CoSMoS models appears to be somewhat coarse and suggests a wave environment on the lee of the southern end of the breakwater that seems anomalously high and not supportable by a solid breakwater. Despite the wave model predictions of significant wave heights as high as 2.9 meters in this location, most of the eelgrass is limited to a distribution within a wave climate of 1 meter or less and only deeper portions of the bed occur within higher wave climate areas. The model results are useful in explaining the relatively tight affinity eelgrass appears to have with the leeward side of the breakwater and why the beds so rapidly diminish towards the Hartford Pier to the north where the energy climate increases. However, the absolute values of significant wave height predictions and the subtleties of the model output should not be relied on as it is believed these are well beyond the model applications intended and any reasonable extension.



Overview of Port San Luis Oceanic Wave Exposure and Influence of the Port San Luis Breakwater

Port San Luis Breakwater Repair Sections
San Luis Obispo County, California

Figure 3



Port San Luis 20-Year Maximum Wave Height

Port San Luis Breakwater Repair Sections

San Luis Obispo County, California

Figure 4

One notable source of energy influencing eelgrass distribution cannot be explained by either the geometry of the site or the CoSMoS model and that is overtopping of the breakwater by westerly waves. It has been noted that the southerly end of the eelgrass beds have a large gap within otherwise similar elevations as occupied by dense eelgrass elsewhere (Figure 2 and 4). This gap was puzzling until the site was examined during a high seas state when it was noted that waves break in a concentrated form over the breakwater at this location (centered on Station 8+00) and impact heavily on the breakwater and waters on the leeward side of the breakwater. It is believed that the bottom disturbance from this overtopping may mobilize the sediment adequately in this location to prevent establishment of small eelgrass plants or larger storms may strip larger plants from the area on a recurrent basis. Because of the slow growing nature of *Z. pacifica* it is reasonable to assume that once cleared of plants it may take a considerable period for plants to recruit back to the site. While the observations made of a potential energy control are anecdotal in this instance, observations of significant damage to Pacific eelgrass beds due to storms have been made in the Malibu area where more frequent surveys were undertaken (K. Merkel, pers. obs.).

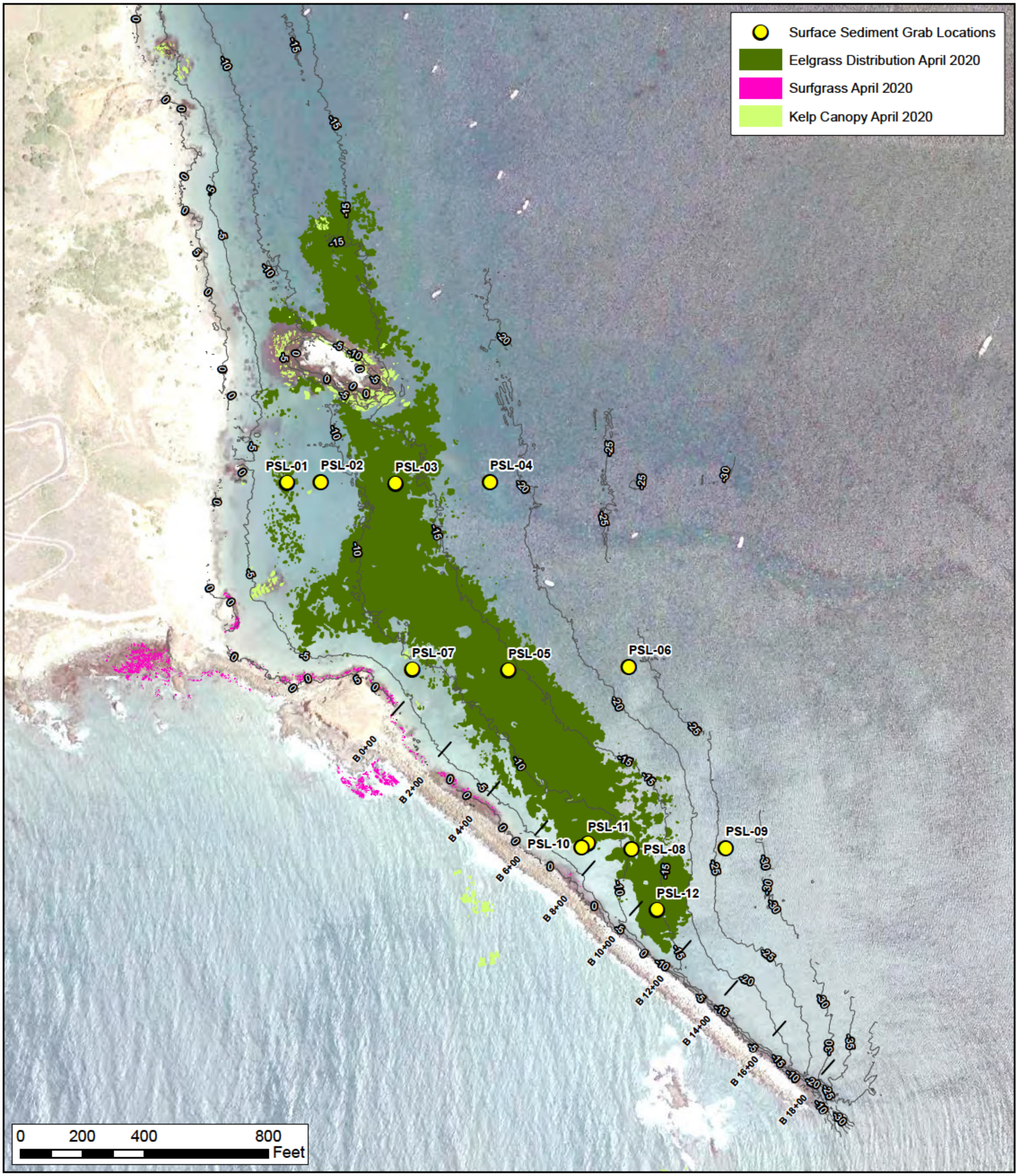
Based on the wave energy modeling, and observed distribution of eelgrass relative to the wave climate, it is believed that for Pacific eelgrass restoration to be successful it must be retained in close proximity to the present dense eelgrass beds. It is not considered feasible to restore eelgrass much further to the east from these beds.

Sediment Grain Size

As noted above, Pacific eelgrass is restricted in its distribution to sandy sediments that have limited concentrations of fine sediments. These sediments are from littoral sources rather than fluvial sources. In order to evaluate the characteristics of sediment and potential suitability of areas to receive eelgrass restoration by way of transplants, sediment grain size distribution was examined within both eelgrass supporting and non-eelgrass supporting habitat areas located in proximity to the existing beds. Surface sediment grab samples were collected at 12 locations spread across multiple transects extending through a depth gradient ranging from -7.4 feet MLLW to -26.7 feet MLLW (Figure 5). Seven of the 12 samples were collected from within eelgrass beds and the remaining five samples were derived from outside of eelgrass.

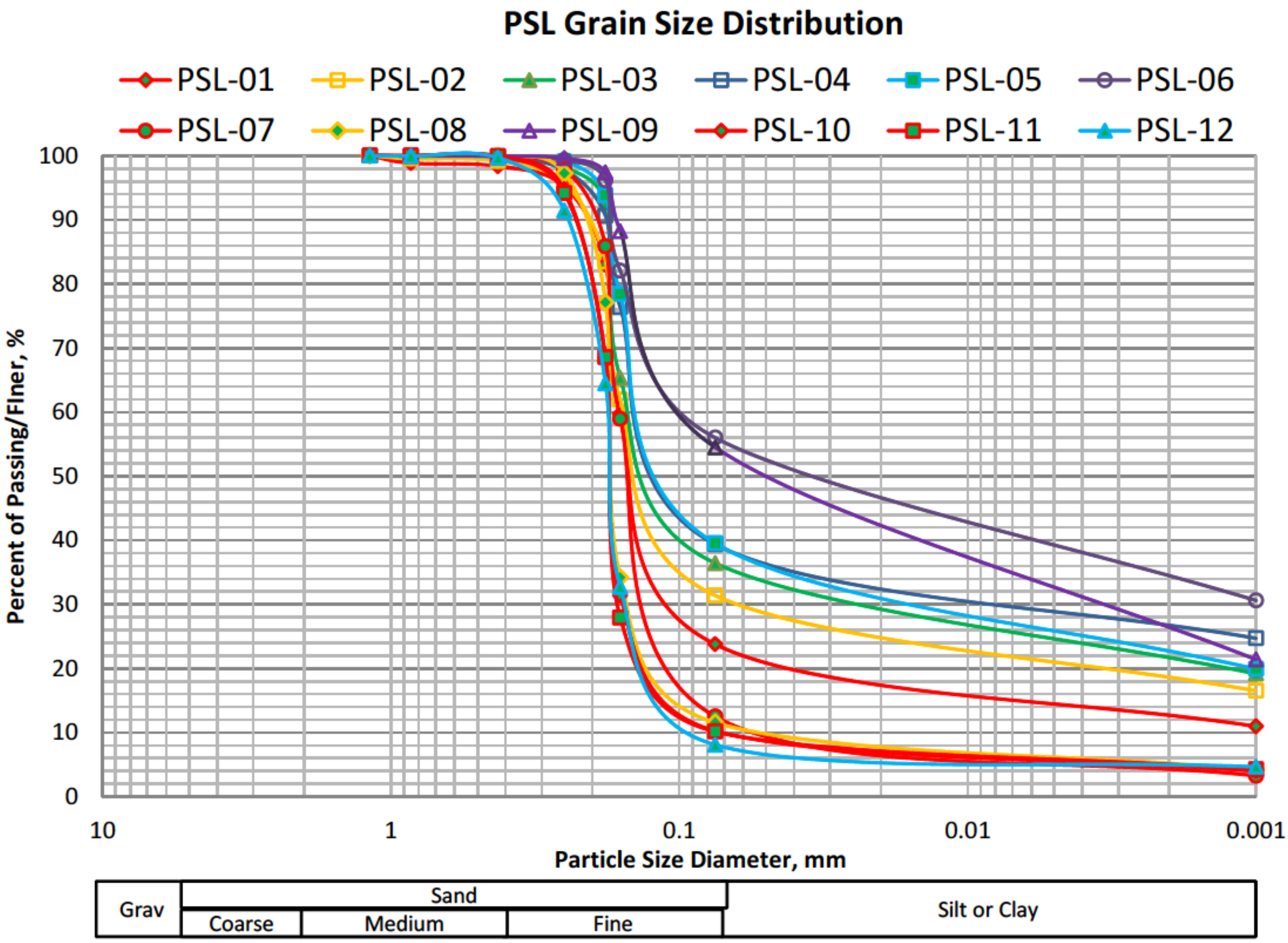
Samples were analyzed for grain size distribution following ASTM D 422 methods. Following analysis, the sediment grain size distribution curves were plotted and the median particle diameter (D50) was estimated (Figure 6). The results of the analyses indicate that fine sand dominates all portions of the study area with the range across samples being 69.4 percent sand in an unvegetated site at -23.2 feet MLLW to 96.7 percent at a site supporting eelgrass in -7.9 feet MLLW. The percent sand and D50 declined with increasing depth. Eelgrass was found in sediment with a D50 ranging between 0.10 and 0.17 mm, although all samples shallower than -18.5 feet MLLW had D50 values within this same range, irrespective of support of eelgrass. The percent sand and D50 both increased with increasing energy exposure.

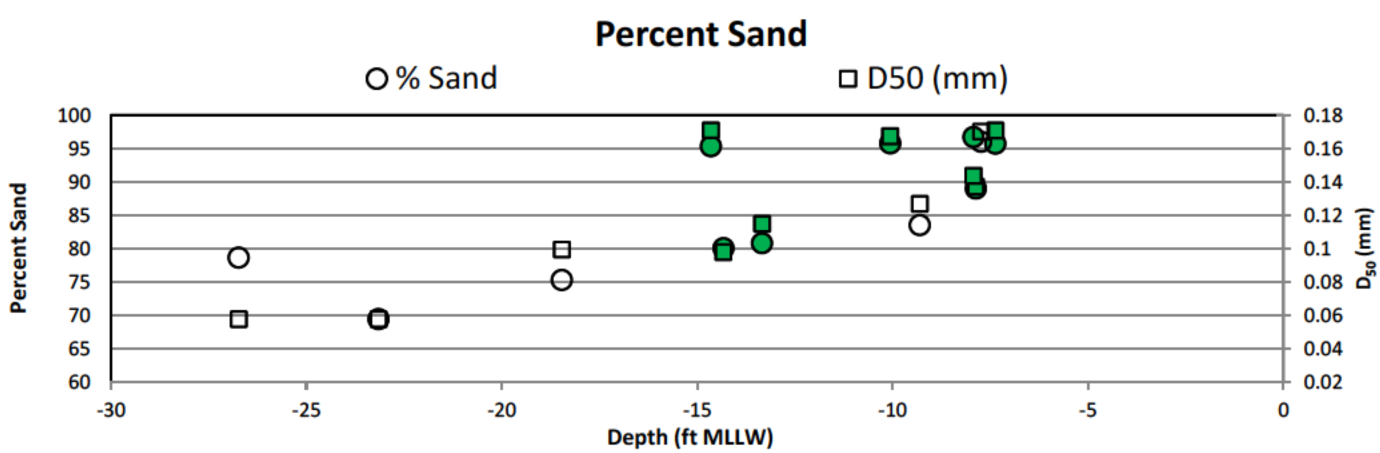
The results of the sediment grain size analysis do not provide any surprises and suggest that sediment characteristics are not likely to limit the restoration potential for eelgrass at this location. The observations also suggest that sediment grain size is a likely function of the energetics of the specific areas sampled.



Surface Sediment Grab Locations
Port San Luis Breakwater Repair Sections
San Luis Obispo County, California

Figure 5





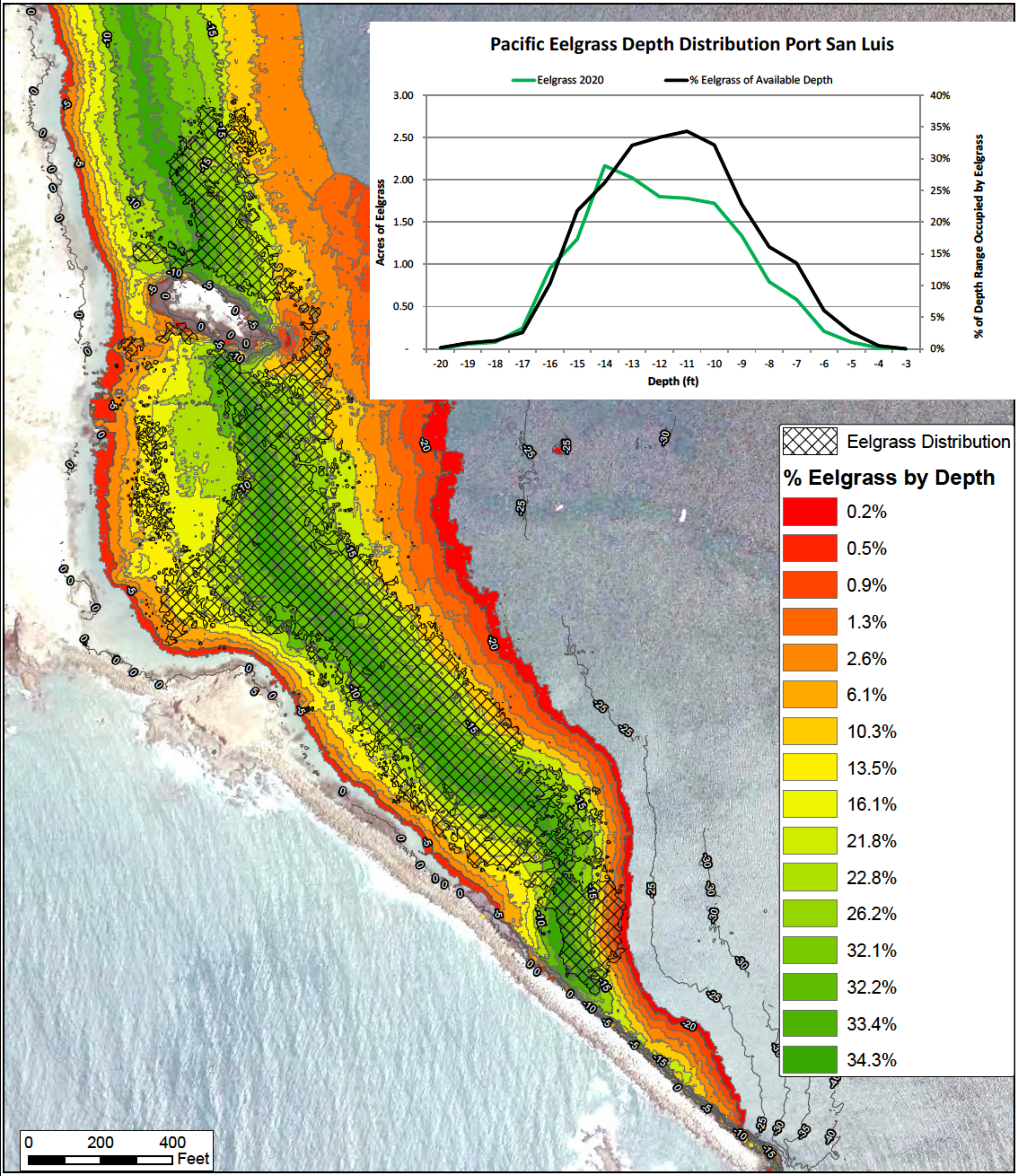
Surface Sediment Grain Size Distribution and D50 at Port San Luis Breakwater
Port San Luis Breakwater Repair Sections
San Luis Obispo County, California

Figure 6

Eelgrass Depth Distribution

An analysis of the vertical distribution of Pacific eelgrass was conducted within the project study area to determine the elevational ranges suited to supporting eelgrass at the site. This was conducted by extracting a bathymetric raster grid using the spring 2020 eelgrass distribution as a clipping mask. The elevations from the extracted bathymetry were then binned to 1 foot elevation steps and the extent of eelgrass within each depth bin was determined and the area of eelgrass present in each depth bin was calculated to create an unweighted depth distribution curve for eelgrass (Figure 7). To expand upon the analyses, the depth distribution curve was weighted by calculating the percent of eelgrass present within the depth bins based on the available area of the depth bins. In other words, this analysis divides the portion of the depth bin occupied by eelgrass by the total available habitat within the binned depth.

The results indicate that Pacific eelgrass within San Luis Obispo Bay has a depth range from -4 to -20 feet MLLW. A full 80 percent of all of the eelgrass present occurs within a much tighter range between -9 to -15 feet MLLW. When considering the availability of bottom area falling within each depth bin, a very even unimodal depth distribution emerges with depths from -10 to -14 feet MLLW all supporting an eelgrass coverage of greater than 25 percent. However, when the percent eelgrass cover by depth bin is used to produce a plot overlaying the existing eelgrass grid depicting bathymetry based on the percent occupation by eelgrass it is clear that depth alone does not account for eelgrass distribution. This is best illustrated by the non-random distribution of eelgrass within predicted high suitability depth ranges and the near absence of eelgrass from areas of apparently suitable depth located to the north of Smith Island and continuing toward Hartford Pier. However, combined with wave energy, the depth distribution of eelgrass at Port San Luis provides a good definition of eelgrass habitat potential and thus an envelope of opportunity for mitigation. It is believed from the analyses that Pacific eelgrass within San Luis Obispo Bay is limited at the upper margins and laterally along the shore by wave energy and is limited at the lower elevations by available light for photosynthesis. These constraints are considered to be fixed and thus mitigation opportunities must comport to these limitations.



Depth Suitability to Support Eelgrass
Port San Luis Breakwater Repair Sections
San Luis Obispo County, California

Figure 7

EELGRASS MITIGATION PLAN

Mitigation Approach

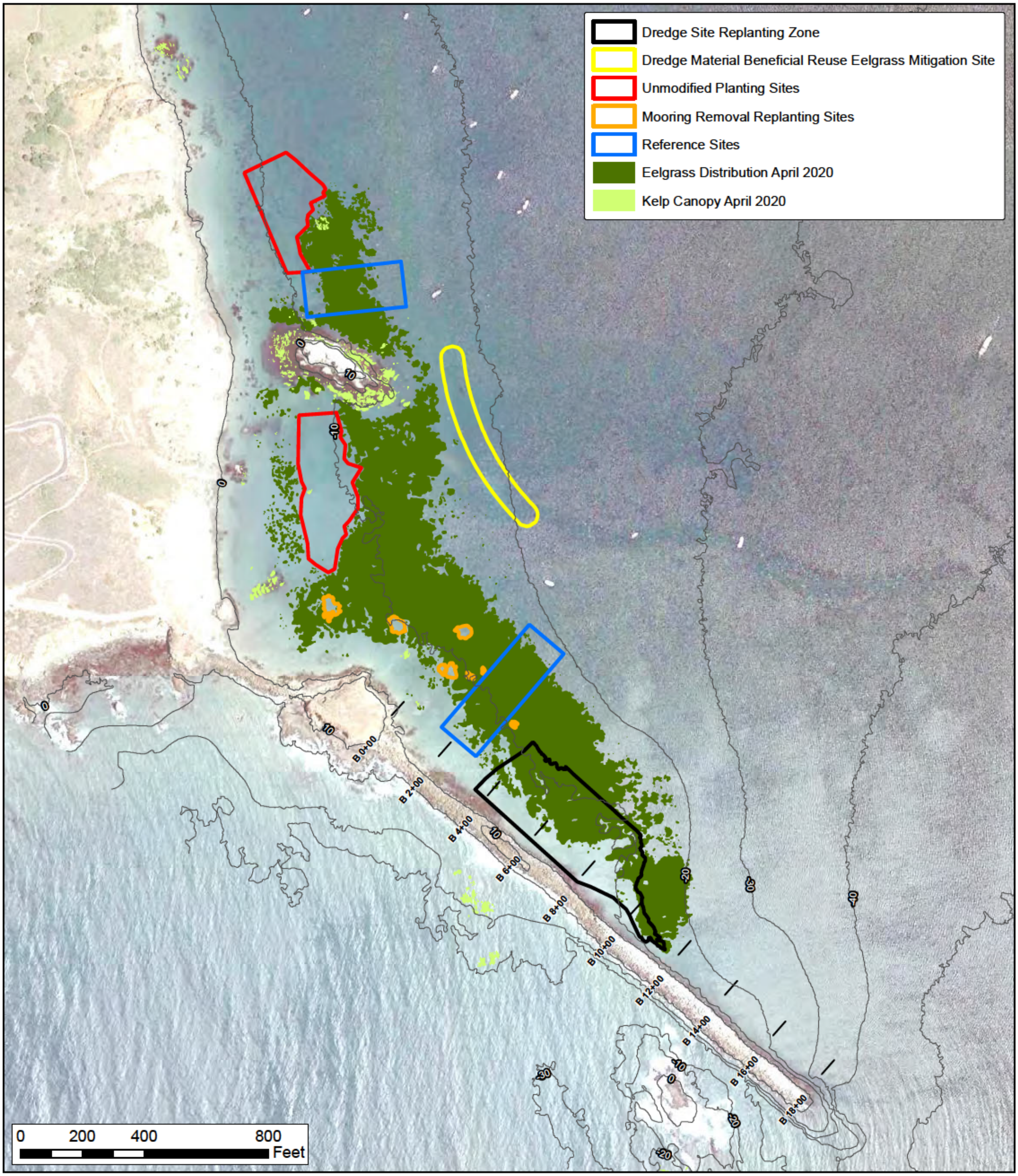
As noted above, the anticipated impacts to eelgrass range from 1.80 acres of direct impact to a maximum of 4.39 acres, including direct impacts and potential secondary impacts associated with construction activities and potential losses associated with less controllable factors including slope erosion at the head of the access channel cut, or temporary localized elevated turbidity following the excavating while fine sediments winnow out of the cut area.

Eelgrass impacts will be mitigated using a number of methodologies to be implemented at three stages of construction work to transplant eelgrass at multiple locations using multiple transplant methods. By spreading the restoration over time and planting areas and methods, it is intended that risk of failure can be controlled and later phases can be used in an adaptive approach to execute restoration activities in a manner that benefits from observed outcomes of early restoration and thus will provide a degree of opportunity to augment early plantings if appropriate. The restoration approach includes four types pf planting areas (Figure 8):

- **Unmodified Planting Sites** – This includes two plots located adjacent to existing eelgrass beds and mostly towards the shallower margin of the present eelgrass. The elevation range of these sandy sediment locations is from approximately -7 to -14 feet MLLW and is bounded within that occupied by the existing eelgrass and centered on the bathymetric range exhibiting the highest frequency of eelgrass presently (Figure7).

- **Mooring Removal Replanting Sites** – Within the inner beach margins of the eelgrass beds there are a number scars in the beds from single point moorings. Some mooring tackle remains on the bottom within some of these scars. The Corps has confirmed with Andrea Lueker, Harbor Manager, and Chris Munson, Facilities Manager, at the Port San Luis Harbor District that the moorings are not part of the permitted moorings and are not those of the District. It is not believed there are any authorized private moorings in these areas.

- **Excavation Material Beneficial Reuse Eelgrass Mitigation Site** – The excavation material reuse site is an area identified along the deeper margin of the existing eelgrass bed where excavated sand from the construction access channel may be placed to raise the bay bottom upward to an elevation suitable to support eelgrass. The material to be excavated is sand supporting dense eelgrass beds. The material would be excavated and transported by scow to the deeper waters outside of existing eelgrass where it would be bottom dumped to raise the seafloor from a deeper margin at -22 feet MLLW up to a crest elevation of -12 feet MLLW, an elevation centered nearly precisely within the depth range presently occupied by Pacific eelgrass at Port San Luis. The fill is to be set back somewhat from the higher subtidal elevations occupied by eelgrass to avoid any direct impacts from placement and to accommodate any storm driven migration of sand towards the existing beds in a manner that natural beds would not be threatened by sand overrun. The excavation and scow loading will be staged in such a manner that much of the eelgrass rhizome rich material will be placed in the upper sediment lifts of the site to facilitate mechanical excavating translocation of eelgrass.



Pacific Eelgrass Mitigation Sites
Port San Luis Breakwater Repair Sections
Stations B 6+00 to Station B 13+00
San Luis Obispo County, California

Figure 8

- **Excavation Site Replanting –** The access channel for construction work is to be cut to a floor depth of -12 feet MLLW to accommodate equipment. As a result of the sloping bathymetry away from the breakwater, the channel would not end up being a trench, but rather a terrace daylighting into eelgrass along the northeastern margin of the cut. Controlling the depth of channel cut to -12 feet allows the channel to be planted with eelgrass after rock work is completed without further manipulating the channel depths by backfilling or deepening the channel to target eelgrass habitat suitability. The channel would be planted with bare root planting units after breakwater work is completed. For this last phase of planting, it will not be possible to use a salvage approach for donor material as would be the case for earlier planting. As a result, harvested eelgrass would be derived from donor beds outside of reference and restoration sites.

- **Other APE Damage Replanting –** While not expected to be substantially impacted by the work, areas within the APE that are outside of the access channel excavation footprint may suffer some losses due to scour, shading, or cable drags. Areas supporting eelgrass that are damaged due to a transient impact are generally highly restorable by installation of planting units within the damaged areas. Often this takes the form of gap infilling around remaining eelgrass and thus it is necessary to define when gap infill will occur. Planting within the APE outside of the excavated site will occur when it is determined that the area has been damaged and eelgrass reduced from that occurring during the pre-construction surveys, when corrected for natural declines as determined using the natural reference sites. When the an impact has been determined to have occurred, any gaps that have developed between the pre- and post-construction surveys that are greater than 1 meter across will be planted with bareroot planting units at 1 meter centers.

Mitigation Phasing

As indicated by the descriptions of the mitigation work to be performed, there is a phasing component in the work in order to capitalize on salvage of eelgrass material for translocation, spreading of planting periods over different time periods, and adaptive management in the final planting actions. To accommodate the phasing of work, a phasing plan is provided.

Phase I (Prior to Access Channel Excavating):

1) Salvage harvesting of eelgrass will be conducted at an unlimited harvest level from within the access channel excavating footprint.
2) Salvaged plant material will be used to plant two unmodified planting areas and six prior mooring scars that have remained unvegetated (Figure 8).
3) The planting within these areas would be performed by preparation and planting of anchored bareroot planting units on 1-meter planting centers.

Phase II (Access Channel Excavating):

1) The first construction action for breakwater repair is the excavation of the access channel as illustrated in Figures 2 and 8.
2) Excavated sand will be placed into the reuse eelgrass mitigation site.
3) The excavation, hauling, and placement of material will be staged to favor viable rhizome rich sediment being placed in the top layer of the fill.

Phase III (Overall Construction):

1) The minimization of avoidable secondary impacts to eelgrass is to be an important objective of the construction process. To achieve, this the following measures are to be required of the contractor:
   a) Environmental training related to operations in and around the eelgrass habitat. This training is anticipated to be merged into the overall environmental training for the project.
   b) Designated equipment staging and storage areas will be identified such that any equipment not being used in the construction access corridor will be required to be stored or staged outside of the beds in a storage area monumented by buoys.
   c) Buoys are to be placed along the eelgrass margin near the sediment reuse site to aid in protection of eelgrass while scows are positioned for site construction.
   d) Spudding, anchoring, or tugs used to position equipment will not be operated or placed on or over eelgrass habitat located outside of the designated APE..
   e) The contractor shall be required to submit an anchoring and positioning plan demonstrating the maximum avoidance of eelgrass that can be achieved in a safe and cost effective manner to include consideration of equipment orientation to minimize anchor rode seafloor contact in eelgrass areas, use of cable floats as may be appropriate, or other means to avoid physical damage to eelgrass habitat. Should initial planned measures to protect eelgrass be determined to be ineffective, these will be adaptively revised as needed during construction.
   f) To reduce the potential of shading losses of eelgrass, operations shall conducted in a manner that does not results in continuous daytime positioning of equipment over the same area of eelgrass for more than 14 consecutive days with an equivalent time period during which the equipment is not positioned over the eelgrass prior to returning to an area should additional work be required.
   g) Tug boat propeller wash scour will be avoided by operational procedures and tug operators will be specifically instructed on the need to protect the eelgrass against damage by grounding of equipment or propeller wash.
   h) Turbidity generation will be controlled throughout construction
2) Construction biological monitoring will be undertaken to ensure contractor compliance with environmental measures and to support completion of regulatory compliance obligations associated with the construction.

Phase IV (Post Construction):

1) The effectiveness of construction period impact control will be evaluated by completion of pre- and post-construction eelgrass bed distribution and density surveys in accordance with the standards of the CEMP. The surveys will provide a determination of the final impact area and that which is required to be mitigated. While it is expected that this will reduce the mitigation need, it is not anticipated that it would alter the initial restoration effort scaling.
2) Eelgrass is to be harvested from donor sites not including reference sites or transplant sites in order to support the replanting of the construction access channel.
3) During the post-construction survey, prior eelgrass transplant sites that were planted prior to start of work (approximately 6 months prior) would be reviewed and any significant gaps in the transplant coverage would be identified. These areas, including gaps within the

beneficial reuse site that were not colonized by eelgrass resprouting from the mechanical translocation, would be planted concurrently with the access channel.

Transplant Area and Anticipated Yield

The eelgrass impact area is expected to range from 1.80 to 4.39 acres depending on effectiveness of impact controls during construction and natural, uncontrollable or unpredictable factors. In order to mitigate the impact, a successful establishment of 2.16 to 5.27 acres of eelgrass would be required at a 1.2:1 mitigation ratio. This impact would be mitigated by eelgrass restoration totaling 5.89 to 8.48 acres to yield the required compensation area at a 1.2:1 ratio (Table 2). This initial planting restoration ratio ranges from 1.93:1 up to 3.27:1 based on comparing the high and low impact areas to the high and low restoration planting areas. As a result, the planting area exceeds the minimum planting area and the minimum successful mitigation area needs under the CEMP.

Table 2. Anticipated impact to seagrasses from Port San Luis breakwater repairs

Mitigation Sites	Acres	Timing
Unmodified Planting	2.84	Before Access Channel Work
Mooring Removals	0.20	Before Access Channel Work
Sediment BU Reuse	1.05	During Access Channel Work
Excavation Replanting	1.80	After Breakwater Work
Other APE Damage	<2.59	After Breakwater Work
Total Area	**5.89-8.48**	**Approx. 6-12 mo duration**

Adaptive Management Plan

Pacific eelgrass impact mitigation poses risks and uncertainties that differ from the mitigation of impacts to common eelgrass impacts. First, there are few examples of restoration projects that have been undertaken with this species; and thus, it is likely that not all issues associated with restoration of the species have been encountered previously. Second, the species is slower growing than common eelgrass; and thus, rates of establishment can be expected to be slower than for common eelgrass. This means that escalating establishment milestones within the CEMP that require distinct coverage and density goals to be met at each annual milestone may be harder to achieve than for common eelgrass, where such milestones are generally easily met. Finally, stressors affecting *Z. pacifica* restoration tend to be episodic and random such as major storm damage; while stressors affecting *Z. marina* restoration tend to be more predictable. These factors may influence eelgrass mitigation success and are the reasons for implementing a diversified mitigation program that spreads the mitigation across multiple sites and depths, uses differing restoration approaches, and stretches the planting across differing timeframes both minimizing risks associated with a particular planting period and providing opportunities for adaptive management. While the plan as outlined is believed to adequately mitigate risk and provide a good potential for successful mitigation, the following adaptive management measures are to be undertaken:

- The status of each restoration element will be separately tracked to assist in identifying strong and weak performers in the mitigation program;
- Assessment of plant expansion rates will be undertaken to evaluate the likelihood of meeting interim establishment milestones;

- Check-in coordination with NMFS and CDFW will occur following each monitoring event to communicate status of the restoration and any adaptive management actions planned to be taken as corrective actions (e.g., augmentation of a restoration approach, expansion of a planting area, increase of plant density, or replanting areas in subsequent phases).

Conflicts with Other Water Uses

In developing the eelgrass mitigation plan, the proposed activities were coordinated with the Port San Luis Harbor District. During this coordination, issues and conflicts were identified in a few locations. The conflicts were discussed, and solutions were identified that are supportable by the Corps and Port San Luis Harbor District. These issues are discussed below:

Excavation Material Beneficial Reuse Eelgrass Mitigation Site:

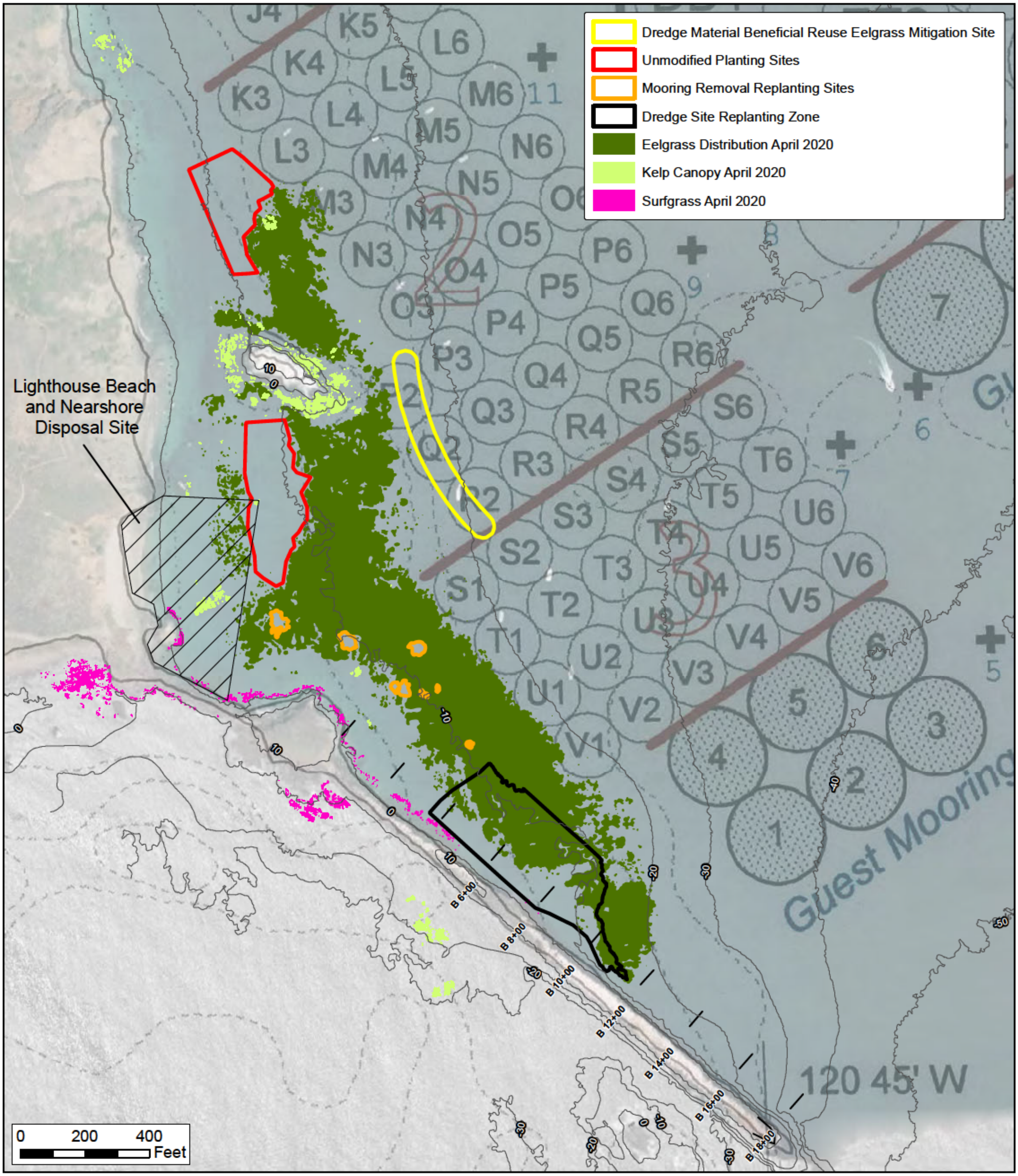
The proposed sediment reuse plateau does not directly conflict with active Port San Luis Harbor District moorings; however, it would be expected to conflict with future installation of three approved moorings P2, Q2, and R2 in the Port San Luis Harbor District Mooring Chart (Figure 9). The solution proposed has been the relocation of these moorings into an alternative areas of the field away from eelgrass or kelp resources when the Port San Luis Harbor District updates moorings and any required permits and approvals. By use of a future relocation strategy, these 3 mooring sites will not be lost, but rather relocated, thus leaving the Harbor District mooring capacity intact.

Mooring Removal Replanting Sites:

The Corps identified mooring scar replanting as part of the mitigation plan. The Harbor District noted that the scars are not on any of the Harbor District mooring maps and are not Harbor District moorings. There is no conflict with the Harbor District in removing these.

Overall Eelgrass Mitigation Plan:

The Harbor District has noted that the eelgrass mitigation and existing eelgrass beds are located adjacent to Lighthouse Beach, the small pocket beach on the leeward side of the breakwater. Lighthouse Beach and an adjacent nearshore disposal area off this beach comprise a 5-acre area designated as a receiver site for excavated sand from maintenance excavating under the Port San Luis Harbor District maintenance excavating permit (SPL-2014-00063) that runs through February 25, 2024. Under the permit, excavating is completed to maintain the harbor area from Hartford Pier to north of the Boat Hoist Launch Basin. To date, Lighthouse Beach has not been used as a disposal site under the permit. The presence of naturally occurring seagrass beds and one of the proposed unmodified planting sites in this plan would preclude future use of this beach as a disposal site without considerable planning effort. While the unsuitability of this area for maintenance sand disposal is not an impact of the breakwater repair project, it clearly should be avoided for maintenance material discharge under the present permit, and the disposal capacity of this beach should be shifted to an alternate location when the District commences work on the replacement permit for the present maintenance permit. No specific site is being identified for the alternate disposal location, but it is appropriate to contemplate this shift for a future permit cycle and to confirm the Harbor District's knowledge of the significant resource conflict so that material is not placed in the site under the current permit and that an alternate site is added by the Harbor District at the appropriate permit renewal stage. No known unresolved issues remain with the Port San Luis Harbor District.



Eelgrass Mitigation Sites and Existing Eelgrass Beds with Port San Luis Moorings

Port San Luis Breakwater Repair Sections

San Luis Obispo County, California

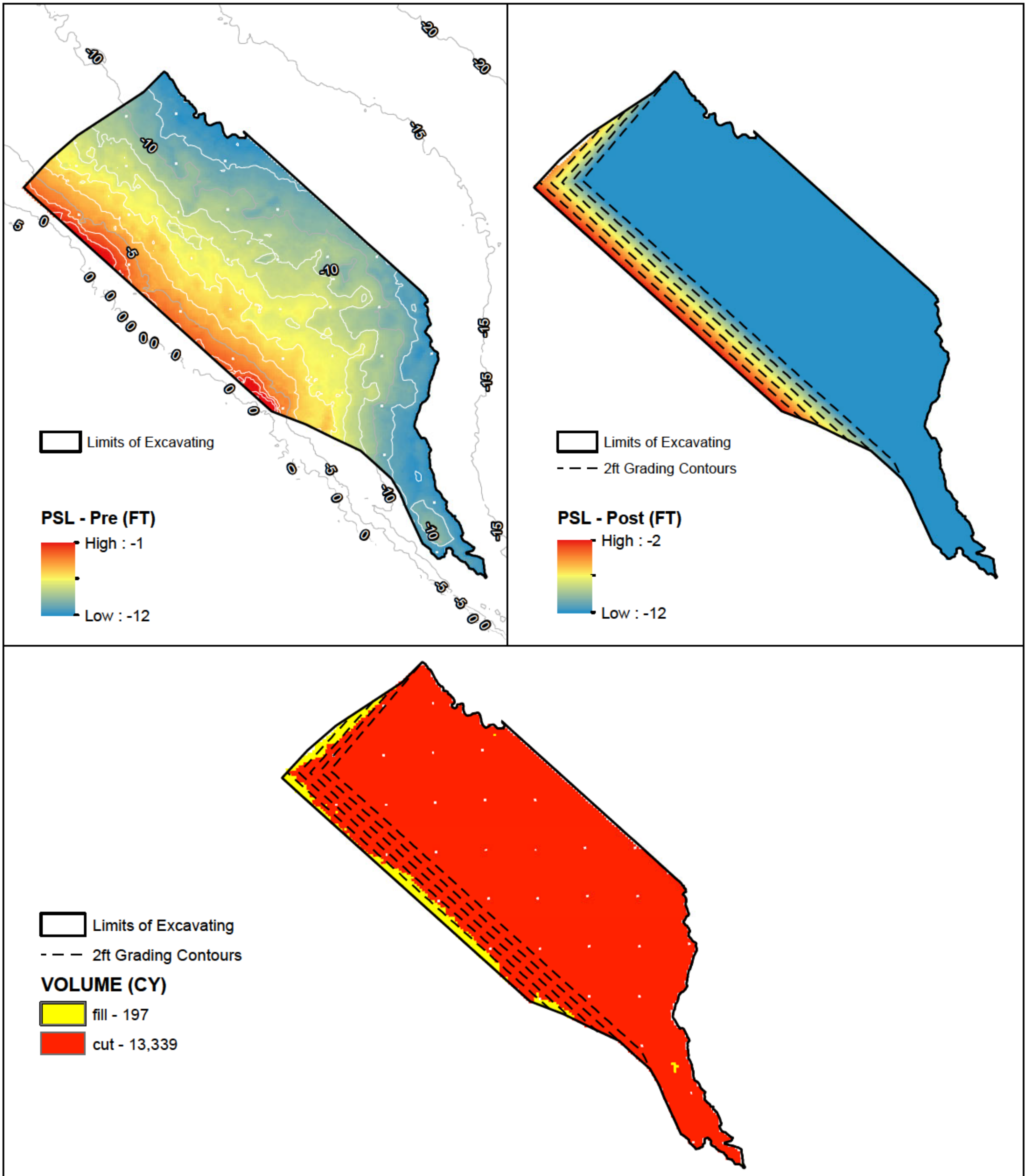
Figure 9

Access Channel Excavating and Beneficial Reuse Plateau Design

The present eelgrass mitigation plan is intended to provide a plan suitable to support eelgrass mitigation in the context of the Corp's breakwater repair project. As such, an excavation concept was developed to estimate project impacts to eelgrass. The excavating plan was developed by M&A working in conjunction with access needs provided by the Corps and equipment information garnered from marine contractors as well as through measuring rock repair work construction spreads captured in Google Earth aerial photography. Excavation planning was performed using bathymetric data provide by the Corps. The access channel floor elevation was developed through an evaluation of draft needs for equipment proposed and goal seeking to optimize the cut depth to support eelgrass. This led to the minimum safe access channel cut possible at -12 feet with an allowance for a depth up to -14 feet MLLW; however, over depth should be minimized. The tin to tin quantity estimated from the channel excavating was determined to be 13,339 cubic yards of cut (Figure 10). This does not account for any over depth volume or continued accretion of the shoal prior to construction. A separate estimate of excavation volume considering these factors was made by the Corps at 15,000 cubic yards. As a result, it should be assumed the cut volume will range between approximately 13,500 and 15,000 cubic yards. Note that, while the -12 foot depth should be achieved in the channel, over depth excavating is not encouraged under this plan.

In some cases, excavating by clam shell excavating methodologies requires subsequent mechanical flattening of the excavated surface to achieve a suitable planting surface that is leveled to eliminate high rugosity that can result in trapping of detritus in depressions or slopes that are too unstable to support planting units. This is addressed by incorporation of tight vertical tolerances, as well as surface slope tolerances. In the case of the present work, it is not believed that tolerances beyond a requirement for excavating to -12 feet MLLW with up to 1 foot unpaid over depth and not more than 10 percent of the site falling below -13 feet MLLW. The unconsolidated sandy nature of the sediments, the high swell environment, and the approximately 6-month long construction period is expected to provide ample time for the sediment in the excavation cut to flatten and become suitable to support plantings without subsequent manipulation of the site.

The Contractor for the breakwater construction should be required to provide a excavating plan that outlines the details of how the excavating and filling of the reuse eelgrass mitigation site plateau will be conducted. The excavating of the access channel should be completed by working from the breakwater outward with the filling of scows in order to ensure that the thinnest excavation cuts in the densest eelgrass will be placed in the uppermost layer of sediment in the reuse area. Scows should be filled and dumped during the same day (24-hr period) in order to minimize decay of eelgrass tissues in the held sediment. The Contractor may offer an alternative excavating operation plan that meets the intent of the mechanized equipment eelgrass translocation. Such a plan would be evaluated by the Corp to assess its suitability to achieve the eelgrass translocation goals.

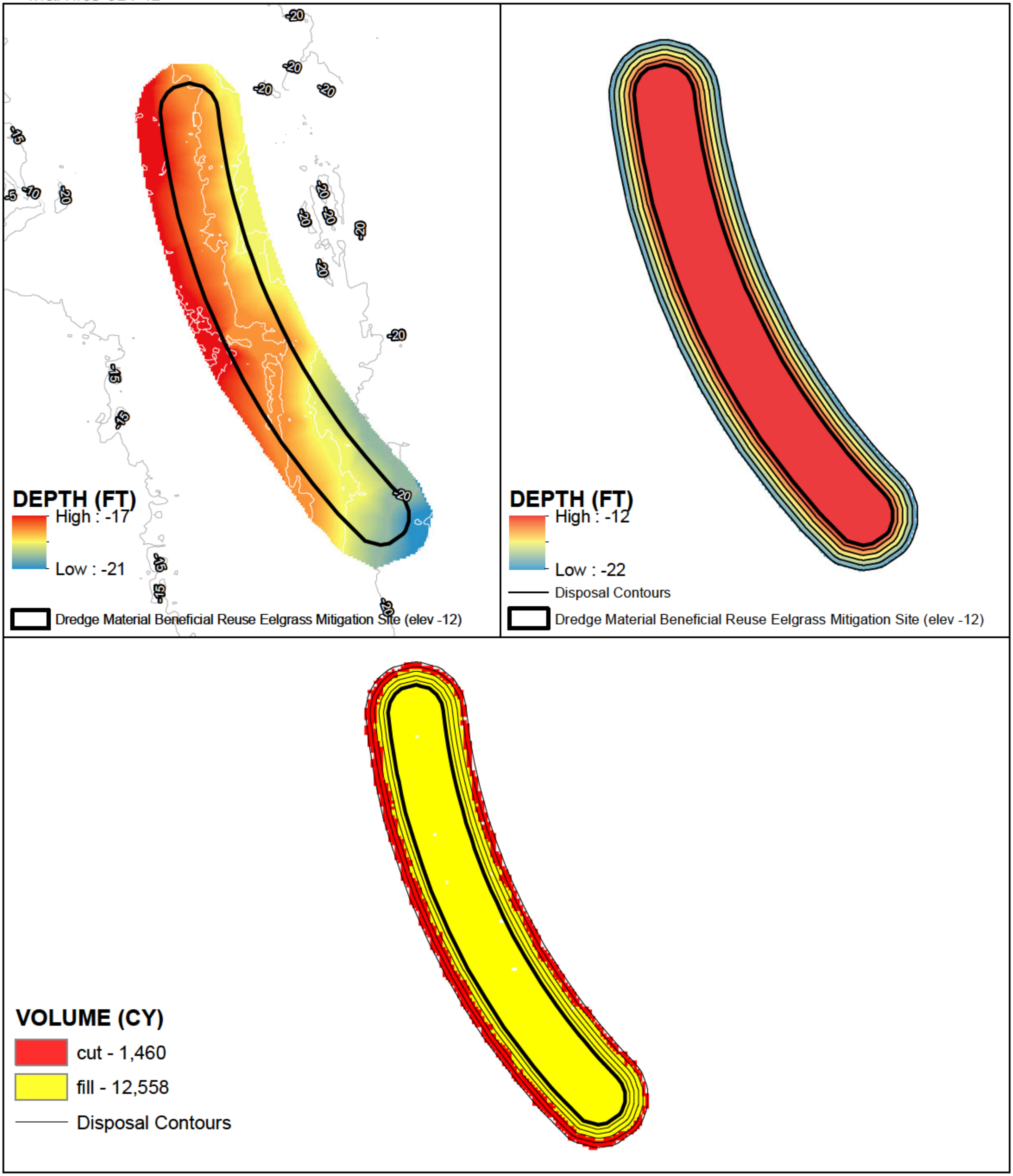


Access Channel Excavating Footprint Template and Rough Volume Calculation
Port San Luis Breakwater Repair Sections
San Luis Obispo County, California

Figure 10

The sediment reuse site has been designed to maximize the area suitable for eelgrass while remaining well outside of the adjacent eelgrass beds. In general, the feature aligns contour parallel with the sloping seafloor (Figure 11). The planned fill is illustrated at only 12,558 cubic yards, although the intent is to accept all excavated material from the access channel. As a result, the size of the plateau may be required to be expanded slightly towards the east and south to exactly balance the excavation cut volume. It is not expected that placed material will yield any substantive consolidation of the underlying sediment as the sediment is comprised of clean sand and would not be highly compressible material.

The targeted elevation of the reuse site is -12 feet. It is expected that fills brought to only slightly above this target will remain close to the final elevation due to low compressibility of the material being excavated and that underlying the fill. Given the position of the fill and the level of exposure of the site to some long-period swell energy, it is expected that sand will weather off the top and southeasterly tip of the site and be translocated north and westward. However, the site is protected to a degree by the eelgrass beds and shallow water shoal located further south along the breakwater; and thus, erosion is not anticipated to be exceptionally significant or rapid and eelgrass establishment on the plateau will further reduce this issue.



Eelgrass Mitigation Site Volume Calculations Will be Adjusted to Balance Cut Volume

Port San Luis Breakwater Repair Sections
San Luis Obispo County, California

Figure 11

EELGRASS RESTORATION EXECUTION

Eelgrass restoration for the project is expected to require extensive planting units to be prepared and planted with short holding times of less than 48 hours from harvest to planting. In addition, the work requires harvest of a large amount of eelgrass. In order to ensure that plants are not unduly exploited or stressed as a result of wasted material or long-holding time, considerable coordination and transplant management is required. Efficient workflow must be maintained.

Transplant Sites

The transplant sites to be used for mitigation purposes are illustrated in Figure 8, and acreage to be planted are summarized in Table 2. A portion of the restoration area consists of unmodified planting sites and prior mooring scars to be restored. The other restoration sites are the access channel excavating sites that will be planted following construction and the beneficial reuse areas that may be supplemented concurrent with the planting of the access channel, should the initial mechanical excavation translocation of material during construction fall short of the desired eelgrass establishment levels. The sites have been discussed previously in this document.

Donor Sites

Donor eelgrass for the transplant will be salvaged from within the access channel excavation cuts for the initial unmodified planting sites and the mooring removal sites. The number of planting units required for these areas is summarized in Table 3. Salvaging of material from the access excavation channel will allow for unrestricted harvest from the area to be excavated with subsequent harvest occurring at a less than 10 percent of the rhizomes available level in order to protect the eelgrass habitat from over harvest. In May 2020, eelgrass within the APE was determined to have a density of 54.4±17.5 turions/m^2 (n=20), while the combined density of the reference site was determined to be 39.2±18.3 turions/m^2 (n=20). Based on the 7,286 m^2 area of the excavated access channel and the turion count average of 54.4 turions/m^2, an estimated 396,358 turions are available in the excavation footprint, and a high estimated total harvest is anticipated to be 98,423 (Table 3) or approximately 25 percent. The remainder of the eelgrass would be mechanically translocated to the beneficial reuse area.

Table 3. Potential maximum eelgrass planting units required to support transplants

Mitigation Sites	Acres	# Planting Units (# Turions)
Unmodified Planting	2.84	11,493 PU (91,948 turions)
Mooring Removals	0.20	809 PU (6,475 turions)
Sediment BU Reuse (replant if needed)	1.05	4,249 PU (33,995 turions)
Access Excavation Channel Replanting	1.80	7,285 PU (58,277 turions)
Other APE Damage (plant if needed)	<1.50	10,472 PU (83,779 turions)
Totals	**5.89-7.39**	**34,308 PU (274,474 turions)**

For the later phase of planting of the access excavation channel following completion of breakwater work and any supplemental planting of the beneficial reuse area as well as areas potentially damaged in the APE but not the excavated channel, the maximum number of turions required to prepare planting units is estimated at 176,051. This would result in the requirement to spread harvesting over 11.1 acres of the existing eelgrass bed to remain below 10 percent harvest levels. The large areas required to meet the harvest requirement is based on the low turion density of *Z. pacifica* compared to *Z. marina* and the conservative assumptions applied to calculate potential upper threshold harvest needs. This included assuming all potential planting and replanting would be conducted, eight turions are used in each bundle rather than six, and the eelgrass bed more closely reflects the very low density of the reference area rather than the higher measured density of the APE. Because of the large donor areas required, the entire eelgrass patch has been designated as a donor bed except for the identified reference sites and the restoration plots.

Reference Sites

Eelgrass reference sites are identified in Figure 8 and have been selected to represent the characteristics of the entire bed and the widely distributed mitigation sites. Reference sites straddle the eelgrass bed from the highest to the lowest elevations and are well aligned to represent all of the mitigation site conditions. Monitoring of the reference sites will be conducted coincident with the monitoring of the excavation and re-use transplant areas. Changes in the reference sites over time will be considered to represent natural environmental variability when evaluating the performance of the transplant sites (see Monitoring Program sections).

RESTORATION METHODS

California Department of Fish & Wildlife

Under California Fish & Game Code (CFGC) Section 1002, Title 14, CCR Section 650, a Scientific Collection Permit is required to remove eelgrass from waters of the State and under CFGC Section 6400 written authorization is required to plant any aquatic plant into waters of the State. The approval for this translocation activity is administered by the California Department of Fish and Wildlife (CDFW) and granted by permit to the entity physically conducting the collection and transplant activities. Prior to commencing eelgrass transplantation work, permission to harvest and plant eelgrass for the project will be obtained from the CDFW. The restoration Contractor shall be required to demonstrate experience with Pacific eelgrass habitat restoration.

To collect and transplant eelgrass and surfgrass for mitigation, a Scientific Collecting Permit (SCP) from the Department is required. The SCP may include conditions such as donor bed surveys, limits on number and density of turions collected, methods for collection and transplanting, notification of activities, and reporting requirements. The Department recommends submitting the SCP application at least three months in advance of the anticipated collection start date to allow adequate time for review by Department staff.

Plant Collection

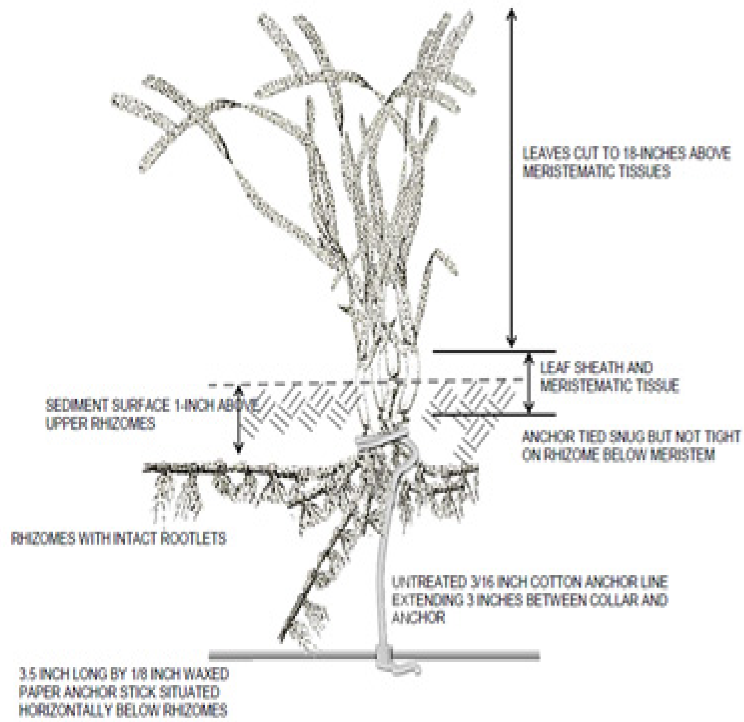
Prior to commencing eelgrass transplants, plant materials will be collected and preserved for future genetic analyses by others. These plant samples will be transferred to NMFS or sent to a third party as directed by Bryant Chesney, NMFS.

Bare-root eelgrass plant material will be salvaged from the donor beds by "raking" rhizomes out of the surface sediment layers and loosely filling a mesh bag with salvaged material. In collecting eelgrass, care will be taken to work the rhizomes free as opposed to ripping the plants free of the sediment. This will preserve as much root material as possible. Salvaged materials will consist of no less than three healthy internodal segments with well-developed root initiates and vigorous shoots. More intact rhizome segments and roots are preferred for use in the planting unit bundles. Salvaging is a mobile exercise and harvesters will move systematically through an area and collect/groom no more than 10 percent of the plant material within a donor bed. At excavation sites, harvesting may be conducted at a 100 percent level if the site has not been excavated previously. If the site has been excavated, then only the loose eelgrass along the excavation cuts of the site margins may be harvested completely.

Collected material will be held in a flow-through seawater source until it is processed into planting units. No material will be stored for over 24 hours from harvesting to unit preparation. Once units are prepared, they will be stored in open water for no longer than 24 hours for a maximum total of 48 hours of storage from harvest to planting with storage generally being loose in flowing seawater or within mesh nets in the bay.

TRANSPLANT UNITS

The proposed mitigation will utilize anchored bare-root transplant units. Bare-root transplants are the preferred means of transplanting eelgrass in most situations, and anchored bare- root units are the principal planting units used in large-scale restoration projects at the current time. The survival of such planting units has been shown to be quite high when properly prepared (Fonseca *et al.* 1982; Merkel 1987, 1990a). Similarly, bare-root units have shown an ability to rapidly expand and colonize bare substrate (Merkel 1990b). In addition to offering high unit survival and rapid expansion rates, bare-root units can be prepared with limited damage to the donor bed. Unlike plug extractions, bare-root units can be prepared using materials collected without substantial sediment disturbance. Each transplant unit for the project work will consist of 6-8 turions.



The Merkel Anchored Bare-root Eelgrass Planting Unit consists of a bundle of turions with intact rhizomes with a minimum of 3 nodes and internodes held on a biodegradable anchor consisting of a cotton twine collar that connects to a wax impregnated paper stick anchor situated horizontally below the planting unit.

The anchors used in this program will be biodegradable and pliable anchors such as those developed initially for transplants in Mission Bay's Sail Bay (Merkel 1987) and which have subsequently been used in more than 86 eelgrass restoration projects throughout California, Oregon, Washington, and Alaska. These units have been used in successful transplanting of Pacific eelgrass within both Mission Bay and Lower Newport Bay.

PLANTING EELGRASS UNITS

Planting at all excavation and re-use transplant sites will be conducted by planting along temporary planting lines laid by spooling weighted lines out from a surface vessel navigating consecutively spaced lines using RTK GPS. By setting lines in this manner early in the day prior to afternoon winds, lines can generally be set with extreme accuracy of less than one meter error. Lines are marked with uniquely identified buoys to allow for location, information management, and surface based retrieval after lines are planted. Using planting lines, the restoration sites are to be planted on 1-meter centers. This layout will allow for ease of tracking work progress and completion of quality control reviews.

The plant materials will be planted by excavating a hole in the sediments with a small trowel or by hand. Each anchor will be planted parallel to the sediment surface and the root/rhizome bundle will be planted approximately 3 to 5 cm below the sediment surface with the anchor being placed approximately 15 cm below the sediment surface. During planting, spot checks of the plantings will be made to ensure proper planting depth and firmness of the anchoring system.

Planting unit spacing is typically determined by balancing the rate of bed establishment with the cost of the transplant project. In some instances, rapid bed establishment is required to minimize potential storm damage or scouring of unconsolidated rhizome mats. In other cases, rapid recovery rates are desirable to meet bed establishment milestone objectives. Taking into account the rate of eelgrass growth, a planting unit spacing of one meter on center will be used for direct transplanting activities.

TIMING OF THE RESTORATION WORK

Under the planned construction schedule, physical work on the breakwater repairs would be targeted to be completed during the summer and fall months, when sea state allows for the most effective and controlled construction with the least amount of swell or storm interference. This means that the pre-construction eelgrass restoration activities would be completed ahead of the summer months of the year of construction during the spring (April-May) and the subsequent post-construction eelgrass transplant would occur during the following spring (April-June) based on the construction terminating in the late fall after the eelgrass high growth period has ended.

The completion of the transplants would require approximately 4 weeks for work conducted prior to commencement of the access channel excavating and 6 weeks during the spring of the subsequent year following completion of construction activities during the fall-winter period.

MONITORING PROGRAM

ESTABLISHMENT OF MITIGATION REQUIREMENTS

Following completion of breakwater repairs, the pre-construction and post-construction surveys will be compared to determine the ultimate impact and mitigation need in accordance with the CEMP. The impacts and resultant compensatory mitigation required under the provisions of the CEMP will be documented in the post-construction eelgrass survey report. The report will document any damage beyond the anticipated levels as well as any site conditions that are anticipated to detract from successful mitigation. It is important to keep clear the distinction between the restoration area targeted in the mitigation plan to address risks of mitigation shortfall and the mitigation required, which is derived by the impact assessment independent from the restoration target designed to ensure mitigation is met.

ESTABLISHMENT MONITORING

Upon completion of the planting effort, a monitoring program will be initiated and will continue for a 60-month (5-year) period as outlined in the CEMP. Spatial distribution, areal extent, percent vegetated cover, and turion density of the transplanted eelgrass and reference sites will be monitored and reported as outlined in the CEMP. Spatial metrics will be evaluated using interferometric sidescan sonar with motion control and RTK corrected GPS for enhanced positional accuracy. The sidescan system provides an acoustic swath image of seafloor within the entire surveyed area. Sidescan backscatter data will be acquired at a frequency of 400 kHz or greater. All data will be collected in latitude and longitude using the North American Datum of 1983 (NAD 83). Surveys will be conducted by running transects spaced to allow for overlap between adjoining sidescan swaths. Following completion of each survey, the data will be converted into a geographically registered mosaic through digital post-processing, and plotted on a geo-rectified aerial image of the excavation, transplant, and reference sites. Eelgrass will then be digitized to show its distribution within the surveyed areas. Eelgrass turion densities will be determined within each transplanted bed collecting a minimum of 20 turion density counts per 1/16 m^2 quadrat within each transplant and reference plot as required to control variance to a level suitable to detect a 25 percent difference between reference and transplant sites with statistical power of 90 percent and $\alpha=0.10$ and $\beta=0.10$.

The monitoring program will be conducted at intervals of 6, 12, 24, 36, 48, and 60-months post-transplant. When monitoring dates fall outside of the normal eelgrass-growing season, dates will be shifted to coincide with the growing season to ensure that valuable information on growth and survival is collected. For each monitoring interval, a draft monitoring report will be prepared and submitted within 30 days of completion of the monitoring interval and data processing. It is anticipated that each monitoring interval will require up to 4 field days to complete the monitoring at all sites.

Monitoring reports will include information from previous monitoring intervals, including numerical comparisons and graphical presentations of changing bed configurations. Graphical comparisons will include generalized bathymetry. The monitoring report will include an analysis of any declines or expansions in eelgrass coverage based on physical conditions of the site, as well as any other significant observations. Finally, the monitoring report will provide a prognosis for the future of the eelgrass bed and will identify the timing for the next monitoring period.

MITIGATION SUCCESS CRITERIA

Mitigation will be deemed successful when it has met the success criteria outlined in the CEMP. Criteria for determination of transplant success will be based upon a comparison of bed areal extent, percent vegetated cover and density (turions per square meter) between the reference sites and the transplant sites. Specific performance metrics include the areal extent as defined where eelgrass is present and where gaps in coverage are less than one meter between individual turion clusters. Density of turions (shoots) is identified as the number of turions per square meter, as measured from representative areas within the control or transplanted beds.

Key success criteria are as follows:

- Month 0 – Monitoring should confirm the full coverage distribution of planting units over the initial mitigation site as appropriate to the geographic region.
- Month 6 – Persistence and growth of eelgrass within the initial mitigation area should be confirmed, and there should be a survival of at least 50 percent of the initial planting units with well-distributed coverage over the initial mitigation site. For seed buoys, there should be demonstrated recruitment of seedlings at a density of not less than one seedling per four (4) square meters with a distribution over the extent of the initial planting area. The timing of this monitoring event should be flexible to ensure work is completed during the active growth period.
- Month 12– The mitigation site should achieve a minimum of 40 percent coverage of eelgrass and 20 percent density of reference site(s) over not less than 1.2 times the area of the impact site.
- Month 24– The mitigation site should achieve a minimum of 85 percent coverage of eelgrass and 70 percent density of reference site(s) over not less than 1.2 times the area of the impact site.
- Month 36– The mitigation site should achieve a minimum of 100 percent coverage of eelgrass and 85 percent density of reference site(s) over not less than 1.2 times the area of the impact site.
- Month 48– The mitigation site should achieve a minimum of 100 percent coverage of eelgrass and 85 percent density of reference site(s) over not less than 1.2 times the area of the impact site.
- Month 60– The mitigation site should achieve a minimum of 100 percent coverage of eelgrass and 85 percent density of reference site(s) over not less than 1.2 times the area of the impact site.

Areas that do not meet the above success criteria may be revegetated and again monitored until the final goal is achieved. Should replanting of the areas at the project site fail to meet the success criteria, reconstruction of portions of one or more transplant sites may be required to carry out this revegetation. Should the reference areas fail or decline alongside the transplant mitigation areas for reasons outside the control of the City, the City will not be held responsible for similar declines in the excavation or transplant mitigation areas.

MITIGATION PROGRAM SCHEDULE

Based on the presently planned transplant window, the preliminary schedule of work is as follows:

ACTIVITIES	TIME PERIOD	REPORTING PERIOD
Pre-construction Surveys	April-May –YR 1	30 Days
Phase I (Planting Prior to Access Channel Excavating)	April-May –YR 1	-
Phase II (Access Channel Excavating)	June – YR 1	30 Days-
Phase III (Overall Construction)	June-December – YR 1	
Phase IV (Post Construction Restoration)	April-June –YR 2	
Complete 0-Month Survey	June – YR 2	July – YR 2
Complete 6-Month Survey	October – YR 2	December – YR 2
Complete 12-Month Survey	June – YR 3	July – YR 3
Complete 24-Month Survey	June – YR 4	July – YR 4
Complete 36-Month Survey	June – YR 5	July – YR 5
Complete 48-Month Survey	June – YR 6	July – YR 6
Complete 60-Month Survey	June – YR 7	July – YR 7

SURFGRASS MANAGEMENT MEASURES

IMPACTS AND MITIGATION FOR SURFGRASS

Approximately 31 m^2 of surfgrass patches occur within the APE and are generally located outside of the proposed work footprint but within the limits of high levels of construction activities. It is presently believed that direct construction impacts to surfgrass may be avoided. However, placing new revetment stone is not an exact science and the specific geometry of all of the rock and the need for construction of a stable terrace to support new stone by repositioning stone may result in some mishandles and dropped or rolled rock. Because surfgrass is at and just below the lower limit of planned construction, there is potential that it may be damaged inadvertently during rock handling or it may be necessary to move a few of the rocks supporting surfgrass to create a base for new rock. Finally, it is anticipated that excavating for the access channel will create the potential for shoal sand to move away from the breakwater down towards the access channel floor. It is presently believed that some of the rock supporting surfgrass is suspended in a matrix of sand rather than being bedded on underlying rock. As result, some of the surfgrass sustaining rock may shift in a manner that impacts surfgrass. These issues may be likely to impact an unknown fraction of the surfgrass present.

The small area of surfgrass present in the APE and the expectation of limited impacts that surfgrass may suffer from the work combine to suggest that compensatory mitigation for this resource is not warranted. Rather, measures should be taken that focus on protection of the resource and bettering the capacity to address unavoidable larger scale impacts in the future. To achieve this, it is recommended that measures include the following:

1) Implementation of best practices to minimize impacts to *in situ* surfgrass;
2) Undertaking field efforts to relocate surfgrass where impacts are deemed unavoidable; and,
3) Implementation of a pilot translocation to advance the understanding of the capacity to restore surfgrass in the future.

SURFGRASS PROTECTION BEST PRACTICES

The surfgrass protection best practices recommendations include the following:

1) Do not remove rock that has fallen off the breakwater and which now resides at the shallow toe on sand. This is typically between Station 3+50 and 5+00 and from approximately 7+50 and 8+20;
2) Minimize access excavation encroachment towards the breakwater adjacent to surfgrass between Station 3+50 and 5+00 and from approximately 7+50 and 8+20. Leave as wide a berth as possible from the toe that will still allow work to be performed. The goal is to minimize sand migration away from the surfgrass areas and potentially undermining the rock in these areas;
3) Do not stage or stockpile rock on the shallow terraces for rehandling or repositioning of stone and don’t walk on the surfgrass when completing the work;

SURFGRASS ROCK RELOCATION

While it is not anticipated to be required, should a rock supporting surfgrass need to be relocated, the Contractor should be directed to grapple the rock up and move it to a similar location, elevation, and orientation where it is to be replaced and positioned. To the extent practical, this process should be monitored to ensure positioning of the rock at the best orientation to provide potential for surfgrass survival. If it is becoming clear that sand is migrating out from around rocks with surfgrass and they are shifting, the rocks should be preemptively salvaged and repositioned where they are sitting atop underlying rock or on sand that remains buttressed by other sand such as north of Station 4+00. Where possible, attempt to maintain the same angle and bedding level of the rock as it was initially.

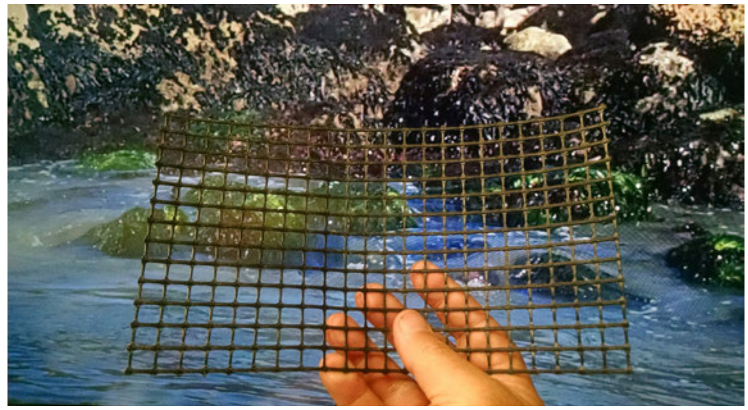
PILOT SURFGRASS TRANSLOCATION

Surfgrass has not been historically restored on a project mitigation scale in coastal California, athough small and short-term studies have been undertaken to translocate laboratory reared seedlings from a laboratory to field sites. These met with mixed success, with some translocations exhibiting short-term survival rates comparable to naturally recruited seedlings. The study, however, was only short-term and did not follow translocated plants for long periods (Holbrook et al 2002, Reed and Holbrook 2003). Other studies explored the potential for restoration of surfgrass by harvested plugs or sprigs that were attached to rock and then deployed (deWit et al. 1998) or attached to native rock (Bull et al. 2004). Pilot transplants were conducted on quarried jetty stone in Mission Bay in the early 1980s by epoxy attaching surfgrass to the rock. However, this met with low success, and the study was terminated after a few months. A second study was conducted using surfgrass attached by sewing surfgrass to squares of shag carpeting that were epoxied to the shore platform rock at Ocean Beach. This study showed promising results with most of the surfgrass surviving and some extending off the carpet samples and becoming attached to the native rock on the shore platform (Merkel, unpub. data, 2008). However, this study was also terminated early as it was undertaken for curiosity sake rather than as a substantive project and field time was ultimately consumed with work endeavors.

While there has been a significant paucity of surfgrass restoration studies, many of the studies that do exist suggest promise for restoration of surfgrass over a short term scale. However, none of the studies extended long enough to determine the ultimate fate of transplants. As a result, there remains such uncertainty with respect to the capacity to restore surfgrass on a large scale that it is not generally mitigated in kind when unavoidable impacts occur. The observations of recent and continuous expansion of surfgrass on the Morro Bay jetties provides some insight into the expansion capacity of surfgrass if it is well distributed in the area. The present breakwater project provides an opportunity to implement a small pilot project to transplant plots of surfgrass that may be followed for an extended period of time concurrent with the 5-year eelgrass mitigation monitoring program. Because the leeward side of the breakwater is highly accessible for work, but receives limited traffic by foot, the area provides a good candidate site to evaluate the potential for and cost effectiveness of establishing surfgrass transplants plots on quarried jetty rock.

A pilot transplant of surfgrass is proposed to be conducted in conjunction with the larger eelgrass restoration project. The work would be conducted as a management directed effort without survival, growth or coverage success standards. The principal project objectives are to test the efficacy of surfgrass over a long period of time suited to a mitigation program and differing from the short period over which experimental transplants have been monitored. The plots would be distributed in replicated clusters of 5 replicate units in each of eight different blocks (2 elevations, and 4 degrees of surge energy and sand exposure) for a total of 40 units (Figure 12).

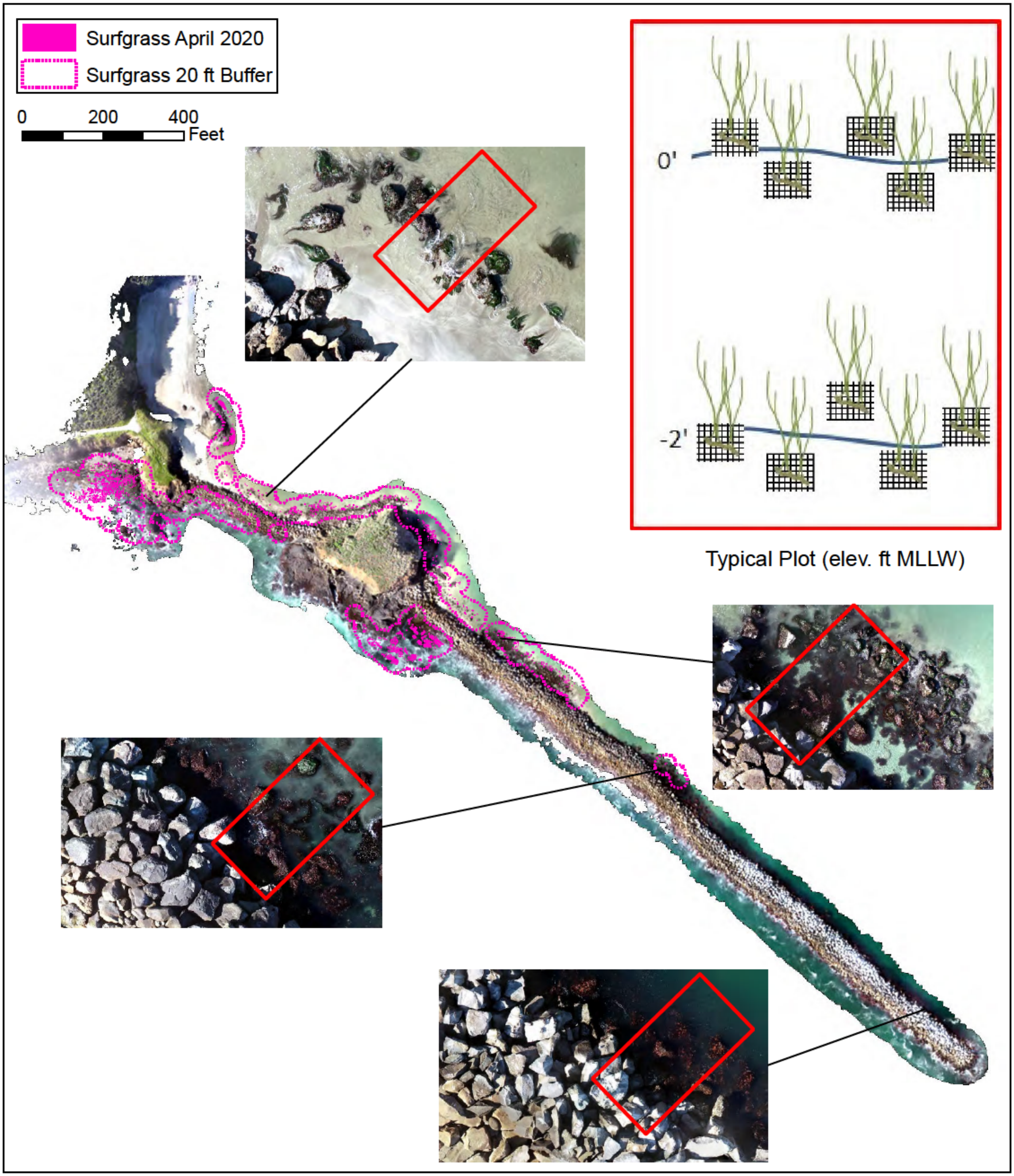
All of the planting units would be constructed in the same manner by threading surfgrass through a 1 cm HDPE plastic mesh that is subsequently attached to rock by marine epoxy. The plots would be monitored during each of the eelgrass monitoring events at 0, 6, 12, 24, 36, 48, and 60 months, and the status of the plots would be reported on during the reporting windows.



HDPE grid to be used to attach surfgrass to breakwater rock with marine epoxy in small test plots. The plots will be established along differing portions of the breakwater in clusters to evaluate long-term survival and growth of plants under different circumstances and the capacity to conduct such transplants at a scale and with the performance certainty necessary to serve as compensatory mitigation.

The monitoring to be conducted includes survival of the transplants, lateral spread based on maximum axial basal spread and maximum basal width as measured perpendicular to the long axis of the plant. Additional data to be recorded is spread beyond the starting grid, algae present with the surfgrass, flowering, leaf length, and observations of any recruitment of new plants near the transplants. The primary benefit of the study is found in the capacity to evaluate potential for restoration over longer periods of time more suitable to a mitigation monitoring performance assessment than a research study. The data is expected to inform future project planning where impacts to surfgrass are larger and deemed to be significant by determining if in-kind mitigation would be feasible based on potential for success affordability, and success potential.

Figure 12 identifies the preliminary locations considered for establishment of nested transplant plots consisting of four blocks of five replicates distributed across paired high and low elevations (0 and -2 feet MLLW). Some of the transplant plots will end up being located within areas supporting healthy surfgrass; and thus, method effect can be evaluated directly by comparing the conditions of the surrounding nature patches.



N
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S

Surfgrass Pilot Transplant Plan

Port San Luis Breakwater Repair Sections
San Luis Obispo County, California

Figure 12

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Appendix A: California Eelgrass Mitigation Policy (NOAA 2014)

NOAA FISHERIES
West Coast Region

California Eelgrass Mitigation Policy and Implementing Guidelines

October 2014

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I. National Marine Fisheries Service's (NMFS) California Eelgrass Mitigation Policy

A. Policy Statement

It is NMFS' policy to recommend **no net loss of eelgrass habitat function** in California.

For all of California, compensatory mitigation should be recommended for the loss of existing eelgrass habitat function, but only after avoidance and minimization of effects to eelgrass have been pursued to the maximum extent practicable. Our approach is congruous with the approach taken in the federal Clean Water Act guidelines under section 404(b)(1) (40 CFR 230). In absence of a complete functional assessment, eelgrass distribution and density should serve as a proxy for eelgrass habitat function. Compensatory mitigation options include comprehensive management plans, in-kind mitigation, mitigation banks and in-lieu-fee programs, and out-of-kind mitigation. While in-kind mitigation is preferred, the most appropriate form of compensatory mitigation should be determined on a case-by-case basis.

Further, it is the intent of this policy to ensure that there is no loss associated with delays in establishing compensatory mitigation. This should be accomplished by creating a greater amount of eelgrass than is lost, if the mitigation is performed contemporaneously or after the impacts occur. To achieve this, NMFS, in most instances, should recommend compensatory mitigation for vegetated and unvegetated eelgrass habitat be successfully completed at a ratio of at least 1.2:1 mitigation area to impact area. This ratio is based on present value calculation[1] using a discount rate of 0.03 (NOAA-DARP 1999). This ratio assumes that restored eelgrass habitat achieves habitat function comparable to existing eelgrass habitat within a period of three years or less (Hoffman 1986, Evans & Short 2005, Fonseca *et al.* 1990).

For ongoing projects, once mitigation has been successfully implemented to compensate for the loss of eelgrass habitat function within a specified footprint, NMFS should not recommend additional mitigation for subsequent loss of eelgrass habitat if 1) ongoing project activities result in subsequent loss of eelgrass habitat function within the same footprint for which mitigation was completed and 2) the project applicant can document that no new area of eelgrass habitat is impacted by project activities.

This policy does not address mitigation for potential eelgrass habitat. NMFS recognizes impacts to potential eelgrass habitat may preclude eelgrass movement or expansion to suitable unvegetated areas in the future, potentially resulting in declines in eelgrass abundance over time. In addition, it does not address other shallow water habitats. Regulatory protections in the estuarine/marine realm typically focus on wetlands and submerged aquatic vegetation. Mudflats, sandflats, and other superficially bare habitats do not garner the same degree of recognition and

[1] Present Value (PV) is a calculation used in finance to determine the present day value of an amount that is received at a future date. The premise of the equation is that receiving something today is worth more than receiving the same item at a future date; $PV = C_1/(1+r)^n$ where C_1= resource at period 1, r= interest or discount rate, n=number of periods.

concern, even though these are some of the most productive and fragile ecosystems (Reilly *et al*. 1999). NMFS will continue to collaborate with federal and state partners on these issues.

B. Eelgrass Background and Information

Eelgrass species (*Zostera marina* L. and *Z. pacifica*) are seagrasses that occur in the temperate unconsolidated substrate of shallow coastal environments, enclosed bays, and estuaries. Eelgrass is a highly productive species and is considered to be a "foundation" or habitat forming species. Eelgrass contributes to ecosystem functions at multiple levels as a primary and secondary producer, as a habitat structuring element, as a substrate for epiphytes and epifauna, and as sediment stabilizer and nutrient cycling facilitator. Eelgrass provides important foraging areas and shelter to young fish and invertebrates, food for migratory waterfowl and sea turtles, and spawning surfaces for invertebrates and fish such as the Pacific herring. Eelgrass also provides a significant source of carbon to the detrital pool which provides important organic matter in sometimes food-limited environments (*e.g.*, submarine canyons). In addition, eelgrass has the capacity to sequester carbon in the underlying sediments and may help offset carbon emissions. Given the significance and diversity of the functions and services provided by seagrass, Costanza *et al.* (2007) determined seagrass ecosystems to be one of Earth's most valuable.

California supports dynamic eelgrass habitats that range in extent from less than 11,000 acres to possibly as much as 15,000 acres statewide. This is inclusive of estimates for poorly documented beds in smaller coastal systems as well as open coastal and insular areas. While among the most productive of habitats, the overall low statewide abundance makes eelgrass one of the rarest habitats in California. Collectively just five systems, Humboldt Bay, San Francisco Bay, San Diego Bay, Mission Bay and Tomales Bay support over 80 percent of the known eelgrass in the state. The uneven distribution of eelgrass resources increases the risk to this habitat and also contributes to its dynamic nature. Further, the narrow depth range within which eelgrass can occur further places this habitat at risk in the face of global climate change and sea level rise predictions.

Seagrass habitat has been lost from temperate estuaries worldwide (Duarte 2002, Lotze *et al.* 2006, Orth *et al.* 2006). While both natural and human-induced mechanisms have contributed to these losses, impacts from human population expansion and associated pollution and upland development is the primary cause (Short and Wyllie-Echeverria 1996). Human activities that affect eelgrass habitat distribution and abundance, including, but not limited to, urban development, harbor development, aquaculture, agricultural runoff, effluent discharges, and upland land use associated sediment discharge (Duarte 2008) occur throughout California. For example, dredging and filling; shading and alteration of circulation patterns; and watershed inputs of sediment, nutrients, and unnaturally concentrated or directed freshwater flows can directly and indirectly destroy eelgrass habitats. Conversely, in many areas great strides have been made at restoring water quality and expanding eelgrass resources through directed efforts at environmental improvements and resource enhancement. While improvements in eelgrass management have occurred overall, the importance of eelgrass both ecologically and economically, coupled with ongoing human pressure and potentially increasing degradation and losses associated with climate change, highlight the need to protect, maintain, and where feasible, enhance eelgrass habitat.

C. Purpose and Need for Eelgrass Mitigation Policy

Eelgrass warrants a strong protection strategy because of the important biological, physical, and economic values it provides, as well as its importance to managed species under the Magnuson-Stevens Fishery Conservation and Management Act (MSA). Vegetated shallows that support eelgrass are also considered special aquatic sites under the 404(b)(1) guidelines of the Clean Water Act (40 C.F.R. § 230.43). The National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) developed this policy to establish and support a goal of protecting this resource and its habitat functions, including spatial coverage and density of eelgrass habitats. This NMFS policy and implementing guidelines are being shared with agencies and the public to ensure there is a clear and transparent process for developing eelgrass mitigation recommendations.

Pursuant to the MSA, eelgrass is designated as an essential fish habitat (EFH) habitat area of particular concern (HAPC) for various federally-managed fish species within the Pacific Coast Groundfish Fishery Management Plan (FMP) (PFMC 2008). An HAPC is a subset of EFH that is rare, particularly susceptible to human-induced degradation, especially ecologically important, and/or located in an environmentally stressed area. HAPC designations are used to provide additional focus for conservation efforts.

This policy and guidelines support but do not expand upon existing NMFS authorities under the MSA, the Fish and Wildlife Coordination Act (FWCA), and the National Environmental Policy Act (NEPA). Pursuant to the EFH provisions of the MSA, FWCA, and obligations under the NEPA as a responsible agency, NMFS annually reviews and provides recommendations on numerous actions that may affect eelgrass resources throughout California. Section 305(b)(1)(D) of the MSA requires NMFS to coordinate with, and provide information to, other federal agencies regarding the conservation and enhancement of EFH. Section 305(b)(2) requires all federal agencies to consult with NMFS on all actions or proposed actions authorized, funded, or undertaken by the agency that may adversely affect EFH. Under section 305(b)(4) of the MSA, NMFS is required to provide EFH Conservation Recommendations to federal and state agencies for actions that would adversely affect EFH (50 C.F.R. § 600.925). NMFS makes its recommendations with the goal of avoiding, minimizing, or otherwise compensating for adverse effects to EFH. When impacts to NMFS trust resources are unavoidable, NMFS may recommend compensatory mitigation to offset those impacts. In order to fulfill its consultative role, NMFS may also recommend, among other things, the development of mitigation plans, habitat distribution maps, surveys and survey reports, progress milestones, monitoring programs, and reports verifying the completion of mitigation activities.

Eelgrass impact management and mitigation throughout California has historically been undertaken without a statewide strategy. Federal actions with impacts to eelgrass require considerable NMFS staff time for project review, coordination and development of conservation recommendations. As federal staff resources vary with budgets, and threats to aquatic resources remain steady or increase, regulatory streamlining and increased efficiency are crucial for continued protection of important coastal habitats, including eelgrass. The California Eelgrass Mitigation Policy (CEMP) is meant to increase efficiency of existing regulatory authorities in a programmatic manner, provide transparency to federal agencies and action proponents, and ensure that unavoidable impacts to eelgrass habitat are fully and appropriately mitigated. It is the intent of NMFS to collaborate with other federal, state, and local agencies charged with the protection of marine resources to seek a unified approach to actions affecting eelgrass such that consistency across agencies with respect to this resource may be enhanced.

D. Relevance to Other Federal and State Policies

Based on our understanding of existing federal and state policies regarding aquatic resource conservation, the CEMP does not conflict with existing policies and complements the federal and state wetland policies as described below. NMFS does not intend to make any recommendations, which, if adopted by the action agency and carried out, would violate other federal, state, or local laws. The CEMP also complements the NOAA Aquaculture Policy and National Shellfish Initiative and builds upon the NOAA Seagrass Conservation Guidelines and the Southern California Eelgrass Mitigation Policy.

1. Corps/EPA Mitigation Rule and supporting guidance

In 2008, the Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (Corps) issued revised regulations governing compensatory mitigation for authorized impacts to wetlands, streams, and other waters of the U.S. under Section 404 of the Clean Water Act. The regulations emphasize avoiding impacts to wetlands and other water resources. For unavoidable impacts, the rule incorporates Natural Resource Council recommendations to improve planning, implementing and managing wetland replacement projects, including: science-based assessment of impacts and compensation measures, watershed assessments to drive mitigation sites and plans, measurable and enforceable ecological performance standards for evaluating mitigation projects, mitigation monitoring to document whether the mitigation employed meets ecological performance standards, and complete compensation plans. The regulations also encourage the expansion of mitigation banking and in lieu fee agreements to improve the quality and success of compensatory mitigation projects.

The NMFS policy to recommend no net loss of eelgrass function and the eelgrass mitigation guidelines offered herein align with the provisions of the EPA and Corps mitigation rule, but provide more specific recommendations on how to avoid and minimize impacts to eelgrass and how to implement eelgrass surveys, assessments, mitigation, and monitoring.

2. State of California Wetland Conservation Policies

The 1993 State of California Wetlands Conservation Policy established a framework and strategy to ensure no overall net loss and long-term gain in the quantity, quality, and permanence of wetlands acreage and values in California in a manner that fosters creativity, stewardship, and respect for private property, reduce procedural complexity in administration of state and federal wetlands conservation programs, and encourage partnerships to make landowner incentive programs and cooperative planning efforts the primary focus of wetlands conservation and restoration.

The State of California is also developing a Wetland and Riparian Area Protection Policy. The first phase of this effort was published as the "Preliminary Draft Wetland Area Protection Policy" with the purpose of protecting all waters of the State, including wetlands, from dredge and fill discharges. It includes a wetland definition and associated delineation methods, an assessment framework for collecting and reporting aquatic resource information, and requirements applicable to discharges of dredged or fill material. The draft specifies that dredge or fill projects will provide for replacement of existing beneficial uses through compensatory mitigation. The preliminary policy includes a determination that compensatory mitigation will sustain and improve the overall abundance, diversity and condition of aquatic resources in a project watershed area.

Based on the definition of wetlands included in these state wetland policies, the policies do not directly apply to subtidal eelgrass habitat, but may apply to intertidal eelgrass habitat. The NMFS policy of recommending no net loss to eelgrass habitat function and recommendations for compensatory mitigation for eelgrass impacts complement the state protection policies for wetlands.

3. NOAA Aquaculture Policy and National Shellfish Initiative

In 2011, NOAA released the National Marine Aquaculture Policy and the National Shellfish Initiative. The Policy encourages and fosters sustainable aquaculture development that provides domestic jobs, products, and services and that is in harmony with healthy, productive, and resilient marine ecosystems, compatible with other uses of the marine environment, and consistent with the National Policy for the Stewardship of the Ocean, our Coasts, and the Great Lakes (National Ocean Policy). The goal of the Initiative is to increase populations of bivalve shellfish in our nation's coastal waters—including oysters, clams, abalone, and mussels—through both sustainable commercial production and restoration activities. The Initiative supports shellfish industry jobs and business opportunities to meet the growing demand for seafood, while protecting and enhancing habitat for important commercial, recreational, and endangered and threatened species and species recovery. The Initiative also highlights improved water quality, nutrient removal, and shoreline protection as benefits from shellfish production and restoration. Both the Policy and the Initiative seek to improve interagency coordination for permitting commercial and restoration shellfish projects, as well as support research and other data collection to assess and refine conservation strategies and priorities.

The regulatory efficiencies, transparency, and compensation for impacts to eelgrass promoted by the CEMP directly support the National Aquaculture Policy statements and National Shellfish Initiative through: (1) protection of eelgrass, an important component of productive and resilient coastal ecosystems in California and habitat for wild species, and (2) improved coordination with federal partners regarding planning and permitting for commercial shellfish projects. Furthermore, research conducted under the direction of the National Shellfish Initiative could be informed by and also inform NMFS consultations regarding eelgrass impacts and mitigation in California.

4. NOAA Seagrass Conservation Guidelines

The NOAA publication, "Guidelines for the Conservation and Restoration of Seagrasses in the United States and Adjacent Waters" (1998) was developed by Mark Fonseca of NOAA's Beaufort Laboratory along with Jud Kenworthy and Gordon Thayer and was funded by NOAA's Coastal Ocean Program. The document presents an overview of seagrass conservation and restoration in the United States, discusses important issues that should be addressed in planning seagrass restoration projects, describes different planting methodologies, proposes monitoring criteria and means for evaluation success, and discusses issues faced by resource managers. The CEMP considers information presented in the Fonseca *et al*. document, but deviates in some cases in order to provide reasonable and practicable guidelines for eelgrass conservation in California.

5. Southern California Eelgrass Mitigation Policy

In southern and central California, eelgrass mitigation has been addressed in accordance with the Southern California Eelgrass Mitigation Policy applied by NMFS, US Fish & Wildlife Service, California Department of Fish and Wildlife, California Coastal Commission, US Army Corps of Engineers, and other resource and regulatory agencies since 1991, and which has generally been effective at ensuring eelgrass impacts are mitigated in most circumstances. Given the success of the Southern California Eelgrass Mitigation Policy over its 20-year history, this policy reflects an expansion of the application of the Southern California policy with minor modifications to ensure a high standard of statewide eelgrass management and protection. This policy will supersede the Southern California Eelgrass Mitigation Policy for all areas of California upon its adoption.

II. Implementing Guidelines for California

This policy and guidelines will serve as the guidance for staff and managers within NMFS for developing recommendations concerning eelgrass issues through EFH and FWCA consultations and NEPA reviews throughout California. This policy will inform NMFS's position on eelgrass issues for California in other roles as a responsible, advisory, or funding agency or trustee. In addition, this document provides guidance to assist NMFS in performing its consultative role under the statutes described above. Finally, pursuant to NMFS obligation to provide information to federal agencies under Section 305(b)(1)(D) of the MSA, this policy serves that role by providing information intended to further the conservation and enhancement of EFH. Should this policy or guidelines be inconsistent with any formally-promulgated NMFS regulations, those formally-promulgated regulations will take precedence over any inconsistent provisions of this policy.

While many of the activities impacting eelgrass are similar across California, eelgrass stressors and growth characteristics differ between southern California (U.S./Mexico border to Pt. Conception), central California (Point Conception to San Francisco Bay entrance), San Francisco Bay, and northern California (San Francisco Bay to the California/Oregon border). The amount of scientific information available to base management decisions on also differs among areas within California, with considerably more information and history with eelgrass habitat management in southern California than the other regions. Gaps in region-specific scientific information do not override the need to be protective of eelgrass habitat while relying on the best information currently available from areas within and outside of California. Although the primary orientation of this policy is toward statewide use, where indicated below, specific elements of this policy may differ between southern California, central California, northern California and San Francisco Bay.

NMFS will continue to explore the science of eelgrass habitat and improve our understanding of eelgrass habitat function, impacts, assessment techniques, and mitigation efficacy. Approximately every 5 years, NMFS intends to evaluate monitoring and survey data collected by federal agencies and action proponents per the recommendations of these guidelines. NMFS managers will determine if updates to these guidelines are appropriate based on information evaluated during the 5-year review. Updates to these guidelines and supporting technical information will be available on the NMFS website.

The information below serves as a common starting place for NMFS recommendations to achieve no net loss of eelgrass habitat function. NMFS employees should not depart from the guidelines provided herein without appropriate justification and supervisory concurrence. However, the recommendations that NMFS ultimately makes should be provided on a case-by-case basis to provide flexibility when site specific conditions dictate. In the EFH context, NMFS recommendations are provided to the action agency, which has final approval of the action; in accordance with the MSA, the action agency may take up NMFS recommendations or articulate its reasons for not following the recommendations. In the FWCA context, NMFS makes recommendations which must be considered, but the action agency is ultimately responsible for the wildlife protective measures it adopts (if any). For these reasons, neither this policy nor its implementing guidelines are to be interpreted as binding on the public.

A. Eelgrass Habitat Definition

Eelgrass distribution fluctuates and can expand, contract, disappear, and recolonize areas within suitable environments. Vegetated eelgrass areas can expand by as much as 5 meters (m) and contract by as much as 4 m annually (Donoghue 2011). Within eelgrass habitat, eelgrass is expected to fluctuate in density and patch extent based on prevailing environmental factors (*e.g.*, turbidity, freshwater flows, wave and current energy, bioturbation, temperature, etc.). To account for seagrass fluctuation, Fonseca *et al.* (1998) recommends that seagrass habitat include the vegetated areas as well as presently unvegetated spaces between seagrass patches.

In addition, there is an area of functional influence, where the habitat function provided by the vegetated cover extends out into adjacent unvegetated areas. Those functions include detrital enrichment, energy dampening and sediment trapping, primary productivity, alteration of current or wave patterns, and fish and invertebrate use, among other functions. The influence of eelgrass on the local environment can extend up to 10 m from individual eelgrass patches, with the distance being a function of the extent and density of eelgrass comprising the bed as well as local biologic, hydrographic, and bathymetric conditions (Bostrom and Bonsdorff 2000, Bostrom *et al*. 2001, Ferrell and Bell 1991, Peterson *et al*. 2004, Smith *et al.* 2008, van Houte-Howes *et al.* 2004, Webster *et al*. 1998). Detrital enrichment will generally extend laterally as well as down slope from the beds, while fish and invertebrates that utilize eelgrass beds may move away from the eelgrass core to areas around the bed margins for foraging and in response to tides or diurnal cycles (Smith *et al*. 2008).

To encompass fluctuating eelgrass distribution and functional influence around eelgrass cover, for the purposes of this policy and guidelines, eelgrass habitat is defined as areas of vegetated eelgrass cover (any eelgrass within 1 m^2 quadrat and within 1 m of another shoot) bounded by a 5 m wide perimeter of unvegetated area (See Attachment 1 for a graphical depiction of this definition). Unvegetated areas may have eelgrass shoots a distance greater than 1 m from another shoot, and may be internal as well as external to areas of vegetated cover. For isolated patches and on a case-by-case basis, it may be acceptable to include an unvegetated area boundary less than or greater than 5 m wide. The definition excludes areas of unsuitable environmental conditions such as hard bottom substrates, shaded locations, or areas that extend to depths below those supporting eelgrass. Suitable depths can vary substantially depending upon site-specific conditions. In general, eelgrass does not extend deeper than 12 feet mean lower low water (MLLW) in most protected bays and harbors in Southern California, and is more limited in Central and Northern California embayments. However, eelgrass can grow much deeper in entrance channels and offshore areas

B. Surveying Eelgrass

NMFS may recommend action agencies conduct surveys of eelgrass habitat to evaluate effects of a proposed action. Eelgrass habitat should be surveyed using visual or acoustic methods and mapping technologies and scales appropriate to the action, scale, and area of work. Surveys should document both vegetated eelgrass cover as well as unvegetated areas within eelgrass habitat (See section II.A. for definition). Assessing impacts to eelgrass habitat relies on the completion of quality surveys and mapping. As such, inferior quality of surveys and mapping (*e.g.*, completed at an inappropriate scale or using inappropriate methods) may make proper evaluation of impacts impossible, and may result in a recommendation from NMFS to re-survey and re-map project areas. Also, to account for fluctuations in eelgrass habitat due to environmental variations, a reference site(s) should be incorporated into the survey (See section V.B.4 below for more details).

1. Survey Parameters

Because eelgrass growth conditions in California vary, eelgrass mapping techniques will also vary. Diver transects or boundary mapping may be suited to very small scale mapping efforts, while aerial and/or acoustic survey with ground-truthing may be more suited to larger survey areas. Aerial and above-water visual survey methods should be employed only where the lower limit of eelgrass is clearly visible or in combination with methods that adequately inventory eelgrass in deeper waters.

The survey area should be scaled as appropriate to the size of the potential action and the potential extent and distribution of eelgrass impacts, including both direct and indirect effects. The resolution of mapping should be adequate to address the scale of effects reasonably expected to occur. For small projects, such as individual boat docks, higher mapping resolution is appropriate in order to detect actual effects to eelgrass at a scale meaningful to the project size. At larger scales, the mapping resolution may be less refined over a larger area, assuming that minor errors in mapping will balance out over the larger scale. Survey reports should provide a detailed description of the survey coverage (*e.g.*, number, location, and type of samples) and any interpolation methods used in the mapping.

While many parameters may be useful to describe eelgrass habitat condition (*e.g.*, plant biomass, leaf length, shoot:root ratios, epiphytic loading), many are labor intensive and may be impractical for resource management applications on a day-to-day basis. For this reason, four parameters have been identified for use in eelgrass habitat surveys and assessment of effects of an action on eelgrass. These parameters that should be articulated in eelgrass surveys are: 1) spatial distribution, 2) areal extent, 3) percentage of vegetated cover, and 4) the turion (shoot) density.

a) Spatial Distribution

The spatial distribution of eelgrass habitat should be delineated by a contiguous boundary around all areas of vegetated eelgrass cover extending outward a distance of 5 m, excluding gaps within the vegetated cover that have individual plants greater than 10 m from neighboring plants. Where such separations occur, either a separate area should be defined, or a gap in the area should be defined by extending a line around the void along a boundary defined by adjacent plants and including the 5 meter perimeter. The boundary of the eelgrass habitat should not extend into areas where depth, substrate, or existing structures are unsuited to supporting eelgrass habitat.

b) Aerial Extent

The eelgrass habitat aerial extent is the quantitative area (*e.g.*, square meters) of the spatial distribution boundary polygon of the eelgrass habitat. The total aerial extent should be broken down into extent of vegetated cover and extent of unvegetated habitat. Areal extent should be determined using commercially available geo-spatial analysis software. For small projects, coordinate data for polygon vertices could be entered into a spreadsheet format, and area could be calculated using simple geometry.

c) Percent Vegetated Cover

Eelgrass vegetated cover exists when one or more leaf shoots (turions) per square meter is present. The percent bottom cover within eelgrass habitat should be determined by totaling the area of vegetated eelgrass cover and dividing this by the total eelgrass habitat area. Where substantial differences in bottom cover occur across portions of the eelgrass habitat, the habitat could be subdivided into cover classes (*e.g.*, 20% cover, 50% cover, 75% cover).

d) Turion (Shoot) Density

Turion density is the mean number of eelgrass leaf shoots per square meter within mapped eelgrass vegetated cover. Turion density should be reported as a mean ± the standard deviation of replicate measurements. The number of replicate measurements (n) should be reported along with the mean and deviation. Turion densities are determined only within vegetated areas of eelgrass habitat and therefore, it is not possible to measure a turion density equal to zero. If different cover classes are used, a turion density should be determined for each cover class.

2. Eelgrass Mapping

For all actions that may directly or indirectly affect eelgrass habitat, an eelgrass habitat distribution map should be prepared on an accurate bathymetric chart with contour intervals of not greater than 1 foot (local vertical datum of MLLW). Exceptions to the detailed bathymetry could be made for small projects or for projects where detailed bathymetry may be infeasible. Unless region-specific mapping format and protocols are developed by NMFS (in which case such region-specific mapping guidance should be used), the mapping should utilize the following format and protocols:

a) Bounding Coordinates

Horizontal datum - Universal Transverse Mercator (UTM), NAD 83 meters, Zone 11 (for southern California) or Zone 10 (for central, San Francisco Bay, and northern California) is the preferred projection and datum. Another projection or datum may be used; however, the map and spatial data should include metadata that accurately defines the projection and datum.

Vertical datum - Mean Lower Low Water (MLLW), depth in feet.

b) Units

Transects, grids, or scale bars should be expressed in meters. Area measurements should be in square meters.

c) File Format

A spatial data layer compatible with readily available commercial geographic information system software producing file formats compatible with ESRI® ArcGIS software should be sent to NMFS when the area mapped supports at least 10 square meters of eelgrass. For those areas supporting less than 10 square meters of eelgrass, a table may alternatively be provided giving the vertices bounding x, y coordinates of the eelgrass areas in a spreadsheet or an ASCII file format. In addition to a spatial layer and/or table, a hard-copy map should be included with the survey report. The projection and datum should be clearly defined in the metadata and/or an associated text file.

Eelgrass maps should, at a minimum, include the following:

- A graphic scale bar, north arrow, legend, horizontal datum and vertical datum;
- A boundary illustrating the limits of the area surveyed;
- Bathymetric contours for the survey area, including both the action area(s) and reference site(s) in increments of not more than 1 foot;
- An overlay of proposed action improvements and construction limits;
- The boundary of the defined eelgrass habitat including an identification of area exclusions based on physical unsuitability to support eelgrass habitat; and

- The existing eelgrass cover within the defined eelgrass habitat at the time of the survey.

3. Survey Period

All mapping efforts should be completed during the active growth period for eelgrass (typically March through October for southern California, April through October for central California, April through October for San Francisco Bay, and May through September for northern California) and should be considered valid for a period of 60 days to ensure significant changes in eelgrass distribution and density do not occur between survey date and the project start date. The 60 day period is particularly important for eelgrass habitat survey conducted at the very beginning of the growing season, if eelgrass habitat expansion occurs as the growing season progresses. A period other than 60 days could be warranted and should be evaluated on a case-by-case basis, particularly for surveys completed in the middle of the growing season. However, when the end of the 60-day validity period falls outside of the region-specific active growth period, the survey could be considered valid until the beginning of the next active growth period. For example, a survey completed in southern California in the August-October time frame would be valid until the resumption of the active growth phase (i.e., in most instances, March 1). In some cases, NMFS and the action agency may agree to surveys being completed outside of the active growth period. For surveys completed during or after unusual climatic events (*e.g.*, high fluvial discharge periods, El Niño conditions), NMFS staff should be contacted to determine if any modifications to the common survey period are warranted.

4. Reference Site Selection

Eelgrass habitat spatial extent, aerial extent, percent cover and turion density are expected to naturally fluctuate through time in response to natural environmental variables. As a result, it is necessary to correct for natural variability when conducting surveys for the purpose of evaluating action effects on eelgrass or performance of mitigation areas. This is generally accomplished through the use of a reference site(s), which is expected to respond similarly to the action area in response to natural environmental variability. It is beneficial to select and monitor multiple reference sites rather than a single site and to utilize the average reference site condition as a metric for environmental fluctuations. This is especially true when a mitigation site is located within an area of known environmental gradients, and reference sites may be selected on both sides of the mitigation site along the gradient. Environmental conditions (*e.g.*, sediment, currents, proximity to action area, shoot density, light availability, depth, onshore and watershed influences) at the reference site(s) should be representative of the environmental conditions at the impact area (Fonseca *et al*. 1998). Where practical, the reference site(s) should be at least the size of the anticipated impact and/or mitigation area to limit the potential for minor changes in a reference site (*e.g.*, propeller scarring or ray foraging damage) overly affecting mitigation needs. The logic for site(s) selection should be documented in the eelgrass mitigation planning documents.

C. Avoiding and Minimizing Impacts to Eelgrass

This section describes measures to avoid and minimize impacts to eelgrass caused by turbidity, shading, nutrient loading, sedimentation and alteration of circulation patterns. Not all measures are equally suited to a particular project or condition. Measures to avoid or minimize impacts should be focused on stressors where the source and control are within the purview of the permittee and action agency. Action agencies in coordination with NMFS should evaluate and establish impact avoidance and minimization measures on a case-by-case basis depending on the action and site-specific information, including prevailing current patterns, sediment source, characteristics, and quantity, as well as the nature and duration of work.

1. Turbidity

To avoid and minimize potential turbidity-related impacts to eelgrass:

- Where practical, actions should be located as far as possible from existing eelgrass; and
- In-water work should occur as quickly as possible such that the duration of impacts is minimized.

Where proposed turbidity generating activities must occur in proximity to eelgrass and increased turbidity will occur at a magnitude and duration that may affect eelgrass habitat, measures to control turbidity levels should be employed when practical considering physical and biological constraints and impacts. Measures may include:

- Use of turbidity curtains where appropriate and feasible;
- Use of low impact equipment and methods (*e.g.*, environmental buckets, or a hydraulic suction dredge instead of clamshell or hopper dredge, provided the discharge may be located away from the eelgrass habitat and appropriate turbidity controls can be provided at the discharge point);
- Limiting activities by tide or day-night windows to limit light degradation within eelgrass habitat;
- Utilizing 24-hour dredging to reduce the overall duration of work and to take advantage of dredging during dark periods when photosynthesis is not occurring; or
- Other measures that an action party may propose and be able to employ to minimize potential for adverse turbidity effects to eelgrass.

NMFS developed a flowchart for a stepwise decision making process as guidance for action agencies to determine when to implement best management practices (BMPs) for minimizing turbidity from dredging actions as part of a programmatic EFH consultation in San Francisco Bay. The parameters considered in the flow chart are relevant to all marine areas of California. This document is posted on the NMFS West Coast Region web page (http://www.westcoast.fisheries.noaa.gov/habitat/habitat_types/seagrass_info/california_eelgrass.html) and may be used to evaluate avoidance and minimization measures for any project that generates increased turbidity.

2. Shading

A number of potential design modifications may be used to minimize effects of shading on eelgrass. Boat docks, ramps, gangways, and similar structures should avoid eelgrass habitat to the maximum extent feasible. If avoidance of eelgrass or habitat is infeasible, impacts should be minimized by utilizing, to the maximum extent feasible, design modifications and construction materials that allow for greater light penetration. Action modifications should include, but are not limited to:

- Avoid siting over-water or landside structures in areas where shading of eelgrass habitat would occur;
- Maximizing the north-south orientation of the structure;
- Maximizing the height of the structure above the water;
- Minimizing the width and supporting structure mass to decrease shade effects;
- Relocating the structure in deeper water and limiting the placement of structures in shallow areas where eelgrass occurs to the extent feasible; and
- Utilizing light transmitting materials in structure design.

Construction materials used to increase light passage beneath the structures may include, but are not limited to, open grating or adequate spacing between deck boards to allow for effective illumination to support eelgrass habitat. The use of these shade reducing options may be appropriate where they do not conflict with safety, ADA compliance, or structure utility objectives.

NMFS developed a stepwise key as guidance for action agencies to determine which combination of modifications are best suited for minimizing shading effects from overwater structures on eelgrass as part of a programmatic EFH consultation in San Francisco Bay. The parameters considered in the flow chart are relevant to all marine areas of California. This document is posted on the West Coast Region web page (http://www.westcoast.fisheries.noaa.gov/habitat/habitat_types/seagrass_info/california_eelgrass.html) and may be used to evaluate avoidance and minimization measures for any project that results in shading.

3. Circulation patterns

Where appropriate to the scale and nature of potential eelgrass impacts, action parties should evaluate if and how the action may alter the hydrodynamics of the action area such that eelgrass habitat within or in proximity to the action area may be adversely affected. To maintain good water flow and low residence time of water within eelgrass habitat, action agencies should ensure actions:

- Minimize scouring velocities near or within eelgrass beds;
- Maintain wind and tidal circulation to the extent practical by considering orientation of piers and docks to maintain predominant wind effects;
- Incorporate setbacks on the order of 15 to 50 meters from eelgrass habitat where practical to allow for greater circulation and reduced impact from boat maneuvering, grounding, and propeller damage, and to address shading impacts; and
- Minimize the number of piles and maximize pile spacing to the extent practical, where piles are needed to support structures.

For large-scale actions in the proximity of eelgrass habitats, NMFS may request specific modeling and/or field hydrodynamic assessments of the potential effects of work on characteristics of circulation within eelgrass habitat.

4. Nutrient loading

Where appropriate to the scale and nature of potential eelgrass impacts, the following measures should be considered for implementation to reduce the potential for excessive nutrient loading to eelgrass habitat:

- diverting site runoff from landscaped areas away from discharges around eelgrass habitat;
- implementation of fertilizer reduction program;
- reduction of watershed nutrient loading;
- controlling local sources of nutrients such as animal wastes and leach fields; and
- maintaining good circulation and flushing conditions within the water body.

Reducing nutrient loading may also provide opportunities for establishing eelgrass as mitigation for project impacts.

5. Sediment loading

Watershed development and changes in land use may increase soil erosion and increase sedimentation to downstream embayments and lagoons.

- To the extent practicable, maintain riparian vegetation buffers along all streams in the watershed.
- Incorporate watershed analysis into agricultural, ranching, and residential/commercial development projects.
- Increase resistance to soil erosion and runoff. Sediment basins, contour farming, and grazing management are examples of key practices.
- Implement best management practices for sediment control during construction and maintenance operations (*e.g.,* Caltrans 2003).

Reducing sediment loading may also provide opportunities for establishing eelgrass as mitigation for project impacts in systems for which sedimentation is a demonstrable limiting factor to eelgrass.

D. Assessing Impacts to Eelgrass Habitat

If appropriate to the statute under which the consultation occurs, NMFS should consider both direct and indirect effects of the project in order to assess whether a project may impact eelgrass. NMFS is aware that many of the statutes and regulations it administers may have more specific meanings for certain terms, including "direct effect" and "indirect effect", and will use the statutory or regulatory meaning of those terms when conducting consultations under those statutes.[2] Nevertheless, it is useful for NMFS to consider effects experienced

[2] In the EFH context, adverse effects include any impact that reduces quality and/or quantity of EFH, including direct or indirect physical, chemical, or biological alterations of the waters or substrate (50 CFR 600.910). The Council of Environmental Quality (CEQ) regulations regarding NEPA implementation (40 CFR 1508.8(a)) define direct and indirect impacts of an action for the purposes of NEPA. Other NMFS statutes provide their own definitions regarding effects.

contemporaneously with project actions (both at the project site and away from the project site) and which might occur later in time.

Generally, effects to eelgrass habitat should be assessed using pre- and post-project surveys of the impact area and appropriate reference site(s) conducted during the time period of maximum eelgrass growth (typically March through October for southern California, April through October for central California, April through October for San Francisco Bay, and May through September for northern California). NMFS should consider the likelihood that the effects would occur before recommending pre- and post-project eelgrass surveys. The pre-construction survey of the eelgrass habitat in the action area and an appropriate reference site(s) should be completed within 60 days before start of construction. After construction, a post-action survey of the eelgrass habitat in the action area and at an appropriate reference site(s) should be completed within 30 days of completion of construction, or within the first 30 days of the next active growth period following completion of construction that occurs outside of the active growth period. Copies of all surveys should be provided to the lead federal agency, NMFS, and other interested regulatory and/or resource agencies within 30 days of completing the survey. The recommended timing of surveys is intended to minimize changes in eelgrass habitat distribution and abundance during the period between survey completion and construction initiation and completion. For example, a post-action survey completed beyond 30 days following construction or outside of the active growing season may show declines in eelgrass habitat as a result of natural senescence rather than the action.

The lead federal agency and NMFS should consider reference area eelgrass performance, physical evidence of impact, turbidity and construction activities monitoring data, as well as other documentation in the determination of the impacts of the action undertaken. Impact analyses should document whether the impacts are anticipated to be complete at the time of the assessment, or whether there is an anticipation of continuing eelgrass impacts due to chronic or intermittent effects. Where eelgrass at the impact site declines coincident with and similarly to decline at the reference site(s), the percentage of decline at the reference site should be deducted from the decline at the impact site. However, if eelgrass expands within the reference site(s), the impact site should only be evaluated against the pre-construction condition of the reference site and not the expanded condition. If an action results in increased eelgrass habitat relative to the reference sites, this increase could potentially be considered (subject to the caveats identified herein) by NMFS and the action agency as potential compensation for impacts to eelgrass habitat that occur in the future (see Section II. E. 3). An assessment should also be made as to whether impacts or portions of the impact are anticipated to be temporary. Information supporting this determination may be derived from the permittee, NMFS, and other resource and regulatory agencies, as well as other eelgrass experts.

For some projects, environmental planning and permitting may take longer than 60 days. To accommodate longer planning schedules, it may also be necessary to do a preliminary eelgrass survey prior to the pre-construction survey. This preliminary survey can be used to anticipate potential impacts to eelgrass for the purposes of mitigation planning during the permitting process. In some cases, preliminary surveys may focus on spatial distribution of eelgrass habitat only or may be a qualitative reconnaissance to allow permittees to incorporate avoidance and minimization measures into their proposed action or to plan for future mitigation needs. The pre-and post- project surveys should then verify whether impacts occur as anticipated, and if planned mitigation is adequate. In some cases, a preliminary survey could be completed a year or more in advance of the project action.

1. Direct Effects

Biologists should consider the potential for localized losses of eelgrass from dredging or filling, construction-associated damage, and similar spatially and temporally proximate impacts (these effects could be termed "direct"). The actual area of the impact should be determined from an analysis that compares the pre-action condition of eelgrass habitat with the post-action conditions from this survey, relative to eelgrass habitat change at the reference site(s).

2. Indirect Effects

Biologists should also consider effects caused by the action which occur away from the project site; furthermore, effects occurring later in time (whether at or away from the project site) should also be considered. Biologists should consider the potential for project actions to alter conditions of the physical environment in a manner that, in turn, reduce eelgrass habitat distribution or density (*e.g.*, elevated turbidity from the initial implementation or later operations of an action, increased shading, changes to circulation patterns, changes to vessel traffic that lead to greater groundings or wake damage, increased rates of erosion or deposition).

For actions where the impact cannot be fully determined until a substantial period after an action is taken, an estimate of likely impacts should be made prior to implementation of the proposed action based on the best available information (*e.g.*, shading analyses, wave and current modeling). A monitoring program consisting of a pre-construction eelgrass survey and three post-construction eelgrass surveys at the impact site and appropriate reference site(s) should be performed. The action party should complete the first post-construction eelgrass survey within 30 days following completion of construction to evaluate any immediate effects to eelgrass habitat. The second post-construction survey should be performed approximately one year after the first post-construction survey during the appropriate growing season. The third post-construction survey should be performed approximately two years after the first post-construction survey during the appropriate growing season. The second and third post-construction surveys will be used to evaluate if indirect effects resulted later in time due to altered physical conditions; the time frames identified above are aligned with growing season (attempting a survey outside of the growing season would show inaccurate results).

A final determination regarding the actual impact and amount of mitigation needed, if any, to offset impacts should be made based upon the results of two annual post-construction surveys, which document the changes in the eelgrass habitat (areal extent, bottom coverage, and shoot density within eelgrass) in the vicinity of the action, compared to eelgrass habitat change at the reference site(s). Any impacts determined by these monitoring surveys should be mitigated. In the event that monitoring demonstrates the action to have resulted in greater eelgrass habitat impacts than initially estimated, additional mitigation should be implemented in a manner consistent with these guidelines. In some cases, adaptive management may allow for increased success in eelgrass mitigation without the need for additional mitigation.

E. Mitigation Options

The term mitigation is defined differently by various federal and State laws, regulations and policies. In a broad sense, mitigation may include a range of measures from complete avoidance of adverse effects to compensation for adverse effects by preserving, restoring or creating similar resources at onsite or offsite locations. The Corps and EPA issued regulations governing compensatory mitigation to offset unavoidable adverse effects to waters of the United States authorized by Clean Water Act section 404 permits and other permits issued by the Corps (73 FR 19594; April 10, 2008). For those regulations (33 CFR 332.2 and 40 CFR 230.92, respectively), the Corps and EPA, define "compensatory mitigation" as "the restoration (re-establishment or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances preservation of aquatic resources for the purposes of offsetting unavoidable adverse effects which remain after all appropriate and practicable avoidance and minimization has been achieved."

When impacts to eelgrass would occur, the action agency should develop a mitigation plan to achieve no net loss in eelgrass function following the recommended steps in this policy. If NMFS determines a mitigation plan is needed, and it was not included with the EFH Assessment for the proposed action, NMFS may recommend, either as comments on the EFH Assessment or as an EFH Conservation Recommendation, that one be provided. Potential mitigation options are described below. The action agency should consider site specific conditions when determining the most appropriate mitigation option for an action.

1. Comprehensive management plans

NMFS supports the development of comprehensive management plans (CMPs) that protect eelgrass resources within the context of broader ecosystem needs and management objectives. Recommendations different from specific elements described below for in-kind mitigation may be appropriate where a CMP (*e.g.,* an enforceable programmatic permit, Special Area Management Plan, harbor plan, or ecosystem-based management plan) exists that is considered to provide adequate population-level and local resource distribution protections to eelgrass. One such CMP under development at the time these guidelines were developed is *City of Newport Beach Eelgrass Protection Mitigation Plan for Shallow Water in Lower Newport Bay: An Ecosystem Based Management Plan.* If satisfactorily completed and adopted, it is anticipated the protection measures for eelgrass within this area would be adequate to meet the objectives of this policy.

In general, it is anticipated that CMPs may be most appropriate in situations where a project or collection of similar projects will result in incremental but recurrent impacts to a small portion of local eelgrass populations through time (*e.g.*, lagoon mouth maintenance dredging, maintenance dredging of channels and slips within established marinas, navigational hazard removal of recurrent shoals, shellfish farming, and restoration or enhancement actions). In order to ensure that these alternatives provide adequate population-level and local resource distribution protections to eelgrass and that the plan is consistent with the overall conservation objectives of this policy, NMFS should be involved early in the plan's development.

2. In-kind mitigation

In-kind compensatory mitigation is the creation, restoration, or enhancement of habitat to mitigate for adverse impacts to the same type of habitat. In most cases in-kind mitigation is the preferred option to compensate for impacts to eelgrass. Generally, in-kind mitigation should achieve a final mitigation ratio of 1.2:1 across all areas of the state, independent of starting mitigation ratios. A starting mitigation ratio is the ratio of mitigation area to impact area when mitigation is initiated. The final mitigation ratio is the ratio of mitigation area to impact area once mitigation is complete. The 1.2:1 ratio assumes: (1) there is no eelgrass function at the mitigation site prior to mitigation efforts, (2) eelgrass function at the mitigation site is achieved within three years, (3) mitigation efforts are successful, and (4) there are no landscape differences (*e.g.*, degree of urban influence, proximity to freshwater source), between the impact site and the mitigation site. Variations from these assumptions may warrant higher or lower mitigation ratios. For example, a higher ratio would be appropriate for an enhancement project where the mitigation site has some level of eelgrass function prior to the mitigation action.

Typically, in-kind eelgrass mitigation involves transplanting or seeding of eelgrass into unvegetated habitat. Successful in-kind mitigation may also warrant modification of physical conditions at the mitigation site to prepare for transplants (*e.g.*, alter sediment composition, depth, etc.). In some areas, other in-kind mitigation options such as removing artificial structures that preclude eelgrass growth may be feasible. If in-kind mitigation that does not include transplants or seeding is proposed, post-mitigation monitoring as described below should be implemented to verify that mitigation is successful.

Information provided below in Section II.F includes specific recommendations for in-kind mitigation, including site selection, reference sites, starting mitigation ratios, mitigation methods, mitigation monitoring and performance criteria. Many of the recommendations provided in these guidelines for eelgrass assessments, surveys, and mitigation may apply throughout the state even if a non-transplant mitigation option is proposed.

3. Mitigation banks and in-lieu-fee programs

In 2006 and 2011, the NMFS Southwest Region (merged with the Northwest Region in 2013 to form the West Coast Region) signed interagency Memorandum of Understandings that established and refined a framework for developing and using combined or coordinated approaches to mitigation and conservation banking and in-lieu-fee programs in California. Other signatory agencies include: the California Resources Agency, California Department of Fish and Wildlife, the Corps, the US Fish &Wildlife Service, the EPA, the Natural Resource Conservation Service, and the State Water Resources Control Board.

Under this eelgrass policy, NMFS supports the use of mitigation bank and in-lieu fee programs to compensate for impacts to eelgrass habitat, where such instruments are available and where such programs are appropriate to the statutory structure under which mitigation is recommended. Mitigation banks and in-lieu fee conservation programs are highly encouraged by NMFS in heavily urbanized waters. Credits should be used at a ratio of 1:1 if those credits have been established for a full three-year period prior to use. If the bank credits have been in place for a period less than three years, credits should be used at a ratio determined through application of the wetland mitigation calculator (King and Price 2004).

At the request of the action party, and only with approval of NMFS and other appropriate resource agencies and subject to the caveats below, surplus eelgrass area that, after 60-months, exceeds the mitigation needs, as defined in section II.F.6 Mitigation Monitoring and Performance Milestones, has the potential to be considered for future mitigation needs. Additionally, only with the approval of NMFS and other appropriate resource agencies and subject to the caveats below, eelgrass habitat expansion resulting from project activities, and that otherwise would not have occurred, has the potential to be considered for future mitigation needs. Exceeding mitigation needs does not guarantee or entitle the action party or action agency to credit such mitigation to future projects, since every future project must be considered on a case-by-case basis (including the location and type of impact) and viewed in light of the relevant statutory authorities.

4. Out-of-kind mitigation

Out-of-kind compensatory mitigation means the adverse impacts to one habitat type are mitigated through the creation, restoration, or enhancement of another habitat type. In most cases, out-of-kind mitigation is discouraged, because eelgrass is a rare, special-status habitat in California. There may be some scenarios, however, where out-of-kind mitigation for eelgrass impacts is ecologically desirable or when in-kind mitigation is not feasible. This determination should be made based on an established ecosystem plan that considers ecosystem function and services relevant to the geographic area and specific habitat being impacted. Any proposal for out-of-kind mitigation should demonstrate that the proposed mitigation will compensate for the loss of eelgrass habitat function within the ecosystem. Out-of-kind mitigation that generates services similar to eelgrass habitat or improves conditions for establishment of eelgrass should be considered first. NMFS and the federal action agency should be consulted early when out-of-kind mitigation is being proposed in order to determine if out-of-kind mitigation is appropriate, in coordination with other relevant resource agencies (e.g., California Department of Fish and Wildlife, California Coastal Commission, U.S. Fish and Wildlife Service)

F. In-kind Mitigation for Impacts to Eelgrass

As all mitigation project specifics will be determined on a case-by-case basis, circumstances may exist where NMFS staff will need to modify or deviate from the recommended measures described below before providing their recommendation to action agencies.

1. Mitigation Site Selection

Eelgrass habitat mitigation sites should be similar to the impact site. Site selection should consider distance from action, depth, sediment type, distance from ocean connection, water quality, and currents. Where eelgrass that is impacted occurs in marginally suitable environments, it may be necessary to conduct mitigation in a preferable location and/or modify the site to be better suited to support eelgrass habitat creation. Mitigation site modification should be fully coordinated with NMFS staff and other appropriate resource and regulatory agencies. To the extent feasible, mitigation should occur within the same hydrologic system (*e.g.*, bay, estuary, lagoon) as the impacts and should be appropriately distributed within the same ecological subdivision of larger systems (*e.g.*, San Pablo Bay or Richardson Bay in San Francisco Bay), unless NMFS and the action agency concur that good justification exists for altering the distribution based on valued ecosystem functions and services.

In identifying potentially suitable mitigation sites, it is advisable to consider the current habitat functions of the mitigation site prior to mitigation use. In general, conversion of unvegetated subtidal areas or disturbed uplands to eelgrass habitats may be considered appropriate means to mitigate eelgrass losses, while conversion of other special aquatic sites (*e.g.*, salt marsh, intertidal mudflats, and reefs) is unlikely to be considered suitable. It may be necessary to develop suitable environmental conditions at a site prior to being able to effectively transplant eelgrass into a mitigation area. Mitigation sites may need physical modification, including increasing or lowering elevation, changing substrate, removing shading or debris, adding wave protection or removing impediments to circulation.

2. Mitigation Area Needs

In-kind mitigation plans should address the components described below to ensure mitigation actions achieve no net loss of eelgrass habitat function. Alternative contingent mitigation should be specified and included in the mitigation plan to address situations where performance milestones are not met.

a) Impacts to Areal Extent of Eelgrass Habitat

Generally, mitigation of eelgrass habitat should be based on replacing eelgrass habitat extent at a 1.2 (mitigation) to 1 (impact) mitigation ratio for eelgrass throughout all regions of California. However, given variable degrees of success across regions and potential for delays and mitigation failure, NMFS calculated *starting* mitigation ratios using "The Five-Step Wetland Mitigation Ratio Calculator" (King and Price 2004) developed for NMFS Office of Habitat Conservation. The calculator utilizes methodology similar to Habitat Equivalency Analysis (HEA), which is an accepted method to determine the amount of compensatory restoration needed to provide natural resource services that are equivalent to loss of natural resource services following an injury (http://www.darrp.noaa.gov/economics/pdf/heaoverv.pdf). HEA is commonly used by NOAA during damage assessment cases, including those involving seagrass. Similar to HEA, the mitigation calculator is based on the "net present value" approach to asset valuation, an economics concept used to compare values of all types of investments, and then modified to incorporate natural resource services. Using the calculator allows for consistency in methodology for all areas within California, avoids arbitrary identification of size of the mitigation area, and avoids cumulative loss to eelgrass habitat that would likely occur with a standard 1:1 ratio (because of the complexity of eelgrass mitigation and the time for created eelgrass to achieve full habitat function).

The calculator includes a number of metrics to determine appropriate ratios that focus on comparisons of quality and quantity of function of the mitigation relative to the site of impact to ensure full compensation of lost function. (see Attachment 4). Among other metrics, the calculator employs a metric of likelihood of failure within the mitigation site based on regional mitigation failure history. As such, the mitigation calculator identifies a recommended starting mitigation ratio (the mitigation area to eelgrass impact area) based on regional history of success in eelgrass mitigation. Increased initial mitigation site size should be considered to provide greater assurance that the performance milestones, as specified in Section II.F.6, will be met. This is a common practice in the eelgrass mitigation field to reduce risk of falling short of mitigation needs (Thom 1990). Independent of starting mitigation ratio utilized for a given mitigation action, mitigation success should generally be evaluated against a ratio of 1.2:1.

The elevated starting mitigation ratio should be applied to the area of impact to vegetated eelgrass cover only. For unvegetated eelgrass habitat, a starting mitigation ratio of 1.2:1 is appropriate.

To determine the recommended starting mitigation ratio for each region, the percentage of transplant successes and failures was examined over the history of transplanting in the region. NMFS staff examined transplants projects over the past 25 years in all mitigation regions (see Attachment 6). Eelgrass mitigation in Southern California has a 35-year history with 66 transplants performed over that period. In the past 25 years, a total of 47 eelgrass transplants for mitigation purposes have been conducted in Southern California. Forty-three of these were established long enough to evaluate success for these transplants. The overall failure rate, with failure defined as not meeting success criteria established for the project, was 13 percent. Eelgrass mitigation within central California has a better history of successful completion than within southern California, San Francisco Bay, and northern California. However, the number of eelgrass mitigation actions conducted in this region is low and limited to areas within Morro Bay. While the success of eelgrass mitigation in central California has been high, the low number of attempts makes mitigation in this region uncertain. Eelgrass habitat creation/restoration in San Francisco Bay and in northern California has had varied success.

In all cases, best information available at the time of this policy's development was used to determine the parameter values entered into the calculator formula. As regional eelgrass mitigation success changes and the results of ongoing projects become available, the starting mitigation ratio may be updated. Updates in mitigation calculator inputs should not be made on an individual action basis, because the success or lack of success of an individual mitigation project may not reflect overall mitigation success for the region. Rather NMFS should re-evaluate the regional transplant history approximately every 5 years, increasing the record of transplant success in 5 year increments for new projects implemented after NMFS' adoption of these guidelines. If the 5-year review shows that new efforts are more successful than those from the beginning of the 25-year period, NMFS staff should consider removing early projects (*e.g.*, those completed 20 years prior) from the analysis.

On a case-by-case basis and in consultation with action agencies, NMFS may consider proposals with different starting mitigation ratios where sufficient justification is provided that indicates the mitigation site would achieve the no net loss goal. In addition, CMPs could consider different starting mitigation ratios, or other mitigation elements and techniques, as appropriate to the geographic area addressed by the CMP.

Regardless of starting mitigation ratio, eelgrass mitigation should be considered successful, if it meets eelgrass habitat coverage over an area that is 1.2 times the impact area with comparable eelgrass density as impacted habitat. Please note, delayed implementation, supplemental transplant needs, or NMFS and action agency agreement may result in an altered mitigation area. In the EFH consultation context, NMFS may recommend an altered mitigation area during implementation of the federal agency's mitigation plan following EFH consultation or NEPA review, or as an EFH Conservation Recommendation if the federal agency re-initiates EFH consultation.

(1) Southern California (Mexico border to Pt. Conception)

For mitigation activities that occur concurrent to the action resulting in damage to existing eelgrass habitat, a starting ratio of 1.38 to 1 (transplant area to vegetated cover impact area) should be recommended to counter the regional failure risk. That is, for each square meter of vegetated eelgrass cover adversely impacted, 1.38 square meters of new habitat with suitable conditions to support eelgrass should be planted with a comparable bottom coverage and eelgrass density as impacted habitat.

(2) Central California (Point Conception to mouth of San Francisco Bay).

For mitigation activities that occur concurrent to the action resulting in damage to existing eelgrass habitat, a starting ratio of 1.20 to 1 (transplant area to vegetated cover impact area) should be recommended based on a 0 percent failure rate over the past 25 years (4 transplant actions). It should however be noted that all of these successful transplants included a greater area of planting than was necessary to achieve success such that the full mitigation area would be achieved, even with areas of minor transplant failure.

(3) San Francisco Bay (including south, central, San Pablo and Suisun Bays).

For mitigation activities that occur concurrent to the action resulting in damage to the existing eelgrass bed resource, a ratio of 3.01 to 1 (transplant area to vegetated cover impact area) should be recommended based on a 60 percent failure rate over the past 25 years (10 transplant actions). That is, for each square meter adversely impacted, 3.01 square meters of new habitat with suitable conditions to support eelgrass should be planted with a comparable bottom coverage and eelgrass density as impacted habitat.

(4) Northern California (mouth of San Francisco Bay to Oregon border).

For mitigation activities that occur concurrent to the action resulting in damage to the existing eelgrass habitat, a starting ratio of 4.82 to 1 (transplant area to vegetated cover impact area) should be recommended based on a 75 percent failure rate over the past 25 years (4 transplant actions). That is, for each square meter of eelgrass habitat adversely impacted, 4.82 square meters of new habitat with suitable conditions to support eelgrass should be planted with a comparable bottom coverage and eelgrass density as impacted habitat.

b) *Impacts to Density of Eelgrass Beds*

Degradation of existing eelgrass habitat that results in a permanent reduction of eelgrass turion density greater than 25 percent, and that is a statistically significant difference from pre-impact density, should be mitigated based on an equivalent area basis. The 25 percent and statistically significant threshold is believed reasonable based on supporting information (Fonseca *et al.* 1998, WDFW 2008), and professional practice under SCEMP. In these cases, eelgrass remains present at the action site, but density may be potentially affected by long-term chronic or intermittent effects of the action. Reduction of density should be determined to have occurred when the mean turion density of the impact site is found to be statistically different ($\alpha=0.10$ and $\beta=0.10$) from the density of a reference and at least 25 percent below the reference mean during two annual sampling events following implementation of an action. The number of samples taken to describe density at each site (*e.g.*, impact and reference) should be sufficient to provide for appropriate statistical power. For small impact areas that do not allow for a sample size that provides statistical power, alternative methods for pre- and post- density comparisons could be considered. Mitigation for reduction of turion density without change in eelgrass habitat area should be on a one-for-one basis either by augmenting eelgrass density at the impact site or by establishing new eelgrass habitat comparable to the change in density at the impact site. For example, a 25 percent reduction in density of 100-square meters (100 turions/square meter) of eelgrass habitat to 75 turions/square meter should be mitigated by the establishing 25 square meters of new eelgrass habitat with a density at or above the 100 turions/square meter pre-impact density.

3. Mitigation Technique

In-kind mitigation technique should be determined on a case-by-case basis. Techniques for eelgrass mitigation should be consistent with the best available technology at the time of mitigation implementation and should be tailored to the specific needs of the mitigation site. Eelgrass transplants have been highly successful in southern and central California, but have had mixed results in San Francisco Bay and northern California. Bare-root bundles and seed buoys have been utilized with some mixed success in northern portions of the state. Transplants using frames have also been used with some limited success. For transplants in southern California, plantings consisting of bare-root bundles consisting of 8-12 individual turions each have proven to be most successful (Merkel 1988).

Donor material should be taken from the area of direct impact whenever practical, unless the action resulted in reduced density of eelgrass at the area of impact. Site selections should consider the similarity of physical environments between the donor site and the transplant receiver site and should also consider the size, stability, and history of the donor site (*e.g.*, how long has it persisted and is it a transplant site). Plants harvested should be taken in a manner to thin an existing bed without leaving any noticeable bare areas. For all geographic areas, no more than 10 percent of an existing donor bed should be harvested for transplanting purposes. Ten percent is reasonable based on recommendations in Thom *et al.* (2008) and professional practice under SCEMP. Harvesting of flowering shoots for seed buoy techniques should occur only from widely separated plants.

It is important for action agencies to note that state laws and regulations affect the harvesting and transplantation of donor plants and permission from the state, where required, should be obtained; for example, California Department of Fish and Wildlife may need to provide written authorization for harvesting and transplanting donor plants and/or flowering shoots.

4. Mitigation Plan

NMFS should recommend that a mitigation plan be developed for in-kind mitigation efforts. During consultation, NMFS biologists should request that mitigation plans be provided at least 60 days prior to initiation of project activities to allow for NMFS review. When feasible, mitigation plans should be developed based on preliminary or pre-project eelgrass surveys. When there is uncertainty regarding whether impacts to eelgrass will occur, and the need for mitigation is based on comparison of pre- and post-project eelgrass surveys, NMFS biologists should request that the mitigation plan be provided no more than 60 days following the post-project survey to allow for NMFS review and minimize any delay in mitigation implementation.

At a minimum, the mitigation plan should include:

- Description of the project area
- Results of preliminary eelgrass survey and pre/post-project eelgrass surveys if available (see Section II.B.1 and II.B.2)
- Description of projected and/or documented eelgrass impacts
- Description of proposed mitigation site and reference site(s) (see Section II.B.4)
- Description of proposed mitigation methods (see Section II.F.3)
- Construction schedule, including specific starting and ending dates for all work including mitigation activities. (see Section II.F.5)
- Schedule and description of proposed post-project monitoring and when results will be provided to NMFS
- Schedule and description of process for continued coordination with NMFS through mitigation implementation
- Description of alternative contingent mitigation or adaptive management should proposed mitigation fail to achieve performance measures (see Section II.F.6)

5. Mitigation Timing

Mitigation should commence within 135 days following the initiation of the in-water construction resulting in impact to the eelgrass habitat, such that mitigation commences within the same eelgrass growing season as impacts occur. If possible, mitigation should be initiated prior to or concurrent with impacts. For impacts initiated within 90 days prior to, or during, the low-growth period for the region, mitigation may be delayed to within 30 days after the start of the following growing season, or 90 days following impacts, whichever is longer, without the need for additional mitigation as described below. This timing avoids survey completion during the low growth season, when results may misrepresent progress towards performance milestones.

Delays in eelgrass mitigation result in delays in ultimate reestablishment of eelgrass habitat functions, increasing the duration and magnitude of project impacts to eelgrass. To offset loss of eelgrass habitat function that accumulates through delay, an increase in successful eelgrass mitigation is needed to achieve the same compensatory habitat function. Because habitat function is accumulated over time once the mitigation habitat is in place, the longer the delay in initiation of mitigation, the greater the additional habitat area needed (i.e., mitigation ratio increasingly greater than 1.2:1) to offset losses. Unless a specific delay is authorized or dictated by the initial schedule of work, federal action agencies should determine whether delays in mitigation initiation in excess of 135 days warrant an increased final mitigation ratio. If increased mitigation ratios are warranted, NMFS should recommend higher mitigation ratios (see Attachment 7). Where delayed implementation is authorized by the action agency, the increased mitigation ratio may be determined by utilizing the Wetlands Mitigation Calculator (King and Price 2004) with an appropriate value for parameter D (See Attachment 4). Examples of delay multipliers generated using the Wetlands Mitigation Calculator are provided in Attachment 5.

Conversely, implementing mitigation ahead of impacts can be used to reduce the mitigation needs by achieving replacement of eelgrass function and services ahead of eelgrass losses. If eelgrass is successfully transplanted three years ahead of impacts, the mitigation ratio would drop from 1.2:1 to 1:1. If mitigation is completed less than three years ahead of impacts, the mitigation calculator can be used to determine the appropriate intermediate mitigation ratio.

6. Mitigation Monitoring and Performance Milestones

In order to document progress and persistence of eelgrass habitat at the mitigation site through and beyond the initial establishment period, which generally is three years, monitoring should be completed for a period of five years at both the mitigation site and at an appropriate reference site(s) (Section II.B.4. Reference Site Selection). Monitoring at a reference site(s) may account for any natural changes or fluctuations in habitat area or density. Monitoring should determine the area of eelgrass and density of plants at 0, 12, 24, 36, 48, and 60 months after completing the mitigation. These intervals will provide yearly updates on the establishment and persistence of eelgrass during the growing season. These monitoring recommendations are consistent with findings of the National Research Council (NRC 2001), the Corps requirements for compensatory mitigation (33 CFR 332.6(b)), and other regional resource policies (Corps 2010, Evans and Leschen 2010, SFWMD 2007).

All monitoring work should be conducted during the active eelgrass growth period and should avoid the recognized low growth season for the region to the maximum extent practicable (typically November through February for southern California, November through March for central California, November through March for San Francisco Bay, and October through April for northern California). Sufficient flexibility in the scheduling of the 6 month surveys should be allowed in order to ensure the work is completed during this active growth period. Additional monitoring beyond the 60-month period may be warranted in those instances where the stability of the proposed mitigation site is questionable, where the performance of the habitat relative to reference sites is erratic, or where other factors may influence the long-term success of mitigation. Mitigation plans should include a monitoring schedule that indicates when each of the monitoring events will be completed.

The monitoring and performance milestones described below are included as eelgrass transplant success criteria in the SCEMP. These numbers represent milestones and associated timelines typical of successful eelgrass habitat development based on NMFS' experience with: (1) conducting eelgrass surveys and monitoring and (2) reviewing mitigation monitoring results for projects implemented under SCEMP. Restored eelgrass habitat is expected to develop through an initial 3 year monitoring period such that, within 36 months following planting, it meets or exceeds the full coverage and not less than 85 percent of the density relative to the initial condition of affected eelgrass habitat. Restored eelgrass habitat is expected to sustain this condition for at least 2 additional years.

Monitoring events should evaluate the following performance milestones:

Month 0 – Monitoring should confirm the full coverage distribution of planting units over the initial mitigation site as appropriate to the geographic region.

Month 6 – Persistence and growth of eelgrass within the initial mitigation area should be confirmed, and there should be a survival of at least 50 percent of the initial planting units with well-distributed coverage over the initial mitigation site. For seed buoys, there should be demonstrated recruitment of seedlings at a density of not less than one seedling per four (4) square meters with a distribution over the extent of the initial planting area. The timing of this monitoring event should be flexible to ensure work is completed during the active growth period.

Month 12–The mitigation site should achieve a minimum of 40 percent coverage of eelgrass and 20 percent density of reference site(s) over not less than 1.2 times the area of the impact site.

Month 24–The mitigation site should achieve a minimum of 85 percent coverage of eelgrass and 70 percent density of reference site(s) over not less than 1.2 times the area of the impact site.

Month 36–The mitigation site should achieve a minimum of 100 percent coverage of eelgrass and 85 percent density of reference site(s) over not less than 1.2 times the area of the impact site.

Month 48–The mitigation site should achieve a minimum of 100 percent coverage of eelgrass and 85 percent density of reference site(s) over not less than 1.2 times the area of the impact site.

Month 60–The mitigation site should achieve a minimum of 100 percent coverage of eelgrass and 85 percent density of reference site(s) over not less than 1.2 times the area of the impact site.

Performance milestones may be re-evaluated or modified if declines at a mitigation site are also demonstrated at the reference site, and therefore, may be a result of natural environmental stressors that are unrelated to the intrinsic suitability of the mitigation site. In the EFH consultation context, NMFS should provide recommendations regarding modification of performance milestones as technical assistance during interagency coordination as described in the mitigation plan or as EFH Conservation Recommendations if the federal action agency re-initiates EFH consultation.

7. Mitigation Reporting

NMFS biologists should request monitoring reports and spatial data for each monitoring event in both hard copy and electronic version, to be provided within 30 days after the completion of each monitoring period to allow timely review and feedback from NMFS. These reports should clearly identify the action, the action party, mitigation consultants, relevant points of contact, and any relevant permits. The size of permitted eelgrass impact estimates, actual eelgrass impacts, and eelgrass mitigation needs should be identified, as should appropriate information describing the location of activities. The report should include a detailed description of eelgrass habitat survey methods, donor harvest methods and transplant methods used. The reports should also document mitigation performance milestone progress (see II.F.6. Mitigation Monitoring and Performance Milestones). The first report (for the 0-month post-planting monitoring) should document any variances from the mitigation plan, document the sources of donor materials, and document the full area of planting. The final mitigation monitoring report should provide the action agency and NMFS with an overall assessment of the performance of the eelgrass mitigation site relative to natural variability of the reference site to evaluate if mitigation responsibilities were met. An example summary is provided in Attachment 3.

8. Supplemental Mitigation

Where development of the eelgrass habitat at the mitigation site falls short of achieving performance milestones during any interim survey, the monitoring period should be extended and supplemental mitigation may be recommended to ensure that adequate mitigation is achieved. In the EFH consultation context, NMFS should provide recommendations regarding extended monitoring as technical assistance during interagency coordination as described in the mitigation plan or as EFH Conservation Recommendations if the federal action agency re-initiates EFH consultation. In some instances, an adaptive management corrective action to the existing mitigation area may be appropriate. In the event of a mitigation failure, the action agency should convene a meeting with the action party, NMFS, and applicable regulatory and/or resource agencies to review the specific circumstances and develop a solution to achieve no net loss in eelgrass habitat function.

As indicated previously, while in-kind mitigation is preferred, the most appropriate form of compensatory mitigation should be determined on a case-by-case basis. In cases where it is demonstrated that in-kind replacement is infeasible, out-of-kind mitigation may be appropriate over completion of additional in-kind mitigation. The determination that an out-of-kind mitigation is appropriate will be made by NMFS, the action agency, and the applicable regulatory agencies, where a regulatory action is involved.

G. Special Circumstances

Depending on the circumstances of each individual project, NMFS may make recommendations different from those described above on a case by case basis. For the scenarios described below, for example, NMFS could recommend a mitigation ratio or 1:1 or for use of out-of-kind mitigation. Because NMFS needs a proper understanding of eelgrass habitat in the project area and potential impacts of the proposed project to evaluate the full effects of authorized activities, NMFS should not make recommendations that diverge from these guidelines if they would result in surveys, assessments or reports inferior to those which might be obtained through the guidance in Section II. The area thresholds described below are taken from the SCEMP and/or reflect recommendations NMFS staff have repeatedly made during individual EFH consultations. These thresholds minimize impacts to eelgrass habitat quality and quantity, based on NMFS' experience with: (1) conducting eelgrass surveys and monitoring and (2) reviewing project monitoring results for projects implemented under SCEMP. The special circumstance included for shellfish aquaculture longlines is supported by Rumrill and Poulton (2004) and the NMFS Office of Aquaculture.

1. Localized Temporary Impacts

NMFS may consider modified target mitigation ratios for localized temporary impacts wherein the damage results in impacts of less than 100 square meters and eelgrass habitat is fully restored within the damage footprint within one year of the initial impact (e.g., placement of temporary recreational facilities, shading by construction equipment, or damage sustained through vessel groundings or environmental clean-up operations). In such cases, the 1.2:1 mitigation ratio should not apply, and a 1:1 ratio of impact to recovery would apply. A monitoring program consisting of a pre-construction eelgrass survey and three post-construction eelgrass surveys at the impact site and appropriate reference site(s) should be completed in order to demonstrate the temporary nature of the impacts. NMFS should recommend that surveys be completed as follows: 1) the first post-construction eelgrass survey should be completed within 30 days following completion of construction to evaluate direct effects of construction, 2) the second and third post-construction surveys should be performed approximately one year after the first post-construction survey, and approximately two years after the first post-construction survey, respectively, during the appropriate growing season to confirm no indirect, or longer term effects resulted from construction. A compelling reason should be demonstrated before any reduced monitoring and reporting recommendations are made.

2. Localized Permanent Impacts

a) If both NMFS and the authorizing action agencies concur, the compensatory mitigation elements of this policy may not be necessary for the placement of a single pipeline, cable, or other similar utility line across existing eelgrass habitat with an impact corridor of no more than 1 meter wide. NMFS should recommend the completion of pre- and post-action surveys as described in section II.B. and II.D. The actual area of impact should be determined from the post-action survey. NMFS should recommend the completion of an additional survey (after 1 year) to ensure that the action or impacts attributable to the action have not exceeded the 1-meter corridor width. NMFS should recommend that, if the post-action or 1 year survey demonstrates a loss of eelgrass habitat greater than the 1-meter wide corridor, mitigation should be undertaken.

b)) If both NMFS and the authorizing action agencies concur that the spacing of shellfish aquaculture longlines does not result in a measurable net loss of eelgrass habitat in the project area, then mitigation associated with local losses under longlines may not be necessary. NMFS should recommend the completion of pre- and post-action surveys as described in section II.B. and II.D. NMFS should recommend the completion of additional post-action monitoring surveys (to be completed approximately 1 year and 2 years following implementation of the action) to ensure that the action or impacts attributable to the action have not resulted in net adverse impacts to eelgrass habitat. NMFS should recommend that, if the 1-year or 2-year survey demonstrates measurable impact to eelgrass habitat, mitigation should be undertaken. c) NMFS should consider mitigation on a 1:1 basis for impacts less than 10 square meters to eelgrass patches where impacts are limited to small portions of well-established eelgrass habitat or eelgrass habitat that, despite highly variable conditions, generally retain extensive eelgrass, even during poor years. A reduced mitigation ratio should not be considered where impacts would occur to isolated or small eelgrass habitat areas within which the impacted area constitutes more than 1% of the eelgrass habitat in the local area during poor years.

c) If NMFS concurs and suitable out-of-kind mitigation is proposed, compensatory mitigation may not be necessary for actions impacting less than 10 square meters of eelgrass.

III. Glossary of Terms

Except where otherwise specified, the explanations of the following terms are provided for informational purposes only and are described solely for the purposes of this policy; where a NMFS statute, regulation, or agreement requires a different understanding of the relevant term, that understanding of the term will supplant these explanations provided below.

<u>Compensatory mitigation</u> – restoration, establishment, or enhancement of aquatic resources for the purposes of offsetting unavoidable authorized adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved.

<u>Ecosystem</u> – a geographically specified system of organisms, the environment, and the processes that control its dynamics. Humans are an integral part of an ecosystem.

<u>Ecosystem function</u> – ecological role or process provided by a given ecosystem.

<u>Ecosystem services</u> – contributions that a biological community and its habitat provide to the physical and mental well-being of the human population (*e.g.*, recreational and commercial opportunities, aesthetic benefits, flood regulation).

<u>Eelgrass habitat –</u> areas of vegetated eelgrass cover (any eelgrass within 1 square meter quadrat and within 1 m of another shoot) bounded by a 5 m wide perimeter of unvegetated area

<u>Essential fish habitat (EFH) –</u> EFH is defined in the MSA as "...those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity."

<u>EFH Assessment –</u> An assessment as further explained in 50 C.F.R. § 600.920(e).

<u>EFH Consultation</u> – The process explained in 50 C.F.R. § 600.920

EFH Conservation Recommendation – provided by the National Marine Fisheries Service (NMFS) to a federal or state agency pursuant to section 305(b)(4)(A) of the Magnuson-Stevens Act regarding measures that can be taken by that agency to conserve EFH. As further explained in 50 C.F.R. § 600.925, EFH Conservation Recommendations may be provided as part of an EFH consultation with a federal agency, or may be provided by NMFS to any federal or state agency whose actions would adversely affect EFH .

Habitat – environment in which an organism(s) lives, including everything that surrounds and affects its life, including biological, chemical and physical processes.

Habitat function – ecological role or process provided by a given habitat (*e.g.*, primary production, cover, food, shoreline protection, oxygenates water and sediments, etc.).

In lieu fee program – a program involving the restoration, establishment, and/or enhancement of aquatic resources through funds paid to a governmental or non-profit natural resources management entity to satisfy compensatory mitigation needs; an in lieu fee program works like a mitigation bank, however, fees to compensate for impacts to habitat function are collected prior to establishing an on-the-ground conservation/restoration project.

In-kind mitigation – mitigation where the adverse impacts to a habitat are mitigated through the creation, restoration, or enhancement of the same type of habitat.

Mitigation – action or project undertaken to offset impacts to an existing natural resource.

Mitigation bank – a parcel of land containing natural resource functions/values that are conserved, restored, created and managed in perpetuity and used to offset unavoidable impacts to comparable resource functions/values occurring elsewhere. The resource functions/values contained within the bank are translated into quantified credits that may be sold by the banker to parties that need to compensate for the adverse effects of their activities.

Out-of-kind mitigation – mitigation where the adverse impacts to one habitat type are mitigated through the creation, restoration, or enhancement of another habitat type

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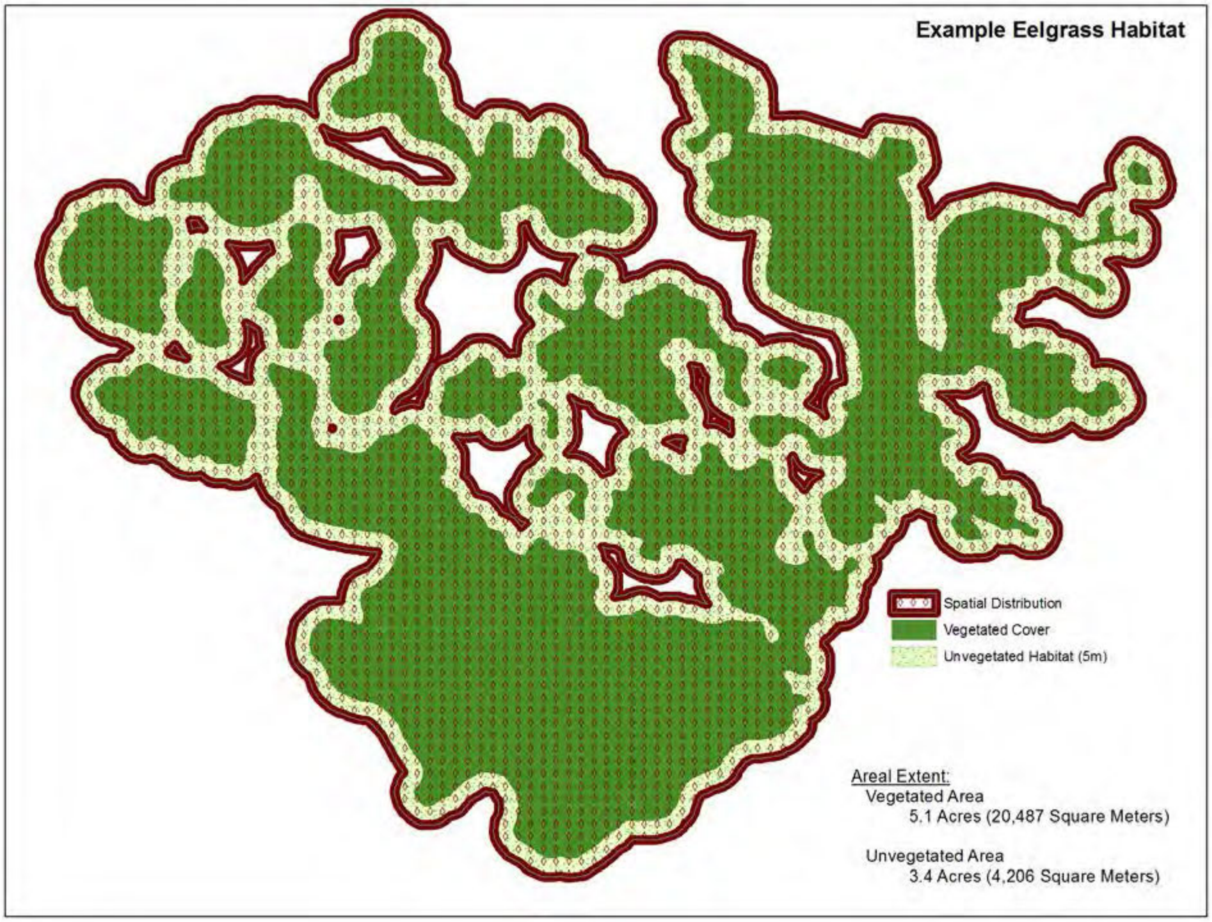
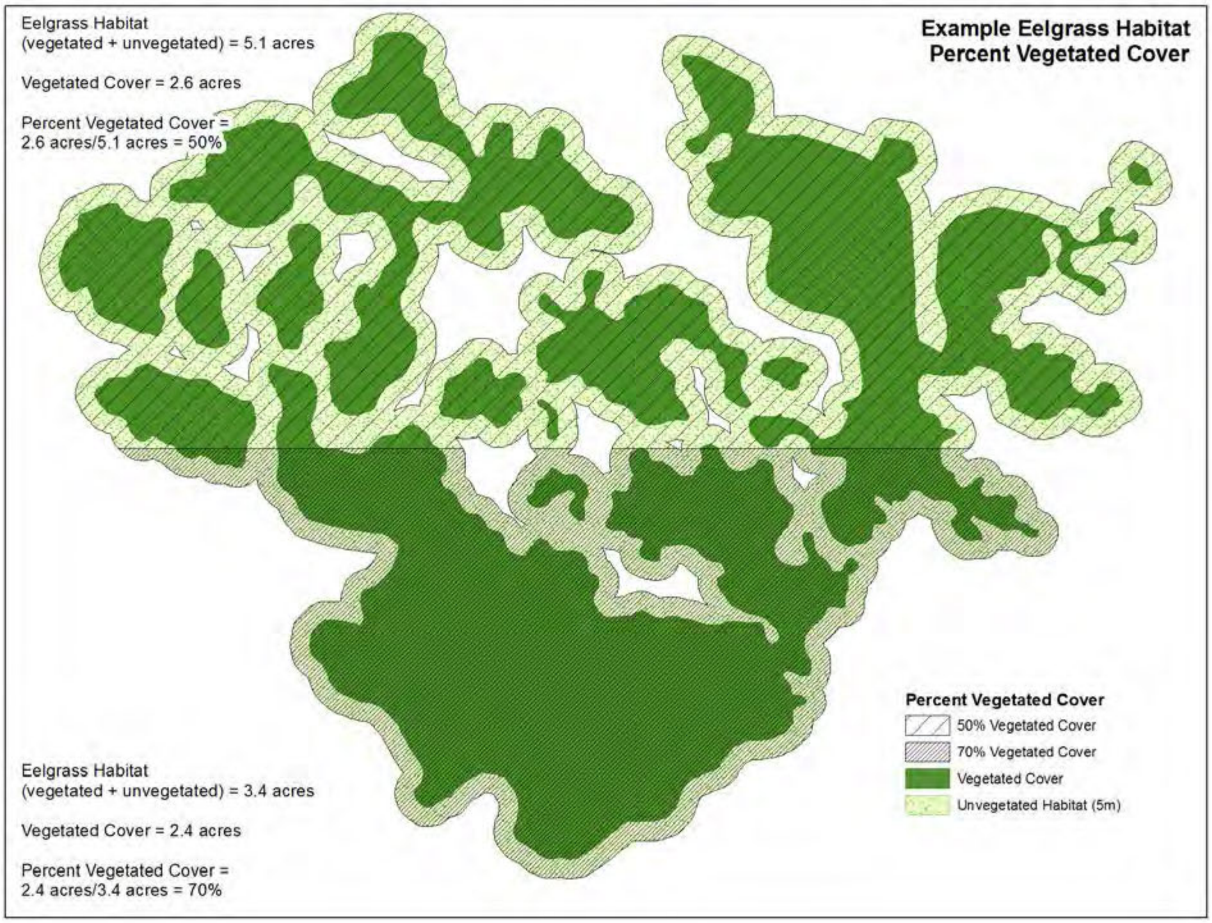
ATTACHMENT 1. Graphic depiction of eelgrass habitat definition including spatial distribution and aerial coverage of vegetated cover and unvegetated eelgrass habitat.

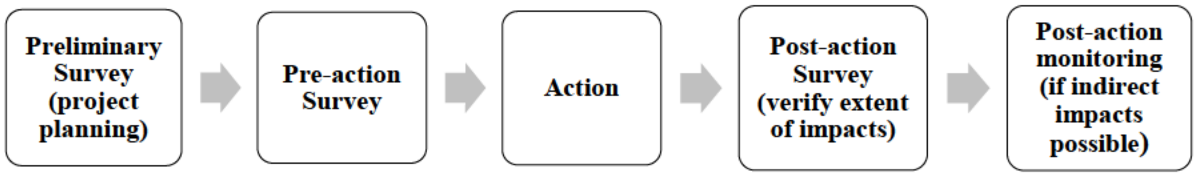


ATTACHMENT 2. Example Eelgrass Habitat Percent Vegetated Cover.



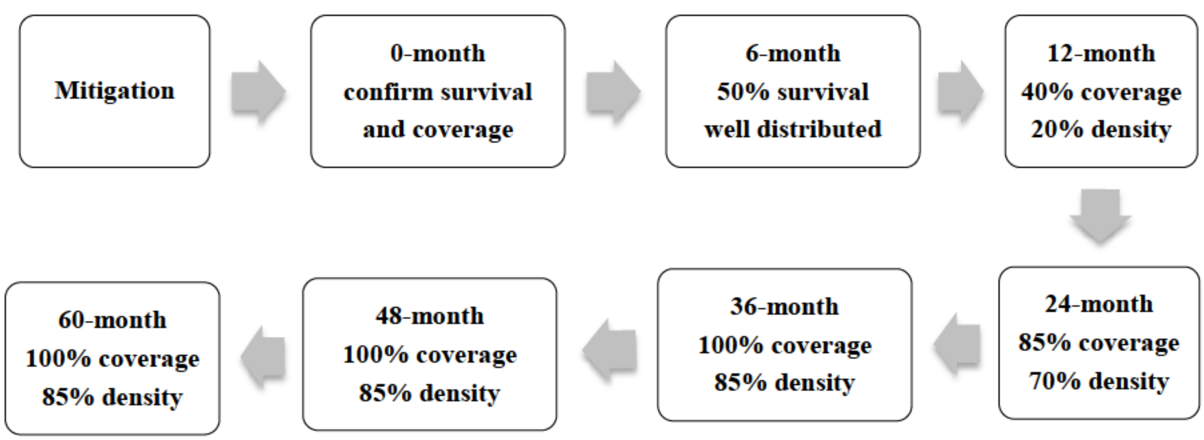
ATTACHMENT 3. Flow chart depicting timing of surveys and monitoring.

a) <u>Eelgrass impact surveys</u>



- All surveys should be completed during the growing season
- Surveys should be completed at the impact site and an appropriate reference site(s)
- A preliminary survey completed for planning purposes may be completed a year or more in advance of the action.
- Pre-action and post-action surveys should be completed within 60 days of the action.
- A survey is good for 60 days, or if that 60 day period extends beyond the end of growing season, until start of next growing season
- Two years of monitoring following the initial post-action monitoring event may be needed to verify lack or extent of indirect effects.
- Survey reports should be provided to NMFS and the federal action agency within 30 days of completion of each survey event

b) <u>Eelgrass mitigation monitoring</u>



- Mitigation should occur coincident or prior to the action
- All monitoring should be completed during the growing season
- Performance metrics for each monitoring event are compared to the 1.2:1 mitigation ratio
- Monitoring reports should be provided to NMFS and the federal action agency 30 days of completion of each monitoring event
- NMFS and action agency will evaluate if performance metrics met, and decide if supplemental mitigation or other adaptive management measures are needed

ATTACHMENT 4. Eelgrass transplant monitoring report.

In order to ensure that NMFS is aware of the status of eelgrass transplants, action agencies should provide or ensure that NMFS is provided a monitoring report summary with each monitoring report. For illustrative purposes only, an example of a monitoring report summary is provided below.

ACTION PARTY CONTACT INFORMATION:

Action Name (same as permit reference):

(a) Action party Information

Name		Address	
Contact Name		City, State, Zip	
Phone		Fax	
Email			

MITIGATION CONSULTANT

Name		Address	
Contact Name		City, State, Zip	
Phone		Fax	
Email			

PERMIT DATA:

Permit	Issuance Date	Expiration Date	Agency Contact

EELGRASS IMPACT AND MITIGATION NEEDS SUMMARY:

Permitted Eelgrass Impact Estimate (m^2):			
Actual Eelgrass Impact (m^2):		On (post-construction date):	
Eelgrass Mitigation Needs (m^2):		Mitigation Plan Reference:	
Impact Site Location:			
Impact Site Center Coordinates (actionion &			

datum):	
Mitigation Site Location:	
Mitigation Site Center Coordinates (actionion & datum):	

ACTION ACTIVITY DATA:

Activity	Start Date	End Date	Reference Information
Eelgrass Impact			
Installation of Eelgrass Mitigation			
Initiation of Mitigation Monitoring			

MITIGATION STATUS DATA:

	Mitigation Milestone	Scheduled Survey	Survey Date	Eelgrass Habitat Area (m^2)	Bottom Coverage (Percent)	Eelgrass Density (turions/m^2)	Reference Information
Month	0						
	6						
	12						
	24						
	36						
	48						
	60						

FINAL ASSESSMENT:

Was mitigation met?	
Were mitigation and monitoring performed timely?	
Were mitigation delay increases needed or were supplemental mitigation programs necessary?	

ATTACHMENT 5. Wetlands mitigation calculator formula and parameters.

Starting mitigation ratios for each region within California were calculated using "The Five-Step Wetland Mitigation Ratio Calculator" (King and Price 2004) developed for NMFS Office of Habitat Conservation. The discrete time equation this method uses to solve for the appropriate mitigation ratio is as follows:

$$R = \frac{\sum_{t=0}^{T_{max}} (1+r)^{-t}}{\left(B(1-E)(1+L)-A\right)\left[\sum_{t=-D}^{C-D-1} \frac{(t+D)}{C(1+r)^{t}} + \sum_{C-D}^{T_{max}} (1+r)^{-t}\right] + \left[\sum_{t=-D}^{T_{max}} \frac{\left(1-(1-k)^{(t+D)}\right)}{(1+r)^{(t+D)}}\right]\left(A(1+L)\right)}$$

The calculator parameters in the above equation and values used to calculate starting mitigation ratios for CEMP are as follows:

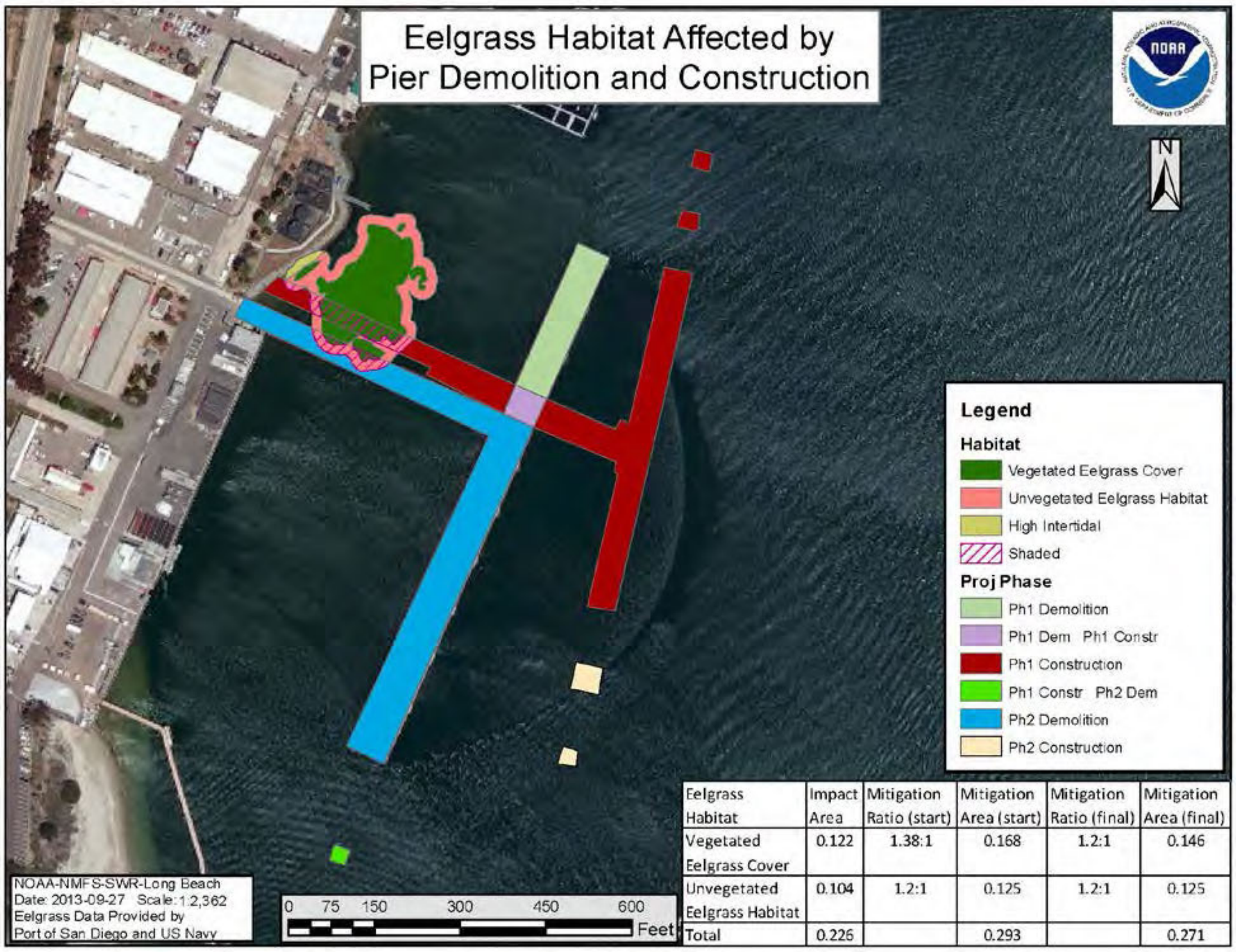
Symbol	Calculator Parameter	Value
A	The level of habitat function provided at the mitigation site prior to the mitigation project	0%
B	The maximum level of habitat function that mitigation is expected to attain, if it is successful	100%
C	The number of years after construction that the mitigation project is expected to achieve maximum function	3 yrs
D	The number of years before destruction of the impacted wetland that the mitigation project begins to generate habitat function	0 yrs
E	The percent likelihood that the mitigation project will fail and provide none of the anticipated benefits	various*
L	The percent difference in expected habitat function based on differences in landscape context of the mitigation site when compared with the impacted wetland	0%
k	The percent likelihood that the mitigation site, in the absence purchase or easement would be developed in any future year	0%
r	The discount rate used for comparing gains and losses that accrue at different times in terms of their present value	3%**
Tmax	The time horizon used in the analysis (chosen to maintain 1.2:1 ratio at E=100% and other parameter values listed above).	13 yrs

* The value for E was based on regional history of success in eelgrass mitigation and varied between regions (see Attachment X).

** NOAA suggests the use of a 3 percent real discount rate for discounting interim service losses and restoration gains, unless a different proxy for the social rate of time preference is more appropriate. (NOAA-DARP 1999) We use this value here, because it is based on best available information and is consistent with the NOAA Damage Assessment and Restoration Program.

ATTACHMENT 6. Example calculations for application of starting and final mitigation ratios for impacts to eelgrass habitat in southern California.

In this example, a pier demolition and construction would impact 0.122 acres of vegetated eelgrass habitat (dark green) and 0.104 acres of unvegetated habitat (pink). Area of impact is indicated by purple hatch mark. Application of recommended starting mitigation ratio for southern California (1.38:1) and final mitigation ratio (1.2:1) to compute starting and final mitigation area for this example are shown in the table.



Eelgrass Habitat	Impact Area	Mitigation Ratio (start)	Mitigation Area (start)	Mitigation Ratio (final)	Mitigation Area (final)
Vegetated Eelgrass Cover	0.122	1.38:1	0.168	1.2:1	0.146
Unvegetated Eelgrass Habitat	0.104	1.2:1	0.125	1.2:1	0.125
Total	0.226		0.293		0.271

ATTACHMENT 7. Example mitigation area multipliers for delay in initiation of mitigation activities.

Delays in eelgrass transplantation result in delays in ultimate reestablishment of eelgrass habitat values, increasing the duration and magnitude of project effects to eelgrass. The delay multipliers in the table below have been generated by altering the implementation start time within "The Five-Step Wetland Mitigation Ratio Calculator" (King and Price 2004).

MONTHS POST-IMPACT	DELAY MULTIPLIER (Percent of Initial Mitigation Area Needed)
0-3 mo	100%
4-6 mo	107%
7-12 mo	117%
13-18 mo	127%
19-24 mo.	138%
25-30 mo.	150%
31-36 mo	163%
37-42 mo.	176%
43-48 mo.	190%
49-54 mo.	206%
55-60 mo.	222%

ATTACHMENT 8. Summary of Eelgrass Transplant Actions in California

See table starting next page.

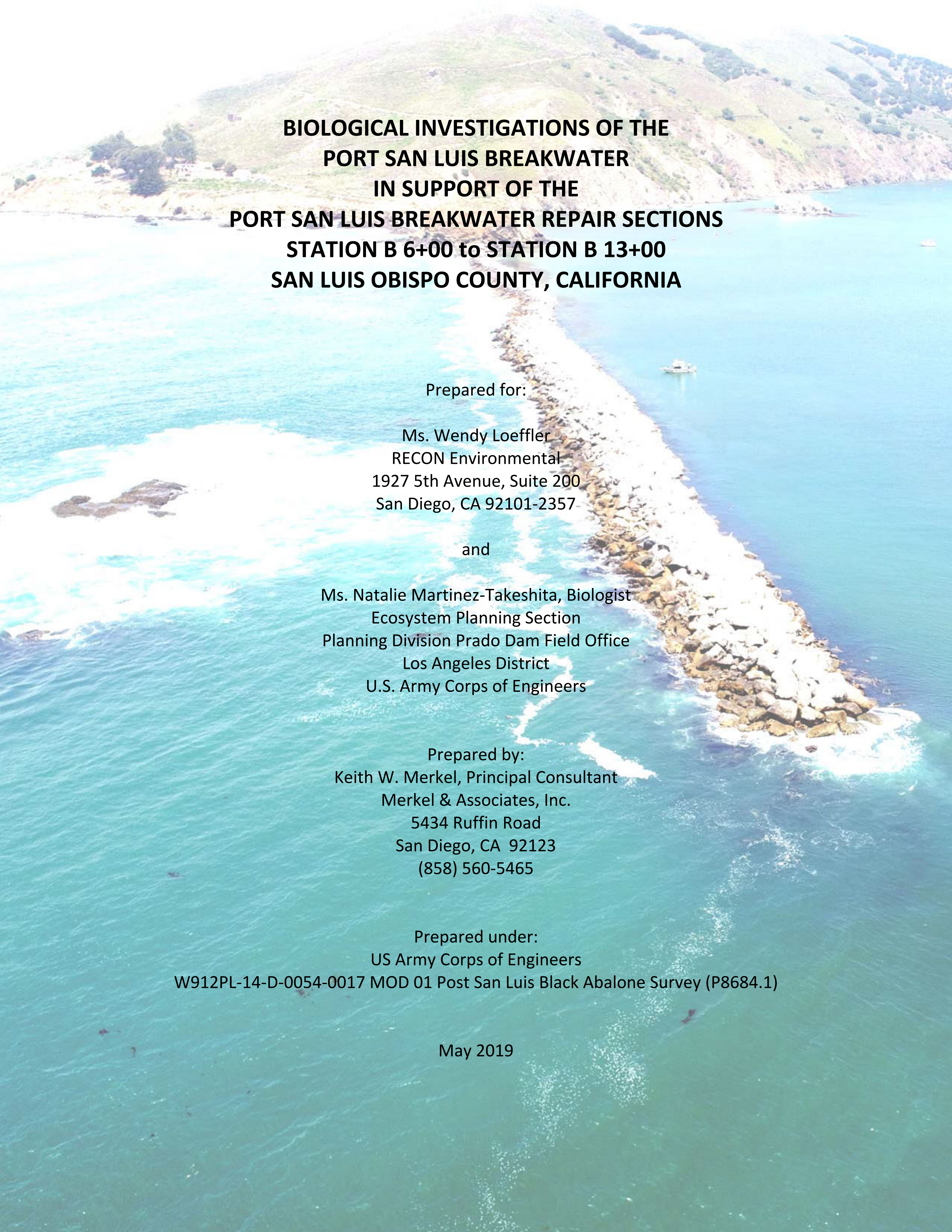
SUMMARY OF EELGRASS (*ZOSTERA MARINA*) TRANSPLANT PROJECTS IN CALIFORNIA

No.	Region	System	Location	Year	Size*	Type**	Consistent with Permit Conditions	Success Status***	Net Result****
Southern California Eelgrass Restoration History									
	Southern	San Diego Bay	North Island	1976	<0.1	SP	yes	no	-
	Southern	San Diego Bay	"Delta" Beach	1977	1.6	SP	yes	partial	-
	Southern	San Diego Bay	North Island	1978	<0.1	SP	yes	yes	+
	Southern	Newport Bay	Carnation Cove	1978	<0.1	SP	no	no	-
	Southern	Newport Bay	West Jetty	1980	<0.1	SP	yes	partial	0
	Southern	Mission Bay	multiple beaches	1982	<0.1	SP	no	partial	0
	Southern	LA/LB Harbor	Cabrillo Beach	1985	<0.1	BR	yes	yes	+
	Southern	Alamitos Bay	Peninsula	1985	<0.1	BR	yes	yes	+
	Southern	Huntington Hbr.	Main Channel	1985	<0.1	BR	yes	no	0
	Southern	Newport Bay	Upper	1985	<0.1	BR	yes	no	0
	Southern	Mission Bay	Sail Bay	1986	2.7	BR	yes	yes	+
	Southern	San Diego Bay	NEMS I	1987	3.8	BR	no	yes	+
	Southern	San Diego Bay	Chula Vista Wildlife Reserve	1987	<0.1	BR	yes	no	+[1]
	Southern	San Diego Bay	Harbor Island	1988	0.1	BR	yes	yes	+
	Southern	Huntington Harbour	Entrance Channel	1989	0.1	BR	no	yes	+
	Southern	San Diego Bay	Le Meridien Hotel	1990	<0.1	BR	yes	yes	+
	Southern	San Diego Bay	Embarcadero	1991	<0.1	BR	yes	yes	+[2]
	Southern	Mission Bay	Sea World Lagoon	1991	<0.1	BR	yes	yes	+
	Southern	San Diego Bay	Loew's Marina	1991	<0.1	BR	yes	yes	+
	Southern	San Diego Bay	NEMS 2	1993	<0.1	BR	yes	yes	+
	Southern	San Diego Bay	Sea Grant Study	1993	<0.1	BR	yes	yes	+
	Southern	Agua Hedionda Lagoon	Outer Lagoon	1993	<0.1	BR	yes	yes	+
	Southern	San Diego Bay	NEMS 5	1994	0.4	BR	yes	yes	+
	Southern	Mission Bay	South Shores Basin	1994	2.9	BR	yes	yes	+
	Southern	Talbert Marsh	Talbert Channel	1995	<0.1	BR	na	yes	+[4]
	Southern	Mission Bay	various sites	1995	4.8	BR	yes	yes	+
	Southern	Mission Bay	Ventura Cove[5]	1996	0.5	BR	yes	yes	+[6]
	Southern	Mission Bay	Santa Clara Cove	1996	<0.1	BR	yes	no	0[10]
	Southern	Mission Bay	West Mission Bay Drive Bridge	1996	<0.1	BR	no	yes	0[10]
	Southern	Mission Bay	De Anza Cove	1996	<0.1	BR	yes	yes	+
	Southern	Batiquitos Lagoon	all basins	1997	21.6[7]	BR	yes	yes	+[4]
	Southern	San Diego Bay	NEMS 5	1997	7.1	BR	yes	yes	+
	Southern	San Diego Bay	Convair Lagoon	1998	2.5	BR	yes	no	-[12]
	Southern	San Diego Bay	NEMS 6	1999	0.3	BR	yes	yes	+
	Southern	Aqua Hedionda	Bristol Cove	1999	0.3	BR	yes	yes	+
	Southern	Aqua Hedionda	Middle Lagoon and Inner Lagoon	1999	4	BR	yes	yes	+
	Southern	Newport Bay	Balboa Is.Grand Cana	1999	<0.1	BR	yes	yes	+
	Southern	Mission Bay	West Ski Island	2001	0.2	BR	yes	yes	+

No.	Region	System	Location	Year	Size*	Type**	Consistent with Permit Conditions	Success Status***	Net Result****
	Southern	San Diego Bay	Expanded NEMS 6	2001	0.6	BR	yes	yes	+
	Southern	Newport Bay	USCG Corona del Mar	2002	<0.1	BR	yes	yes	+
	Southern	Huntington Harbour	Sunset Bay	2002	<0.1	BR	yes	yes	+
	Southern	San Diego Bay	Navy Enhancement Is.	2002	1	BR	yes	yes	+
	Southern	San Diego Bay	Coronado Bay Bridge	2003	0.3	BR	no	no	0
	Southern	LA Harbor	P300 Expansion Area	2003	5.9	BR	yes	partial	-[9]
	Southern	Newport Bay	Newport Bay Channel Dredging	2004	0.4	BR	yes	no	-
	Southern	San Diego Bay	South Bay Borrow Pit	2004	4.2	BR	yes	yes	pending[8]
	Southern	San Diego Bay	USCG ATC Pier	2004	0.1	BR	yes	yes	+
	Southern	San Diego Bay	South Bay Borrow Pit Sup.	2006	4.2	BR	yes	yes	pending[8]
	Southern	San Diego Bay	D Street Marsh	2006	0.3	BR	yes	pending	pending
	Southern	LA Harbor	P300 Supplement	2007	0.8	BR	yes	yes	pending
	Southern	San Diego Bay	Glorietta Bay Shoreline Park	2007	0.2	BR	yes	yes	pending
	Southern	Bolsa Chica	Pilot Eelgrass Restoration	2007	0.5	BR	yes	yes	+[4]
	Southern	San Diego Bay	Borrow Pit Supplement	2007	4.2	BR	yes	yes	pending[8]
	Southern	San Diego Bay	Sweetwater Silvergate Frac-out	2008	<0.1	BR	yes	yes	0[11]
	Southern	San Diego Bay	Harbor Drive Bridge/NTC Channel	2009	<0.1	BR	yes	pending	pending
Southern California Eelgrass Success Rate (1989-2009, Last 20 Years)								**87%**	**n=43**
Central California Eelgrass Restoration History									
	Central	Morro Bay	Anchorage Area	1985	<0.1	BR	no	yes	+
	Central	Morro Bay	Target Rock	1997	<0.1	BR	no	yes	+
	Central	Morro Bay	Morro Bay Launch Ramp	2000	<0.1	BR	yes	yes	+
	Central	Morro Bay	Mooring Area A1	2002	0.3	BR	yes	yes	+
	Central	Morro Bay	Western Shoal	2010	0.8	BR	yes	pending	pending
Central California Eelgrass Success Rate (1985-2009, Inadequate History to Exclude Older Projects)								**100%**	**n=4**
San Francisco Bay Eelgrass Restoration History									
	San Francisco Bay	San Francisco Bay	Richmond Training Wall	1985	<0.1	BR	NA	no	NA[4]
	San Francisco Bay	San Francisco Bay	Keil Cove and Paradise Cove	1989	0.1	Plugs	NA	partial	NA[4]
	San Francisco Bay	San Francisco Bay	Bayfarm Island/Middle Harbor Shoal	1998	0.1	BR and Plugs	NA	partial	NA[4]
	San Francisco Bay	San Francisco Bay	Bayfarm Island	1999	0.1	BR	NA	partial	NA[4]
	San Francisco Bay	San Francisco Bay	Brickyard Cove, Berkeley	2002	0.2	BR	yes	yes	+[13]
	San Francisco Bay	San Francisco Bay	Emeryville Shoals	2002	0.1	Mixed Test	NA	no	NA[4]
	San Francisco Bay	San Francisco Bay	Marin CDay, R&GC, Audubon	2006	0.6	Seed Bouy	NA	partial	pending[4]
	San Francisco Bay	San Francisco Bay	Marin CDay, R&GC, Audubon	2006	<0.1	mod. TERFS	NA	partial	pending[4]
	San Francisco Bay	San Francisco Bay	Marin CDay, R&GC, Audubon	2006	<0.1	Seeding	NA	no	NA[4]
	San Francisco Bay	San Francisco Bay	Clipper Yacht Harbor, Sausalito	2007	<0.1	Frames	yes	pending	pending
	San Francisco Bay	San Francisco Bay	Albany, Emeryville, San Rafael	2007	<0.1	BR	NA	partial	pending[4]
	San Francisco Bay	San Francisco Bay	Belvedere	2008	<0.1	Frames	yes	pending	pending
San Francisco Bay Eelgrass Success Rate (1985-2009, Inadequate History to Exclude Older Projects)								**40%**	**n=10**

No.	Region	System	Location	Year	Size*	Type**	Consistent with Permit Conditions	Success Status***	Net Result****
Northern California Eelgrass Restoration History									
	Northern	Humboldt Bay	Indian Island	1982	unknown	BR	unknown	no	-
	Northern	Bodega Harbor	Spud Point Marina	1984	1.3	BR	yes	no	-
	Northern	Humboldt Bay	Indian Island	1986	<0.1	BR	yes	no	-
	Northern	Humboldt Bay		1986	0.2	unknown	unknown	no	-
	Northern	Humboldt Bay	SR255 Bridge	2004	<0.1	BR	yes	no	-
	Northern	Humboldt Bay	Maintenance Dredging Project	2005	<0.1	BR	yes	yes	+
Northern California Eelgrass Success Rate (1982-2009, Inadequate History to Exclude Older Projects)								**25%**	**n=4**

* size in hectares
SP = sediment laden plug
** BR = bare root
*** success status is measured as yes, no, partial, pending, or unknown. Success rate is reported as percentage of sucessful over total completed within the past 25 years.
yes = 1, partial = 0.5, no = 0, and pending or unknown are not counted in either the numerator or denominator in determining success percentage.
**** + = net increase in eelgrass coverage, 0 = no change in eelgrass coverage, - = net decrease in eelgrass coverage
1 Transplant was initially adversely impacted by an unknown source of sediment and was deemed unsuitable.
2 The transplant declined initially and later recovered from what was determined to be a one time sedimentation event.
3 Transplant was experimental due to dense beds of the exotic muscle *Musculista senhousia*
which inhibited the growth of the transplant. Replacement transplant done elsewhere.
Transplant was completed in an area deemed unsuitable. Insufficient coverage required the construction of a remedial site.
Monitoring continues at both the initial and remedial sites.
4 Transplant was experimental.
5 Multiple sites.
6 Mitigation for marina at Princess Resort, project not built
7 Amount of eelgrass present within all basins as of 2000 mapping.
8 Regional eelgrass decline has resulted in die-offs both within restoration and reference areas equally full recovery had not occurred at the time of evaluation, yet project exceeds control-corrected requ
9 Original site was constructed as a plateau that was underfilled and anticipated to fall short of objectives. A supplemental
transplant was therefore completed when development began to exhibit shortfalls in area.
10 Shortfall mitigated by withdraw from established eelgrass mitigation bank.
11 Exception conditions from SCEMP requiring only replacement in place for unanticipated damage
12 Mitigated out-of-kind with non-eelgrass to satisfy permit requirements after shortfall in eelgrass mitigation.



BIOLOGICAL INVESTIGATIONS OF THE PORT SAN LUIS BREAKWATER IN SUPPORT OF THE PORT SAN LUIS BREAKWATER REPAIR SECTIONS STATION B 6+00 to STATION B 13+00 SAN LUIS OBISPO COUNTY, CALIFORNIA

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Prepared under:
US Army Corps of Engineers
W912PL-14-D-0054-0017 MOD 01 Post San Luis Black Abalone Survey (P8684.1)

May 2019

3.2 Surfgrass Survey

3.2.1 Methods

Surfgrass surveys were conducted using a number of field data collection methods including on-foot low tide surveys, prior diving and snorkeling observation from June 2018, and ultra-low altitude orthorectified photography in June 2018 and January-February 2019. On-foot ground surveys focusing on surfgrass were conducted on the leeward side of the breakwater, while prior black abalone surveys conducted on both the seaward and leeward sides of the study area noted the presence of surfgrass where it occurred, but did not focus on mapping surfgrass. During the January and February 2019 surveys, tide and surf conditions were not suited to ground survey of surfgrass on the exposed portions of the breakwater. However, UAV based photography covered this area very well and prior abalone investigations in 2018 also did not note any surfgrass on the seaward side of the breakwater except for that found on the formational bedrock of Whaler's Island and Point San Luis.

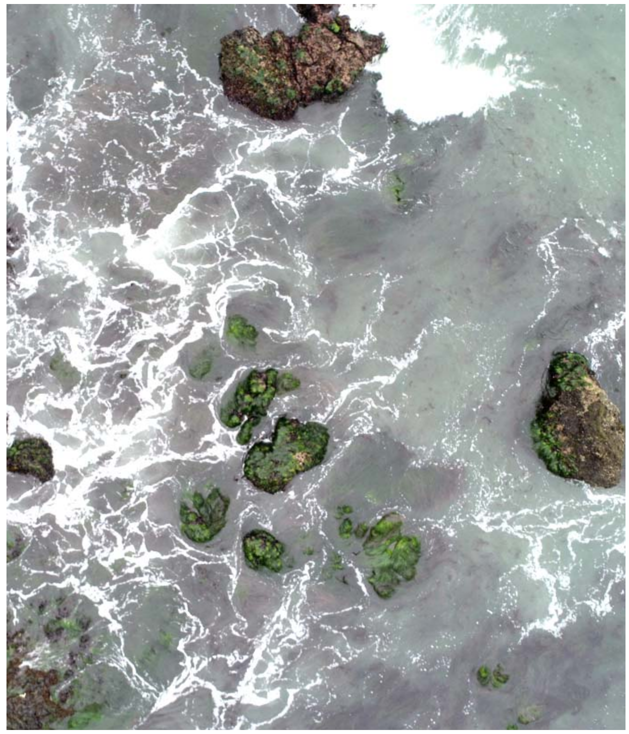
The Port San Luis Breakwater was surveyed at extreme low tides by UAV equipped with a 20 megapixel three color camera on June 30, 2018, January 30 and 31, and February 1, 2019. Surveys were completed at elevations of 400 feet and 250 feet, with a lower flight survey conducted at 100 feet being used to ground-truth the survey data. The native pixel resolutions of the collected imagery ranged from 0.4 inch at 100 feet up to 1.6 inches at 400 feet. The multiple flights were beneficial in providing a range of lighting and turbidity conditions thus ensuring that both exposed and shallow submerged surfgrass could be detected and mapped. The imagery collected was mosaicked to a georectified image and classification of surfgrass was accomplished using a combination of processing tools including spectral classification with manual training, followed by a process of manual cleaning and supplemental mapping completed on a dynamic stretch spectral range adjusted image. The mapping was completed in ESRI ArcGIS software.

3.2.2 Results

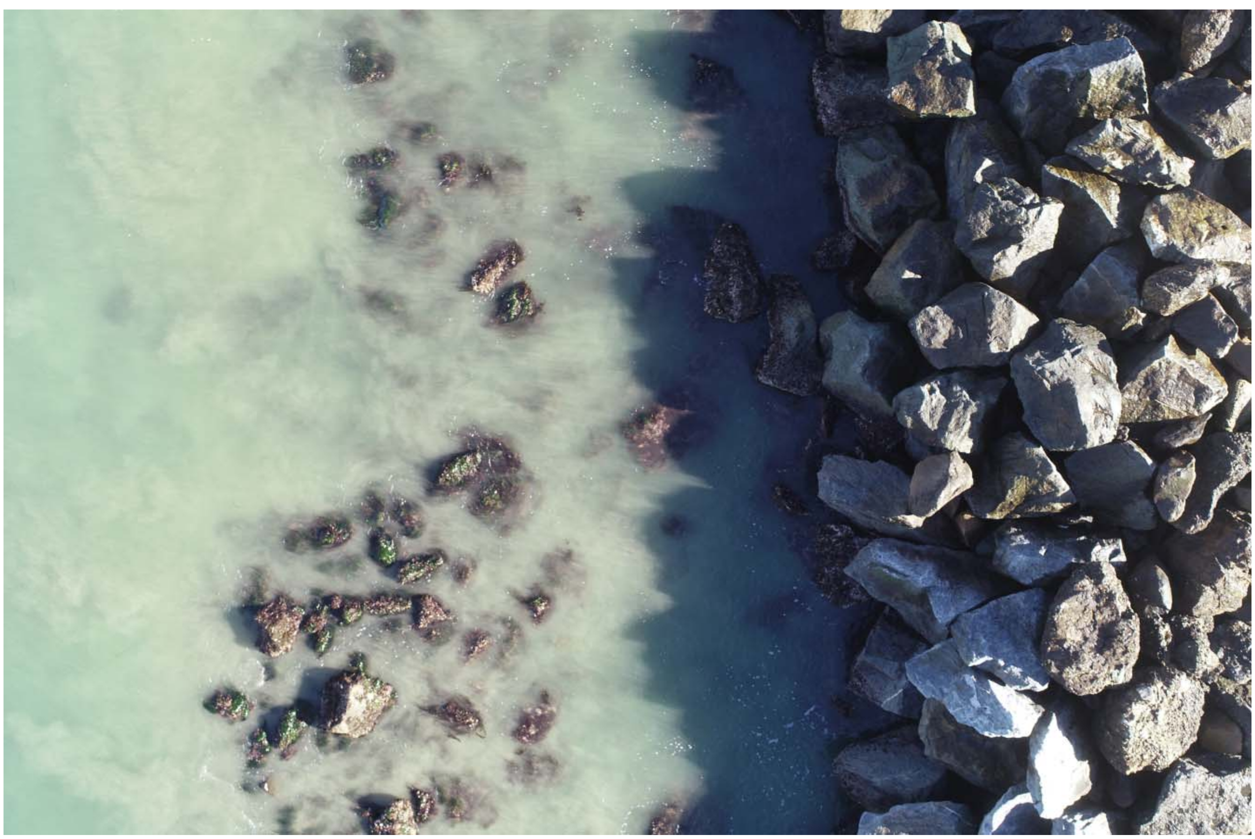
Torrey's surfgrass (*Phyllospadix torreyi*) was found to occur extensively on the native bedrock of Point San Luis and Whaler's Island, and to a much lesser degree on the low-lying boulder rock of what appears to be the remnants of a previously removed construction haul road on the leeward side of the breakwater (Figure 4). Although *P. torreyi* was specifically observed, Scouler's surfgrass (*P. scouleri*) is also present in the area with records existing from Diablo Canyon and Pismo Beach, and it would not be unexpected for both species to be represented in the study area.

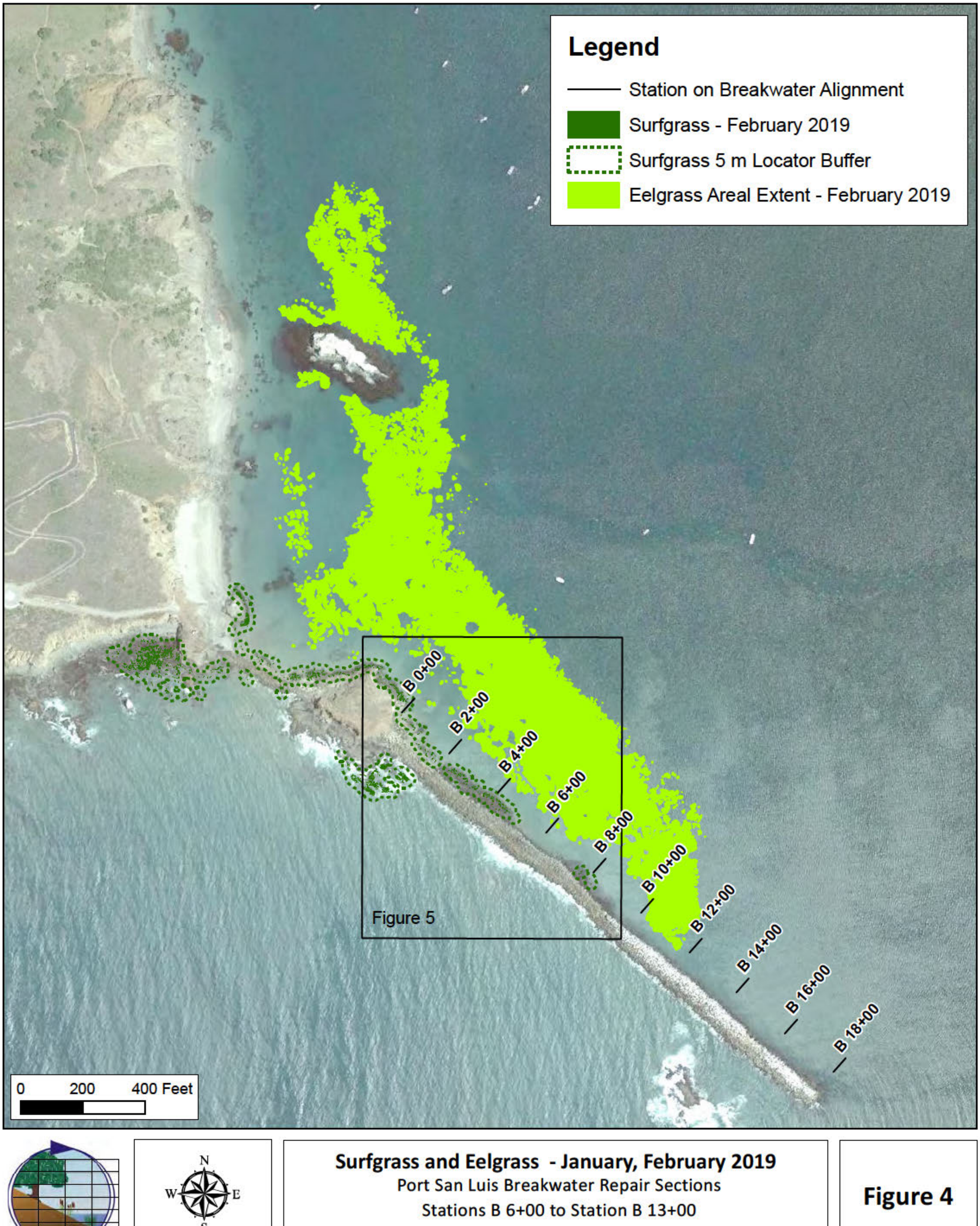
On the seaward side of the breakwater, surfgrass is found only within the partially sheltered areas near Point San Luis. On the lee side of the breakwater, surfgrass was most abundant on small areas of bedrock outcrops extending above the sand or adjacent to the breakwater boulder. However, surfgrass was also found on the lower intertidal imported boulder rubble that extended outward from the breakwater. These locations are intermittently sanded. No surfgrass was found further out on the breakwater where the surfgrass may be precluded from occurrence by a number of factors including well developed macroalgal cover, steep slopes that provide only a narrow potentially suitable elevation range, and a lack of disturbance that would allow surfgrass to become established.

Of particular note to the proposed breakwater repairs is the presence of the limited extent of surfgrass extending along the breakwater between Stations B 0+00 and B 8+00 (Figure 5). All of the surfgrass in this area is located between 0 and -3 feet MLLW. As a result, the surfgrass in this area should be outside of the elevation range within which repairs would take place, however well within the work area limits.



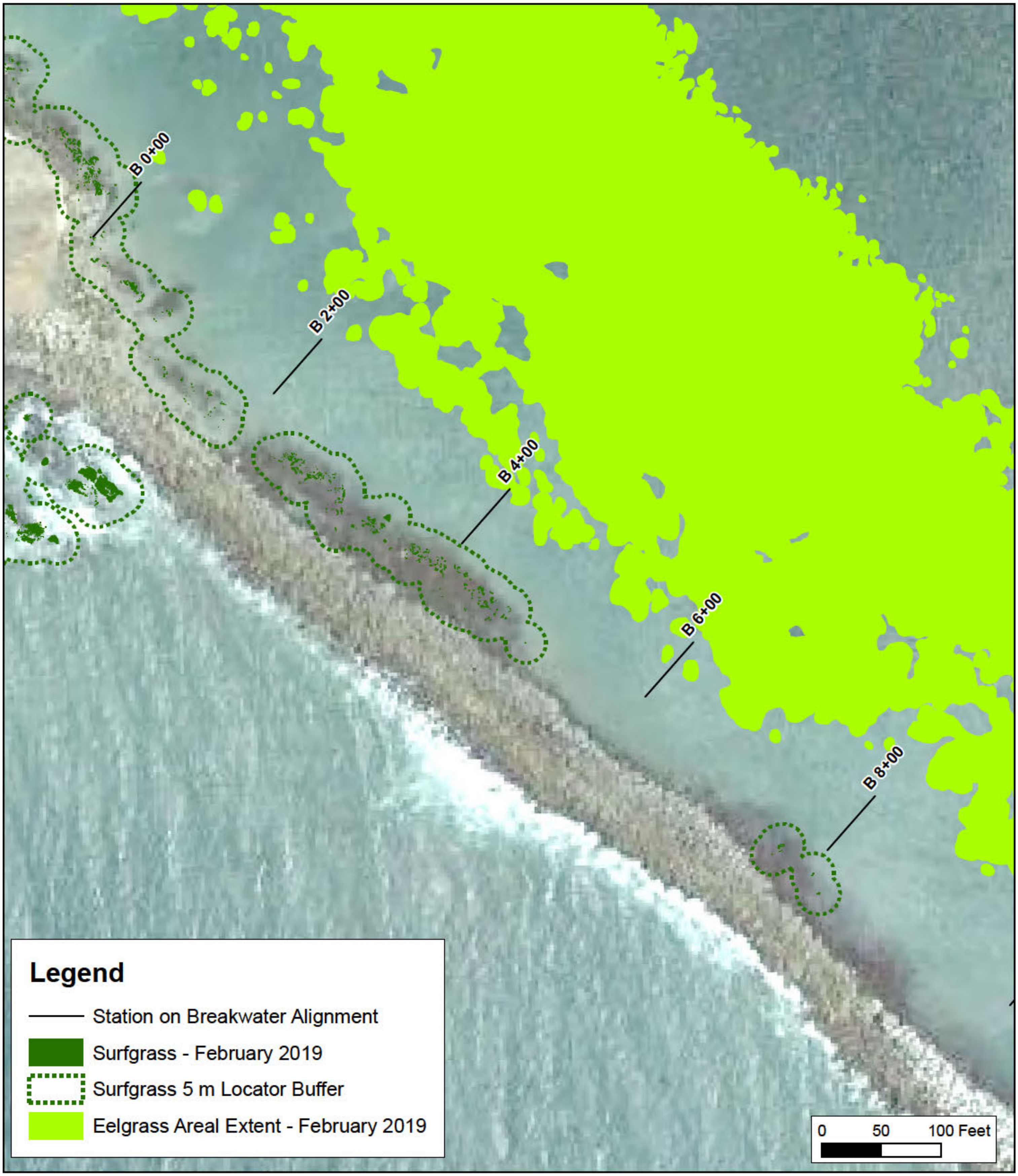
Surfgrass on bedrock (left) and within orthorectified UAV aerial image of surfgrass January-February 2019 (right). Surfgrass also occurs on what appears to be remnants of a prior breakwater roadway on the lee of the the breakwater (bottom).





Surfgrass and Eelgrass - January, February 2019
Port San Luis Breakwater Repair Sections
Stations B 6+00 to Station B 13+00
San Luis Obispo County, California

Figure 4



Surfgrass and Eelgrass - January, February 2019
Port San Luis Breakwater Repair Sections
Stations B 6+00 to Station B 13+00
San Luis Obispo County, California

Figure 5

3.3 Kelp Survey

3.3.1 Methods

The kelp surveys at Port San Luis breakwater were conducted from January 29 to February 1, 2019 within 500 feet of the centerline of the breakwater (Figure 1). During the prior black abalone surveys in June and July 2018, kelp surveys were not conducted, but anecdotal observations of canopy kelp were made.

During the winter period survey, no canopy kelp was noted in the kelp survey area. As a result, the kelp assessment was expanded to examine historic kelp distribution in the project region. This was completed by accessing the digital regional kelp mapping data prepared by the CDFW for any kelp beds located within approximately 4,000 feet of the breakwater. Data were acquired for this effort through queries of ftp://ftp.dfg.ca.gov/R7_MR/BIOLOGICAL/Kelp/, on the CDFW data server. The kelp canopy is mapped by CDFW and its contractors using aerial overflight surveys that are subsequently digitally interpreted to plot kelp canopy. The beds identified are typically dominated by giant kelp (*Macrocystis pyrifera*).

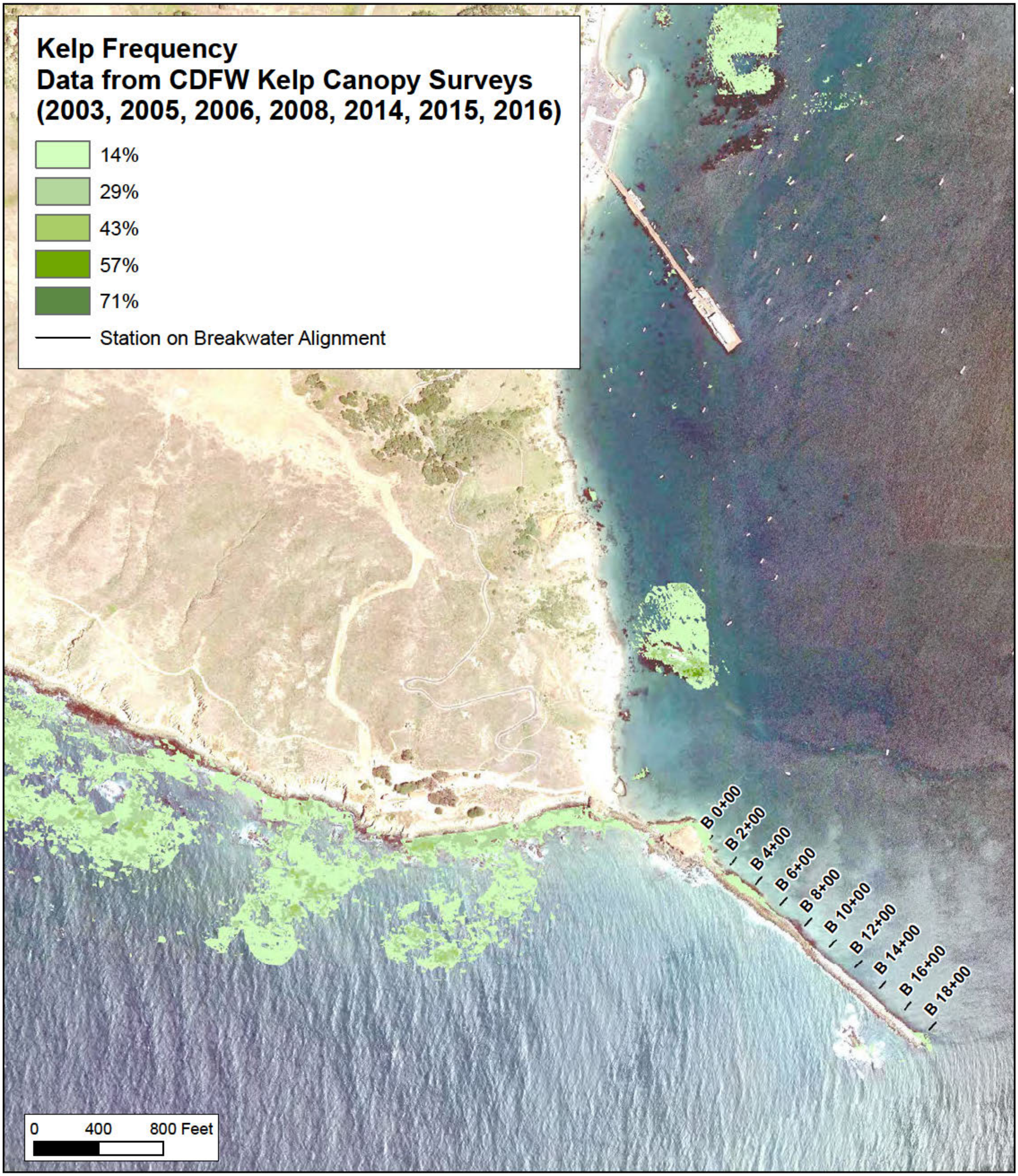
A total of seven kelp surveys for the recent years of 2003, 2005, 2006, 2008, 2014, 2015, and 2016 were accessed. These were compiled as raster data sets and a frequency of occurrence canopy kelp distribution map was prepared by summing the presence of kelp canopy over all survey years and dividing the results by the number of years surveyed (Figure 6).

3.3.2 Results

During the June-July 2018 surveys, kelp beds in proximity to the breakwater were explicitly sought but none were identified. Drift bull kelp (*Nereocystis luetkeana*) was observed within surge channels on Point San Luis and Whaler's Island and some individual giant kelp and bull kelp plants were noted very near shore to Point San Luis, but no developed kelp beds were observed. Similarly, during the focused January-February 2019 kelp surveys, no giant kelp or bull kelp was observed anywhere around the project site.

Drift bull kelp, attached feather boa kelp, and many other macroalgal species in surge channel on Whaler's Island June 2018.

The canopy kelp frequency analysis completed (Figure 6) suggests an irregular occurrence of kelp canopy along the outside of Point San Luis and kelp extending to north of Smith Island on the lee side of the breakwater. The kelp Is generally non-persistent with the majority of the beds occurring between 14 percent and 29 percent of the time over the surveyed years. An inspection of the data also noted a regularly occurring error in canopy kelp mapping in the very shallow waters along the inside of the breakwater. In these areas, water is too shallow to support canopy kelp, but the areas do support a regular seasonal occurrence of the understory feather boa kelp (*Egregia menziezii*) that was noted in 2018 consistent with areas mapped in Figure 6. This species is often an annual dominant in shallow semi-energetic environments and when reaching the surface, could be mistaken for canopy kelp species. *Egregia* is an abundant macroalgal element along the breakwater on both native bedrock and breakwater boulders.



Kelp Frequency
Port San Luis Breakwater Repair Sections
Stations B 6+00 to Station B 13+00
San Luis Obispo County, California

Figure 6

3.5 Marine Mammals Survey

3.5.1 Methods

Marine mammal surveys were conducted in order to identify hauled out mammals along the Port San Luis breakwater and in proximity to the breakwater. Investigations were completed by two methods. The first was visual surveys conducted from a vessel navigated slowly along the breakwater and adjacent rocks to identify marine mammals hauled out. In addition, anecdotal observations were made of marine mammal in the project area during completion of various biological investigations in June-July 2018 and January-February 2019.

The second method of survey was a quantitative assessment of marine mammals on the breakwater and adjacent rock islands completed by completion of multiple UAV overflights. The marine mammal surveys were conducted during two different seasons with varying weather, sea state, and environmental conditions. Surveys were completed on June 30, 2018 and again on January 30 during high and low tides, January 31 during low tide, and February 1, 2019 during high tide and low tides. Aerial flights were conducted at elevations of 250 meters with true vertical overflights and offset oblique photographs of the breakwater and nearby rock islands. Using the collected photographs, marine mammals were identified, counted, and mapped on the breakwater using ESRI ArcGIS spatial mapping software.

The first surveys conducted by M&A biologists for the Port San Luis breakwater repair were completed between June 29–July 1, 2018 and were ancillary to focused surveys for black abalone. During the first survey, biologists noted the presence of marine mammals in the water and on the breakwater, as well as within the protected waters of Port San Luis. During the surveys a UAV was flown over the breakwater to produce an orthomosaic image of the survey area. The field observations and the photomosaic were subsequently used to inventory mammals on the breakwater. During the survey period, the cloud cover was typically overcast in the morning and approximately 20 percent cover in the afternoon. Winds were 0-1 Beaufort Scale (BS), and calm sea state with waves in the range of 1-2 feet on the lee of the breakwater and 3-6 feet on the windward side of the breakwater.

The second set of marine mammal surveys was conducted between January 29 and February 1, 2019. During this time, the Port of San Luis area was experiencing several days of stormy weather conditions and high surf just prior to the commencement of the survey. The weather was generally misty or rainy during the period. The conditions were wet and windy with surf between 4 and 6 feet outside of the breakwater. Breaks in the weather allowed the completion of all necessary aerial survey flights. Conditions during the surveys were between 53 ˚F to 63˚F. Cloud cover ranged from 100 to 30 percent, winds ranged between 0 and 3 BS. Surveys were initially intended to be completed twice, one day apart, but due to an absence of any marine mammals hauled out on the breakwater on the first day, January 29, surveys were conducted on all three days.

Sea lions photographed in June 2018 using high resolution low altitude UAV aerial photography. Overflights provided an opportunity to map individual animals hauled out by species, gender, and age class.

January-February 2019 visual surveys and UAV surveys of the breakwater did not identify any marine mammals. However, during this period Smith's Island supported hauled out Pacific harbor seals.

3.5.2 Results

There were four marine mammal species observed during both surveys. *Species present in the area included Steller sea lion (Eumetopias jubatus), California sea lion (Zalophus californianus)*, Southern sea otter (*Enhydra lutris nereis*), and Pacific harbor seal (*Phoca vitulina*). Other marine mammals are known to be sighted within San Luis Obispo County, but are more transient and not likely to utilize the Port San Luis Breakwater repair sections project area as a substantial habitat area.

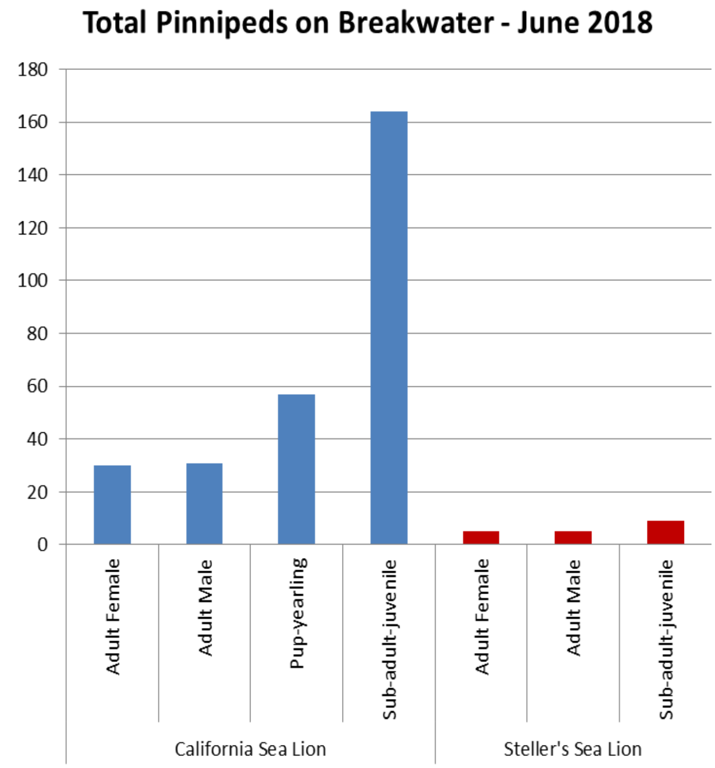
Mammals known in the San Luis Obispo County waters but not observed during the current surveys include: Guadalupe fur seal (*Arctocephalus townsendi*), Northern elephant seal (*Mirounga angustirostris*), Humpback whale (*Megaptera novaeangliae*), Blue whale (*Balaenoptera musculus*), Fin whale (*Balaenoptera physalus*), Killer whale (*Orcinus orca*), Eastern North Pacific Gray whale (*Eschrichtius robustus*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), Risso's dolphin (*Grampus griseus*), Northern right whale dolphin (*Lissodelphis borealis*), Long-beaked common dolphin (*Delphinus capensis*), Short-beaked common dolphin (*Delphinus delphis*), Dall's porpoise (*Phocoenoides dalli*), and Bottlenose dolphin (*Tursiops truncatus*). While not observed during the present survey, whale vertebrae, probably from gray whale, were observed at multiple locations on the breakwater during both the 2018 and 2019 surveys.

One of two whale vertebrae observed on breakwater June 30, 2018

The marine mammal species observed within the project location during the 2018 survey include Southern sea otter, Pacific harbor seal, Steller sea lion. and California sea lion. During the 2018 black abalone survey work Southern sea otters and Pacific harbor seal were observed in proximity to the breakwater in low abundance and intermittently, and were more common within the inner harbor where they were observed foraging and resting in small patch kelp beds. During the course of the surveys, only two to three otters were observed and observations of seals were likely less than a dozen observations of likely fewer individuals. While not observed, it is believed that the otters were likely foraging on the breakwater as it appears that there are abundant crabs, shellfish, and octopus available on the subtidal and intertidal rocks. Also observed in abundance in the water along the breakwater were otariid pinnipeds including Steller sea lion and California sea lion. No attempt was made to count pinnipeds in the water during the surveys.

High resolution aerial imagery collected on June 30, 2018 allowed counting of hauled out pinnipeds on the breakwater. A total of 282 California sea lions and 19 Steller sea lions were observed occupying areas on the breakwater. The survey divided observed marine mammals first by species then by age class. The most abundant age class was the sub-adult-juvenile class followed by pup-yearling and leaving an almost equal amount of both the adult male and adult female classes in both California sea lion and Steller sea lion. Also notable during the surveys were four dead young pup carcasses on the breakwater rocks. No very young live pups were noted during either the on-water surveys or within the aerial survey photographs.

The general distribution of marine mammals along the breakwater is influenced by direct wave energy against exposed breakwater segments. An offshore rock formation on the seaward side of the breakwater's southern end absorbs direct wave energy and reduces the intensity of waves reaching the breakwater. This allows for manageable haul out locations on both the seaward and leeward sides of the breakwater in proximity to this rock. As Figure 7 shows, the most densely populated haul out areas occur on the leeward side of the south eastern end of the breakwater and spread around the revetment stone to the protected segment of the seaward side of the breakwater. In the open water, near the breakwater shoreline, sea lion were noted to be abundant, but it was not possible to count animals, or positively identify species or demographic metrics. As such, they were noted but not enumerated.

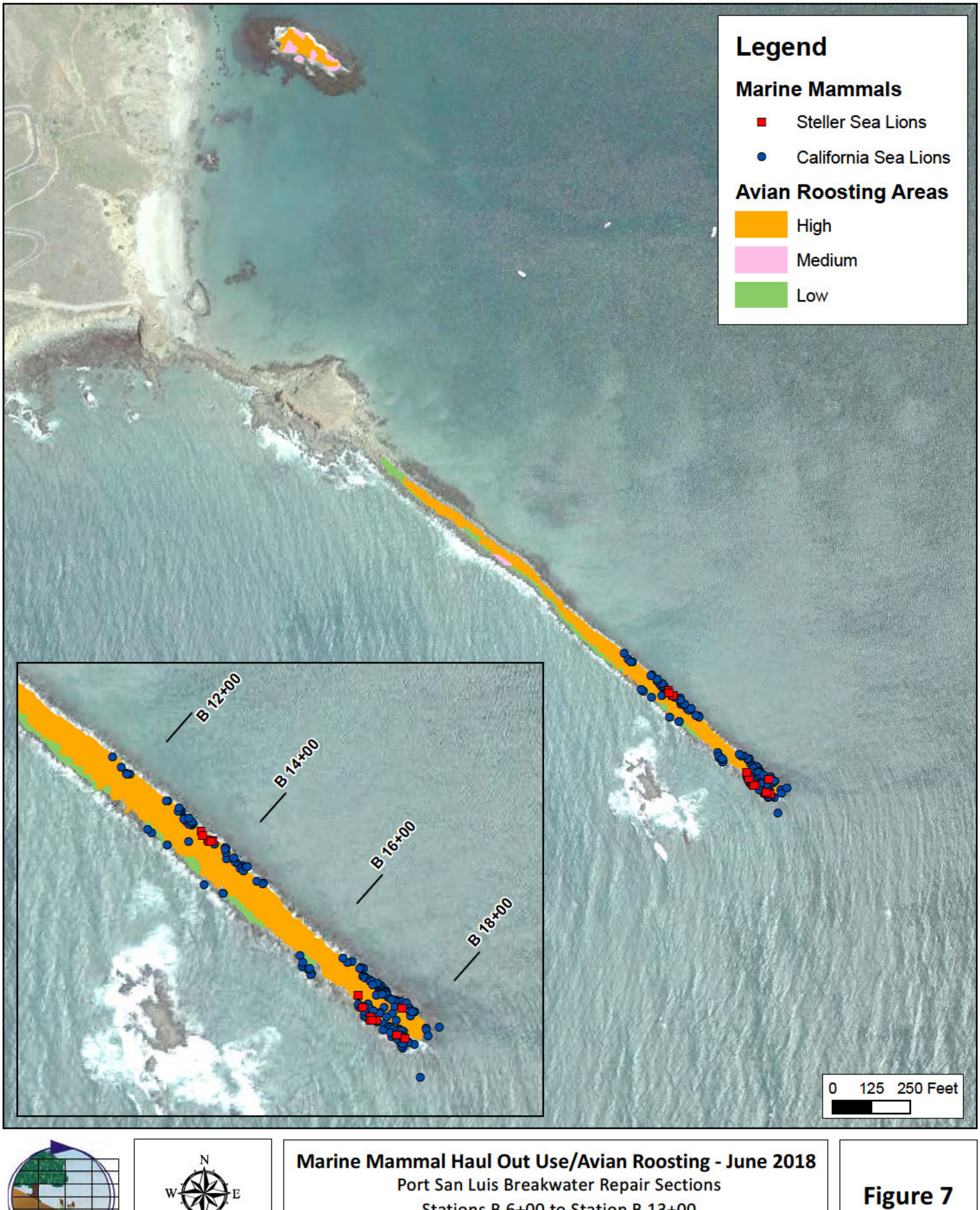


Population demographics of sea lions hauled out on Port San Luis Breakwater June 30, 2018

Further from the breakwater, California sea lions were also observed resting on a floating barge just east of the fishing pier. California sea lions, sea otters, and harbor seals were observed transiting / foraging and resting in the water around the fishing pier and boat moorings in the harbor and were even noted to enter the boat hoist launch basin.

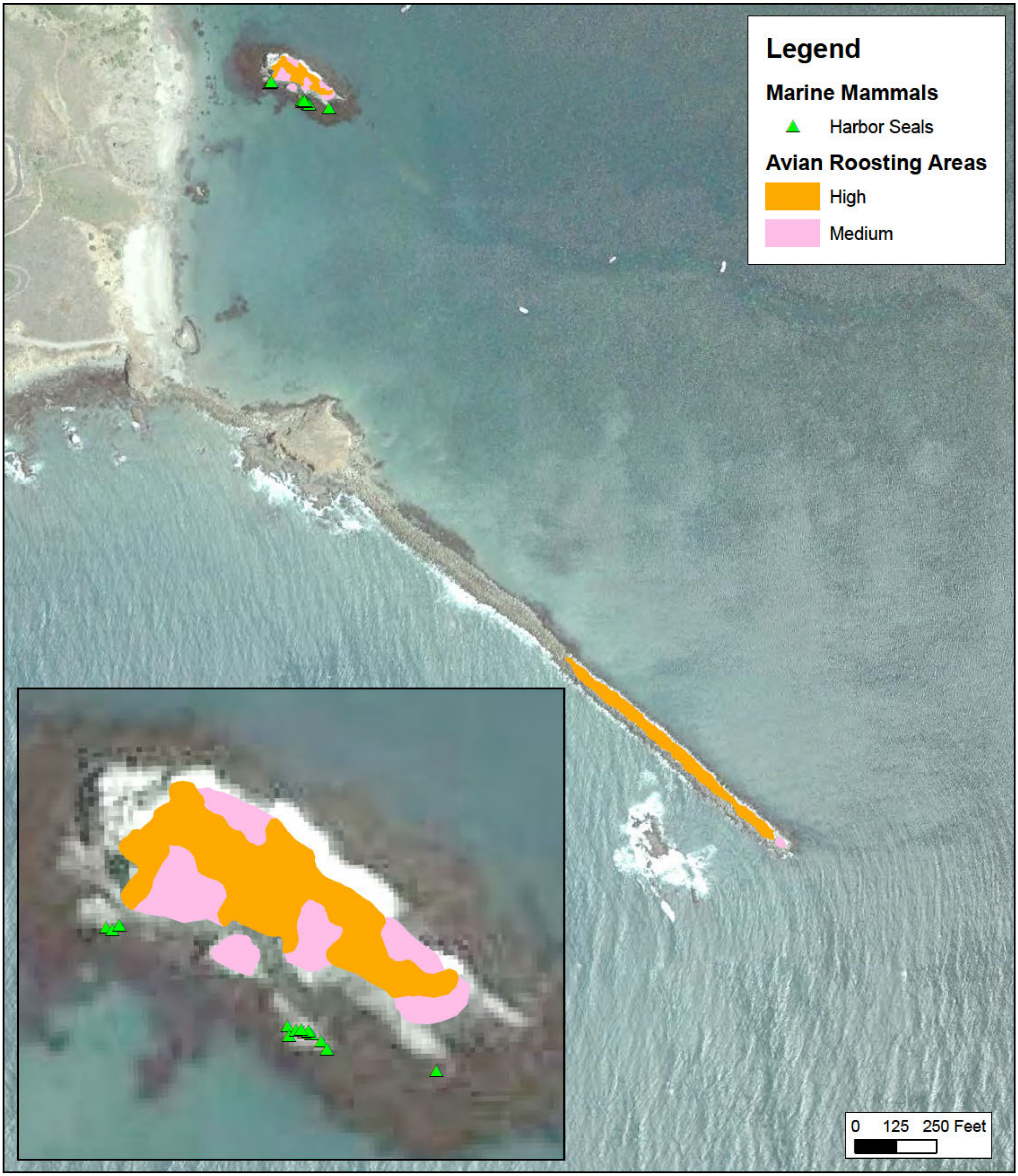
During the January and February 2019 surveys, there were no marine mammals observed on the breakwater or within the immediate project area. A total of 13 Pacific harbor seal were found hauled out on and nearby Smith Island (Figure 8). As was the prior case with sea lions, several additional harbor seals were noted in the water around Smith Island, but were not counted. Smith Island has low lying bedrock benches that are better suited as haul-outs for seals than is the steep boulder rock of the breakwater. Noting that seals haul out on Smith Island, it would not be unexpected to see seals similarly haul out on the sand beach near Point San Luis in the lee of the breakwater, or under calm sea states, on the rocky terraces of Whaler's Island or Point San Luis on the seaward side of the breakwater.

While sea lions were notably absent from the breakwater during the winter months, a small number of California sea lions were noted hauled out on the purpose placed sea lion float near the fishing pier. Other sea lions as well as sea otters and harbor seals were noted in the protected waters of Port San Luis during transiting trips back and forth from moorings and launch facilities to the breakwater.



Marine Mammal Haul Out Use/Avian Roosting - June 2018
Port San Luis Breakwater Repair Sections
Stations B 6+00 to Station B 13+00
San Luis Obispo County, California

Figure 7



Marine Mammal Haul Out Use/Avian Roosting - February 2019
Port San Luis Breakwater Repair Sections
Stations B 6+00 to Station B 13+00
San Luis Obispo County, California

Figure 8

3.6 Sea Birds

3.6.1 Methods

Concurrent with completion of other biological investigations, avian species making use of the survey areas were noted. Some bird nesting on the cliffs of Whaler's Island was noted although not heavily investigated. Bird nesting was also noted on the cliffs of Smith Island. A list of birds observed in the project area was compiled from biologist observations and photographs taken during the surveys and the locations of observations by habitat type were noted.

Black oystercatcher on leeward face of Whaler's Island (top) and avian roosting on breakwater (bottom). June 30, 2018

In addition to anecdotal observations of avian species and activities in the area, a more focused mapping of avian roosting on the breakwater was also undertaken. Using the areal imagery collected during the multiple surveys, the distribution of roosting activities was identified by a combination of both the presence of large aggregations of birds and by the extent of accumulated guano.

3.6.2 Results

Avian observations were made during both survey periods between June 29 – July 1, 2018 and January 29 and February 1, 2019. A list of birds observed during these two periods by period and habitat has been prepared (Table 2). Because the identification of birds was not undertaken as a specific goal of the surveys, the list should not be taken as comprehensive, but likely included the most notable of species present in the area during the surveys.

The survey periods occurred in summer and in winter which resulted in a change of seasonal / migratory bird presence in the surveyed areas. Avian observations included the broader Port of San Luis breakwater area and were not restricted to the proposed breakwater project area. Further observations of avian use patterns were garnered from photographic evidence of bird roosting on the rocks in the area and of accumulated guano that indicated roosting area patterns (Figures 7 and 8). Roosting was classified as high, medium, and low based on concentration of guano along the breakwater and observed birds. However, these relative classification levels should be interpreted with some caution since guano can be purged by wave washing of the area and thus areas with greater exposure may be under represented as roosting areas due to more frequent cleaning of the rock. However, these areas are also less frequently available to birds due to wave washing influences.

Table 2. Incidental Avian Species Observed During Monitoring (Summer 2018, Winter 2019)

Species	Scientific Name	6/29 – 7/1/2018					1/29 – 2/1/2019				
		Flying	Water	Breakwater/Rocky Shore	Beach	Scrub	Flying	Water	Breakwater/Rocky Shore	Beach	Scrub
Brant	*Branta bernicla*									X	
Canada goose	*Branta canadensis*	X									
Surf scoter	*Melanitta perspicillata*							X			
Red - throated loon	*Gavia stellata*		X					X			
Common loon	*Gavia immer*		X					X			
Northern fulmar	*Fulmarus glacialis*		X								
Horned grebe	*Podiceps auritus*							X			
Western grebe	*Aechmophorus occidentalis*							X			
Clark's grebe	*Aechmophorus clarkii*							X			
Brandt's cormorant	*Phalacrocorax penicillatus*	X		X					X		
Pelagic cormorant	*Phalacrocorax pelagicus*	X		X					X		
Double - crested cormorant	*Phalacrocorax auritus*	X	X	X			X	X	X		
Brown pelican	*Pelecanus occidentalis*	X	X	X			X	X	X		
Great blue heron	*Ardea herodias*			X					X	X	
Snowy egret	Egretta thula									X	
Black oystercatcher	*Haematopus bachmani*			X					X		
Whimbrel	*Numenius phaeopus*						X			X	
Long - billed curlew	*Numenius americanus*									X	
Marbled godwit	*Limosa fedoa*									X	
Black turnstone	*Arenaria melanocephala*			X					X		
Surfbird	*Aphriza virgata*								X	X	
Spotted sandpiper	*Actitis macularius*									X	
Wandering tattler	*Tringa incana*									X	
Willet	*Tringa semipalmata*									X	
Pigeon guillemot	*Cepphus columba*		X								
Heermann's gull	*Larus heermanni*			X			X		X		
Western gull	*Larus occidentalis*			X			X	X	X		
Caspian tern	*Hydroprogne caspia*								X		
Royal tern	*Thalasseus maximus*						X				

Species	Scientific Name	6/29 – 7/1/2018					1/29 – 2/1/2019				
		Flying	Water	Breakwater/Rocky Shore	Beach	Scrub	Flying	Water	Breakwater/Rocky Shore	Beach	Scrub
Rock pigeon	*Columba livia*			X							
White - throated swift	*Aeronautes saxatalis*		X								
Black pheobe	*Sayornis nigricans*					X					
American crow	*Corvus brachyrhynchos*					X				X	X
Barn swallow	*Hirundo rustica*	X									
European starling	*Sturnus vulgaris*	X									
House finch	*Haemorhous mexicanus*					X					X

4.0 CONCLUSIONS

Surveys conducted during the present period are varied and add to the information base to support project planning and assessment for the repair of the Port San Luis Breakwater. Notable in the survey results were the following:

- [redacted]
- Pacific eelgrass exists as a contiguous and seasonally stable bed along the leeward margin of the breakwater;
- Surfgrass is present in proximity to the breakwater, but is patchy and restricted in its occurrence to native bedrock terraces and imported boulders that are adjacent too but not part of the breakwater;
- Canopy kelp is intermittent within the study area and is generally located away from the breakwater;
- Although some small kelp occurrences along the breakwater may occur, the mapped kelp on the breakwater is more than likely due to the understory feather boa kelp rather than canopy species;
- Sea lions haul out seasonally on the Port San Luis breakwater and were abundant within the Port San Luis area during June-July 2018, but were highly reduced in numbers and not present on the breakwater during January-February 2019;
- Southern sea otters are present within Port San Luis and do visit the breakwater area in small numbers, and;
- Sea birds roost on the breakwater and other rock features including Whaler's Island and Smith Island and cliff nesting birds nest on Whaler's Island and Smith Island.