US Army Corps
of Engineers®

Los Angeles District **DRAFT**

DRAFT ENVIRONMENTAL ASSESSMENT
MORRO BAY
SIX YEAR FEDERAL MAINTENANCE DREDGING PROGRAM
SAN LUIS OBISPO COUNTY, CALIFORNIA

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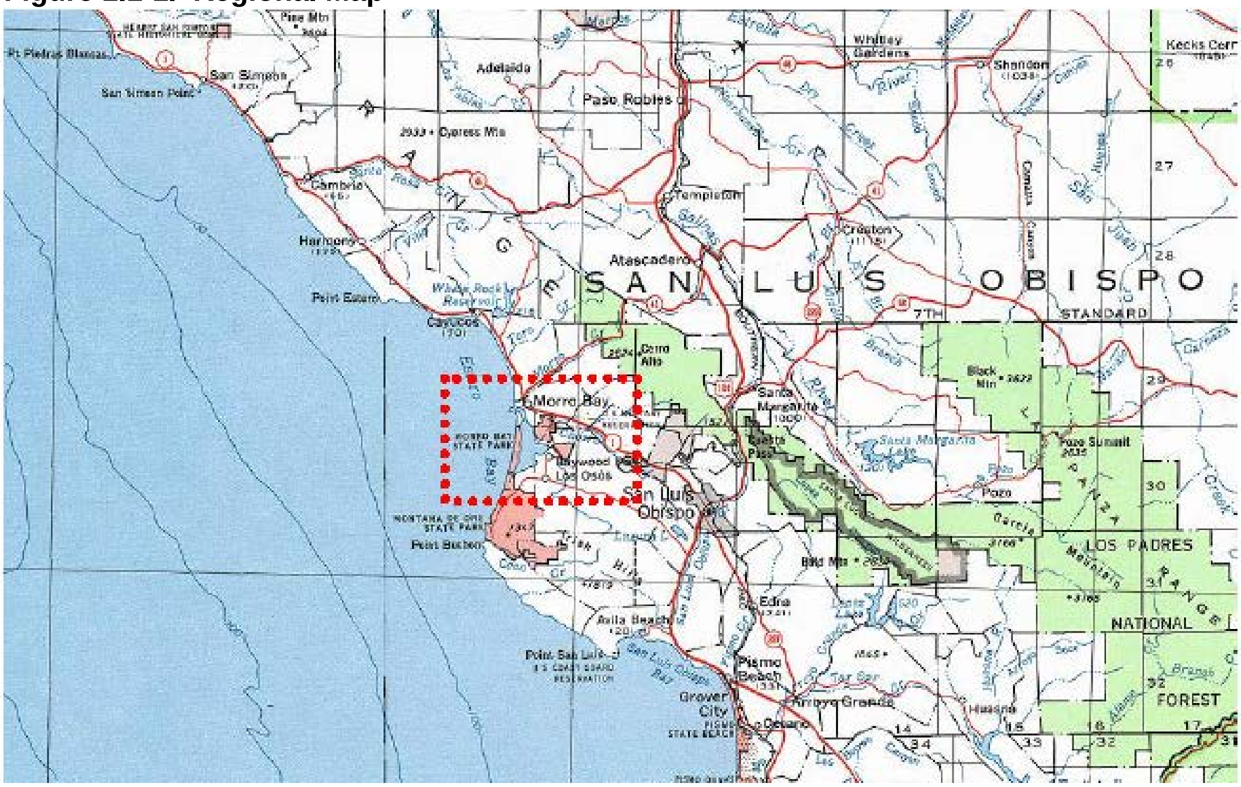
1.0 INTRODUCTION

1.1 Location

The Morro Bay Maintenance Dredging Program ("dredging program") is located in Morro Bay, along the central California coast in San Luis Obispo County (See Figure 1.1-1). Morro Bay is located in the City of Morro Bay, California, approximately 12 miles northwest of the City of San Luis Obispo. The geographic coordinates of Morro Bay are: 35°22'39"N., 120°51'03"W.

Figure 1.1-1. Regional Map



1.2 Segments of the Federal Channel

The program would dredge the federal channel at Morro Bay. The federal channel is comprised of the entrance channel, the transition channel, the sand trap, the main channel, the Navy channel, and the Morro Channel (See Figure 1.2-1).

1.3 Dredging History at Morro Bay

Since the 1960s, maintenance dredging of the federal channel has been performed routinely on an annual basis, dredging approximately 150,000 cubic yards (cy) to 200,000 cy per year. In some instances up to 850,000 cy have been dredged.

Figure 1.2-1. Morro Bay Dredging Program Map (Preferred Alternative 2)

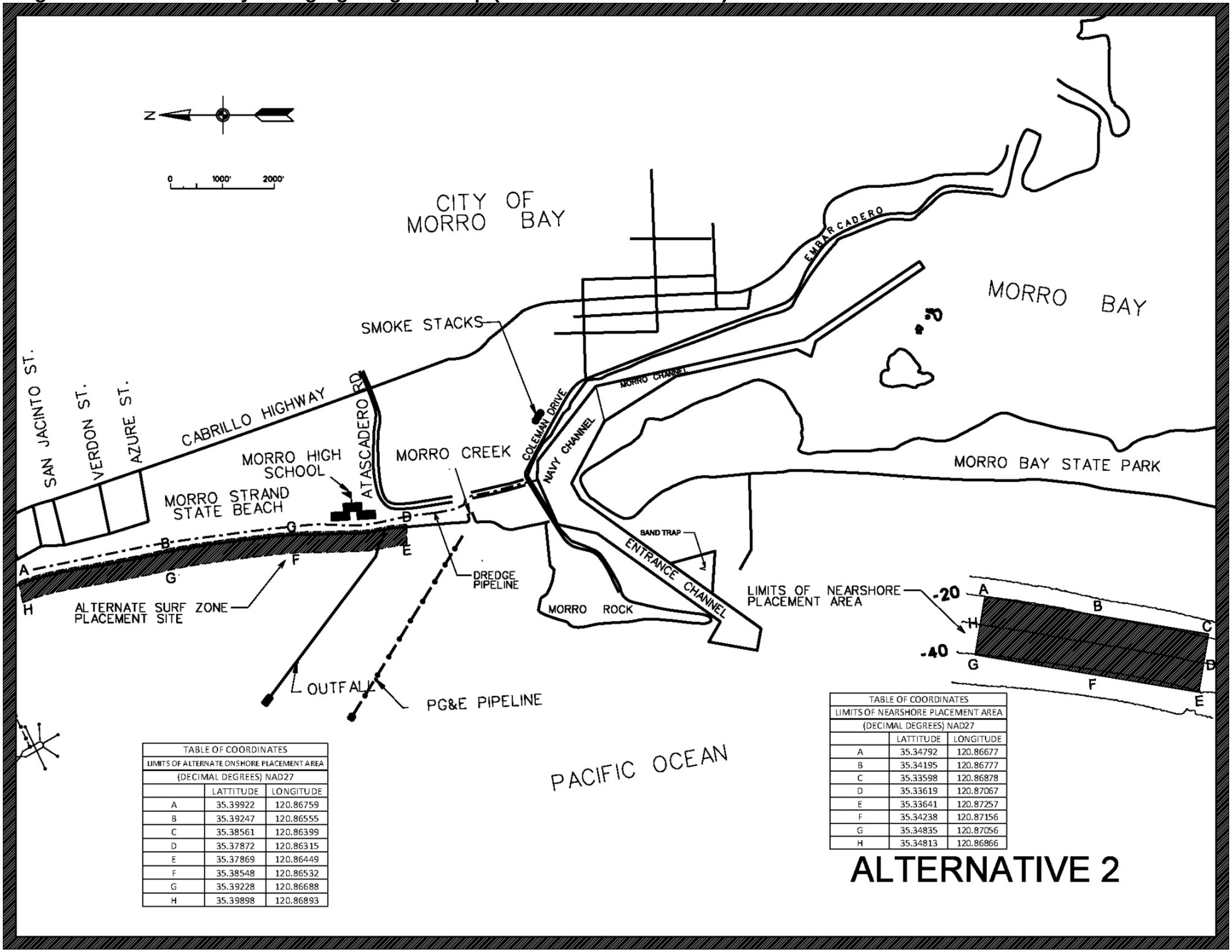


TABLE OF COORDINATES		
LIMITS OF ALTERNATE ONSHORE PLACEMENT AREA		
(DECIMAL DEGREES) NAD27		
	LATTITUDE	LONGITUDE
A	35.39922	120.86759
B	35.39247	120.86555
C	35.38561	120.86399
D	35.37872	120.86315
E	35.37869	120.86449
F	35.38548	120.86532
G	35.39228	120.86688
H	35.39898	120.86893

TABLE OF COORDINATES		
LIMITS OF NEARSHORE PLACEMENT AREA		
(DECIMAL DEGREES) NAD27		
	LATTITUDE	LONGITUDE
A	35.34792	120.86677
B	35.34195	120.86777
C	35.33598	120.86878
D	35.33619	120.87067
E	35.33641	120.87257
F	35.34238	120.87156
G	35.34835	120.87056
H	35.34813	120.86866

Prior to 1990, maintenance dredging of the federal channel occurred on average twice per decade for approximately 30 years, from the 1960s to 1990. From 1994 through the present, maintenance dredging of the federal channel has occurred annually. See Appendix D for summary of dredging parameters for maintenance dredging in Morro Bay since 1986.

Dredged materials have historically been placed in the near shore area off Morro Bay State Park sand spit or the surfzone at Morro Strand State Beach. Use of either site is dependent on the type of dredge platform. The nearshore area at Morro Bay State Park sand spit is associated with the use of the hopper dredge. Alternatively, the surfzone at Morro Strand State Beach in is associated with the use of the hydraulic suction dredge.

1.4 Authorization

The 1945 Rivers and Harbors Act authorizes the Corps to maintain the federal channel at Morro Bay to authorized depths.

1.5 Dredging Duration

Dredging via a hopper dredge would occur during a one month period between March 1 and September 15. Dredging via a hydraulic suction dredge would occur during a one month period between September 16 and February 29. Total dredging days for the entire federal channel would be 60 days. Weather conditions, performance of dredging equipment, and funding levels could extend the dredging window to 90 days annually.

1.6 Dredge Platforms

The program would utilize a combination of dredge platforms depending on the areas of the federal channel to be dredged (see Table 1.6-1). A hopper dredge would be used for the Entrance Channel due to its depth and straight alignment which minimizes the need for turning maneuvers. Furthermore, a hopper dredge is not able to turn from the Entrance Channel to the back-bay area. In contrast, a hydraulic suction or a clam shell dredge would be utilized in the back-bay area where waters are shallow and more maneuverability is required. In general the Navy Channel and Morro Channel are in the back-bay area.

Table 1.6-1. Dredging Program Platforms (Preferred Alternative 2)

Typical Dredge Platform	Alternate Dredge Platform	Channel Dredged	Dredged Material Placement Site
Hopper	Clam shell with dump scow	Entrance Channel	Nearshore
Hydraulic suction	Clam shell	Navy Channel & Morro Channel	Surfzone

1.7 Dredge Volume

The quantity of sediment available for dredging as of the condition survey in June 2012 was 450,040 cy for the whole channel, including the Morro Channel. An additional volume of approximately 661,744 cy of shoaling material could be expected by 2013 due to the strong wave action and greater than normal wet weather during autumn 2012 through winter 2013.

Therefore, the maximum volume of material that could potentially be dredged annually is approximately 1,111,800 cy (see Table 1.7-1).

Table 1.7-1. Dredging Depths and Volumes

Dredge Area	Location	Area (Acres)	Design Depth (ft., MLLW)	Design Depth & Overdredge (ft., MLLW)	Approximate 2012 Design Depth Volume (Cubic Yards)	Allowable Overdepth Volume (Cubic Yards)	Dredge Volume with Allowable Overdredge (Cubic Yards)
A	Modified Entrance Channel	15.1	-40	-40	230,300	0	230,300
B	Sand Trap	8.0	-25	-25	34,520	0	34,520
C	Transition	4.0	-16 to -40	-18 to -42	9,160	5,930	15,100
D	Main Channel	14.4	-16	-18	22,410	8,570	30,980
E	Navy Channel	45.4	-16	-18	60,490	39,500	100,000
F	Morro Channel	30.7	-12	-14	11,790	27,350	39,140
				Total Volume	368,670	81,350	450,040[a]

Note: [a] The quantity of sediment available for dredging as of the condition survey in June 2012 was 450,056 cy for the whole channel, including the Morro Channel. An additional volume of approximately 661,744 cy of shoaling material could be expected by 2013 due to the strong wave action and greater than normal wet weather during autumn 2012 through winter 2013. Therefore, the maximum volume of material that could potentially be dredged annually is approximately 1,111,800 cy .

2.0 PURPOSE AND NEED

The federal channel allows access from Morro Bay to the Pacific Ocean. Morro Bay is home to a commercial and recreational crafts. A recreational marina within the bay consists of 50 slips and approximately 125 moorings. Being the only all-weather small craft commercial and recreational harbor between Santa Barbara and Monterey, the marina also functions as a small craft refuge. Furthermore, the United States Coast Guard operates Coast Guard Station Morro Bay which provides Coast Guard services for the entire Central California Coast, including port safety coverage for the Diablo Canyon Nuclear Power Plant and Vandenberg Air Force Base and search and rescue. Therefore, there is a need to maintain navigational safety for commercial and recreational crafts along California's central coast.

The purpose is to maintain the federal channel to its authorized depths to allow safe passage to Morro Bay.

3.0 ALTERNATIVES

Alternatives based on dredging different depths or dredging locations were not carried forward for further analysis since they would not meet the statement of purpose and need articulated in Section 2.0.

Alternative 1 (No Federal Action Alternative)

Under Alternative 1, the federal channel at Morro Bay would not be dredged. Continued shoaling of the federal channel would render navigation unsafe. The channel will be impassable for all but the smallest of vessels. Commerce associated with commercial and recreational fleets would be affected. US Coast Guard operations would be hampered. Beach compatible sand would not be discharged to attenuate beach erosion processes at Morro Bay State Park sand spit and Morro Strand State Beach.

However, it is likely that local governments would conduct limited dredging to minimize economic, recreational, and navigational safety impacts associated with a shoaled federal channel. As a result, placement of dredged material at Morro Bay State Park sand spit and Morro Strand State Beach is likely. There would be temporary impacts to air quality and water quality during dredging. Furthermore, dredging activities would likely be implemented on emergency basis. As a result, there would be limited or no sampling of dredged material. Coordination with resource agencies to minimize impacts to environmental resources may be curtailed which could likely result in increased environmental impacts during dredging operations.

Alternative 2 (Preferred)

The preferred dredging program (Alternative 2) requires annual dredging of the entrance channel, transition channel, main channel, and sand trap (see Table 1.2-1 above). The Preferred Alternative also requires the innermost portions of the Federal channel (Navy and Morro Channels) to be dredged once every six years. No dredging or placement of dredged material will occur directly in sensitive habitats such as established eelgrass beds, hard-bottom reefs, or the kelp beds. Dredge parameters description:

- Dredge approximately 150,000 cy to 1,111,800 cy of sediment from the federal channel at Morro Bay for a six year duration from 2014 through 2019 (see Section 1.7);

- Utilize a combination of dredge platforms based on the dredging location (see Section 1.6);

- Dredge for a one month period between March 1 through September 15, or September 16 through February 29 (see Section 1.5);

Under Alternative 2, dredged materials deemed suitable for aquatic placement would be placed in the near shore area off of Morro Bay State Park sand spit or the surfzone at Morro Strand State Beach (see Figure 1.2-1 above).

- **Morro Bay State Park sand spit nearshore dredge placement site** would be utilized if either a hopper dredge or clamshell dredge with a dump scow is used for dredging operations. The area is a sandy and is located approximately 4,921 feet to 9,843 feet south of federal channel immediately offshore of Morro Bay State Park sand spit. The landward limit of nearshore discharge would be immediately seaward of the surf break approximately -20 feet Mean Lower Low Water (MLLW). The seaward limit of discharge would be at approximately -40 feet MLLW contour line (see table 1.7-1). Dredging operation using this placement site would typically take place during a 30 day dredging window between March 1 and September 15.

Morro Strand State Beach surfzone dredge placement site would be utilized when a hydraulic suction dredge is utilized for dredging the Navy and Morro Channels (occurs during one-cycle within the six-year dredging program, 30-60 day duration, between September 16 and February 29). The alternate dredged material placement site is the surfzone area located on the Morro Strand State Beach, between Sienna Street and north of Morro Creek, north of Morro Bay. A temporary pipeline would be placed seaward of small, vegetated “pioneer” dunes, and would extend from the cutterhead hydraulic dredge along the side of Coleman Drive, then westward at Morro Creek, then north to the surfzone, placement of dredged material area footprint. The outlet would consist of a perpendicular section of temporary pipe extending into the surf-zone.

At Morro Strand State Beach, placement of dredged material operations would begin at the northern limit (Sienna Street) and work south, as sections of temporary pipe are removed, and end north of Morro Creek (the southern limit). This extension will be moved as needed, as profile specifications are met, and as work continues southward. Morro Creek’s potential flow out of the creek’s mouth into the Pacific Ocean would be maintained by either elevating or burying the pipeline where it transects the creek’s mouth (see Figure 3.0-1 below).

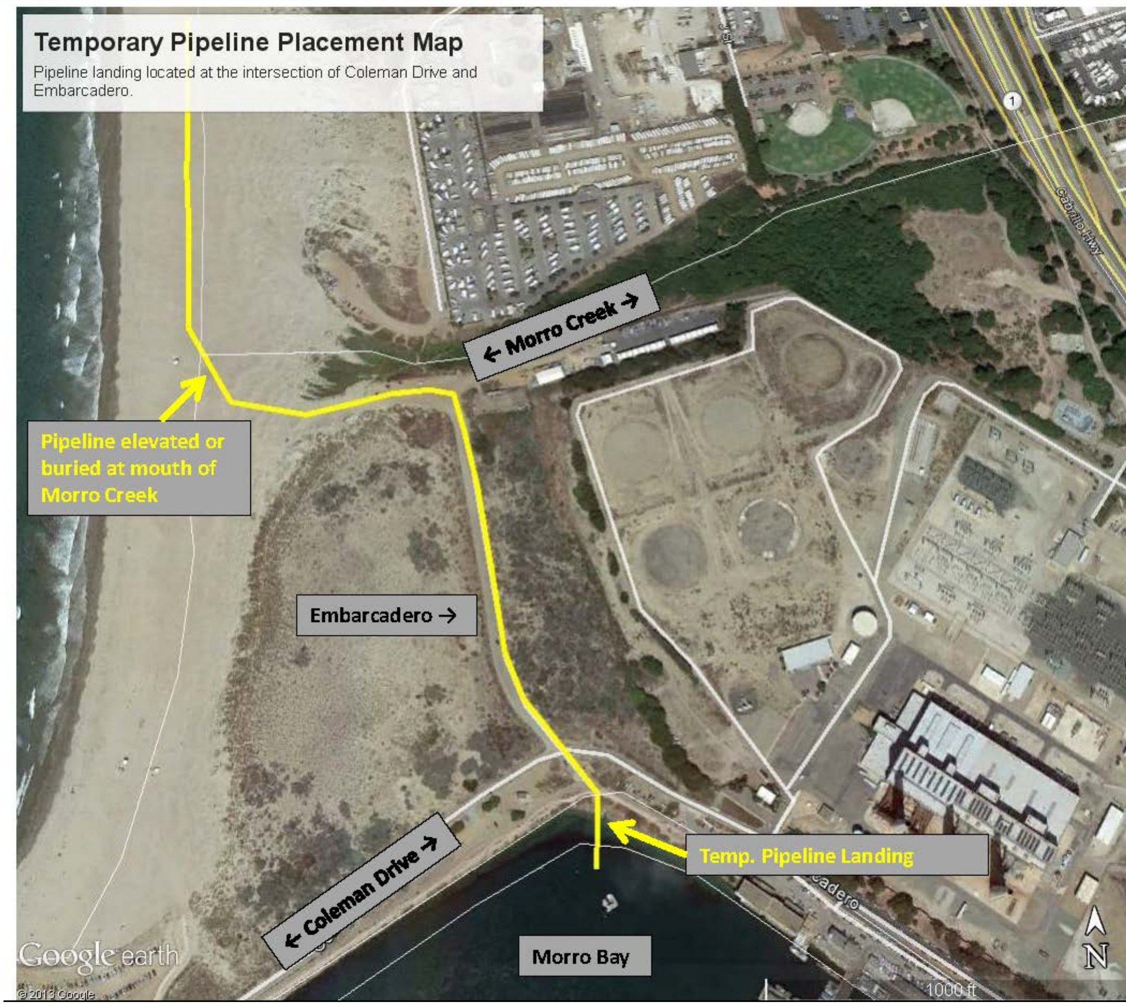
The location of the temporary pipeline’s landing will be within the Navy channel, near the intersection of Coleman Drive and Embarcadero (see Figure 3.0-1 below). The pipeline will utilize flotation buoys at the pipeline landing to keep the pipeline afloat and the pipeline will be placed in a north/south azimuth to minimize shading from the pipeline on the eelgrass bed. Installation/removal of the pipeline will require a D8 dozer and various light construction equipment on land, and a vessel with a crane/wench in the bay.

The Corps will provide maximum public access to roads, streets and highways that might be utilized for hauling and construction. Temporary sand access ramps would be built over the temporary pipeline at road crossings, and at intervals along the beach, to maintain public access. The temporary sand access ramps will be placed at intervals of approximately one quarter of a mile (1,320 feet). A 200 foot by 200 foot area (0.09 acres) around the pipeline outlet will be cordoned-off for public safety considerations, and the public will have an approximate 100 foot wide area to get around the pipeline outlet area. The 100-foot wide public pedestrian bypass along the 200-foot stretch of cordoned area would accommodate approximately 100 feet of clearance between the foredune vegetation and the landward edge of the cordoned area. Due to beach conditions and sight line visibility, the Corps must seek approval from the City of Morro Bay Department, the San Luis Obispo County Parks Department, and the California Department of Parks and Recreation (CDPR) prior to constructing the temporary sand access ramps.

A D8 dozer and various types of light construction equipment would be used within -4 feet MLLW to +200 feet MLLW to move and maintain the temporary pipeline, and to build the pedestrian temporary access sand ramps. Pipeline maintenance crews would regularly inspect the pipeline, and use an ATV/Gator (with trailer) on a single ingress/egress tract seaward of the dunes and vegetation located approximately +300 feet MLLW and extending eastward.

Maintenance dredging operations using the alternate, north site, surfzone area of Morro Strand State Beach will occur between September 16 and February 29 (outside of the western snowy plover nesting season). The 30-60 day dredging of the Navy and Morro Channels would occur during one-cycle within the six-year dredging program, and is restricted to the aforementioned dates to avoid/minimize impacts to T&E or sensitive species, and recreational beach users.

Figure 3.0-1 Temporary Pipeline Placement Map



Source: Google Earth Pro (2013)

4.0 WATER QUALITY

4.1 Affected Environment

Morro Bay receives waters from a 76 square-mile watershed that includes two main tributaries: Chorro Creek and Los Osos Creek. Land use in the watershed includes about 60% ranchland, 19% brushland, 7% urban areas (City of Morro Bay, Los Osos and Baywood), 7% agriculture (crops) and 7% woodland. Excess nutrients from urban and agricultural runoff affect water quality in Chorro and Los Osos Creeks. Nutrients contribute to the growth of nuisance algae. The breakdown of the algae decreases the concentration of dissolved oxygen within the water column. As a result, Morro Bay is on the 303(d) list of water quality limited waterbodies for D.O., pathogens, and sedimentation/siltation as cited in the 2010 303(d) List of Water Quality Limited Segments. (USEPA 2011). Water quality is typically characterized by salinity, pH, temperature, clarity, and dissolved oxygen (D.O.). Table 4.1-1 characterizes a number water quality parameters for Morro Bay.

Table 4.1-1. Water Quality Characteristics, Morro Bay

Parameters	Range
Salinity (ppt;mg/l)	32.43 – 34.96 ppt; 32.43 – 34.96 mg/l
Surface Temperature(ºF; ºC)	50.54 – 56.66 ºF; 10.3 – 13.7 ºC
pH	7.95 – 8.20
Clarity (feet; m)	13 feet – 15 feet 3.96 – 5.22 m
D.O. (mg/l)	8.75 – 16.14

Source: USACE 2008.

Although water quality within Morro Bay is compromised, the water quality within the federal channel is expected to be better due to its distance from tributaries to the bay, dilution, and exposure to more a dynamic marine environment such as wave action.

4.2 Environmental Consequences

Significance Threshold

Based on the existing conditions discussed above, impacts would be considered significant if the alternative results in:

- Long term impairment or degradation of water quality.

Alternative 1 (No Federal Action Alternative)

Under Alternative 1, the federal channel at Morro Bay would not be dredged. Continued shoaling of the federal channel would render navigation unsafe. The channel will be impassable for all but the smallest of vessels. Beach compatible sand would not be discharged at to attenuate beach erosion processes at Morro Bay State Park sand spit and Morro Strand State Beach.

However, it is likely that local governments would conduct limited dredging to minimize economic, recreational, and navigational safety impacts associated with a shoaled federal channel. As a result, placement of dredged material at Morro Bay State Park sand spit and Morro Strand State Beach is likely. Thus, there would be temporary impacts to water quality during dredging. However, water quality impacts associated with Alternative 1 would be similar to those characterized for Alternative 2.

Alternative 2 (Preferred)

Under Alternative 2, the federal channel will be dredged using a clamshell, cutterhead/hydraulic suction, or a hopper dredge. A cutterhead dredge does not generally create extensive turbidity plumes. Increases in turbidity levels above background levels are usually confined from 50 to 150 yards of the dredge and near or below mid-column depths. Turbidity impacts from a hopper dredge are similar to the hydraulic cutterhead dredge. A clamshell dredge has impacts across the entire water column as sediments are carried up to the surface in the clamshell. As the dredged materials are primarily sandy sediments, the sediment plume would be relatively localized to the area near the dredge.

The placement of dredged material in the nearshore of Morro Bay State Park sand spit would create local turbidity impacts during discharge operations. Material to be discharged at this site would be beach-compatible sand. Turbidity plumes could migrate up to one half mile down coast. However, material placed in the nearshore would be composed of beach-compatible sand. As a result, the dredged material is expected to settle out of the water column quickly. Furthermore, beach-compatible sand would be free of contaminants. As a result, contaminants would not be released into the water column.

The placement of dredged materials in the surfzone, beach along Morro Strand State Beach would also result in localized turbidity impacts. Material to be discharged at this site would be beach-compatible sand. As a result, the dredged material is expected to settle out of the water column quickly and contaminants would not be released into the water column. Turbidity plumes would be predicted to remain in the surfzone environment and drift approximately 100-150 yards downcoast.

Potential accidents resulting in spills of fuel, lubricants, or hydraulic fluid from the equipment used during dredging and disposal operations could occur during the program and affect water quality. Severity and size of impacts would depend on the amount and type of material spilled as well as specific conditions (i.e. currents, wind, temperature, waves, tidal stage, and vessel activity). With the incorporation of WQ-2 below, water impacts from accidental fuel spills would be less than significant.

Based on above, dredging and dredged material placement operations would result in temporary impacts to turbidity. However, since the settlement is expected to be beach-compatible sand, suspended material are expected to quickly settle out of the water column. Furthermore, the dredged material is expected to be free of contaminants. Therefore, there is expected to be minimal resuspension of contaminants within the water column. Furthermore, with the incorporation of environmental commitments below, the alternative would result in less than significant impacts to water quality.

4.3 Environmental Commitments

- **WQ-1:** Monitoring for bacterial levels within the turbidity plume will be performed on a weekly basis when Morro Channel is dredged due to the presence of oyster beds.

- **WQ-2:** Spills would be cleaned up immediately. Standard dredge specifications include a Spill Prevention Plan, employee training, and the staging of materials on site to clean up accidental spills.

- **WQ-3:** In coordination with the city of Morro Bay, a public notice will be distributed to residents adjacent to Morro Strand State Beach when dredged material is discharged into the surfzone. The public notice will contain information on dredging duration as well as temporary impacts to water quality and odor during discharge operations.

- **WQ-4:** The Corps is responsible for cleaning up all trash and debris, as soon as possible. The Corps' contracting representative will make it clear to the contractor that cleaning up of all trash and debris must be done on a daily basis, and will inspect the nearshore or the surfzone placement of dredged material area(s) whenever he/she visits the site to ensure this is done.

5.0 BIOLOGICAL RESOURCES

5.1 Affected Environment

Habitats within, and adjacent to, the general dredging program area consists of: estuary, coastal water, benthic, and beach (terrestrial):

Estuary habitat

The Morro Estuary Natural Preserve is an 800 acre wetland located in the southeastern edge of the Bay. The preserve is in the vicinity of, but not immediately adjacent to, the proposed Morro Bay maintenance dredging program area. The preserve supports intertidal mudflats, wetlands (emergent and submergent), and tidal marshes that support more than 250 species of birds and function as a nursery for larval fishes before they move into open coastal waters.

Coastal water habitat

Coastal water habitats are present throughout the federal channel and include vegetation such as eelgrass (*Zostera marina*) beds and giant kelp (*Macrocystis pyrifera*). Pinnipeds, such as the harbor and Pacific harbor seals (*Phoca vitulina spp.*), southern sea otter (*Enhydra lutris*), and the California sea lion (*Zalophus californianus*) frequent Morro Bay and forage in the coastal water habitat. Additionally, shorebirds, such as the California brown pelican (*Pelecanus occidentalis* *californicus*), and the western gull (*Larus occidentalis*), feed in Morro Bay's coastal water habitat.

Planktonic organisms drift with the currents and include phytoplankton and zooplankton. Phytoplankton (autotrophic plants) are the primary producers in the pelagic food web. Zooplankton (heterotrophic animals) are the animal component of plankton communities. Many species, including invertebrates and fishes important to commercial and recreational fisheries, spend the early stages of their life histories in plankton communities with higher densities. Planktonic communities are characterized by patchiness in distribution, composition, and abundance. Due to circulation and tidal influences between the bay and the Pacific Ocean, the plankton distribution and abundance may be assumed to be similar between the bay and nearshore areas. However, increased concentrations of chemical nutrients within the bay may cause an increased abundance of phytoplankton (*e.g.* algal blooms) as compared to the nearshore environment.

Benthic habitat

Benthic habitat is located below the open water. The benthos supports a diverse assemblage of approximately 250 species of invertebrates including annelid and polychaete worms, mollusks, crustaceans, and echinoderms. Nineteen species of clams have been found in the bay, with Washington clams (*Saxidomus nutalli*), gaper clams (*Tresus nutalli*), and geoducks (*Panope generosa*) being the most common. A commercial oyster bed is located in the southern part of the Bay. Other species include the spiny brittle stars (*Ophiothrix spiculata*), sand dollars (*Dendraster excentricus*), sea cucumbers (*Parastichopus parvimensis*) and globe crabs (*Randallia ornata*) may feed and rest in or move through this habitat. Fish, such as the speckled sanddabs, staghorn sculpin, and the English sole, are also present.

Beach habitat

Beach habitat (terrestrial) is located at Morro Bay State Park sand spit or Morro Strand State Beach. Small vegetated dunes are present at Morro Strand State Beach, and larger vegetated dunes are present on Morro Bay State Park sand spit. Native vegetation in these areas include saltbush (*Atriplex leucophylla*), sea rocket (*Cakile edentula*), silver beach weed (*Ambrosia chamissonis*), dune evening primrose (*Oenothera deltoides*), and sand verbena (*Abronia maritima*). Non-native species such as European beach grass (*Ammophila arenaria*) and ice plant (*Carpobrotus edulis*) occur on the larger, established dunes to the east of Morro Strand State Beach.

5.1.1 Essential Fish Habitat (EFH)

Estuaries function as nurseries for larval fishes before they move into open coastal waters and are an Essential Fish Habitat (EFH). The Morro Bay estuary is comprised of approximately 2,300 acres of shallow, semi-enclosed intertidal and subtidal habitat. The estuary is bordered to the west by a four-mile vegetated natural sand spit that separates Morro Bay from the Pacific Ocean. Seagrass beds are dominated by eelgrass (*Zostera marina*) and widgeon grass (*Ruppia maritime*) interspersed throughout the estuary. The Morro Estuary Natural Preserve is an 800 acre wetland located in the southeastern edge of the Bay. The preserve is in the vicinity of, but not immediately adjacent to, the proposed Morro Bay maintenance dredging project area. The preserve supports intertidal mudflats, wetlands (emergent and submergent), and tidal marshes that support more than 250 species of birds and function as a nursery for larval fishes before they move into open coastal waters. The Morro Bay Estuary is recognized by the Environmental Protection Agency (EPA) as one of 28 sites within the National Estuary Program (NEP).

The project area is located within the essential fish habitat (EFH) for various federally managed fish species within the Pacific Groundfish and Coastal Pelagics Fishery Management Plans (FMP). Morro Bay and surrounding waters provide habitat for several of these species, Pacific sanddab, including the northern anchovy (*Engraulis mordax*), several species of rockfishes and many sport fish species. The most abundant species collected were speckled sanddab (*Citharichthys stigmaeus*), staghorn sculpin (*Leptocottus armatus*) and English sole (*Parophrys vetulis*) (USACE 2001). Reef associated fish were enumerated along the detached north and south breakwater during the year. Morro Bay Harbor is also an important nursery ground for fishes, with numerous larval forms.

The Morro Estuary Natural Preserve configuration was radically altered in 1933 when a man-made causeway was built closing the north entrance and connecting Morro Rock with the mainland (City of Morro Bay 2008). Later, large parts of the original Morro estuary were filled and drainage patterns were altered due to commercial and residential development, and to a lesser extent, to create farmland. Over time, all estuaries eventually filled in due to sedimentation. However, there is concern in Morro Bay that this natural process was accelerated due to watershed disturbance. The changes due to increased sedimentation are most evident in the delta formed by Chorro and Los Osos Creeks and in the southern portion of the Morro Bay harbor, in general. Both Chorro and Los Osos Creek outflows are outside of the proposed Morro Bay Harbor maintenance dredging project area. The portion of the federal navigation that has maintenance dredging, that being the Morro Channel, is at a minimum 1,500 feet northwest of the Morro Estuary Natural Preserve.

A fish species of particular concern is the California grunion (*Leuresthes tenuis*), although it rarely occurs in Morro Bay because the principal range of the grunion is between Point Conception in southern California and Punta Abreojos in Baja California, Mexico (CDFG 2008); Morro Bay Harbor and the proposed action are located approximately one hundred northwest of Point Conception. However, there are small populations both north and south of these points. Occasionally grunion may appear in fair numbers as far north as Morro Bay, California. The grunion, a member of the “silversides” family (Atherinidae), utilizes the beaches in the Morro Bay area for spawning from March through mid-September, with an expected peak in activity between April and June. Spawning activity commences when the grunion deposit their eggs in the sand on the high intertidal portions of the beach, during high tides. The eggs subsequently incubate in the sand, and hatch during the ascending series of high tide conditions before the following full or new moon.

In addition, the project area is within areas designated as Habitat Areas of Particular Concern (HAPC) for some federally managed fish species within the Pacific Groundfish FMP. HAPC are subsets of EFH and include canopy kelp, seagrass, estuaries, and rocky reefs.

The North and South breakwater, the groin, and the revetment in Morro Bay Harbor act as man-made rocky reef. During World War II, the North and South breakwater were constructed to improve the south channel harbor entrance but created an additional impact, altering the flow dynamics in Morro Bay Harbor and on the existing estuarine system, which further reduced the size of the estuary. Although not their primary purpose, breakwaters form artificial reefs and have been shown to be fish enhancement structures (Southern California Academy of Sciences 2005). Breakwaters also provide habitats that are ideal for reef-associated fishes. Artificial reefs have been shown to support high densities of fish due to either attraction or production of fishes, but generally have low standing stocks compared to natural reefs because artificial reefs are generally smaller than natural reefs. The North and South breakwaters, the groin, and the revetment in Morro Bay Harbor, are adjacent to the proposed action in Morro Bay Harbor. The North Breakwater is a minimum 165 feet north of the Modified Entrance Channel; the South Breakwater is a minimum 410 feet south of the Sand Trap; the revetment is a minimum 660 feet north of the Navy channel, and the groin is a minimum 150 feet southeast of the Main Channel.

Biologically important aquatic habits adjacent to the Morro Bay Federal navigation channels include eelgrass, kelp and surfgrass:

Eelgrass

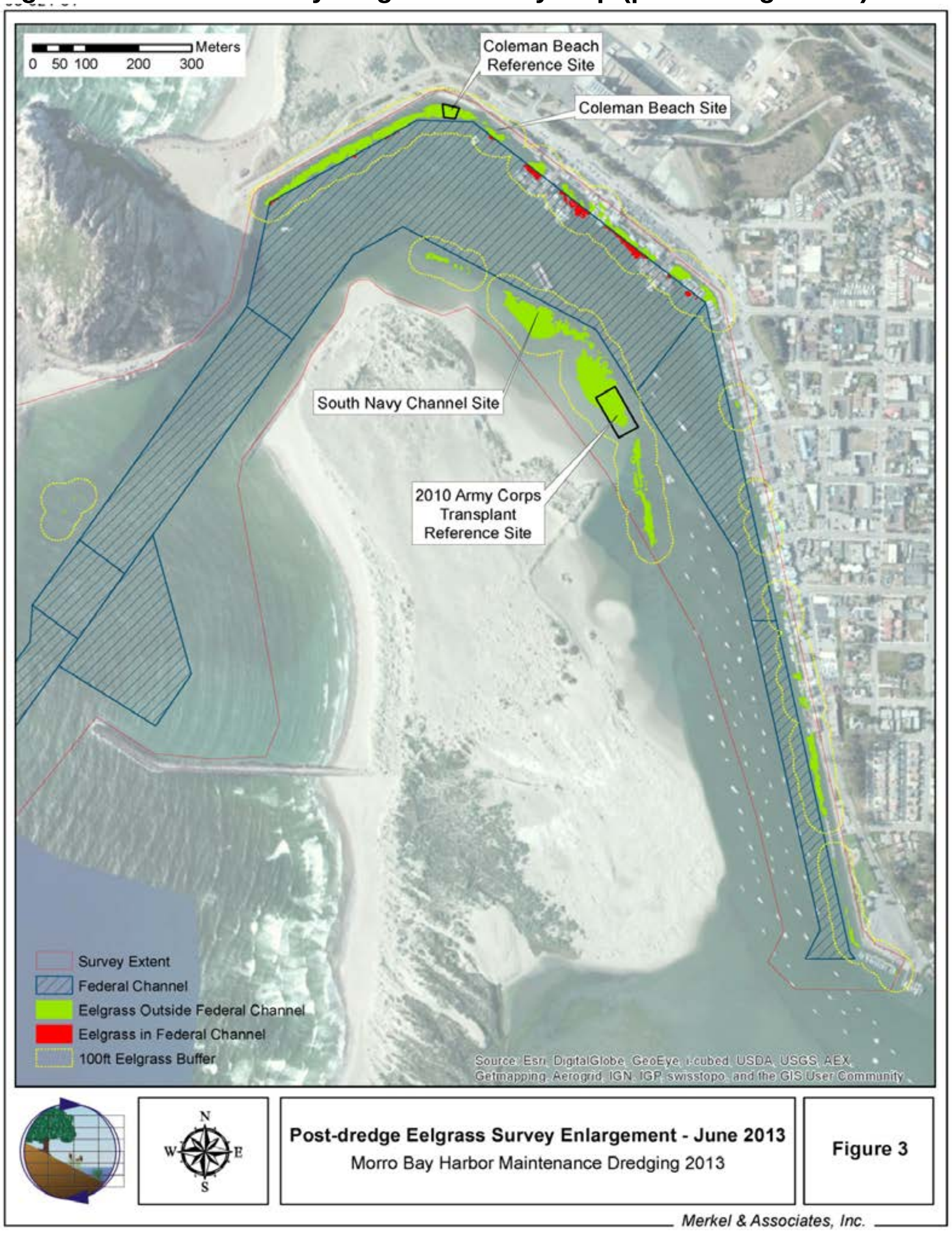
Eelgrass is a subtidal and intertidal vascular plant that grows in sandy substrates. Eelgrass provides forage base, spawning substrate, nursery values, and protection from predation for many species of fishes and invertebrates. The major eelgrass beds are found in the southern part of the Bay, but beds also occur along the eastern side of the Morro Bay sand spit, and the northern side of the Main Channel. Patches of eelgrass are scattered along the banks adjacent to the Morro Channel. It is unlikely that significant populations of eelgrass have established in the Main and Navy navigation channels since the previous dredging operation; however, figure 5.1.1-1 (below) from the post-dredge survey in 2013 illustrates several incidences of eelgrass on the northern periphery of the Navy Channel. These navigation channels generally are beyond the depth at which this species grows in Morro Bay. Results of Morro Bay pre/post-dredge surveys in May/June of 2013 are included in Appendices A and B (Merkel & Associates, Inc. 2013a and 2013b), and a Morro Bay Eelgrass Survey Map (post-dredge 2013) from that survey is located in Figure 5.1.1-1 (below). An historical eelgrass survey map from post-dredging 2010 supplemental mitigation site planting is available in Figure 3 of Appendix G (attached to this EA) (Merkel & Associates, Inc. 2013c).

Eelgrass is present along the base of the man-made revetment located northwest of the North T Pier in the Navy Channel. Eelgrass was not observed along the manmade North and South breakwaters or the groin in Morro Bay Harbor, which are structures adjacent to, but not in the footprint of, the proposed action. Though the revetment is not within the Morro Bay Harbor maintenance dredging footprint project, the revetment is located approximately 660 feet north of the dredging footprint within the Navy Channel between the two narrowest points.

Several species of commercial or recreational interest are known to associate with eelgrass, including several species of rock crab (*Cancer* spp.) and California spiny lobster (*Panulirus* *interruptus*). Many juvenile fishes use the structure of seagrass beds as shelter from predators during development before shifting to different habitats as adults, including northern anchovy (*Engraulis mordax*), many species of surfperch (Embiotocidae), rock fishes (*Sebastes* spp.), and soles/flounders (Pleuronectidae, Bothidae, Paralichthyidae). Eelgrass is also a food item for the black brant (*Branta bernicula ssp. nigricans*).

Eelgrass grows in beds in shallow bays and lagoons, supporting food webs, filtering nutrients, and stabilizing sediments. By trapping sediment, seagrasses increase water clarity permitting sunlight to penetrate deeper into the water column.

Figure 5.1.1-1 Morro Bay Eelgrass Survey Map (post-dredge 2013)

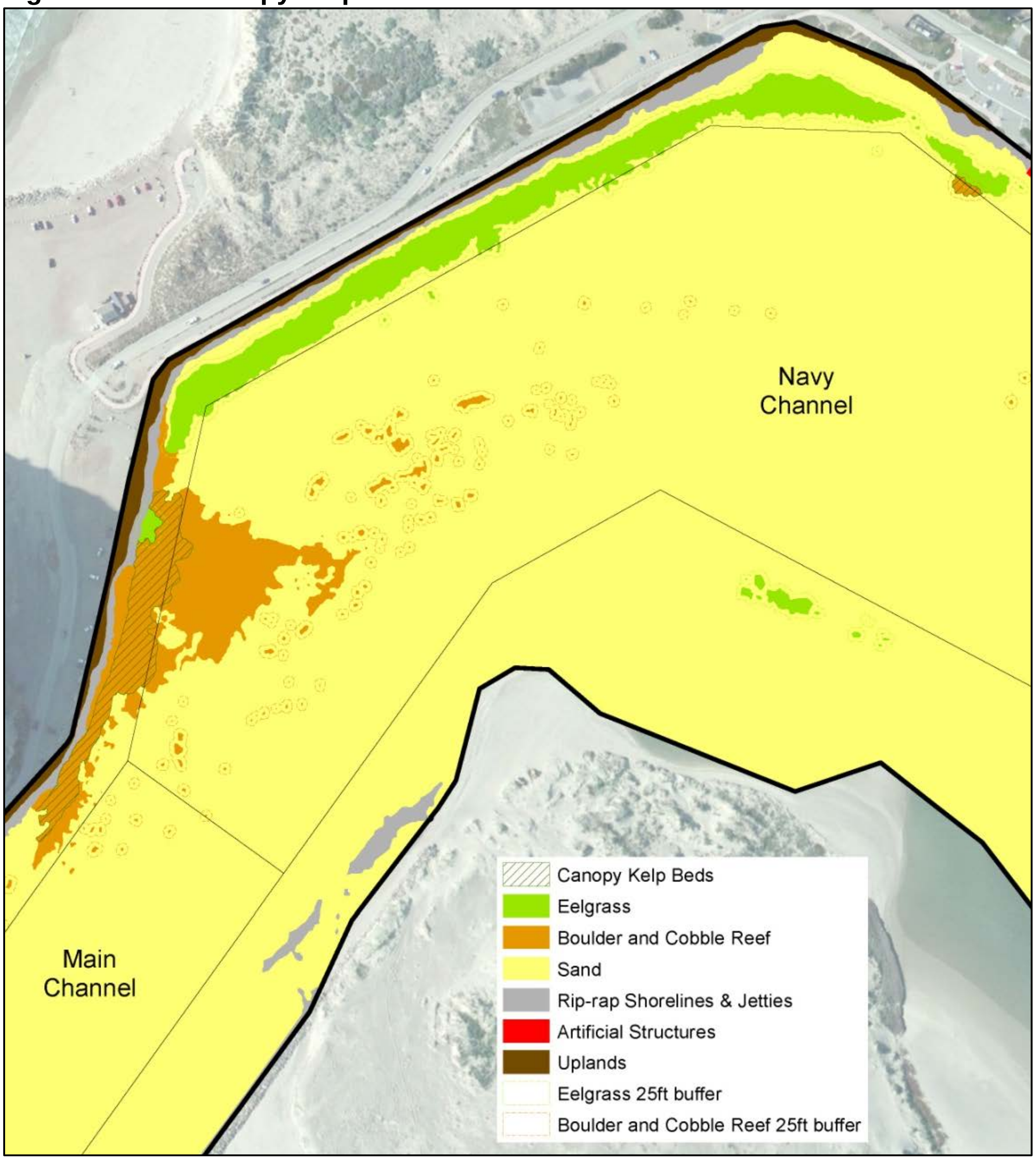


Source: Merkel & Associates, Inc. 2013b (Appendix B)

Giant Kelp

Giant kelp is located north of the Main Channel, west (and within) the Navy Channel, and within the northeast portion of the Navy Channel (Figure 5.1.1-2). Like eelgrass, kelp provides structure and food for fishes and invertebrates and is a particularly productive habitat. In addition, the kelp bed in Morro Bay Harbor is habitat for the Federally threatened southern sea otter (*Enhydra lutris nereis*). The kelp grows on boulder and cobble reefs that formed from rocks have fallen from the rip-rap along the harbor side of Morro Rock (Chambers Group 2000). Subtidal boulders with sparse kelp growth are found along the base of Morro Rock west of the kelp bed.

Figure 5.1.1-2 Canopy Kelp Beds



Source: Merkel & Associates, Inc. (Appendix A)

Of the habitats associated with rocky shelf habitat composite, canopy kelp is of primary importance to the ecosystem and serves as important groundfish habitat (NMFS 2005), and habitat for the sea otters.

Canopy kelp was not observed along the manmade North and South breakwaters or the groin in Morro Bay Harbor, which are structures adjacent to, but not in the footprint of, the proposed action. Though the revetment is not within the Morro Bay Harbor maintenance dredging footprint project area, the revetment is adjacent to the proposed action and is at a minimum distance of approximately 660 feet (201 meters) north of the maintenance dredging area going through the Navy channel between the two narrowest points.

Isolated areas of canopy kelp are located along the base of the man-made revetment, which is located northwest of the North T Pier in the Navy Channel within Morro Bay Harbor, and runs parallel to Coleman Park.

5.1.2 Birds

Morro Bay is part of an estuary fed by Chorro and Los Osos Creeks. The estuary is a major wintering and stopover area for migratory waterfowl and shorebirds (USACE 2001a). Data gathered for all shorebirds in Morro Estuary Natural Preserve show that approximately 20,000 shorebirds winter in the estuary. Migrating and wintering birds include the black-bellied plover (*Pluvialis squatarola)*, willet (*Catoptrophorus semipalmatus)*, long-billed curlew (*Numenius americanus)*, marbled godwit (*Limosa fedoa)*, sanderling (*Calidris alba)*, western sandpiper (*Calidris mauri)*, and the least sandpiper (*Calidris minutilla)*. Another bird of interest is the brant (*Branta bernicla*), a species of goose that is found in large numbers in Morro Bay and utilizes the eelgrass beds in the Bay as a food source (USACE 2001a).

Various species of seabirds breed in or near Morro Bay. Species that nest on Morro Rock and/or Pillar Rock, which is just offshore of Morro Rock, include the American peregrine falcon (*Falco peregrinus anatum)*, double-crested cormorant (*Phalacrocorax auritus*), Brandt's cormorant (*Phalacrocorax penicillatus*), pelagic cormorant (*Phalacrocorax pelagicus*), western gull (*Larus occidentalis*) and pigeon guillemot (*Cephus columba*) (Carter *et al.* 1992). Two small colonies of double-crested cormorants (*Phalacrocorax auritus*) nest within Morro Bay, but are not directly associated with the estuary (Carter *et al.* 1995). The Federally threatened western snowy plover (*Charadrius alexandrinus nivosus*) nests on some of Morro Bay's beaches, including those adjacent to the sand spit and Morro Strand State Beach (Federal Register 2012). Morro Strand State Beach is the alternate sediment placement site that is utilized outside of the breeding bird season (September 16 to February 29).

The American peregrine falcon (*Falco peregrinus*), a California state listed endangered species and a Federal Species of Concern, is present in Morro Bay.[1] American peregrine falcons range throughout California during migrations and in the winter season. The varied habitats and associated bird species diversity found in proximity to Morro Bay and it's estuary support both resident and migratory peregrine falcons. Morro Rock, located northwest of the proposed Morro Bay maintenance dredging program area, is a historical nest site that continues to support the

1 The peregrine falcon was removed from the Federal List of endangered species on August 25, 1999.

annual breeding attempts of one resident pair of falcons. The nesting season for peregrine falcons may extend from January to July, with the most critical period extending from courtship (February) until the young birds are fledged (June) (USACE 2001). Falcons maintain distinct territories, and forage over vast areas in both wetland and upland locations. Their primary food source is predation of other birds.

5.1.3 Mammals

Approximately 30 species of mammals are present in and around Morro Bay, including four species of marine mammals (USACE 2001). The most frequent marine mammal pinnipeds found in the Bay are harbor seals (*Phoca vitulina*) and the southern sea otter (*Enhydra lutris nereis)* (described in detail in section 5.1.4). The Pacific harbor seal (*Phoca vitulina richardsi*) has a rookery in the Morro Bay mudflats, where adults and pups have been sighted. There are a group of approximately 6-8 resident southern sea otters in the Bay area. The California sea lion (*Zalophus californianus*), the most common pinniped in California, has been sighted in the Bay on harbor buoys and floating docks. There have been infrequent sightings of gray whales *(Eschrichtius robustus)*, bottle nose dolphins *(Tursiops truncatus)*, the long-beaked common dolphin *(*Delphinus capensis*)* and the harbor porpoise *(Phocoena phocoena)* at the entrance of Morro Bay during their migration up and down the coastline. The aforementioned pinnipeds and cetaceans, as well as northern elephant seals (*Mirounga angustirostris*), the largest pinniped, congregate during their migration at Point Piedras Blancas (lighthouse), northwest of San Simeon, which is outside of the maintenance dredging program area. The Steller sea lion (*Eumetopias jubatus*) has not been observed in the Morro Bay area.

5.1.4 Threatened, Endangered (T&E) Species

Threatened and endangered (T&E) species which may occur at Morro Bay include the western snowy plover (*Charadrinus alexandrinus*), southern sea otter (*Enhydra lutris nereis*), Southern California steelhead trout (*Oncorhynchus mykiss*), and Morro shoulderband snail (*Helminthoglypta walkeriana*).

Western Snowy Plover (*Charadrius alexandrinus nivosus*)

The western snowy plover was listed as a Federally Threatened species by the USFWS on March 5, 1993, and is also a state Species of Concern (SC). The Primary Constituent Elements (PCE) for the Pacific Coast population of the western snowy plover includes:

- Nesting areas located above the high tide line on the coastal beaches near sand spits, dune-backed beaches, sparsely vegetated dunes, beaches at creek and river mouths, salt panes at lagoons and estuaries. Nest sites typically occur in flat, open areas with sandy or saline substrates; vegetation and driftwood are usually sparse or absent.
- Less common nesting habitats include bluff-backed beaches, placement of dredged material areas, salt pond levees, dry salt ponds, and river bars.
- In the winter, western snowy plovers are found on many of the beaches used for renesting as well as on beaches where they do not nest, in man-made salt ponds, in estuaries, and on mudflats.
- Foraging habitat is primarily in the wet sand and amongst surf-cast kelp within the

intertidal zone. Plovers also forage in dry, sandy areas above the high tide, on salt pans, on spoil sites, and along the edges of salt marshes, salt ponds, and lagoons.

Western snowy plovers are primarily visual foragers, using the run-stop-peck method of feeding typical of Charadrius species. The western snowy plovers forage on invertebrates in the wet sand and amongst surf-cast kelp within the intertidal zone, in dry, sandy areas above the high tide, on salt pans, on spoil sites, and along the edges of salt marshes, salt ponds, and lagoons. Plovers sometimes probe for prey in the sand, and pick insects from low-growing plants. Western snowy plover food consists of immature and adult forms of marine and terrestrial invertebrates. Little quantitative information is available on food habits. Food items reported for coastal snowy plovers include mole crabs (*Emerita analoga*), crabs (*Pachygrapsus crassipes*), polychaetes (*Neridae, Lumbrineris zonata, Polydora socialis, Scoloplos acmaceps*), amphipods (*Corophium ssp., Ampithoe spp., Allorchestes angustus*), tanadacians (*Leptochelia dubia*), flies (*Ephydridae*), beetles (*Carabidae*, *Buprestidae*, *Tenebrionidae*), clams (*Transenella spp*.), and ostracods (Page et al. 1995a).

The Pacific Coast population of western snowy plover migrates from their nesting areas along the U.S. West Coast to southern latitudes along the coast from approximately late-June to late-October. Plovers will vacate Morro Bay nesting areas to occupy wintering grounds in southern latitudes, and an influx of plovers from northern latitudes will occupy Morro Bay as a wintering habitat. Therefore, western snowy plovers are present in the Morro Bay area for the majority of the year and require year-round consideration.

Western snowy plovers use the beaches in the Morro Bay area for nesting and wintering (Miller *et al.* 1999). Snowy plovers inhabit the Morro Bay sand spit in Morro Bay and are dispersed along the entire length of the spit. Sand spit habitats have the highest densities of snowy plovers along the California coast (Page and Stenzel 1981).

From 2002 to 2013, the breeding season western snowy plover population on Morro Strand State Beach has dramatically decreased, and the population on the Morro Bay State Park sand spit has fluctuated greatly according to the results of a breeding window survey (California State Parks 2013). In 2002, Morro Strand had 23 western snowy plovers, and population remained relatively stable until a decline in 2007-2013 that yielded a population as low as 2 plovers. A possible explanation for the dramatic decline on Morro Strand State Beach (critical habitat unit CA-29) is the large amount of human activity that includes vehicle beach patrols by lifeguards, camping, pedestrian foot traffic, domestic dogs and horses. The Morro Bay State Park sand spit population of western snowy plovers was 56 in 2002, which increased to 203 in 2004, decreased to 59 in 2008, and increased to 101 in 2013 (California State Parks 2013). The large fluctuation in the sand spit's plover population could be attributable to extensive human activities that include pedestrian foot traffic, dogs, and horses. Fluctuating populations could also be attributable nesting success rates (discussed below), and to factors that influence plover mortality rates in their wintering grounds in southern latitudes.

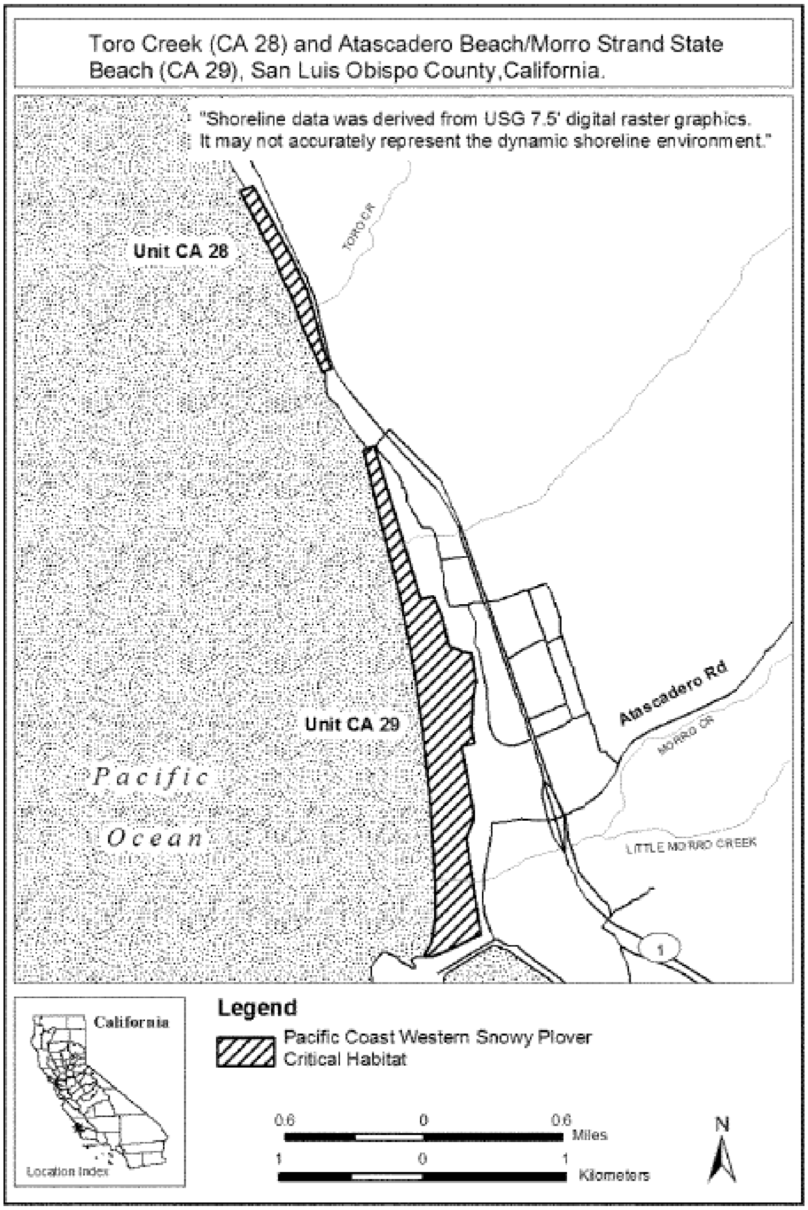
The number of western snowy plover nests in the Morro Bay area show similar trends to their breeding season population counts. In 2004 Morro Strand had 38 nests, which declined to just 12 nests in 2012, and the same number in 2013. The majority of nests (approximately 75%) on

Morro Strand are consistently located near in the Azure Street to the Cloisters Boardwalk corridor. The number of nests in the sand spit was 272 in 2004, which decreased to 96 in 2008, and increased to 157 in 2013 (California State Parks 2013). Nest failures are typically associated with depredation from wind, high tides, and predation from other birds or mammals (primarily coyotes on the sand spit, and foxes/skunks/opossums on Morro Strand). Plovers at Morro Bay usually produce two clutches, with unfledged young cared for until the end of August.

On June 19, 2012, the USFWS made its final rule on the designation of critical habitat for the Pacific coast population of the western snowy plover (see Figure 5.1.4-1 below) (Federal Register 2012). One area of critical habitat is near the city of Morro Bay, revised critical habitat unit CA-29, located at Morro Strand State Beach, and is managed entirely by the California Department of Parks and Recreation (CDPR). Revised critical habitat unit CA-29 extends about 2.25 mi (4 km) north along Morro Strand State Beach from to the parking area northeast of Morro Rock to an unnamed rocky outcrop opposite the end of Yerba Buena Street at the north end of Morro Bay. This is an important breeding area supporting up to 40 nests each year (Larson 2003). This 213 acre critical habitat unit is also an important wintering area, with up to 249 plovers being recorded during a single season over the last 7 years (USFWS unpublished data). This unit is essential to species conservation because it contributes significantly to the regional conservation goal by providing habitat capable of supporting 40 breeding birds under proper management.

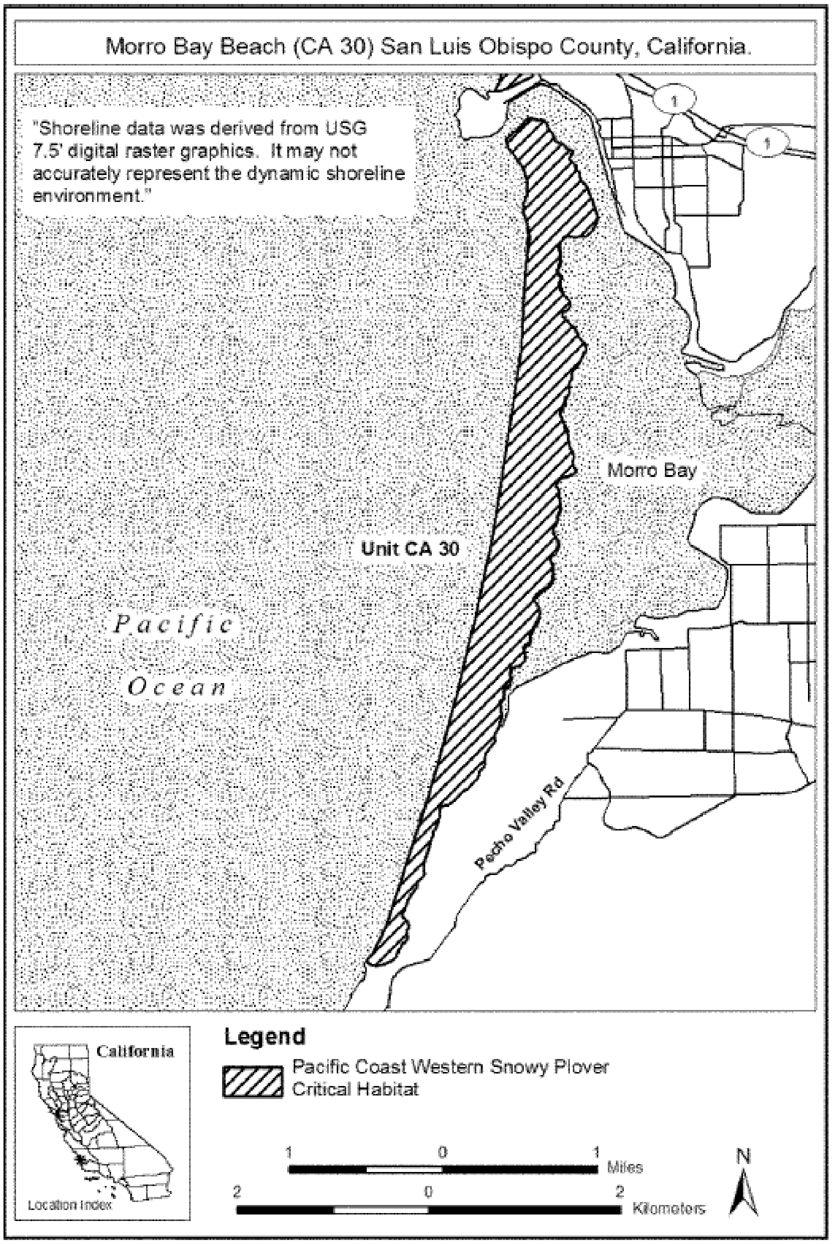
Morro Bay State Park's sand spit (also known as Morro Bay Beach) is designated as critical habitat unit CA-30 for the western snowy plover by the USFWS (see Figure 5.1.4-2 below) (Federal Register 2012). This unit is located on the sand spit south of Morro Rock, and extends 5.5 miles north from a rocky outcrop north of Hazard Canyon to the tip of the sand spit. CA-30 is managed by California State Parks (948 acres), the City of Morro Bay (69 acres), and private entities (60 acres). This important breeding area supports as many as 205 breeding western snowy plovers in a single year, and up to 104 plovers for wintering habitat (USFWS unpublished data). The sand spit habitat includes wind-blown sand dunes, areas of intertidal sandy beach on either side of the dunes, and occasional surf-cast wrack supporting small invertebrates. The area is characterized by barren to sparsely vegetated terrain.

Figure 5.1.4-1 Western Snowy Plover Critical Habitat (CA-29) on Morro Strand State Beach



Source: USFWS (Federal Register 2012)

Figure 5.1.4-2 Western Snowy Plover Critical Habitat (CA-30) on Morro Strand State Beach



Source: USFWS (Federal Register 2012)

Southern sea otter (*Enhydra lutris nereis*)

The southern sea otter was Federally listed by the U.S. Fish and Wildlife Service (USFWS) as a Threatened species on January 14, 1977. The sea otter is a marine mammal species for which the USFWS has oversight. Morro Bay is within the known range for sea otters, and although increased numbers were reported in the early 1980's, the Morro Bay sea otter population has been in decline over the last decade, as reported by CDFG and USFWS. A maximum number of 60 otters were observed in 1984, in contrast to more recent estimates of 6-8; with minimum numbers present in the summer months (M. Harris, CDFG, personal communication, 2001). Part of the reason for the decreased numbers of sea otters in the Morro Bay area could be associated with the outdated Morro Bay sewage treatment plant, which discharges heavily polluted wastewater into the geographic center of California sea otter habitat (NRDC 2007). Some studies have linked otter deaths to pollutants in wastewater.

In 2001, the resident population included one dominant breeding male, along with approximately 5 or 6 females, and possibly a few juvenile non-breeding males. This population, once believed not to be breeding in the Bay, in 2001 produced its first recorded pup in many years (M.Harris, CDFG, personal communication, 2001). The sea otters in this area feed on a variety of organisms, but focus primarily on clams, crabs, and barnacles found in the sandy substrates of Morro Bay's channels. The general habitat for the sea otter is the coastal waters within a mile of shore, especially rocky shallows with kelp beds and abundant shellfish (CNDDB 2008). Kelp bed locations in Morro Bay are illustrated in figure 5.1.1-2 (Appendix A). The kelp bed provides important foraging habitat, and at night the otter wraps strands of kelp about its body to secure its position while it sleeps.

Steelhead trout (*Oncorhynchus mykiss*)

The South-Central California Coast steelhead trout Evolutionarily Significant Unit (ESU) of steelhead was listed as Threatened by the Federal government on August 18, 1997. This genetically distinct population of steelhead includes fish that spawn in coastal basins from the Pajaro River near Monterey and south to, but not including, the Santa Maria River.

Historical data on the South-Central California Coast steelhead ESU are sparse. In the mid-1960s, the CDFG (1965) estimated that the ESU-wide run size was about 17,750 adults (NMFS 2005). No comparable recent estimate exists; however, recent estimates exist for five river systems (Pajaro, Salinas, Carmel, Little Sur, and Big Sur), indicating runs of fewer than 500 adults where previous runs had been on the order of 4,750 adults. Time-series data only existed for one basin (the Carmel River), and indicated a decline of 22% per year over the interval 1963 to 1993. Many of the streams were thought to have somewhat to highly impassable barriers, both natural and anthropogenic, and in their upper reaches to harbor populations of resident trout. The relationship between anadromous and resident *O. mykiss* is poorly understood in the South-Central California Coast steelhead ESU, but was thought to play an important role in its population dynamics and evolutionary potential. A status review update conducted in 1997 listed numerous reports of juvenile *O.mykiss* in many coastal basins, but noted that the implications for adult numbers were unclear.

In 2002, an extensive study was made of steelhead occurrence in most of the coastal drainages between the northern and southern geographic boundaries of the South-Central California Coast steelhead ESU (NMFS 2005). Steelhead were considered to be present in a basin if adult or juvenile *O. mykiss* were observed in any stream reach that had access to the ocean (*e.g.* no impassable barriers between the ocean and the survey site), in any of the years 2000–2002 (*i.e.* within one steelhead generation). Of 36 drainages in which steelhead were known to have occurred historically, between 86% and 94% were currently occupied by *O. mykiss*. The range in the estimate of occupancy occurs because three basins could not be assessed due to restricted access. Of the vacant basins, two were considered to be vacant because they were dry in 2002, and one was found to be watered, but a snorkel survey revealed no *O. mykiss*. One of the "dry" basins (Old Creek) is dry because no releases were made from Whale Rock Reservoir; however, a landlocked population of steelhead is known to occur in the reservoir above the dam. Occupancy was also determined for 18 basins with no historical record of steelhead occurrence. Three of these basins (Los Osos, Vicente, and Villa creeks) were found to be occupied by *O. mykiss*, which annually migrate from the bay upstream into the creeks between November and January. The 2002 study discussed that it was somewhat surprising that no previous record of steelhead seemed to exist for Los Osos Creek, which is located Morro Bay and San Luis Obispo. Los Osos Creek is southeast of the proposed Morro Bay maintenance dredging program area, and is not part of, or adjacent to, the proposed action.

Steelhead may occasionally migrate through Morro Bay to reach spawning grounds within Chorro Creek or Morro Estuary Natural Preserve, waterways that are not part of or adjacent to the proposed Morro Bay maintenance dredging program area. Los Osos Creek also flows into Morro Bay but is located southeast of the proposed Morro Bay maintenance dredging program area, and is not in the vicinity of the proposed action. The proposed action is in the vicinity of the Morro Estuary Natural Preserve, but is not immediately adjacent to the Morro Estuary Natural Preserve.

On September 2, 2005, the USFWS designated critical habitat for seven ESU of Pacific salmon and steelhead trout in California, which included South-Central Coast *O. mykiss* discussed above (Federal Register 2005). The critical habitat is designated for this species within Hydrologic Subareas (HSA's). The Morro Bay and Los Osos Creek HSA's are part of the critical habitat for the South-Central Coast *O. mykiss*, whereas the Chorro (Creek) HSA. Both Los Osos and Chorro Creeks, which drain into Morro Bay south of White Point, are east and south of the dredging program area. Therefore, the deltas of Los Osos and Chorro Creeks would not be impacted by the proposed Morro Bay maintenance dredging operation.

Morro shoulderband snail (*Helminthoglypta walkeriana*)

The Morro shoulderband snail, commonly known as the banded dune snail, is found only in western San Luis Obispo County (Federal Register 2001). At the time of its addition to the List of Endangered and Threatened Wildlife on December 15, 1994 (59 FR 64613), the Morro shoulderband snail was known to be distributed near Morro Bay, but this species had not been observed in several years in the Morro Bay area, possibly due to survey limitations and drought conditions (USACE 2001). The snail's known range includes areas south of Morro Bay, west of Los Osos Creek and north of Hazard Canyon (Federal Register 2001). Historically, the species has also been reported near the city of San Luis Obispo and south of Cayucos. The endangered Morro shoulderband dune snail was previously identified on the Morro Bay sand spit (CDPR 2005). The snail also exists in or close to the foredunes of Morro Strand State Beach.

Critical habitat for the Morro shoulderband snail is located in San Luis Obispo County, California (Federal Register 2001). The Morro shoulderband snail exists in three critical habitat units in San Luis Obispo County. Critical Habitat Unit 1 is Morro Spit and West Pecho, which encompasses areas managed by Morro Bay State Park sand spit (Dunes Natural Preserve) and the City of Morro Bay (north end of spit), including the length of the spit and the foredune areas extending south toward Hazard Canyon. Unit 1 provides dune scrub habitat for the populations of Morro shoulderband snail that live there. The spit's windward side and its north end are non-vegetated; patches of vegetation occur along its leeward side on Morro Bay. The West Pecho portion of this unit lies to the east of the Morro Spit Conservation Planning Area and is bounded on the east by Pecho Road and the community of Los Osos. Unit 1 extends north to the Bay and south to Hazard Canyon. Elevations range from sea level on the Bay to about 75 meters (m) along its southeastern edge. Vegetation associations include coastal dune scrub, with coastal sage scrub closer to Hazard Canyon. The Morro Spit and West Pecho Unit 1 critical habitat for the Morro shoulderband snail is located in the vicinity of, but not immediately adjacent to, the proposed Morro Bay maintenance dredging area and primary nearshore dredge material placement site at Morro Bay State Park sand spit. The Morro Spit and West Pecho Unit 1 critical habitat is not in the vicinity of, or immediately adjacent to, the alternate surfzone dredge material placement site on Morro Strand State Beach.

Unit 2 critical habitat for the Morro shoulderband snail exists in South Los Osos and is bounded on the north and east by residential development and agriculture in the community of Los Osos. The South Los Osos Unit 2 critical habitat for the Morro shoulderband snail is not in the vicinity of, or immediately adjacent to, the proposed Morro Bay maintenance dredging area, the primary nearshore dredge material placement site, or the alternate surfzone dredge material placement site.

Unit 3 critical habitat for the Morro shoulderband snail is located in Northeast Los Osos and includes the undeveloped areas between Los Osos Creek and Baywood Park and is divided by South Bay Boulevard. The Northeast Los Osos Unit 3 critical habitat is not in the vicinity of, or immediately adjacent to, the proposed Morro Bay maintenance dredging area, the primary nearshore dredge material placement site, or the alternate surfzone dredge material placement site.

The Morro shoulderband snail occurs in coastal dune and scrub communities and maritime chaparral. Away from the immediate coast, immature scrub in earlier successional stages may offer more favorable shelter sites than mature stands of coastal dune scrub. The immature shrubs provide canopy shelter for the snail, whereas the lower limbs of larger older shrubs may be too far off the ground to offer good shelter.

5.2 Environmental Consequences

Alternative 1 (No Federal Action Alternative)

The "No Action" alternative would not provide potential benefits to shorebirds and terrestrial organisms, from the creation of new beach habitat at the placement of dredged material site. Future shoaling impacts could result in frequent emergency dredging operations to relieve shoaled conditions that could result in unsafe navigation. It is likely that any emergency dredging operations would be limited in scope and duration. Emergency dredging operations would likely involve maintenance dredging of the Federal dredge areas that require immediate removal of severely shoaled areas that prevent safe navigation. If emergency dredging is necessary, the potential impacts to marine life, shorebirds, and threatened and endangered species would be commensurate with those listed in Alternative 2 analyses (below).

Alternative 2 (Preferred)

The Corps has concluded that the proposed Morro Bay maintenance dredging program is expected to produce temporary, minimally adverse impacts to the biological resources. The impacts will be limited in duration and geographic scope.

The habitat that will be affected directly by the proposed maintenance dredging activity and the placement of dredged material activity is the soft bottom habitat of the navigation channels, as well as in the nearshore and surfzone dredge material placement sites.

The dredging and sediment deposition activities will result in temporary adverse impacts. The proposed action will affect primarily sand-sized particles that are above the soft bottom habitat. No dredging or placement of dredged material activity will occur directly in sensitive habitats such as established eelgrass beds, hard-bottom reefs, or the kelp beds. Sparse, isolated patches of eelgrass could possibly be present in the general dredging vicinity, and within Morro Channel which is less frequently dredged. However, most of the navigation channels are deeper than the deepest depth where eelgrass is generally observed in Morro Bay.

The Corps has determined that within the footprint of the proposed Morro Bay maintenance dredging area, approximately 120 acres of dredged, subtidal area will be temporarily impacted. Additionally, approximately 71 acres of intertidal area will be temporarily impacted at the alternate surfzone placement site on Morro Strand State Beach; and 116 acres of subtidal area and 12 acres of intertidal areas will be temporarily impacted at the primary nearshore placement site off of Morro Bay State Park sand spit.

The Morro Strand State Beach alternate surfzone placement site will be utilized when the entire Federal channel is dredged (once within the 6-year dredging program, duration of 30-60days). The dredge material placement site at the outlet of the temporary pipeline on Morro Strand State beach is estimated to temporarily impact approximately 0.9 acres of beach habitat due to a 200 foot by 200 foot area that will be cordoned off around the pipeline's outlet. The approximate 0.9 acre dredge material placement cordon will initially be established on the northernmost extent of the Morro Strand State Beach dredge placement site, and be moved south along the beach towards the Morro Rock parking lot until the end of dredge material placement operations.

Estuary Habitat

Turbidity from dredging is not expected to significantly affect the kelp bed near Morro Rock or eelgrass beds in shallow water adjacent to the navigation channels. Although the sediments to be dredged consist of sand-sized particles that settle rapidly, some temporary and short term turbidity is expected during dredging. Surveys of eelgrass beds before and after dredging operations in Lower Newport Bay, where sediments are much finer than in Morro Bay, did not indicate that turbidity from dredging had adverse effects on eelgrass (Chambers Group and Coastal Resources Management 1999).

Eelgrass could be adversely affected if the temporary pipeline for placement of dredged material was cushioned with aggregate material within an eelgrass bed. During previous dredging operations the use of aggregate materials to cushion the temporary pipeline was found to be detrimental to eelgrass. Therefore, the use of aggregates such as sand, gravel, asphalt, concrete or similar materials will be prohibited in the eelgrass area. In addition, because boat propellers can harm eelgrass, the use of propellers within the eelgrass bed also will be prohibited.

Morro Creek's potential flow out of the creek's mouth into the Pacific Ocean would be maintained by either elevating or burying the pipeline where it transects the creek's mouth.

The proposed Morro Bay maintenance dredging program would also be consistent with the Morro Bay Comprehensive Conservation and Management Plan (CCMP) and the proposed action would not affect natural resources. The proposed action will also not affect the Morro Bay SMR or the Morro Bay SMRMA.

Coastal Water Habitat

The Corps has determined that the primary nearshore placement site for dredged material at Morro Bay State Park sand spit will impact approximately 116 acres of subtidal area, and approximately 12 acres of intertidal areas will be temporarily impacted. Additional habitat will be affected by surfzone placement of dredged material activities: the Corps has determined that the alternate, north site, surfzone placement of dredged material area at Morro Strand State Beach will impact approximately 71 acres of intertidal area.

The proposed dredging and placement of dredged material activities are expected to produce temporary, short term, and minimal impacts to marine organisms including aquatic invertebrates. Temporary increases in turbidity and suspended solids at the dredge and placement of dredged material sites could decrease light penetration (or transmissivity), causing a decline in primary productivity due to decreased photosynthesis by phytoplankton. Any appreciable turbidity increase may also cause clogging of gills and feeding apparatuses of fish and filter feeders. Impacts, however, would not be significant due to the short duration of dredging activities (typically less than 30 days), the localized nature of the dredge operation in Morro Bay (activities would be restricted to the Federal jurisdictional channels), and the relative close vicinity of the proposed dredge operation to the primary, south site, nearshore placement of dredged material area at Morro Bay State Park sand spit (immediately offshore).

Motile organisms would most likely evacuate and avoid the dredging area, or temporarily relocate to adjacent undisturbed areas. Although turbidity could have an indirect affect on organisms, maintenance dredging activities contribute only a small percentage to the total turbidity found in near-shore waters when compared with: (1) turbidity created by natural beach erosion; and (2) re-suspension of material by waves, currents, tidal action, and boat traffic. Moreover, these impacts would be confined to the immediate vicinity of the proposed dredging activities, with turbidity levels dissipating rapidly through resettlement. Also, the high percentage of sand present in Morro Bay, relative to silts, would cause most sediment to settle, rather than to remain suspended in the water column.

Planktonic organisms in the water column may suffer some short-term, localized stress from the turbidity created during dredging. There may be a general decline in aquatic primary productivity due to temporary loss of phytoplankton populations. However, planktonic species are adapted to large losses from naturally high mortality. From the above discussions, impacts from dredging (*e.g.* mechanical abrasion) to aquatic invertebrates and fish are expected to be short term and temporary. Because of the localized and short-term disturbance of bottom sediment associated with dredging and because of the transitory nature and high reproduction rates of marine plankton, impacts of dredging on phytoplankton and zooplankton are considered insignificant.

Thackston and Palermo (2000) have shown the relationship of turbidity to total suspended solids (TSS) [measured in Nephelometric Turbidity Units (NTU)] for a variety of different areas. For instance, a turbidity measurement of 50 NTU corresponds to a TSS concentrations ranging between 225 milligram per liter (mg/l) and 300 mg/l. At a turbidity level of 25 NTU, the correlation suggests that TSS in all areas studied would be less than 150 mg/l and, in most cases would be less than 100 mg/l. Literature on TSS concentrations during dredging indicate that for clamshell dredging, a concentration of 75 mg/l to 350 mg/l at a distance of 400 feet from the dredge and a concentration of 100 mg/l to 900 mg/l within 100 feet of the dredge (Palermo and Pankow 1988). Turbidity associated with hopper dredge and cutterhead dredge operations is normally less.

Additional survey data shows that TSS concentrations during three different dredging activities in the Los Angeles area (1998 and 1999/2000 Marina Del Rey dredging projects, and 1999 LA River dredging) only briefly reached levels that could affect sensitive marine species (Chambers Group 2001) with suspended solid levels during the Marina Del Rey and LA River dredging activities posing little impact to marine life. Based on general corollaries between NTU and TSS, the TSS cited during the Marina Del Rey and Los Angeles river dredging actions would be expected to have few, if any, effects on aquatic life. Because similar types of sediments would be dredged, this information is applicable to the proposed Morro Bay maintenance dredging program. These data suggest that the proposed Morro Bay maintenance dredging program is not likely to generate turbidity levels at 100 meters or more from the dredge that would have a significant effect on marine organisms (Chambers Group 2001).

LaSalle (1991) reported that dredging-related turbidity impacts are expected to be limited to within 500 meters (1640 ft.) of the area excavated, with the maximum concentrations generally restricted to the lower water column, and decreasing rapidly with distance due to settling and dilution. Field observations of some hydraulic cutter head dredging operations in California indicate that turbidity increases above background levels may be considerably more limited than those reported by LaSalle (1991), and are typically confined to within 70 to 170 meters of the dredging activity (USACE 1994b, 1998b). Following dredging activities, fish and shellfish are expected to recolonize previously disturbed areas. Measurements around properly operated dredges have also shown that elevated levels of suspended bottom sediments can be confined to several hundred meters from the cutterhead location and dissipate exponentially towards the surface with little turbidity actually reaching surface waters (Herbich and Brahme, 1991; LaSalle and others, 1991; Herbich, 2000). In many cases, the suspended sediment concentrations are no greater than those generated by commercial shipping operations or during severe storms.

Storms, floods, and large tides can increase suspended sediments over much larger areas and for longer periods than dredging activities, which makes it very difficult to distinguish between dredging -induced turbidity and that generated by marine natural processes or normal navigation activities (Pennekamp and others, 1996). Also, a dense, sediment-laden dynamic plume descends rapidly through the water column as a well-defined jet of high-density fluid, entraining ambient seawater as it falls. At the same time, a passive plume arises from turbidity-induced entrainment of sediment along the perimeter of the dynamic plume. It has also been estimated that 95-99 percent of most discharged sediment loads descend to the bottom within 30 meters of the point of discharge with only the remaining few percent being stripped from the outside of the dynamic plume (Schubel and others, 1978; Neal and others, 1978).

A secondary impact of dredging would be the potential redeposition of suspended sediments on adjacent areas. Sediment movement is also part of the natural, nearshore environment. Where the rain of fines is minimal (*i.e.* the outer edges of a turbidity plume), adjacent animals may work their way up through the sediment (Soule and Oguri 1976). Since most of Morro Bay sediment material is large-grained sand, however, indirect impacts would be less extensive. Therefore, secondary impacts from the proposed Morro Bay maintenance dredging program to the benthic community would be short-term and insignificant since effects would be concentrated in a small area.

After the annual completion of the proposed Morro Bay maintenance dredging, there is a high probability that the affected area will be recolonized. The planktonic stage of these organism's life cycles is expected to contribute greatly to the decolonization of newly exposed substrate, as will contributions by the migration of juvenile and adult individuals from adjacent undisturbed areas. Field studies of dredged areas have shown that decolonization occurs within 2 weeks to 3 years after dredging stops (McCauley *et al.* 1977; Oliver *et al.* 1977; Rosenberg 1977). Oliver *et al.* (1977) found that shallow water communities, which include some of the Morro Bay Federal channels such as Morro Channel, the Navy Channel, inhabiting naturally highly variable and frequently disrupted physical environments rebounded or recovered more quickly from experimental disturbances than those found in less variable and more benign conditions.

Therefore, The Corps has concluded that the impacts from the Morro Bay maintenance dredging program on aquatic invertebrates are expected to be temporary, short term, and minimal.

Benthic Habitat

A commercial oyster bed is maintained in the southern end of Morro Bay. Turbidity from the proposed Morro Bay maintenance dredging program is not expected to extend to this area. Sedentary and slow-moving benthic organisms within the immediate program area are expected to be eliminated by proposed dredging and placement of dredged material activities due to either site excavation or burial. Among such potentially affected organisms are gaper clams, Washington clams, geoducks, small crustaceans, and polychaete worms. Dredging will disperse benthic fish resting or feeding in the immediate dredge area. In some cases, fish may be cut by the cutter head mechanism or sucked into the dredge.

Upon completion of each cycle of the Morro Bay maintenance dredging program, the dredged areas will be devoid of any benthic fauna originally present. Field studies of dredged areas have shown that recolonization occurs within 2 weeks to 3 years after dredging stops (McCauley *et al.* 1977; Oliver *et al.* 1977; Rosenberg 1977). Oliver et al. (1977) found that shallow water communities inhabiting naturally highly variable and frequently disrupted physical environments rebounded or recovered more quickly from experimental disturbances than those found in less variable and more benign conditions. The planktonic larval stage found in most of these organisms is the main contributing factor behind this quick recolonization of the newly exposed substrate, although migration by juvenile and adult individuals from the adjacent undisturbed areas is also possible.

Recently, The Corps Wilmington Harbor Project deepened and realigned the navigational entrance channel to the Cape Fear River located near Wilmington, North Carolina (Versar 2004). The work required the removal of about 5.6 million cubic yards (cy) of sandy material from the lower portion of the Cape Fear River navigation channel as well as the offshore navigational river entrance channel. The dredged material was used beneficially to replenish the sands of four North Carolina Brunswick County beaches (Bald Head Island, Caswell Beach, Oak Island, and Holden Beach), which had eroded over the past years. Environmental monitoring was undertaken as part of The Corps beach replenishment project to document effects of the beach placement of dredged material activities on fish and benthic invertebrate communities inhabiting the surfzone and adjacent offshore areas. A two-year study was designed to assess the immediate impact of beach replenishment on the biological living resources within and adjacent to the project area and to access recovery of the biota up to one-year post replenishment. To document effects on and potential recovery to the marine biota resources examined at eight stations at four study sites in North Carolina, the study and reference beaches for this project included ghost crab holes behind the wrack area of the beach. Benthic macroinvertebrates were sampled in the swash zone and shallow and deep subtidal areas of the beach surfzone. Surfzone beach seining and offshore trawling was conducted to sample fish and large macrobenthos. Offshore gillnet sampling and nearshore ichthyoplankton tows were also conducted. Sand placement impacts on benthic communities were evident at all beach habitats examined but appeared to be more limited in terms of seasonal impacts at some habitats. The benthic communities of the swash habitat appeared to be the most directly impacted by the sand placement, as effects were apparent across all sampling seasons and when all sampling trips were combined. Impacts in the shallow subtidal habitat occurred during the spring and summer sampling periods. Impacts in the deep habitat occurred during the spring sampling period, the major recruitment period for benthic macroinvertebrates. Impacts detected during the summer sampling period in the shallow habitat most likely were compounded by the additional sand placement that occurred at Caswell Beach the summer 2001. The second year of the study documented recovery of the benthic community at most of the impacted areas. Immediate impacts in the wrack zone were only found at Bald Head Island in the spring. The number of ghost crab holes detected immediately after sand placement at this beach was significantly lower than those detected before the disturbance. The species appeared to have recovered after one-year but since no quarterly sampling was conducted at the beach the speed of recovery is unknown. In The Corps beach replenishment study (Vaser, 2004), the benthic communities of the swash habitat appeared to be the most directly impacted by the sand placement, as effects were apparent across all sampling seasons and when all sampling trips were combined. The timing of beach construction did not appear to influence the immediate impact on the benthic community as all seasons displayed immediate impacts. However, the season when the beach was constructed or the way the beach was constructed (*e.g.* double impact at Caswell Beach) may have affected the recovery rate of the benthic community (Vaser, 2004). Sampling immediately after sand placement revealed much lower populations of bean clams (*Donax variabilis*) at all four beaches, but the most severe impact was detected in spring (Bald Head Island) and summer (Caswell Beach). In the swash habitat of Bald Head Island, *Donax* abundance decreased by 2 orders of magnitude from undisturbed conditions and remained at this low level one-year later. Additionally, *Emerita* mole crabs decreased by 1 order of magnitude immediately after sand placement and remained that way one-year later. In the swash habitat of Caswell Beach, an immediate impact was detected for *Donax* clam populations. Clam abundance decreased by about 10 fold immediately after sand placement and was still at this low level one-year later. Quarterly sampling at this beach also showed much reduced numbers of clams at the study beach when compared to the reference beach. It is hypothesized that the double impact that occurred at Caswell Beach (this beach was reconstructed twice in the summer of 2001) could have caused a disruption in recruitment of *Donax* clams that persisted in the clam abundances up to a year after the placement effects. If the impacts were restricted to one placement event in the summer, then it could be expected that the clam population would have been able to recover within a year. Oak Island clam population (the season with the second highest numbers of clams) also displayed a significant decrease in clam populations immediately after beach reconstruction but abundances had recovered within a year of the impact.

Beach Habitat at Morro Bay State Park sand spit (annual nearshore dredge material placement)

The Morro Bay State Park sand spit habitat is critical habitat for the Morro shoulderband snail, and vital habitat for many other animals. The sand spit would not be impacted by the nearshore placement of dredged material. No dredging program activities would take place on the terrestrial area of Morro Bay State Park's sand spit.

Beach Habitat at Morro Strand State Beach (surfzone dredge material placement once within the six-year dredging program)

Morro Strand State Beach is designated as Critical Habitat for the western snowy plover and the Morro shoulderband snail. Placement of the temporary pipeline in conjunction with a cutterhead hydraulic dredge, and other activities associated with the surfzone placement of dredged material, would temporarily impact approximately 0.9 acres of beach habitat at Morro Strand State Beach. Temporary pipeline placement in front of the small foredunes (closer to water on sandy beach area) will avoid flora and fauna to the maximum extent practicable. If small amounts of vegetation are incidentally impacted by pipeline placement or ATV/gator use, the vegetation community is expected to recover through natural recruitment of adjacent, undisturbed habitat.

Beach profiles indicate that sufficient space exists for the temporary pipeline and corridor between the surf and the foredunes, so that operations will not affect vegetation in the areas surveyed. It is possible that in other areas the transportation corridor will slightly overlap the dunes, but the Corps will avoid placing the temporary dredge pipeline within vegetated areas to the maximum extent possible. The area of impact will also include seaward extensions of the temporary pipe, into the surfzone. This method of surfzone placement of dredged material operation is less obtrusive than direct beach placement of dredged material, and would not significantly change the profile of the beach, including the size and shape of the dunes.

The profile of the beach would be changed to the extent that the beach is widened by placement of dredged material but large mounds of material are not expected to form. In addition, building up the beach may potentially improve nesting and foraging habitat for the western snowy plover. The long-term benefits of placement of dredged material activities would be to provide important beach nourishment and replenishment to the alternate surfzone Strand State Beach site for dredged material placement.

Potential biological and physical effects of using dredged material for beach nourishment, at either the southern near-shore or northern surfzone placement of dredged material area(s), include coverage and disturbance of benthic fauna, and temporary turbidity increases within the replenishment areas. Intertidal and subtidal invertebrates of open coast sand beaches are subjected to the frequent disturbance of sediment resuspension by waves. Recovery from the effects of sediment placement of dredged material areas would be rapid. A study by Parr and his co-workers (Parr *et al.* 1978) of the effects of beach replenishment on the nearshore sand fauna at Imperial Beach in San Diego County found that effects were short term.

The Corps has concluded that the proposed Morro Bay maintenance dredging activity and the placement of dredged material activities will have a temporary, short term, and minimal adverse impact on habitat or critical habitat (western snowy plover and Morro shoulderband snail). Utilizing the alternative surfzone dredge placement site on Morro Strand State Beach only once within the six-year dredging program is intended to minimize the aforementioned impacts on beach habitat. Furthermore, Morro Strand State Beach will only be utilized outside of the plover's breeding season (September 16 through February 29)

5.2.1 Essential Fish Habitat (EFH)

Temporary impacts from the proposed Morro Bay maintenance dredging may adversely affect EFH including Habitat Areas of Particular Concern (HAPC). Some of the temporary impacts on EFH may include turbidity caused by the collection and transport of dredged materials, and the potential loss of HAPC for fish species.

Turbidity and disturbance associated with the proposed Morro Bay maintenance dredging and placement of dredged material may alter fish distribution and behavior. Fish populations in the local area will be affected in several ways. Temporary displacement of fish covered under the Fishery Management Plans (FMPs) could occur during maintenance dredging in Morro Bay and at the placement of dredged material areas. Turbidity impacts will be localized and temporary. Turbidity will limit visibility for sight-feeding fish, and these species will likely avoid the turbidity plume. Turbidity levels are expected to subside to ambient levels almost immediately after completion of the placement of dredged material operations (LaSalle 1991).

Most fish will avoid the dredge area due to turbidity and noise, resulting only in a temporary loss of habitat. Although some fish may avoid the immediate placement of dredged material area due to the increases in suspended sediments, other fish would probably be attracted to the area to feed on remains of any mollusks, crustaceans, and other organisms removed along with the dredged material. Other species will be attracted to the site to forage on benthic organisms suspended by the dredging. Noise effects may be indirectly beneficial, causing fish to avoid the direct mechanical effects of the dredge. Noise will affect a relatively small area but short, high-intensity noises that can startle responses in fish are not expected. Additionally, there will be no loss of rocky intertidal or rocky subtidal fish habitat from the proposed action. Loss of soft-bottom fish habitat within the Federal navigation channel will be temporary.

Fish surveys were done immediately following a dredging operation in Marina del Rey Harbor in Los Angeles County (Soule *et al.* 1993). An unusually low number of fish species was collected, and the investigators concluded that the dredging had disturbed the fishes. When fishes in the area were sampled again a few months later, the number of fish species had returned to normal. Therefore, impacts of the proposed Morro Bay maintenance dredging operation on the fish populations in Morro Bay would largely be limited to temporary avoidance of the dredging area and localized loss of some food resources. Any appreciable turbidity increase over a wide area may clog the respiratory and feeding apparatuses of fish and filter feeders. This potential effect is not expected with this dredging program. Motile organisms would most probably avoid the dredging area, temporarily relocating to adjacent undisturbed areas. Turbidity may potentially alter fish distribution and behavior by causing fish to dive deeper into the water column or temporally disperse to adjacent locales forcing piscivorous bird species to forage in wider areas of the adjacent program site. However, there is considerable technical evidence to support that turbidity and associated suspended sediment impacts from dredging activities are minimal. For example, a number of researchers compared suspended sediment and turbidity levels of dredge activities to those from natural storms events such as storms and floods, and found that these natural evens far exceed the turbidity levels created by most dredging activities (reviewed in Hartman 1996). Therefore, The Corps has concluded that temporary disturbance to fishes from the proposed Morro Bay maintenance dredging would be a short term impact, and that no significant or long-term impacts to fish foraging or spawning habitat will occur from the proposed action.

The Corps has determined that the proposed Morro Bay maintenance dredging and placement of dredged material activities could affect the California grunion. The California grunion (*Leuresthes tenuis*) rarely occurs in Morro Bay because the principal range of the grunion is between Point Conception in southern California and Punta Abreojos in Baja California, Mexico

(CDFG 2008); Morro Bay and the proposed action are located approximately 100 miles northwest of Point Conception. However, there are small populations both north and south of these points. Occasionally grunion may appear in fair numbers as far north as Morro Bay, California. California grunion may occasionally utilize beaches in the Morro Bay area for spawning. The California grunion spawning season extends from late February or early March to August or early September, varying slightly in length from year to year. Since the spawning (runs) on beaches are part of the California grunion lifecycle, the Morro Strand State Beach could potentially be an important habitat for the grunion.

Placement of the temporary pipeline in conjunction with a cutterhead hydraulic dredge, and other activities associated with the surfzone placement of dredged material, would temporarily impact beach habitat at Morro Strand State Beach. Temporary, short term impacts may infrequently occur on the north site surfzone placement of dredged material area on Morro Strand State Beach during the beginning of the grunion spawning season (late-February to early-March). The impacts from the surfzone placement of dredged material activity could include the premature washing of eggs out to sea by the sand slurry, the burial of eggs with sand too deep to allow successful hatching and subsequent return of fry to the sea during the upcoming high tides, and elevated turbidity levels associated with the maintenance dredging activity. However, the placement of dredged material in the surfzone at Morro Strand State Beach between September 16 and February 29 avoids impacts to nesting plovers. This alternate placement of dredged material between September 16 and February 29 is also outside of the grunion spawning season. Therefore, any potential impacts to the grunion from the alternate, north site, surfzone placement of dredged material at Morro Beach State Park would be less than significant. With the incorporation of the Biological Environmental Commitment B-6, discussed under Section 5.3 of this EA, for placement of dredged material between September 16 and February 29, The Corps has determined and concluded a no adverse effect for the grunion.

The south site, near-shore placement of dredged material area at Morro Bay State Park sand spit (immediately off shore) in contrast, would not be expected to affect the grunion species' reproductive behavior because the grunion are not common in the south site, near shore placement of dredged material area (Miller and Lea 1972).

The Corps has determined that the proposed Morro Bay maintenance dredging activities will have only short term, temporary impacts to the HAPC including canopy kelp, eel grass, estuary, and rocky reef (*e.g.* North and South Breakwaters, groin, and revetment), which are all located adjacent to the proposed action. Canopy kelp and eel grass is present along certain sections of the revetment, the Morro Estuary Natural Preserve is southeast of the proposed action, and the North Breakwater and revetment are northwest of the Morro Bay maintenance dredging while the South breakwater and groin are southeast of the proposed action. The existing fish and habitat at or near these HAPCs in Morro Bay are not expected to be significantly impacted by the proposed action. Temporary, short term impacts to the HAPC from turbidity associated with the proposed action would be localized within the footprint of the proposed dredging area. With the incorporation of the Water Quality Environmental Commitment and the Biological Commitment to avoid environmentally sensitive areas such as salt marsh, canopy kelp, eelgrass, estuary, and rocky reef, the Corps has concluded that the proposed action would have a *de minimus* impact on canopy kelp, eel grass, estuary, or manmade rocky reefs that includes the North and South breakwaters, groin or revetment.

The aforementioned environmental monitoring related to the Corps' Wilmington Harbor Project revealed that, based on fish sampling with seines and trawls, no immediate impacts in fish abundances and diversities among the disturbed, undisturbed, and reference stations were found at any beach (Versar 2004). These results were further supported by the second year study where annual and quarterly seine and trawl sampling exhibited no significant depressions in abundance and diversity one-year after the initial beach construction. When significant difference where observed either an enhancement was indicated or seasonal differences between the subject beach and the reference beach were inconsistent. The schooling nature of a number of dominant species (e.g., bay anchovy) and the highly mobile nature of the fish community constrained the ability to detect impacts and recovery. The fish community's ability to migrate caused a highly variable community in both a temporal and spatial aspect but also indicated that they could move in and out of the beaches impacted by the replenishment activities. Because of the inherent mobility and migratory behavior exhibited by many adult and transient marine species, the primary goal of the gillnet survey was to document the occurrence and relative abundance of large mobile species utilizing the habitat just outside the surfzone. Additionally, as with the gillnet survey, the premise of ichthyoplankton survey was only to document species occurrence and relative abundance of ichthyoplankton adjacent to the surfzone. Large changes in species composition in both the gillnet and ichthyoplankton surveys were documented in the quarterly and yearly data obtained from the reference data. Since large changes in community composition are displayed naturally within the two community types, the changes displayed within the data collected for these two surveys could not be attributable to beach construction impacts. Other researchers have found the same highly variable results when evaluating beach construction impacts on these fish communities (USACE 2001). They concluded that with the high natural variability in communities, only catastrophic events could be detected in the data. No such catastrophic events were displayed during the current study.

Based upon the research study from North Carolina and the data for the local fisheries, and from the Corps field work and site surveys in Morro Bay, the proposed Morro Bay maintenance dredging program would not have a significant adverse impact on EFH, including HAPC.

5.2.2 Birds

Depending on the decibels range over time, noise and activity associated with the dredging could disturb bird populations in the vicinity of the proposed Morro Bay maintenance dredging program area. Disturbance of feeding or roosting birds may cause a temporary dispersal away from the dredging area. Some birds may habituate to the dredging activities and its associated effects (*e.g.* noise, turbidity), while other more responsive birds would be expected to return after the termination of dredging. Furthermore, during dredging activities, there may be some increased foraging opportunities at the fringe of the turbidity plume due to resuspension of benthic invertebrates at the dredging site.

Piscivorous seabirds that rely on visual cues to find their prey may potentially avoid foraging in the immediate area of the dredge turbidity plume generated during the placement of dredged material operation at the south site, near shore, Morro Bay State Park sand spit. However, impacts are expected to be minimal because a relatively small area would be affected by the placement of dredged material activity. Some seabirds species would be attracted to the either the primary, south site, near shore, Morro Bay State Park sand spit (immediately offshore) or the alternate, north site, surfzone, Morro Strand State Beach placement of dredged material, beach replenishment sites, to feed on the benthic organisms dredged from the proposed action (USACE, 2004b).

No direct impacts from the proposed Morro Bay maintenance dredging program would occur to seabird colonies in Morro Bay. Seabirds that nest in the bay are accustomed to the regular noise and activity of vessel traffic and would not be significantly impacted by the noise and activity of dredging.

The proposed maintenance dredging operations are not expected to impact the state endangered American peregrine falcon. The falcons have been nesting on Morro Rock since at least the late 1960s, and have proven tolerant of the noise and activities associated with typical bay operations, including numerous previous maintenance dredging activities. It is likely that they would be tolerant of any short-term increase in the activity and noise associated with dredging activities, since dredging was with undertaken in the area numerous times since 1949, when the peregrine falcons were present and successfully brooded. Helicopters will not be used to lay or remove temporary pipe on the alternate, north site, surfzone, Morro Strand State Beach placement of dredged material area. As a result, the proposed program is not expected to have a significant impact upon the peregrine falcon.

Therefore, The Corps has concluded that birds, overall, that regularly inhabit Morro Bay would have a temporary, short and insignificant impact by the proposed action.

5.2.3 Mammals

Seals, sea lions, and other sea mammal species are expected to avoid the dredging program area and, thus, avoid direct impacts. Some species would be attracted to the primary, south site, near shore, Morro Bay State Park sand spit (immediately off shore) placement of dredged material and the alternate, north site, surfzone, Morro Strand State Beach placement of dredged material area, to feed on the benthic organisms dredged from the bay. Sea lions, for example, have historically been observed actively foraging in the vicinity of the south site, near shore during placement of dredged material operations (USACE 2001).

If a haul-out area is in close vicinity to the dredge activity, which could be the scenario with the south site, near shore, Morro Bay State Park sand spit (immediately off shore) placement of dredged material area, the harbor seals and sea lions may temporarily withdraw from immediate area. Any harbor seals and sea lions that happen to be inside the bay, or encountered in route to the placement of dredged material areas may be startled by this activity of dredging and avoid the area around the dredge. Therefore, some harbor seals and sea lions may not be able to forage the immediate vicinity of the dredge. Sea lions may also avoid the area during the dredging activities, but the area would again be conducive to use as soon as dredging stops. Yet there are also instances when in the water, sea lions are known to be curious to different types of activities and thus become unperturbed. Therefore, The Corps has concluded that impacts to the sea otter, harbor seal and sea lion from the proposed Morro Bay maintenance dredging program would be no significant impact.

Cetaceans and other pinnipeds including the gray whale, the common dolphin-long beaked, harbor porpoise, and the northern elephant seal, will not be impacted by the proposed action for these cetaceans and pinniped move through the outer portion of Morro Bay and Estero Bay waters, away from mechanized environment in Morro Bay, and migrate north to Point Piedras Blancas, which is northwest of San Simeon, and outside of the proposed Morro Bay maintenance dredging program area. Therefore, The Corps has concluded that no impact from the proposed Morro Bay maintenance dredging program would occur on the above mentioned cetaceans and northern elephant seal.

5.2.4 Threatened, Endangered (T&E)

A "No Effect" determination is the appropriate conclusion when the action agency determines its proposed action would not affect a listed species or designated critical habitat. Accordingly, the action agency may proceed with the action as proposed, provided no incidental take is anticipated (USFWS 1998). A letter of concurrence from the USFWS is not required when the proposed action would have no affect on listed species or critical habitat, but is required when the proposed action is designated as "May Effect, but Not Likely to Adversely Effect."

Determination of "May Effect, but Not Likely to Adversely Effect" for the western snowy plover (*Charadrius alexandrinus nivosus*) related to Morro Strand State Beach dredge material placement (once with the six-year dredging program):

The Corps has determined that the proposed action, including the placement of a temporary dredge pipeline on Morro Strand State Beach (revised critical habitat unit CA-29) for surfzone placement of dredged material, would not adversely affect the western snowy plover or its designated critical habitat for following reasons:

1. The proposed dredging program will only involve critical habitat during the dredging of the back channel that requires temporary pipeline placement on Morro Strand State Beach (revised critical habitat CA-29 for the western snowy plover). This activity will occur once within the six-year dredging program within a 30-60 day duration during the non-breeding season between September 16 and February 29. These temporal parameters have been established to minimize potential impacts to plovers.
2. To minimize impacts to the western snowy plovers that nest on the Morro Strand State Beach, placement of dredged material area in the alternate, north site, surfzone area will not occur during the plover's nesting season (March 1 through September 15). Any dredge operations that occurs during this time period will utilize the primary, south site, near shore placement of dredged material area nearshore of Morro Bay State Park sand spit (immediately offshore).
3. The temporary pipeline would be placed seaward of small, vegetated "pioneer" dunes to avoid prime western snowy plover nesting habitat. Foraging habitat (wet sand) impacts would be minimized by establishing a 200 foot by 200 foot (0.9 acre) cordoned off area around the pipeline's outlet. This area would be deconstructed and moved down the

beach so that no more than 0.9 acres is impacted at any one time. Placement of the temporary pipeline on the Morro Strand State Beach would not adversely affect the western snowy plover foraging efficiency because most snowy plovers forage on the wet sand. Running and flying short distances is typical of the species and the temporary pipeline would not impede these behaviors. Therefore, the temporary pipeline would not present a significant barrier for foraging plovers in the vicinity of the temporary pipeline on Morro Strand State Beach.

4. The Corps has used the Morro Strand State Beach surfzone placement area on several occasions in the past. Plovers roost and nest on Morro Strand State Beach, north of the bay. Preferred nesting areas on this beach are primarily on the foredunes south of Azure Street to Highway 41. Successful nesting in this area occurred following The Corps' 1993, 1995, and 1997 maintenance dredging and beach placement of dredged material. Approximately 47 nests were established in 1996 and 50 in 1997, which resulted in no negative impact on the western snowy plover. Several years of beach placement of dredged material activities using a hydraulic dredge in conjunction with a temporary pipeline in Ventura have also not resulted in noticeable impacts to roosting or foraging plovers (USACE 2004b). In fact, monitoring revealed that the plovers tend to congregate near the placement of dredged material site, perhaps due to limited public access at that point. The 1992-1993 beach placement of dredged material operation in Ventura was followed by the first plover nesting in that area in years. This is not conclusive evidence of a beneficial result, but does indicate that winter placement of dredged material (September 16 to February 29) does not have a negative impact on nesting success.
5. Construction equipment use for pipeline placement/inspection will be limited to -4 feet MLLW to +200 feet MLLW to avoid vegetation that plovers use for nesting.
6. Maintenance and patrol of the temporary pipeline by the dredging crew would occur daily with an ATV/Gator (with trailer). However, the driving of an ATV/Gator by the dredging crew on the Morro Strand State sandy Beach would not constitute any greater effect than is already occurring from the City of Morro Bay department staff, San Luis Obispo County Parks lifeguards' daily patrols, camping activities, pedestrian foot traffic, and domestic dogs. Personnel will not use the ATV/Gator for recreational use. ATV/Gator speed limit is 5 mph, and personnel will use the same ingress/egress tract daily. All beach and dune vegetation will be avoided to the maximum extent practicable.
7. Avoidance and minimization measures for western snowy plovers include biological monitoring by a Corps biologist that is qualified/experienced/knowledgeable about western snowy plovers during all activities that require beach access.
8. A Corps biologist would conduct a daily brief relaying all minimization and avoidance measures for all personnel when beach access is required.

With the inclusion of these Environmental Commitments, the proposed program may affect but not adversely affect the western snowy plover.

Determination of "No Effect" for the western snowy plover (*Charadrius alexandrinus nivosus*) related to annual maintenance dredging of the entrance, transition, and main channels with dredge placement located in the nearshore area of Morro Bay State Park's sand spit:

Western snowy plover critical habitat unit CA-30, located on Morro Bay State Park's sand spit, will not be impacted by the annual placement of dredged material in the nearshore area of the sand spit (-20 feet MLLW to -40 feet MLLW). No personnel or vehicles will access the sand spit, and no dredged material will be placed directly on the beach of the sand spit. Therefore, the Corps concludes that the dredged material placement nearshore of Morro Bay State Park's sand spit will not affect western snowy plover or its critical habitat unit CA-30.

Determination of "No Effect" for the Southern sea otter (*Enhydra lutris nereis*)

The Corps has developed Environmental Commitments (Section 5.3) that establish avoidance and minimization measures to avoid the take of southern sea otters, avoid impacting their kelp bed habitat, and avoid harassment of sea otters within Morro Bay. These avoidance and minimization measures have been developed in coordination with the USFWS (L. Carswell, personal communication, March 18, 2014 & March 20, 2014). The established avoidance measures include not dredging or dredge material placement in sea otter habitats such as kelp beds, eelgrass beds, and hard-bottom reefs. Vessels will avoid disturbing sensitive vegetation by vertically dropping/retrieving anchors, not dragging anchors, and using crown buoys for anchoring. The pipeline landing (occurs once within the six-year dredging program for a 30-60 day duration) will be located approximately 1300 feet northeast of the kelp bed habitat near the intersection of Coleman Drive and Embarcadero. The pipeline will be placed over the eelgrass area in a north-south azimuth to minimize potential impacts from the pipeline and its float shading the eelgrass. Vessels will be limited to a 100 foot wide area around the pipeline during installation/removal/inspection of the pipeline. Vessels will avoid using propellers within the eelgrass bed.

All Corps vessels will minimize interference with sea otters by reducing vessel speeds to 3 to 5 knots if sea otters are visually observed in the vessel's vicinity, and maintaining a distance of 50 yards from all sea otters (avoidance). Vessel's will also avoid sea otters by revisiting work areas if sea otters are located therein, and vessel's will not be used to encourage sea otters to move.

With the application of these minimization and avoidance measures, the proposed program will not affect southern sea otters.

Determination of "No Effect" for the Steelhead trout (*Oncorhynchus mykiss*)

The proposed Morro Bay maintenance dredging program could potentially affect steelhead if turbidity and/or reduced levels of dissolved oxygen (DO) occurred over a wide area, or if individuals were entrained in the dredge. Turbidity and disturbance associated with the proposed Morro Bay maintenance dredging and placement of dredged material could also potentially affect fish distribution and behavior. Dredging will disperse benthic fish resting or feeding in the immediate dredge area. In some cases, fish may be cut by the cutter head mechanism or sucked into the dredge. The proposed action, however, is not expected to adversely affect steelhead. Turbidity impacts from the proposed action will be localized and temporary. Turbidity will limit visibility for steelhead, and the steelhead will likely avoid the turbidity plume. Turbidity levels are expected to subside to ambient levels almost immediately after completion of the proposed Morro Bay maintenance dredging operation including placement of dredged material operations

(LaSalle, 1991). Most fish including steelhead will avoid the dredge area due to turbidity and noise, resulting only in a temporary loss of habitat. From previous dredging operations, turbidity plume that may form is expected to extend less than 90 m (300 feet), with significant (potentially lethal) levels of suspended sediment occurring only immediately adjacent to the dredge (USACE 2001). Significant decreases in DO would also be limited to the immediate work area. The Morro Bay is 230 m (765 feet) wide at its narrowest point (between the north and south breakwaters); steelhead, therefore, would easily be able to avoid areas of turbidity or reduced oxygen generated from the proposed dredging activity. Finally, steelhead are not expected to feed or idle within the entrance or navigation channels, due to the high-energy wave environment and limited food availability compared to the open ocean and the Morro Estuary Natural Preserve. Entrainment within the dredge, therefore, is highly unlikely. Therefore, The Corps has concluded that the proposed action is not expected to affect the steelhead, and consultation under Section 7 of the ESA is not required.

An Environmental Commitment discussed in Section 5.3 will be put in place to further ensure that potential impacts to the steelhead do not occur at the alternate, north site, surfzone area on Morro Strand State Beach. To ensure that the steelhead's access to/from the mouth of Morro Creek and to/from the Pacific Ocean is not obstructed, the creek's flow would be maintained by either elevating or burying the pipeline where it transects the creek's mouth.

Determination of "No Effect" for the Morro shoulderband snail (*Helminthoglypta walkeriana*)

As discussed above in Section 5.1.4, the Morro shoulderband snail exists in three critical habitat units (Federal Register 2001) in San Luis Obispo County. None of these critical habitats will be accessed by Corps personnel during the annual dredging and dredge material placement nearshore (-20 feet MLLW to -40 feet MLLW) of the Morro Bay State Park sand spit.

The Morro Spit and West Pecho Unit 1 critical habitat for the Morro shoulderband snail is on land, which is in the vicinity of but not adjacent to, the proposed Morro Bay maintenance dredging and the primary, south site, nearshore placement of dredged material area at Morro Bay State Park sand spit (immediately offshore), dredging activities that occur in the open water. Unit 1 critical habitat is approximately 1.5 miles southwest of the alternate, north site, surfzone Morro Strand State Beach placement of dredged material area. The proposed Morro Bay maintenance dredging program with the primary, south site, nearshore placement of dredged material at Morro Bay State Park sand spit (immediately offshore) will not affect the Morro shoulderband snail or its Unit 1 critical habitat because the dredging will occur within the open waters of the bay and because placement of dredged material will occur in the near shore, where the placement of dredged material will be dispersed within the open waters of the Pacific Ocean verses beach placement of dredged material. The proposed Morro Bay maintenance dredging program with the alternate, north site, surfzone placement of dredged material at Morro Strand State Beach will also not affect the Morro shoulderband snail or its Unit 1 critical habitat because the dredging will occur within the open waters of the bay and because the alternate, north site, surfzone placement of dredged material is not adjacent to or in the vicinity of the Unit 1 critical habitat in Morro Spit and West Pecho. Therefore, The Corps has concluded that the proposed action will not have an effect on the Morro shoulderband snail or its Unit 1 critical habitat.

The South Los Osos Unit 2 critical habitat for the Morro shoulderband snail is on land, and is approximately 5.5 miles south of the proposed Morro Bay maintenance dredging and the primary, south site, nearshore placement of dredged material area, and is approximately 7 miles south of the alternate, north site, surfzone placement of dredged material area. The proposed Morro Bay maintenance dredging program with the primary, south site, nearshore placement of dredged material or with the alternate, north site, surfzone placement of dredged material will not affect the Morro shoulderband snail or its Unit 2 critical habitat because the proposed action is also not adjacent to or in the vicinity of Unit 2 critical habitat in South Los Osos. Therefore, The Corps has concluded that the proposed action will not have an effect on the Morro shoulderband snail or its Unit 2 critical habitat.

The Northeast Los Osos Unit 3 critical habitat for the Morro shoulderband snail is on land, and is approximately 3 miles southeast of the proposed Morro Bay maintenance dredging and the primary, south site, nearshore placement of dredged material area, and is approximately 4.5 miles south of the alternate, north site, surfzone placement of dredged material area. Therefore, The Corps has concluded that the proposed action with not have an impact on the Morro shoulderband snail in its Unit 3 critical habitat. The proposed Morro Bay maintenance dredging program with the primary, south site, nearshore placement of dredged material or with the alternate, north site, surfzone placement of dredged material will not affect the Morro shoulderband snail or its Unit 3 critical habitat because the proposed action is also not adjacent to or in the vicinity of Unit 3 critical habitat in Northeast Los Osos. Therefore, The Corps has concluded that the proposed action will not have an effect on the Morro shoulderband snail or its Unit 3 critical habitat.

As previously discussed under Section 5.1.4, the Morro shoulderband snail exists in or close to the foredunes of Morro Strand State Beach (Vince Cicero, California Department of Parks and Recreation, personal communication, May 2008). The alternate, placement of dredged material north site is a surfzone area located along the Morro Strand State Beach, between Sienna Street and north of Morro Creek, north of Morro Bay. Depending on funding requirements, a cutter-head hydraulic (temporary pipeline) dredge normally performs placement of dredged material at this alternate, north site, surfzone, placement of dredged material area. Placement of dredged material operations at this alternate placement of dredged material area would begin at the northern limit (Sienna Street) and work south, as sections of temporary pipe are removed, and end north of Morro Creek (the southern limit). The temporary pipeline would be placed seaward of small, vegetated "pioneer" dunes. Activities would be restricted to a corridor immediately adjacent to the temporary pipeline, from +2.0 m (+7 feet) MLLW to 15 m (50 feet) landward, to avoid or minimize impacts to the dunes and to avoid impacts to the Morro shoulderband snail.

Due to the potential presence of the Morro shoulderband snail near or in the foredunes, pre-construction surveys with State Parks and the dredging crew to define the limits of construction, and/or biological surveys to determine presence/absence of the snail (or potential snail habitat), will be performed. The outlet would consist of a perpendicular section of temporary pipe extending into the surfzone. This extension will be moved as needed, as profile specifications are met, and as work continues southward. The temporary pipeline would extend from the cutterhead hydraulic dredge along the side of Coleman Drive, then westward at Morro Creek, then north to the surfzone, placement of dredged material area footprint. The Corps will provide maximum public access to roads, streets and highways that might be utilized for hauling and construction.

In some cases where placement of dredged material occurs in the surfzone or on the beach, temporary sand access ramps will be required and be placed over the temporary pipeline to allow continued public access to all areas of the beach, except at the immediate point of placement of dredged material. Temporary sand access ramps will be constructed over all road crossings, and at intervals along the beach, to maintain public access. The temporary sand access ramps will be placed at intervals of approximately one quarter of a mile (1,320 feet). Due to beach conditions and sight line visibility, the Corps must seek approval from the City of Morro Bay Department, the San Luis Obispo County Parks Department, and the California Department of Parks and Recreation (CDPR) prior to constructing the temporary sand access ramps. Due to the potential presence of the Morro shoulderband snail near or in the foredunes, pre-construction surveys with State Parks and the dredging crew to define the limits of construction, and/or biological surveys to determine presence/absence of the snail (or potential snail habitat) will be performed. Therefore, The Corps has concluded that the proposed action will have no affect on the Morro shoulderband snail in the foredunes of Morro Strand State Beach, or elsewhere.

5.3 Environmental Commitments

Biological Commitments

B-1: Specific measures will be taken to minimize and avoid impacts to sea otters by all vessels and personnel, which include:

- Vessels will reduce speed to 3 to 5 knots if sea otter(s) are visually observed in the vicinity of the vessel (minimization).
- Vessels will maintain a minimum distance of 50 yards from any sea otter (avoidance).
- Vessels will NOT be used to encourage sea otters to move (avoidance).
- If a sea otter(s) are in the intended survey or dredging path, then that location will be revisited at later time when no otters are present, or the survey/dredge location may need to be moved to avoid sea otters (avoidance).
- A Corps biologist that is qualified/knowledgeable/experienced with sea otters will annually brief all construction personnel on minimization and avoidance measures prior to the commencement of annual dredging activities.

B-2: Eelgrass and kelp bed avoidance within Morro Bay:

- No dredging or dredge material placement will occur directly in sensitive habitats such as established eelgrass beds, hard-bottom reefs, or the kelp beds (avoidance).
- Vessels will drop/retrieve anchors vertically, utilize crown buoys for anchoring, won't drag anchors, and will avoid visible kelp bed canopy and eelgrass beds to the maximum extent practicable (minimization).
- Avoid dredging and placement of dredged material within the area containing the Target Rock kelp bed and eelgrass, which are identified from a May 2013 survey in Figure 5.1.1-2 of this EA.
    - The Corps will contact the U.S. Fish and Wildlife Service's Ventura office 30

days before dredging in the vicinity of the Target Rock kelp bed to determine the precise areas to be avoided.
    - The Corps will conduct pre and post dredge eelgrass surveys to avoid this essential fish habitat (EFH).
- Pipeline landing placement at the intersection of Coleman Drive and Embarcadero:
    - The temporary pipeline will be placed over the eelgrass area in a north-south azimuth to minimize potential impacts from the pipeline and its float shading the eelgrass.
    - Vessels will be limited to a 100 foot wide area around the pipeline during installation/removal/inspection of the pipeline.
    - Vessels will avoid using propellers within the eelgrass bed.

B-3: To ensure that the steelhead's access to/from the mouth of Morro Creek and to/from the Pacific Ocean is not obstructed, the creek's flow would be maintained by either elevating or burying the pipeline where it transects the creek's mouth. During pipeline construction and maintenance, a D8 dozer and various light construction equipment will avoid beach vegetation and animal life. A qualified/knowledgeable/experienced Corps biologist will be present to avoid beach vegetation and animals.

B-4: To avoid impacts to beach dune and native vegetation, the temporary pipeline will be placed in un-vegetated areas. The specific pipeline placement will be determined at a pre-construction meeting with the City of Morro Bay, California State Parks, and a USACE biologist.

B-5: The Corps will not harass any marine mammal, bird, or fish in the project area:
- During pipeline placement on Morro Strand State Beach, the D8 dozer and various light construction equipment will be limited to operation within -4 feet MLLW and +200 feet MLLW.
- Vehicle use on the beach for daily pipeline maintenance is limited to ATV or gator (with trailer if necessary). The vehicle will utilize the same tract daily to minimize impacts to beach habitat. The vehicle will avoid all beach vegetation and wildlife.
- There will be no recreational use of ATVs/Gators by personnel.
- Vehicle speeds on the beach will be limited to 5 mph on the beach.
- Stockpiling of construction materials on shore will be confined to authorized staging areas.
- Helicopters will not be used to place or remove pipe, to avoid possible impacts to peregrine falcons.

B-6: Specific measures will be taken to minimize and avoid impacts to nesting western snowy plovers if surfzone placement of dredged material occurs. These measures include:
- Avoid plover breeding season by restricting surfzone placement of dredged material to the period between September 16 and February 29 (30-60 day duration, occurs once during the six-year dredge program);
- Restriction of pipeline placement, and, vehicle use, and other placement of dredged material activities to a 15.2 m (50 foot) corridor;
- Coordination with resource agencies, including the US Fish and Wildlife Service

(USFWS), will be re-initiated if surfzone placement of dredged material would be required to continue on or beyond March 1;

- Biological monitoring will be performed by a Corps biologist that is qualified/experienced/knowledgeable to monitor western snowy plovers while the Morro Strand State Beach surfzone area is utilized for dredged material placement;
- Personnel will be briefed daily by the Corps' biological monitor regarding avoidance and minimization measures while the Morro Strand State Beach surfzone area is utilized for dredged material placement.

B-7: To avoid impacts to the Morro shoulderband snail near or in the foredunes on Morro Strand State Beach, pre-construction surveys with State Parks and qualified/experienced/knowledgeable Corps biologists prior to dredging to define the limits of construction, and/or biological surveys to determine presence/absence of the snail (or potential snail habitat), will be performed.

B-8: Prior to the annual dredging cycle, The Corps will conduct Surveillance Level surveys for Caulerpa taxifolia, an invasive species of green seaweed native to tropical waters that have been identified in two Southern California locations (Orange County and northern San Diego County). Surveys will be conducted for dredging cycles located within the Navy Channel and/or Morro Channel:

- The Corps will coordinate with the Southern California Caulerpa Action Team (SCCAT) to assess the need for pre-construction surveys. Surveys will be conducted in accordance with the Caulerpa Control Protocol (see http://swr.nmfs.noaa.gov/hcd/caulerpa/ccp.pdf) not earlier than 90 days prior to planned construction and not later than 30 days prior to construction.
- The results of that survey should be transmitted to NMFS and the California Department of Fish and Game at least 15 days prior to initiation of proposed work.
- In the event that Caulerpa is detected within the project area, no work will be conducted until such time as the infestation has been isolated, treated, and the risk of spread is eliminated.
- Results of the survey will be transmitted as described above. In the event that NOAA Fisheries/CDFG determines that the risk of Caulerpa infestation was eliminated or substantially reduced, the requirement for Caulerpa surveys may be rescinded, or the frequency of surveys may be decreased.

B-9: In the unlikely event of a collision with a marine mammal, The Corps must immediately contact the NMFS Emergency Marine Stranding Line at 562-506-4315.

6.0 AIR QUALITY

6.1 Affected Environment

Meteorology/Climate

The climate of Morro Bay in San Luis Obispo County is strongly influenced by the Pacific

Ocean. It can generally be characterized as Mediterranean, which implies that almost all of the rainfall comes during the cooler part of the year (California Department of Forestry and Fire Protection 2003), that can include warm, dry summers and cooler, relatively damp winters. Among the factors that strongly influence local weather are the proximity of the Pacific Ocean on the west side and the arrangement of the mountain ranges, which stand parallel to the coast.

During spring and early summer in Morro Bay, as the onshore breezes pass over the cool water of the ocean, fog and low clouds often form in the marine air layer along the coast. Surface heating in the interior valleys dissipates the marine layer as it moves inland. The Pacific High tends to migrate southwards, allowing northern storms to move across the county.

A monthly climate summary for Morro Bay characterizes the weather conditions as described in Table 4.3.1 below (Weather Channel 2012). The average summer (June-September) high and average summer low temperatures in Morro Bay range from 71°F to 53°F, respectively, with the average warmest month being September. Average winter (December-March) high temperature and average winter low temperature in Morro Bay range from 65°F to 45°F, with the average coolest month being January. The average annual precipitation is approximately 17.61 inches with approximately 77 percent of the annual total average precipitation occurring between December and March. Summers (June-September) are typically drier months with these 4 months averaging less than a quarter (0.25) of an inch of precipitation per month. Little precipitation occurs during summer because a high-pressure cell blocks migrating storm systems over the eastern Pacific.

Table 6.1-1. Morro Bay Monthly Temperatures and Precipitation

Month	**Morro Bay, California**			
	Temperatures			**Average Precipitation (in inches)**
	Average High	**Average Low**	**Mean**	
January	65°F	45°F	55°F	3.57
February	66°F	46°F	56°F	3.90
March	66°F	47°F	57°F	3.29
April	67°F	48°F	58°F	1.10
May	66°F	50°F	58°F	0.43
June	67°F	53°F	60°F	0.08
July	68°F	55°F	62°F	0.01
August	69°F	56°F	63°F	0.05
September	71°F	55°F	63°F	0.24
October	71°F	52°F	62°F	0.82
November	69°F	49°F	59°F	1.40
December	65°F	45°F	55°F	2.72

Source: The Weather Channel 2012.

Airflow around the San Luis Obispo County plays an important role in the movement and dispersion of pollutants. The speed and direction of local winds are controlled by the location and strength of the Pacific High pressure system and other global patterns, by topographical factors, and by circulation patterns resulting from temperature differences between the land and sea. Meteorological conditions, and the composition and concentration of pollutants in the air primarily determine air quality. Typical pollutant sources are vehicles, wood burning fireplaces, construction activities, and windblown dust.

Winds across Morro Bay can be an important meteorological parameter as winds control both the initial rate of dilution and direction of pollutants. The prevailing winds during summer daytime blow from southwest, however winds during summer nighttime reverse direction, coming from the north. During winter time, dominant winds are ocean winds from the southwest. During autumn season, typically hot and dry easterly winds can occur.

Air Quality

Many factors have a potential impact on air quality, including local climate, topography, and land use. The proposed Morro Bay maintenance dredging program is located in the South Central Coast Air Basin (SCCAB). The SCCAB consists of San Luis Obispo County and that portion of Santa Barbara County north of the Santa Ynez Mountain ridgeline. Air quality is determined primarily by meteorological conditions, the type and amount of pollutants emitted, and their subsequent dispersion into the atmosphere. Atmospheric pollutant concentrations in the SCCAB are generally moderate, due to persistent west-to-northwesterly winds that blow off the Pacific Ocean and enhance atmospheric mixing. Although meteorological conditions in the program area are usually conducive to pollutant dispersal, pollution can sometimes accumulate during the fall and winter summer months when the Eastern Pacific High can combine with high pressure over the continent to produce light winds and extended inversion conditions in the region (City of Morro Bay 2004).

Pollutants of potential concerns include ozone (O3), carbon monoxide (CO), nitrogen dioxide (NO2), particulate matter (PM10, PM2.5), sulfur dioxide (SO2), and lead (Pb). These chemicals, called criteria pollutants, are harmful to an individual's health, materials and agriculture. The quality of surface air (air quality) is evaluated by measuring ambient concentrations of pollutants that are known to have harmful effects on public health. The degree of air quality degradation is then compared to ambient air quality standards (AAQS), such as the California and National Ambient Air Quality Standards (CAAQS and NAAQS, respectively). The Federal Clean Air Act (CAA) [42 U.S.C. Sections 7401-7671q] requires the adoption of NAAQS to protect the public health and welfare from the effects of air pollution. The NAAQS have been updated on many occasions to adjust the criteria pollutants. Current standards are set for SO2, CO, NO2, O3, PM10 and PM2.5, and Pb. The State of California Air Resources Board (CARB) has established additional standards that are generally more restrictive than the NAAQS.

The 1990 Federal CAA amendments (CAAA), Section 176 require the U.S. Environmental Protection Agency (USEPA) to put in to effect rules to ensure that federal actions conform to the appropriate State Implementation Plan (SIP). These rules, known as the General Conformity Rule (40 CFR, Sections 51.850-.860 and 40 CFR Sections 93.150-.160), require any federal agency responsible for an action in a no-attainment area, to determine that the action is either exempt from the General Conformity Rule's requirements or to positively determine that the action conform to the applicable SIP. In addition to the roughly 30 presumptive exemptions established and available in the General Conformity Rule, an agency may establish that emission rates would be less than specified emission rate thresholds, known as *de minimis* limits. An action is exempt from a conformity determination if an applicability analysis shows that the total direct and indirect emissions from the program will be below the applicable *de minimis* thresholds and will not be regionally significant, which is defined as representing 10 percent or more of an area's emissions inventory or budget. Air quality in the U.S. is governed by the Federal CAA and is administered by the USEPA.

In addition to being subject to the requirements of the CAA, air quality in California is also governed by more stringent regulations under the California CAA. The United States Environmental Protection Agency (USEPA), the California Air Resources Board (CARB), and the local air district, the San Luis Obispo County Air Pollution Control District (SLOCAPCD), classify an area as attainment, unclassified, or nonattainment, depending on whether or not the monitored ambient air quality data shows compliance, insufficient data available, or non-compliance with the ambient air quality standards, respectively. The NAAQS and CAAQS are provided in Table 6.1-2 below (CARB 2012).

Table 6.1-2. National (Federal) and state of California Ambient Air Quality Standards

Ambient Air Quality Standards

Pollutant	Averaging Time	California Standards [1] Concentration [3]	California Standards [1] Method [4]	National Standards [2] Primary [3,5]	National Standards [2] Secondary [3,6]	National Standards [2] Method [7]
Ozone (O_3)	1 Hour	0.09 ppm (180 $\mu g/m^3$)	Ultraviolet Photometry	—	Same as Primary Standard	Ultraviolet Photometry
	8 Hour	0.070 ppm (137 $\mu g/m^3$)		0.075 ppm (147 $\mu g/m^3$)		
Respirable Particulate Matter (PM10)	24 Hour	50 $\mu g/m^3$	Gravimetric or Beta Attenuation	150 $\mu g/m^3$	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	20 $\mu g/m^3$		—		
Fine Particulate Matter (PM2.5)	24 Hour	—	—	35 $\mu g/m^3$	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	12 $\mu g/m^3$	Gravimetric or Beta Attenuation	15 $\mu g/m^3$		
Carbon Monoxide (CO)	1 Hour	20 ppm (23 mg/m^3)	Non-Dispersive Infrared Photometry (NDIR)	35 ppm (40 mg/m^3)	—	Non-Dispersive Infrared Photometry (NDIR)
	8 Hour	9.0 ppm (10 mg/m^3)		9 ppm (10 mg/m^3)	—	
	8 Hour (Lake Tahoe)	6 ppm (7 mg/m^3)		—	—	
Nitrogen Dioxide (NO_2)[8]	1 Hour	0.18 ppm (339 $\mu g/m^3$)	Gas Phase Chemiluminescence	100 ppb (188 $\mu g/m^3$)	—	Gas Phase Chemiluminescence
	Annual Arithmetic Mean	0.030 ppm (57 µg/m3)		53 ppb (100 $\mu g/m^3$)	Same as Primary Standard	
Sulfur Dioxide (SO_2)[9]	1 Hour	0.25 ppm (655 $\mu g/m^3$)	Ultraviolet Fluorescence	75 ppb (196 $\mu g/m^3$)	—	Ultraviolet Flourescence; Spectrophotometry (Pararosaniline Method)
	3 Hour	—		—	0.5 ppm (1300 $\mu g/m^3$)	
	24 Hour	0.04 ppm (105 $\mu g/m^3$)		0.14 ppm (for certain areas)[9]	—	
	Annual Arithmetic Mean	—		0.030 ppm (for certain areas)[9]	—	
Lead[10,11]	30 Day Average	1.5 $\mu g/m^3$	Atomic Absorption	—	—	High Volume Sampler and Atomic Absorption
	Calendar Quarter	—		1.5 $\mu g/m^3$ (for certain areas)[11]	Same as Primary Standard	
	Rolling 3-Month Average	—		0.15 $\mu g/m^3$		
Visibility Reducing Particles[12]	8 Hour	See footnote 12	Beta Attenuation and Transmittance through Filter Tape	**No National Standards**		
Sulfates	24 Hour	25 $\mu g/m^3$	Ion Chromatography			
Hydrogen Sulfide	1 Hour	0.03 ppm (42 $\mu g/m^3$)	Ultraviolet Fluorescence			
Vinyl Chloride[10]	24 Hour	0.01 ppm (26 $\mu g/m^3$)	Gas Chromatography			

See footnotes on next page …

For more information please call ARB-PIO at (916) 322-2990 **California Air Resources Board (2/7/12)**

Source: CARB 2012.

The San Luis Obispo County Air Pollution Control District (SLOCAPCD) is the agency responsible for attaining NAAQS and CAAQS in the San Luis Obispo area (SLOCAPCD 2012a). The SLOCAPCD is the regional agency charged with being primarily responsible for managing local air quality by regulating emissions from stationary sources of air pollution. In San Luis Obispo County, O3 and PM10 are the pollutants of main concern, since exceedances of state health-based standards for those are experienced in the county during most years. San Luis Obispo County has been designated as a non-attainment area for the state 8-hour O3 standard, and for the state PM10 standard. (SLOCAPCD 2010). Table 6.1-3 below lists the Federal and State attainment status for the SLOCAPCD portion of the SCCAB.

Table 6.1-3. Federal and State Attainment Status for SLOCAPCD portion of the South Central Coast Air Basin

Pollutants	Federal Classification	State Classification
O_3 (1-hour standard)	Classification revoked June 2005	Moderate Nonattainment
O_3 (8-hour standard)	Unclassified/Attainment	Nonattainment
PM_{10}	Unclassified	Nonattainment
$PM_{2.5}$	Unclassified/Attainment	Attainment
CO	Unclassified/Attainment	Attainment
NO_2	Unclassified/Attainment	Attainment
SO_2	Unclassified	Attainment

Source: CARB 2011.

SLOCAPCD has air monitoring stations that are located at different sites around San Luis Obispo County that measure air pollutants of concern. At these monitoring stations, the air pollutants that are measured and sampled are ozone (O3), nitrogen oxides (NOx), sulfur oxides (SOx), and carbon monoxide (CO). Respirable (inhalable) particulate matter 10 microns or less in size, [PM10], and fine particulate matter of 2.5 microns or less in size (PM2.5). It is worth noting that some of the SLOCAPCD monitoring sites, such as in Morro Bay, which is closest to the proposed action, located at 899 Morro Bay Blvd. (ARB Number 40833), only monitor pollutants O3, NOx, and PM10. Existing levels of ambient air quality and historical trends and projections in the proposed Morro Bay maintenance dredging program area are best documented by measurements made by the SLOCAPCD at its Morro Bay air monitoring station located near the proposed program. Data from the SLOCAPCD Morro Bay air monitoring station is summarized in Table 6.1-4.

Table 6.1-4. Air Quality Monitoring Summary for the Morro Bay Air Monitoring Station (Number of Days Standards were Exceeded and the Maximum Levels During Such Violations)

Pollutant/Standard	2010	2011	2012
Ozone ($O3$)			
#Days >State 1-hour Std. of > 0.09 ppm	0	0	0
#Days >State 8-hour Std. of > 0.07 ppm	1	0	0
#Days >Federal 8-hour Std. > 0.075 ppm	0	0	0
Max. 1-hour concentration (ppm)	0.079	0.067	0.059
Max. 8-hour concentration (ppm)	0.075	0.062	0.052
Nitrogen Dioxide ($NO2$)			
#Days >State 1-hour Std. of > 0.18 ppm	0	0	0
Annual Average (ppm)	0.003	0.003	0.003
Max. 1-hour concentration (ppm)	0.035	0.038	0.048
Respirable Particulate Matter (PM_{10})			
# Days Exceed State 24-hr Std.> 50µg/m^3	1[a]	3[b]	2[b]
# Days Exceed Fed.24-hr Std.>150 µg/m^3	0[a]	0[b]	0[b]
Annual Average (µg/m^3)	19.0[a]	20.0[b]	17.0[b]
Max. 1-hour concentration (µg/m^3)	78.0[a]	76.0[b]	64.0[b]

Source: CARB 2012.

Air quality is influenced by a variety of factors and sources in the vicinity of the proposed Morro Bay maintenance dredging program area. Sources of air pollutants affecting the City include a variety of small and large-scale businesses and facilities including dry cleaners, gas stations, the wastewater treatment plant, bay dredging operations and the Morro Bay Power Plant. Other sources outside of the City such as offshore and onshore oil and gas operations within San Luis Obispo County can also influence air quality within the City. The single, largest sources of emissions in the vicinity of Morro Bay include Duke Energy's Morro Bay Power Plant and the Unocal Santa Maria Refinery, which emits large quantities of sulfur dioxide (SO2). This facility performs preliminary refining and sulfur removal from high-sulfur crude oil produced in Central California. There are few other industrial sources of air pollution at Morro Bay. The major additional sources are the automobile, followed by recreational facilities (e.g., boats, campers), and marine vessels. In 1998, the two largest stationary sources of air pollutant emissions affecting the City were the Morro Bay Power Plant and the Chevron Estero Marine Terminal (City of Morro Bay 2004). The Chevron Terminal has since been decommissioned. According to staff at the SLOCAPCD, the power plant is the largest stationary air pollutant emission source within the City. However, within the last few years NO2 emissions from the plant have been dramatically reduced due to the implementation of new air quality rules and boiler modifications made at the plant in order to comply with the new rules. The Morro Bay Power Plant had no emission violations between 1993 and 1998 (City of Morro Bay 2004). Duke Energy is currently proposing a modernization project for the Power Plant that if implemented, will further reduce emissions from the Power Plant. The third most significant source of air pollutants within the City of Morro Bay is Hanson Concrete. No incidents of emission violations occurred from 1993 to 1998 (City of Morro Bay 2004). Emissions from terrestrial vehicular traffic and marine vessel traffic are an additional source of area emissions.

Air quality in the proposed Morro Bay maintenance dredging program area generally meets state and federal standards for compounds monitored with few exceptions. Although standards are exceeded only a few times annually in the coastal zone, they are exceeded more frequently inland, due to pollutants carried by prevailing winds. The major source of air pollution in the program area is the automobile, followed by recreational facilities, and power boats.

The SLOCAPCD Board, at its March 28, 2012, meeting approved APCD staff's proposal for a Greenhouse Gas (GHG) Carbon Dioxide equivalent (CO_2e) Industrial ((Stationary Sources) Threshold value of 10,000 Metric Tons (MT) of CO_2e per year (SLOCAPCD 2012).

6.2 Environmental Consequences

Significance Threshold

Based on the existing conditions discussed above, impacts would be considered significant if the alternative results in:

- Air emissions that would exceed any SLOCAPCD daily construction significance thresholds
- Air emissions that would exceed Federal General Conformity Rule *de minimis* thresholds

Alternative 1 (No Federal Action Alternative)

The No Federal Action Alternative would avoid impacts to air quality since there would be no annual maintenance dredging. There would be no diesel emissions from dredging operation or earth moving equipment or staging activities. Based on the above, there would be no impact air quality.

However, future shoaling impacts could result in frequent emergency dredging operations to relieve shoaled conditions that could result in unsafe navigation. It is likely that any emergency dredging operations would be limited in scope and duration. Emergency dredging operations would likely involve maintenance dredging of the Federal dredge areas that require immediate removal of severely shoaled areas that prevent safe navigation. If emergency dredging is necessary, there would be temporary increases in emissions from the dredge equipment, ancillary vessels, and laborers vehicles. However, the impacts would be short term. It is unlikely that air quality impacts associated with emergency repairs would exceed SLOCAPCD daily construction emissions thresholds or surpass federal General Conformity *de minimis* thresholds.

Proposed Action (Alternative 2)

Most of the emissions associated with the proposed dredging activities will come mainly from the dredge.

- **Morro Bay State Park sand spit** is the primary placement site and would be utilized if either a hopper dredge or clamshell dredge with a dump scow is used for dredging operations. Clamshell dredges would require the use of tug boats to move the dredge as necessary within the dredge footprint. Barges would be used to collect and transport sediment with the assistance of a tug. A crew boat will be used to ferry crew out to the tug and for miscellaneous transport of personnel and equipment on an as-needed basis. Near shore placement of dredged material will not produce dust since both of these operations are aquatic disposal with sediments being placed into the water.

- **Morro Strand State Beach** is the secondary placement site located between Sienna Street and north of Morro Creek, north of the federal channel. Dredged material is placed at the site when a hydraulic cutterhead dredge is utilized. Construction equipment (bulldozer) will be used to lay temporary pipeline and to grade the newly placed sand. Grading operations will be limited to daylight hours to meet City of Morro Bay noise ordinances. A tug boat will be used to move the hydraulic dredge as necessary within the dredge footprint. A crew boat will be used to ferry crew out to the tug and for miscellaneous transport of personnel and equipment on an as-needed basis. Surfzone, beach placement of dredged material would not produce dust since the material is primarily wet sand. There may be some odor from the freshly dredged material placed on the beach, but it will be minor, short-term, and not affect air quality in the area. Construction equipment (bulldozer) will be used to lay temporary pipeline and to grade the newly placed sand. Grading operations will be limited to daylight hours to meet City of Morro Bay noise ordinances. There may be some odor from the freshly dredged material placed on the beach, but it will be minor, short-term, and not permanently affect air quality in the area.

Emissions, including fugitive dust emissions, were estimated using USEPA air pollution emission factors as shown in Appendix E. Emissions results were compared to CEQA Air Quality Handbook daily emission thresholds and Federal *de minimus* thresholds.

A comparison of the maximum construction emissions with the Federal *de minimus* threshold construction emissions are shown in Table 6.2-1 below.

Table 6.2-1. Comparison of Federal de minimis thresholds (in Tons/Year) and Proposed Action (Alternative 2) maximum (worst case scenario) estimated emissions (Tons/Year)

Air Pollutant	Federal de minimis thresholds[1] (tons/year)	Proposed Action estimated emissions[2] (tons/year)
Volatile organic compounds (VOC)[3]	10	0.18
Carbon monoxide (CO)	100	0.28
Nitrogen Dioxide (NO2)	10	0.49
Sulfur Dioxide (SO2)	100	0.14
PM 10	70	0.11
PM 2.5	100	0.03

Source 1: 40 CFR 93.153 (USEPA 2010).
Source 2: SLOCACPD, 2012; USEPA; 1985 w/updates through 2013. and Appendix E of this document.
Source 3: Volatile organic compound (VOC) are also referred as Reactive Organic Gases (ROG).

The estimated emissions for the annual dredging program (Alternative 2) are below the yearly Federal *de minimis* thresholds. Therefore, a conformity determination is not required.

Table 6.2-2 below describes the SLOCAPCD threshold of significance for construction projects (SLOCAPCD 2012b).

Table 6.2-2. SLOCAPCD Threshold of Significance for Construction Operations

Pollutant	Threshold[(1)]		
	Daily	Quarterly Tier 1	Quarterly Tier 2
ROG + NO_x (combined)	137 lbs	2.5 tons	6.3 tons
Diesel Particulate Matter (DPM)	7 lbs	0.13 tons	0.32 tons
Fugitive Particulate Matter (PM_{10}), Dust[(2)]		2.5 tons	
Greenhouse Gases (CO_2, CH_4, N20, HFC, CFC, F6S)	Amortized and Combined with Operational Emissions (See Below)		

1. Daily and quarterly emission thresholds are based on the California Health & Safety Code and the CARB Carl Moyer Guidelines.
2. Any project with a grading area greater than 4.0 acres of worked area can exceed the 2.5 ton PM_{10} quarterly threshold.

Source: SLOCAPCD 2012.

A comparison of the maximum (worst case scenario) lbs/day and lbs/quarter Proposed Action (Alternative 2) construction emissions with the SLOCAPCD significance threshold construction emissions (lbs/day; tons/quarter) are shown in Table 6.2-3 below.

Table 6.2-3. Comparison of SLOCAPCD thresholds and Proposed Action (Alternative 2) maximum (worst case scenario) estimated emissions

Air Pollutant	SLOCAPCD construction significance thresholds[1,2] (lbs/day)	SLOCAPCD Quarterly Tier 1 - significance thresholds[1,2] (tons/quarter)	SLOCAPCD Quarterly Tier 2 – significance thresholds [1,2] (tons/quarter)	Proposed Action estimated emissions[1,2] (lbs/day) (tons/quarter)
ROG + NO2	137	2.5	6.3	44.41 lbs/day; 0.67 tons/qrt.
Diesel Particulate Matter (DPM)	7	0.13	0.32	4.7 lbs/day; .07 tons/qrt.
Fugitive Particulate Matter (PM10), Dust	NA	2.5[3]	NA	0.11 tons/qrt.
Greenhouse Gases (CO2, CH4, N2O, HFC, CFC, F6S)	Amortized and Combined with Operational Emissions	Amortized and Combined with Operational Emissions	Amortized and Combined with Operational Emissions	0.2 Metric Tons/Yr

Source 1: SLOCAPCD 2012a.
Source 2: Daily and quarterly emissions thresholds are based on the California Health and Safety Code and the CARB Carl Moyer Guidelines (SLOCAPCD 2012a).
Source 3: Any project with a grading area greater than 4.0 acres of worked area can exceed the 2.5 ton PM10 quarterly threshold (SLOCAPCD 2012a).
NA means "not applicable"

The estimated emissions for the annual dredging program (Alternative 2) are below the SLOCAPCD construction significance thresholds.

Based on the above, the estimated annual emissions associated with the annual dredging program (Alternative 2) are less than the General Conformity Federal de minimis thresholds and less than the estimated SLOCAPCD daily emissions thresholds. Therefore, based on the above, the Proposed Action (Alternative 2) would have less than significant impact on air quality.

6.3 Environmental Commitments

AQ-1: Haul trucks and construction equipment will be properly maintained in order to minimize release of diesel and hydrocarbon effluent into the atmosphere. The Corps will follow all air quality standards, including those regarding emissions, fuel use and fuel consumption. Appropriate measures will be taken to reduce fugitive dust caused by beach operations. Vehicle speed on the beach, for example, will be kept at (15 mph) on all unpaved surfaces to avoid the formation of dust clouds. Water sprayers or other stabilization techniques should be proactively employed to prevent dust from occurring. Other dust minimization measures recommended include: reducing the amount of the disturbed area where possible; spraying dirt stockpile areas daily if needed; and coverings or maintenance of two feet of freeboard (in accordance with CVC Section 23114) for trucks hauling dirt, sand, soil, or other loose material.

AQ-2: Dredging equipment and cranes are subject to permit requirements by the APCD and/or statewide registration through the California Air Resources Board (CARB) portable equipment registration program. The Corps will obtain a permit from the San Luis Obispo County Air Pollution Control District (SLOCAPCD), pay all associated fees, and follow all permit requirements. A list of all equipment to be operated in the project area should be submitted to the APCD. Once permits have been received, the APCD Enforcement group will be notified prior to bringing the dredge equipment on site. For any dredge that is not currently permitted, coordinate with the APCD staff to determine the most appropriate measures to satisfy Best Available Control Technology (BACT) requirements and determine if a health risk assessment (HRA) will be required pursuant to APCD Rule 219.

AQ-3: The Corps will provide the APCD with a list of all construction equipment to be operated in the project area, including that which does not require an air quality permit. The Corps will be responsible for monitoring air quality during operations.

AQ-4: If necessary, the Corps will use Best Available Control Technology (BACT) for all permitted emission sources for which the potential to emit 185 lb./day of ROG or NOx (or 2.5 Tons/Qtr of ROG or NOx) or 2.5 Tons/Qtr of PM10 or more of any criteria pollutant is expected. Therefore, in addition to measures imposed by the APCD through the permitting process the following minimization measures should be incorporated into the project:

AQ-5: Use CARB certified motor vehicle diesel fuel (low sulfur) diesel fuel for all land-based and dredging equipment. Install particulate filters on all off road and portable on-shore equipment. Install particulate filters on the dredge auxiliary engines and the dredge pump engines, or where deemed unsuitable or not cost effective, and use and oxidation catalyst. Suitability is to be determined by an independent California Licensed Mechanical Engineer who will submit for APCD approval a Suitability Report that identifies and explains the particular constraints to using the preferred particulate filter.

AQ-6: Mobile or diesel power equipment used in the existing parking lot adjacent to Morro Rock will limit idling times to 5 minutes or less.

AQ-7: The Corps will be required to obtain all necessary air quality permits and comply with the SLOCAPCD Guidelines. Construction equipment will be properly maintained to reduce emissions. Emissions associated with the proposed dredging activities derive almost exclusively from the dredge's motor drive. Compared to the hundreds of tons of pollutants emitted in the County each day, the limited levels of dredge drive exhaust pollutants are small, but still adverse. Impacts, however, will be temporary and will be further reduced by measures required by The Corps. Such measures may include: (1) retarding injection timing of diesel-powered equipment for nitrogen oxide (NOX) control, and (2) using reformulated diesel fuel to reduce reactive organic compounds (ROC) and SO2.

7.0 NOISE

7.1 Affected Environment

In general, noise is defined as unwanted sound. The effects of noise on people range from annoyance to inconvenience to temporary or permanent hearing loss. Level of annoyance or impact produced by a sound depends on its loudness, duration, time of day, and land use. Sound measurements are usually expressed as decibels (dB) which equally weights all frequencies. However, the human ear is not equally sensitive to sounds at all frequencies. Therefore, the dBA scale which primarily weighs frequencies within the human range of hearing is used to assess the impact of noise on human hearing (USEPA, 1972). A range of noise levels in dBA are shown in Table 7.1-1below.

Table 7.1-1. Range of Noises

Noise level (dBA)	Examples	Human Response
0	recording studio	hearing threshold
20	rustling leaves	
40	conversational speech	quiet
60	freeway at 50 feet	
70	freight train at 100 feet	moderately loud
90	heavy truck at 50 feet	
110	ambulance siren at 100 feet	very loud
120	jet engine at 200 feet	threshold of pain

Source: USEPA 1972.

There are no baseline noise levels available for the dredging area since it is located within an open marine environment. The existing ambient noise level within this environment is associated with wind and surf break as well as noise from passing vessels. Noise levels tend to increase during summer months from heavy recreational activities. Noise levels near the dredge material placement area are associated with traffic noise on PCH-1 and Highway 41.

The City of Morro Bay (1995) does not provide specific ordinances for construction noise. The closest applicable noise ordinance is the city's General Noise Limitation:

> *Any business operation with sustained or intermittent noise levels exceeding 70 dB Ldn (or CNEL) as described by the noise element including, but not limited to, wood or machine milling, air hammers, generators, or prolonged or excessive truck deliveries, will not be allowed within one hundred feet of residential uses,*

hospitals, and other nose sensitive uses unless noise levels are mitigated in compliance with this section.

7.2 Environmental Consequences

Significance Threshold

Based on the existing conditions discussed above, impacts would be considered significant on noise if the alternative results in:

- Noise levels above 70dBA near sensitive receptors from 7:00 a.m.-to-10:00 p.m.

Alternative 1 (No Federal Action Alternative)

With the No Federal Action Alternative, there would be no annual maintenance dredging, earth moving equipment or staging activities. There would be no temporary noise impacts associated with the use of the dredge or earth moving equipment in the dredging program area. The ambient noise level within the program area would continue to be affected by the traffic noise on PCH-1 and Highway 41, and from recreational and commercial vehicles such as boaters on Morro Bay. Therefore, noise levels ranging from 60dB to 70dB may best characterize ambient noise levels under the No Federal Action Alternative.

Alternative 2 (Preferred)

- **Morro Bay State Park sand spit** is the primary placement site and would be utilized if either a hopper dredge or clamshell dredge with a dump scow is used for dredging operations. Operational noise of a hopper dredge at the source ranges from 85 to 108 dBA (Bowes 1990).

- **Morro Strand State Beach** is the secondary placement site located between Sienna Street and north of Morro Creek, north of the federal channel. Dredged material is placed at the site when a hydraulic cutterhead dredge is utilized. Operational noise of a hydraulic dredge at 50 feet from the source ranges from 60 to 80 dBA. Furthermore, up to two dozers would be used to assemble the temporary pipeline on the beach. Operational noise of a dozer at 50 feet from the source is approximately 85 dBA.

The work would entail use of dredge and mechanical earth moving equipment. Noise associated with construction equipment at 50 feet (ft) ranges from 80 dBA to 90 dBA (USEPA, 1972). Furthermore, noise levels are atmospherically attenuated by a factor of 6 dB per doubling of the distance. The dredge placement area (placement of dredged material area in the surf, beach zone in Morro Strand State Beach) is located 2,600 feet west of the residential area off of Siena Street. Potential noise levels at various distances are shown in the Table 7.2-1 below.

Table 7.2-1. Potential Noise Levels At Various Distances

Distance from Construction Activities (ft)	Noise Levels (dBA)
50	80 - 90
100	74 – 84
200	68 – 78
400	66 – 72
800	60 – 66

Source: USEPA 1972.

At a distance of more than 800 feet, the noise level at the residential development located east of Morro Strand State Beach that is approximately ½ mile, would be under 70dBA and may not be distinguishable from ambient noise levels. Noise levels will return to baseline conditions upon completion of construction. Based on the above, the Proposed Action (Alternative 2) would result in less than significant impacts to noise levels.

7.3 Environmental Commitments

N-1: Haul trucks and construction equipment will be properly maintained and scheduled in order to minimize unsafe and nuisance noise effects to sensitive biological resources, residential areas, and the socio-economic environment. Sensitive receptors, such as schools and hospitals, will be avoided whenever possible. Pipeline boosters will not be used between Morro Creek and Morro Bay High School.

8.0 CULTURAL RESOURCES

8.1 Affected Environment

The area of potential effects (APE) was with assessed four times for this project site. A survey for routine maintenance dredging was conducted in 1990, and a survey for the channel deepening feasibility report was done in 1991. The work done for the channel deepening was done over the course of two contracts; (1) the initial survey that identified three anomalies, and (2) a negative assessment of the three anomalies. The fourth study was completed in 1993 for the primary south site, near shore, Morro Bay State Park sand spit and the alternate north site, surfzone, Morro Strand State Beach and placement of dredged material areas that are to be used for the dredged material from routine maintenance dredging. All investigations were negative. There are no National Register of Historic Places listed, or eligible resources present within the APE.

8.2 Environmental Consequences

Significance Threshold

Based on the existing conditions discussed above, impacts would be considered significant on noise if the alternative results in:

- Unmitigatable impacts to cultural resources listed or eligible for listing on the National Register of Historic Places.

Alternative 1 (No Federal Action Alternative)

With the No Federal Action Alternative, there would be no annual maintenance dredging, earth moving equipment or staging activities. There would be no benthic disturbing activities associated with the use of the dredge or substrate disturbing activities associated with the use of earth moving equipment in the project area.

Alternative 2 (Preferred)

There would be benthic disturbing activities associated with the use of the dredge or substrate disturbing activities associated with the use of earth moving equipment in the project area. However, as various cultural resources identification efforts did not locate the presence of cultural resources, the proposed program will not have an effect on historic properties.

8.3 Environmental Commitments

CR-1: In the unlikely event that cultural resources are encountered during dredging, all action in the immediate area of the discovery will cease until the provisions of 36 CFR 800.13, (*Post-review discoveries)* are met.

9.0 VESSEL TRAFFIC AND SAFETY

9.1 Affected Environment

Morro Bay is a heavily used recreational and small commercial waterbody. The City of Morro Bay Department manages 50 city slips and approximately 125 moorings within the Morro Bay harbor (City of Morro Bay 2012a). Of the 125 moorings within the City of Morro Bay, approximately 50 are privately owned.

The harbor is used, on average, by approximately 180 commercial and sport fishing boats, and 350 small recreational boats (USACE 2001). During the fishing season, approximately 200 boats based at other ports land fish at Morro Bay. There are other operations in the bay that provide fishing, boating, and water recreational facilities.

The Morro Bay Marina has 24 moorings, 16 slips, and offers a variety of services for recreational vessels (USACE, 2001). The Morro Bay Yacht Club offers an additional six mooring balls and a 150-foot dock for transient yachts. Additional moorage is available at Morro Bay State Park's small marina.

In 2000 six Morro Bay residents held six federal groundfish permits (NMFS, 2007). There were at least 292 commercial fishing permits registered to Morro Bay residents in 2000, including 286 registered state permits.

The USCG operates Coast Guard State Morro Bay in Morro Bay. The USCG maintains a 27 person National Security Base and Search and Rescue Station at Morro Bay to provide the Coast Guard services for the entire central California Coast, including port safety coverage for the Diablo Canyon Nuclear Power Plant and Vandenberg Air Force Base and search and rescue (City of Morro Bay 2012b).

Morro Bay serves as the only all-weather safe harbor of refuge between Monterey Harbor to the north and Santa Barbara Harbor to the south (World Port Source. 2012). Safe navigation in Morro Bay is maintained by well-marked channels and the presence and activity of various law enforcement agencies (e.g., City of Morro Bay Harbor Patrol; USCG; San Luis Obispo County Sheriff's Office; California Department of Parks and Recreation Lifeguards; etc.).

9.2 Environmental Consequences

Significance Threshold

Based on the existing conditions discussed above, impacts would be considered significant on vessel transportation and safety if the alternative results in:

- A navigational hazard to boat traffic or interfere with any emergency response or evacuation plans.
- Substantially changes vessel traffic or patterns.

Alternative 1 (No Federal Action Alternative)

There would be no maintenance dredging that under the No Federal Action Alternative. Vessel traffic and traffic patterns would remain unchanged since the number of slips and moorings would remain unchanged. However, continued shoaling of the federal channel would compromise navigational safety. Furthermore, the inability of US Coast Guard vessels to transit could compromise emergency response and evacuation plans. It is likely that a limited and localized emergency dredging operation would be undertaken in the event that continued shoaling threatens navigational safety.

Alternative 2 (Preferred)

The proposed program would maintenance dredge the federal channel. Restoring shoaled areas to their design depths would improve navigation safety. To ensure safe transit during dredge construction activity, appropriate coordination would be maintained with the City of Morro Bay and the USCG, and in- and egress lanes would be established and regulated. Information regarding dredging operations would be published in Local Notice to Mariners, warning boat users about times, durations, and locations of construction activities. Construction would not impede access to any channels or entranceways, and would, therefore, not create a substantial reduction in navigation safety or create a navigational hazard to vessel traffic or interfere with local emergency/excavation response plans. Last, the proposed program would not change the number of slips and moorings. As a result, vessel traffic or patterns would remain unaffected. Based on the above, the Proposed Program (Alternative 2) would result in less than significant impacts to vessel traffic and safety.

9.3 Environmental Commitments

VTS-1: The Corps will provide maximum public access to roads, streets and highways that might be utilized for hauling and construction. Dredging and placement of dredged material activities will be coordinated with the U.S. Coast Guard (USGS). The dredge operator will move the dredge equipment for USCG and Harbor Patrol law enforcement and rescue vessels.

10.0 RECREATION

10.1 Affected Environment

Fishing, boating, swimming and surfing, hiking, nature photography, and bird watching are recreational activities in Morro Bay and the harbor.

Morro Bay Harbor is a mix of public and private recreational boating and commercial uses. The coastal waters provide for recreational boating and fishing. The Morro Bay Marina has 24 moorings, 16 slips, and offers a variety of services for recreational vessels. The Morro Bay Yacht Club offers an additional six mooring balls and a 150-foot dock for transient yachts. Additional moorage is available at Morro Bay State Park's small marina.

The Morro Bay harbor complex, known as the Embarcadero, includes a restaurants, resort hotels, parking areas, public boat-launch ramp, sport-fishing center, boat repair yard, marine hardware stores, and adjoining campground, natural history museum, and golf course (National Oceanic and Atmospheric Administration, 2007), located southeast of the dredging area. There are over two dozen inns and hotels along the Embarcadero in Morro Bay.

Morro Bay is an important destination for recreation and tourism and has a high scenic value including the Morro Estuary Natural Preserve (MENP) located on the east side of Morro Bay State Park (Ohrangeer 2012), which is comprised of a confluence of creeks, wetlands, salt marshes, mudflats, sand dunes, and open water that attracts a tremendous variety of wildlife. Morro Bay and the MENP have an abundance of wildlife including a great variety of birds, over 200 species, which are viewed and photographed by both tourists and bird-watchers.

Morro Bay State Park sand spit has secluded beaches, and trails for walking and hiking, mountain biking and equestrian trails (CDPR 2012). Morro Strand State Beach is a beach that is coastal frontage park featuring picnic sites, and a three mile stretch of beach for fishing, windsurfing, jogging and kite flying. Water contact recreation (swimming/wading; surfing) occurs at Morro Strand State Beach located north of Morro Bay in the along the coast, yet there are other beaches south of the Morro Bay for water contact and other recreational activities.

10.2 Environmental Consequences

Significance Threshold

Based on the existing conditions discussed above, impacts to recreation would be considered significant if the alternative results in:

- A permanent loss of existing recreational uses.

Alternative 1 (No Federal Action Alternative)

There would be no maintenance dredging under the No Federal Action Alternative. As a result, there would be no temporary impacts to recreational uses at Morro Bay State Park sand spit and Morro Strand State Beach associated with the placement of beach compatible sand. However, continued shoaling of the federal channel would compromise navigational safety. As a result, recreational boating at Morro Bay would be affected. Non-recreational boating activities would remain unaffected. It is likely that a limited and localized emergency dredging operation would be undertaken in the event that continued shoaling threatens navigational safety. If emergency dredging requires the use of either beach, some recreational activities could be temporarily affected during dredging operations.

Alternative 2 (Preferred)

The proposed program would maintenance dredge the federal channel. Restoring shoaled areas to their design depths would improve navigation safety. The annual maintenance dredging would improve navigation safety for recreational and commercial boating by keeping the approaches and entrance channels open and free of navigational hazards. Dredging activities would be physically separated from the water contact recreational uses. The recreational activities primarily take place along the edges of Morro Bay and typically are outside the Federal navigational channels.

- **Morro Bay State Park sand spit:** Placement of dredged material in the nearshore of Morro Bay State Park sand spit would temporarily affect turbidity at the point of discharge, temporarily rendering the immediate area unsuitable for water contact recreation. Turbidity impacts would be temporary since sand is expected to settle out of the water column quickly. Since the placement of fans is in the nearshore, the program would not interfere with other recreational uses such as walking, hiking, mountain biking and equestrian riding along Morro Bay State Park sand spit. Dredging operation using this placement site would typically take place during a 30 day dredging window between March 1 and September 15.

- **Morro Strand State Beach:** Placement of dredged material in the surfzone at Morro Strand State Beach would require the placement of a temporary pipeline on the beach. The pipeline outlet would be cordoned off from recreational users by a 200x200 foot (0.9 acre) safety cordon. As a result, a 0.9 acre section of the beach would be unavailable for recreational use during construction, but pedestrians would have an approximate 100 foot corridor between beach vegetation and the cordoned-off area to have uninterrupted access to the rest of the beach. Recreational uses would be restored upon completion of construction. The remaining coastal area of Morro Strand State Beach would be open to fishing, windsurfing, jogging, kite flying, surfing and swimming opportunities. Furthermore, temporary impacts to recreation at Morro Strand State Beach are not expected to occur annually since the use of a hydraulic dredge is expected to be infrequent (once-cycle within six-year dredging program). Dredging operations using this placement site would typically take place during a 30 day dredging window between March 1st and September 15th.

Based on the above, the Proposed Program would benefit maintenance recreational boating at Morro Bay. The proposed program will not result in any permanent loss of recreational uses. Based on the above, the Proposed Program (Alternative 2) would result in less than significant impacts to recreation.

10.3 Environmental Commitments

REC-1: The Corps will cordon-off a 200x200 foot area (approximately 0.9 acres) around the pipeline's outlet, and will construct sand access ramps over the pipeline at intervals of approximately one quarter of a mile (1,320 feet) to maintain public safety and allow for continued access to the rest of Morro Strand State Beach by City of Morro Bay department staff, San Luis Obispo County Parks lifeguards daily patrols, and pedestrians.

11.0 AESTHETICS

11.1 Affected Environment

The dominant visual elements within Morro Bay consist of open waters, Morro Rock, and the adjacent coastline including beaches.

11.2 Environmental Consequences

Significance Threshold

Based on the existing conditions discussed above, impacts would be considered significant on aesthetics if the alternative results in:

- A substantial modification of the scenic vista.

Alternative 1 (No Federal Action Alternative)

There would be no maintenance dredging under the No Federal Action Alternative. However, continued shoaling would prevent safe navigation through the bay. Emergency dredging would require removal of shoaled material from the navigation channels. It is likely that emergency dredging would be limited in scope and duration. There could be temporary visual impacts to nearby beaches if dredged material is placed in the within the vicinity.

Alternative 2 (Preferred)

The proposed program would maintenance dredge the Federal channel. In general, dredging entails temporary construction activities. Therefore, the presence of the dredge and supporting vessels within Morro Bay would not permanently affect views of Morro Rock, the open water, or the bay.

Placement of dredged material in the surfzone at Morro Strand State Beach would require the placement of a temporary pipeline on the beach. The pipeline would be cordoned off from recreational users by 50 foot safety corridor. The visual impacts would be temporary since the pipeline would be removed upon completion of construction. Furthermore, temporary impacts to aesthetics at Morro Strand State Beach are not expected to occur annually since the use of a hydraulic dredge is expected to be infrequent. Based on the above, the Proposed Program (Alternative 2) would result in less than significant impacts to aesthetics.

12.0 LAND USE

12.1 Affected Environment

Land uses in the vicinity of the proposed dredging area consist of primarily recreational and commercial land uses. Originally built as a base around World War II, the harbor currently has restaurants, resort hotels, parking areas, public boat-launch ramp, sport-fishing center, boat repair yard, marine hardware stores, campground, natural history museum, and golf course. The nearest residences are located approximately a half-mile away from the dredging area.

12.2 Environmental Consequences

Significance Threshold

Based on the existing conditions discussed above, impacts would be considered significant on land use if the alternative results in:

- Permanent changes incompatible with designated uses.

Alternative 1 (No Federal Action Alternative)

There would be no maintenance dredging under the No Federal Action Alternative. However, continued shoaling would prevent safe navigation through the bay. Emergency dredging would require removal of shoaled material from the navigation channels. It is likely that emergency dredging would be limited in scope and duration. Emergency dredging could require the use of nearby beaches for placement of dredged material. However, placement of beach compatible material would not result in permanent changes in incompatible with designated land uses.

Alternative 2 (Preferred)

The proposed program would maintenance dredge the Federal channel. Dredging operations would be located within the marine environment away from existing land uses. Placement of dredged material in the surfzone at Morro Strand State Beach would require the placement of a temporary pipeline on the beach. The pipeline would be cordoned off from recreational users by 50 foot safety corridor. As a result, a section of the beach would be unavailable for recreational use during construction. Recreational uses would be restored upon completion of construction. Furthermore, temporary impacts to recreation at Morro Strand State Beach are not expected to occur annually since the use of a hydraulic dredge is expected to be infrequent.

12.3 Environmental Commitments

LU-1: The Corps will give an advance notice of at least 72 hours, to Duke Energy Company, (formerly Pacific Gas and Electric), before dredging adjacent to their intake structure.

LU-2: The Corps will coordinate with Duke Energy Company on marine terminal pipeline locations.

LU-3: The Corps will minimize access restrictions to the Harbor during dredging and placement of dredged material operations.

LU-4: The Corps will give an advance notice of at least 2 weeks, to the U.S. Coast Guard (USCG) prior to annual (Federal Fiscal year) maintenance dredging. The Corps will also coordinate with the USCG on the relocation of aids-to-navigation, prior to annual (Federal Fiscal year) dredging and Placement of dredged material activities.

LU-5: The Corps must seek approval from the City of Morro Bay Department, the San Luis Obispo County Parks Department, and the California Department of Parks and Recreation (CDPR) prior to constructing the temporary sand access ramps.

13.0 GROUND TRANSPORTATION

13.1 Affected Environment

Transportation and traffic routes in the vicinity of the program area include the following:

- Coast Highway (PCH) is a four lane highway before entering and going through the City of Morro Bay, and is the key north/south highway serving this portion of San Luis Obispo (State of California Energy Office 2000).

- Main Street, predominately a four lane street through the City of Morro Bay, is a primary artery roadway.

- SR-41 (also known as Atascadero Road) is predominately a two lane highway located east of Morro Strand State Beach.

- Embarcadero Street is a two lane street that provides major access for visitors and local residents to the commercial and marine uses along the harbor.

- Coleman Drive is a two lane street that provides access to Morro Rock, and is considered a secondary artery road.

Annual Average Daily Traffic (AADT) capacities represent the general level of daily traffic that each roadway type can carry. Table 13.1-1 below shows the current (baseline) traffic volumes including the 2010 AADT totals for roadways in the vicinity of the program area (CALTRANS, 2011).

Table 13.1-1. Current Traffic Volumes

Roadway Name	AADT
California State Route (SR) -1 (at N. Morro Bay Exit)	24,500
Main Street	16,000*
SR-41	18,300
Embarcadero Street	4,122*
Coleman Drive	2,061*

Source: CALTRANS, 2011.
Source: *State of California Energy Office, 2000.

13.2 Environmental Consequences

Significance Threshold

Based on the existing conditions discussed above, impacts would be considered significant on traffic if the alternative results in:

- A substantial increase in AADTs of main arteries used to access the site.

Alternative 1 (No Federal Action Alternative)

There would be no maintenance dredging by the Corps under the No Federal Action Alternative. However, continued shoaling would prevent safe navigation through the bay. Emergency dredging would require removal of shoaled material from the navigation channels. It is likely that emergency dredging would be limited in scope and duration. Emergency dredging could require the use of highways and streets above. Any traffic impacts would *de minimis* and short-term and impacts.

Alternative 2 (Preferred)

Under Proposed Program Alternative, potential impacts to traffic would include daily commutes from 18 laborers, and the hauling of construction material to and from the project site (plus 1 bulldozer) for a total of 19 vehicles per day. Thus, a maximum of 18 individuals and 19 vehicles would utilize highways and streets for approximately month long duration of construction. The increases in AADT associated with the alternative are shown in Table 13.2.-1. Furthermore, the Preferred Project Alternative (2) would not require the closure of any roads. Traffic conditions would return to baseline levels upon completion of the proposed program construction. Based on the above, the Proposed Program Alternative would have temporary and less than significant impact on transportation.

Table 13.2-1. Comparison of Baseline AADT to Project Traffic Increases

Roadway Name	AADT	Projected Increase in AADT for Soil Cement	Percent Increase from baseline AADT
SR-1 (at N. Morro Bay Exit)	24,500	19	0.08%
Main Street	16,000*	19	0.12%
SR-41	18,300	19	0.10%
Embarcadero Street	4,122*	19	0.46%
Coleman Drive	2,061*	19	0.91%

Source: CALTRANS 2011.
Source: State of California Energy Office 2000.

14.0 CUMULATIVE IMPACTS

The federal channel allows access from Morro Bay to the Pacific Ocean. Morro Bay is home to a commercial and recreational crafts. A recreational marina within the harbor consists of 50 slips and approximately 125 moorings. Being the only all-weather small craft commercial and recreational harbor between Santa Barbara and Monterey, the harbor also functions as a small craft refuge. Therefore, there is a need to continually maintain navigational safety for commercial and recreational crafts along California's central coast.

Since 1994, the Federal navigational maintenance dredging has occurred annually in the Morro Bay. A total of approximately 6,624,906 cy of material was dredged from 1994 through 2012 during this time period, averaging approximately 574,474 cy per year of sediment removed. For the next six years, the Corps would annually dredge approximately 150,000 cy to 200,000 cy.

In the reasonably foreseeable future, there will be a need for annual dredging because there is a harbor within Morro Bay, and because services need to be provided since there are commercial and recreational uses. Future dredging quantities would likely remain the same as past and current quantities, cited above since the Federal maintenance dredging areas would remain the same.

Impacts to environmental resources during construction such as air quality, substrate, water quality, recreation and biological resources are expected to be temporary, and will not result in significant cumulative impacts.

Air Quality

Morro Bay is in an open marine environment along the central coast of the Pacific Ocean and a relatively undeveloped portion of San Luis Obispo County. Morro Bay area is in attainment for all air criteria pollutants. Emissions associated with the Proposed Action (Alternative 2) are below the Federal *de minimis* threshold, and SLOAPCD quarterly air emission threshold for all air criteria pollutants. Since the Proposed Project would result in temporary construction emissions for approximately one month, there would be no significant cumulative impacts to air quality.

Substrate

Dredging and the discharge of dredged material would not result in significant impacts, individually and cumulatively, to littoral material because the project area is exposed to a high energy, turbulent marine environment. Sand removed from the dredged footprint would be replenished via natural sediment transport. Sand deposited on the beaches and nearshore would be dispersed by high energy waves and currents down-coast.

Water Quality

Impacts to water quality such as turbidity and dissolved oxygen are expected to be temporary and localized. LaSalle (1991) reported that dredging-related turbidity impacts are expected to be limited to within 500 meters (1640 ft.) of the area excavated, with the maximum concentrations generally restricted to the lower elevations of the water column, and decreasing rapidly with distance due to settling and dilution. Field observations of hydraulic dredging activities in southern California indicate that turbidity increases above background levels may be considerably more limited than those reported by LaSalle (1991), and are typically confined to within 70 to 170 meters of the activities (USACE 1994b, 1998). Water quality parameters would return to baseline levels upon completion of the dredging activity.

Biological Resources

Cumulative impacts from the Proposed Program (Alternative 2) on biological resources would not occur to coastal bird (avian) species during its nesting season or to the grunion because the program avoids these environmental windows for these species. Cumulative impacts to other species, such as invertebrates, would be less than significant because impacts would be temporary and localized, and it is anticipated that immediate recolonization would occur for these organisms. The planktonic stage of these organisms' life cycles is expected to contribute greatly to the recolonization of this newly exposed substrate, as would contributions by the migration of juvenile and adult individuals from adjacent undisturbed areas. Field studies of dredged areas have shown that recolonization occurs within 2 weeks to 3 years after dredging stops (McCauley *et al.* 1977; Oliver *et al.* 1977; Rosenberg 1977; USACE 1998). Oliver *et al.* (1977) found that shallow water communities inhabiting naturally highly variable and frequently disrupted physical environments, which include sediment, sand, and/or littoral transport (or substrate), rebounded or recovered more quickly from experimental disturbances than those found in less variable and more benign conditions, and would therefore achieve an equilibrium in the bay and/or on the beach. With the implementation of the Biological Resources Environmental Commitments in Section 5.3 of this EA, the cumulative impact of the Proposed Dredging Program (Alternative 2) on biological resources would be a less than significant impact.

15.0 ENVIRONMENTAL COMMITMENTS

The Corps commits to avoiding or minimizing for adverse effects during the proposed Morro Bay maintenance dredging and placement of dredged material activities. Based on the information available to The Corps Los Angeles District (LAD) and recommendations of Resource Agencies, the following environmental commitments will be implemented to minimize potential environmental impacts. Applicable commitments will be incorporated into the project plans and contract specifications.

Water Quality

WQ-1: Monitoring for bacterial levels within the turbidity plume will be performed on a weekly basis when Morro Channel is dredged due to the presence of oyster beds.

WQ-2: Spills would be cleaned up immediately. Standard dredge specifications include a Spill Prevention Plan, employee training, and the staging of materials on site to clean up accidental spills.

WQ-3: In coordination with the city of Morro Bay, a public notice will be distributed to residents adjacent to Morro Strand State Beach when dredged material is discharged into the surfzone. The public notice will contain information on dredging duration as well as temporary impacts to water quality and odor during discharge operations.

WQ-4: The Corps is responsible for cleaning up all trash and debris, as soon as possible. The Corps' contracting representative will make it clear to the contractor that cleaning up of all trash and debris must be done on a daily basis, and will inspect the nearshore or the surfzone placement of dredged material area(s) whenever he/she visits the site to ensure this is done.

Vessel and Traffic Safety

VTS-1: The Corps will provide maximum public access to roads, streets and highways that might be utilized for hauling and construction. Dredging and placement of dredged material activities will be coordinated with the U.S. Coast Guard (USGS). The dredge operator will move the dredge equipment for USCG and Harbor Patrol law enforcement and rescue vessels.

Noise

N-1: Haul trucks and construction equipment will be properly maintained and scheduled in order to minimize unsafe and nuisance noise effects to sensitive biological resources, residential areas, and the socio-economic environment. Sensitive receptors, such as schools and hospitals, will be avoided whenever possible. Pipeline boosters will not be used between Morro Creek and Morro Bay High School.

Air Quality

AQ-1: Haul trucks and construction equipment will be properly maintained in order to minimize release of diesel and hydrocarbon effluent into the atmosphere. The Corps will follow all air quality standards, including those regarding emissions, fuel use and fuel consumption. Appropriate measures will be taken to reduce fugitive dust caused by beach operations. Vehicle speed on the beach, for example, will be kept at (15 mph) on all unpaved surfaces to avoid the formation of dust clouds. Water sprayers or other stabilization techniques should be proactively employed to prevent dust from occurring. Other dust minimization measures recommended include: reducing the amount of the disturbed area where possible; spraying dirt stockpile areas daily if needed; and coverings or maintenance of two feet of freeboard (in accordance with CVC Section 23114) for trucks hauling dirt, sand, soil, or other loose material.

AQ-2: Dredging equipment and cranes are subject to permit requirements by the APCD and/or statewide registration through the California Air Resources Board (CARB) portable equipment registration program. The Corps will obtain a permit from the San Luis Obispo County Air Pollution Control District (SLOCAPCD), pay all associated fees, and follow all permit requirements. A list of all equipment to be operated in the project area should be submitted to the APCD. Once permits have been received, the APCD Enforcement group will be notified prior to bringing the dredge equipment on site. For any dredge that is not currently permitted, coordinate with the APCD staff to determine the most appropriate measures to satisfy Best Available Control Technology (BACT) requirements and determine if a health risk assessment (HRA) will be required pursuant to APCD Rule 219.

AQ-3: The Corps will provide the APCD with a list of all construction equipment to be operated in the project area, including that which does not require an air quality permit. The Corps will be responsible for monitoring air quality during operations.

AQ-4: If necessary, the Corps will use Best Available Control Technology (BACT) for all permitted emission sources for which the potential to emit 185 lb./day of ROG or NOx (or 2.5 Tons/Qtr of ROG or NOx) or 2.5 Tons/Qtr of PM10 or more of any criteria pollutant is expected. Therefore, in addition to measures imposed by the APCD through the permitting process the following minimization measures should be incorporated into the project:

AQ-5: Use CARB certified motor vehicle diesel fuel (low sulfur) diesel fuel for all land-based and dredging equipment. Install particulate filters on all off road and portable on-shore equipment. Install particulate filters on the dredge auxiliary engines and the dredge pump engines, or where deemed unsuitable, or not cost effective use and oxidation catalyst. Suitability is to be determined by an independent California Licensed Mechanical Engineer who will submit for APCD approval a Suitability Report that identifies and explains the particular constraints to using the preferred particulate filter.

AQ-6: Mobile or diesel power equipment used in the existing parking lot adjacent to Morro Rock will limit idling times to 5 minutes or less.

AQ-7: The Corps will be required to obtain all necessary air quality permits and comply with the SLOCAPCD Guidelines. Construction equipment will be properly maintained to reduce emissions. Emissions associated with the proposed dredging activities derive almost exclusively from the dredge's motor drive. Compared to the hundreds of tons of pollutants emitted in the County each day, the limited levels of dredge drive exhaust pollutants are small, but still adverse. Impacts, however, will be temporary and will be further reduced by measures required by The Corps. Such measures may include: (1) retarding injection timing of diesel-powered equipment for nitrogen oxide (NOX) control, and (2) using reformulated diesel fuel to reduce reactive organic compounds (ROC) and SO2.

Biological Commitments

B-1: Specific measures will be taken to minimize and avoid impacts to sea otters by all vessels and personnel, which include:

- Vessels will reduce speed to 3 to 5 knots if sea otter(s) are visually observed in the vicinity of the vessel (minimization).
- Vessels will maintain a minimum distance of 50 yards from any sea otter (avoidance).
- Vessels will NOT be used to encourage sea otters to move (avoidance).
- If a sea otter(s) are in the intended survey or dredging path, then that location will be revisited at later time when no otters are present, or the survey/dredge location may need to be moved to avoid sea otters (avoidance).
- A Corps biologist that is qualified/knowledgeable/experienced with sea otters will annually brief all construction personnel on minimization and avoidance measures prior to the commencement of annual dredging activities.

B-2: Eelgrass and kelp bed avoidance within Morro Bay:

- No dredging or dredge material placement will occur directly in sensitive habitats such as established eelgrass beds, hard-bottom reefs, or the kelp beds (avoidance).
- Vessels will drop/retrieve anchors vertically, utilize crown buoys for anchoring, won't drag anchors, and will avoid visible kelp bed canopy and eelgrass beds to the maximum extent practicable (minimization).
- Avoid dredging and placement of dredged material within the area containing the Target Rock kelp bed and eelgrass, which are identified from a May 2013 survey in Figure 5.1.1-2 of this EA.
    - The Corps will contact the U.S. Fish and Wildlife Service's Ventura office 30 days before dredging in the vicinity of the Target Rock kelp bed to determine the precise areas to be avoided.
    - The Corps will conduct pre and post dredge eelgrass surveys to avoid this essential fish habitat (EFH).
- Pipeline landing placement at the intersection of Coleman Drive and Embarcadero:
    - The temporary pipeline will be placed over the eelgrass area in a north-south azimuth to minimize potential impacts from the pipeline and its float shading the eelgrass.
    - Vessels will be limited to a 100 foot wide area around the pipeline during installation/removal/inspection of the pipeline.

- Vessels will avoid using propellers within the eelgrass bed.

B-3: To ensure that the steelhead's access to/from the mouth of Morro Creek and to/from the Pacific Ocean is not obstructed, the creek's flow would be maintained by either elevating or burying the pipeline where it transects the creek's mouth. During pipeline construction and maintenance, a D8 dozer and various light construction equipment will avoid beach vegetation and animal life. A qualified/knowledgeable/experienced Corps biologist will be present to avoid beach vegetation and animals.

B-4: To avoid impacts to beach dune and native vegetation, the temporary pipeline will be placed in un-vegetated areas. The specific pipeline placement will be determined at a pre-construction meeting with the City of Morro Bay, California State Parks, and a USACE biologist.

B-5: The Corps will not harass any marine mammal, bird, or fish in the project area:

- During pipeline placement on Morro Strand State Beach, the D8 dozer and various light construction equipment will be limited to operation within -4 feet MLLW and +200 feet MLLW.
- Vehicle use on the beach for daily pipeline maintenance is limited to ATV or gator (with trailer if necessary). The vehicle will utilize the same tract daily to minimize impacts to beach habitat. The vehicle will avoid all beach vegetation and wildlife.
- There will be no recreational use of ATVs/Gators by personnel.
- Vehicle speeds on the beach will be limited to 5 mph on the beach.
- Stockpiling of construction materials on shore will be confined to authorized staging areas.
- Helicopters will not be used to place or remove pipe, to avoid possible impacts to peregrine falcons.

B-6: Specific measures will be taken to minimize and avoid impacts to nesting western snowy plovers if surfzone placement of dredged material occurs. These measures include:

- Avoid plover breeding season by restricting surfzone placement of dredged material to the period between September 16 and February 29 (30-60 day duration, occurs once during the six-year dredge program) ;
- Restriction of pipeline placement, and, vehicle use, and other placement of dredged material activities to a 15.2 m (50 foot) corridor;
- Coordination with resource agencies, including the US Fish and Wildlife Service (USFWS), will be re-initiated if surfzone placement of dredged material would be required to continue on or beyond March 1;
- Biological monitoring will be performed by a Corps biologist that is qualified/experienced/knowledgeable to monitor western snowy plovers while the Morro Strand State Beach surfzone area is utilized for dredged material placement;
- Personnel will be briefed daily by the Corps' biological monitor regarding avoidance and minimization measures while the Morro Strand State Beach surfzone area is utilized for dredged material placement.

B-7: To avoid impacts to the Morro shoulderband snail near or in the foredunes on Morro

Strand State Beach, pre-construction surveys with State Parks and qualified/experienced/knowledgeable Corps biologists prior to dredging to define the limits of construction, and/or biological surveys to determine presence/absence of the snail (or potential snail habitat), will be performed.

B-8: Prior to the annual dredging cycle, The Corps will conduct Surveillance Level surveys for Caulerpa taxifolia, an invasive species of green seaweed native to tropical waters that have been identified in two Southern California locations (Orange County and northern San Diego County). Surveys will be conducted for dredging cycles located within the Navy Channel and/or Morro Channel:

- The Corps will coordinate with the Southern California Caulerpa Action Team (SCCAT) to assess the need for pre-construction surveys. Surveys will be conducted in accordance with the Caulerpa Control Protocol (see http://swr.nmfs.noaa.gov/hcd/caulerpa/ccp.pdf) not earlier than 90 days prior to planned construction and not later than 30 days prior to construction.
- The results of that survey should be transmitted to NMFS and the California Department of Fish and Game at least 15 days prior to initiation of proposed work.
- In the event that Caulerpa is detected within the project area, no work will be conducted until such time as the infestation has been isolated, treated, and the risk of spread is eliminated.
- Results of the survey will be transmitted as described above. In the event that NOAA Fisheries/CDFG determines that the risk of Caulerpa infestation was eliminated or substantially reduced, the requirement for Caulerpa surveys may be rescinded, or the frequency of surveys may be decreased.

B-9: In the unlikely event of a collision with a marine mammal, The Corps must immediately contact the NMFS Emergency Marine Stranding Line at 562-506-4315.

Recreation

REC-1: The Corps will cordon-off a 200x200 foot area (approximately 0.9 acres) around the pipeline's outlet, and will construct sand access ramps over the pipeline at intervals of approximately one quarter of a mile (1,320 feet) to maintain public safety and allow for continued access to the rest of Morro Strand State Beach by City of Morro Bay department staff, San Luis Obispo County Parks lifeguards daily patrols, and pedestrians.

Land (Harbor) Use

LU-1: The Corps will give an advance notice of at least 72 hours, to Duke Energy Company, (formerly Pacific Gas and Electric), before dredging adjacent to their intake structure.

LU-2: The Corps will coordinate with Duke Energy Company on marine terminal pipeline locations.

LU-3: The Corps will minimize access restrictions to the Harbor during dredging and placement of dredged material operations.

LU-4: The Corps will give an advance notice of at least 2 weeks, to the U.S. Coast Guard (USCG) prior to annual (Federal Fiscal year) maintenance dredging. The Corps will also coordinate with the USCG on the relocation of aids-to-navigation, prior to annual (Federal Fiscal year) dredging and Placement of dredged material activities.

LU-5: The Corps must seek approval from the City of Morro Bay Department, the San Luis Obispo County Parks Department, and the California Department of Parks and Recreation (CDPR) prior to constructing the temporary sand access ramps.

Cultural Resources

CR-1: In the unlikely event that cultural resources are encountered during dredging, all action in the immediate area of the discovery will cease until the provisions of 36 CFR 800.13, (Post-review discoveries) are met.

16.0 COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS

- **National Environmental Policy Act of 1969 (NEPA):** This EA has evaluated a reasonable range of alternatives and associated environmental impacts commensurate with the level of available information.

- **Coastal Zone Management Act (CZMA) of 1972:** The dredging program entails annual dredging of an existing federal channel to its design depths. With the incorporation of environmental commitments outlined in this EA, it is likely that the program would qualify for a Negative Determination. The Corps has coordinated with Larry Simon from the California Coastal Commission (CCC), and will request a Negative Determination from the CCC. With the CCC's concurrence, the program would be in compliance with the CZMA.

- **Endangered Species Act of 1973:** The Corps is coordinating with the U.S. Fish and Wildlife Service ("the Service") to finalize minimization and avoidance measures for a "No Effect" determination for the southern sea otter and Morro shoulderband snail. Additionally, the Corps will coordinate with the Service to establish minimization and avoidance measures for the Service's concurrence of a "May Effect, but Not Likely to Adversely Effect" determination for the western snowy plover (related to one-cycle within the six-year dredging program utilizes Morro Strand State Beach for dredged material placement); and a determination of "No Effect" for the western snowy plover during the annual dredging and placement in the nearshore area of Morro Bay State Park's sand spit. The Corps will coordinate with the National Oceanic Atmospheric Administration's (NOAA) National Marine Fishery Service (NMFS) to establish a "No Effect" determination for steelhead trout. The program would be in compliance with the Endangered Species Act pending the aforementioned concurrence with the Service and the NMFS, and application of minimization and avoidance measures identified Section

15.0 (Environmental Commitments) for all dredging program activities (surveys, dredging, and dredge material placement).

- **Magnuson-Stevens Fishery Management and Conservation Act (MSFMCA):** This EA document incorporates the Essential Fish Habitat (EFH) Assessment as required by the MSFMCA. Although dredging would occur within EFH, the Corps has preliminarily determined that this project would not adversely affect EFH.

- **National Historic Preservation Act (NHPA) of 1966:** This project is in compliance with Section 106 of the National Historic Preservation Act (NHPA), 36 CFR 800. The Corps has determined that the dredging program is a Federal undertaking, but there is no potential to cause effects to historic properties per 36 CFR 800.3(a)(1). Therefore, the dredging program is in compliance with the NHPA.

- **Marine Protection, Research, and Sanctuaries Act (MPRSA) of 1972:** Sampling and analysis of material to be dredged was coordinated with the Southern California Dredged Material Management Team. On January 22, 2014, SC-DMMT reviewed the sampling results and deemed suitable the discharge of dredged sediment at Morro Bay State Park sand spit and Morro Strand State Beaches. With the SC-DMMT's concurrence, the dredging program would be in compliance with the MPRSA.

- **Clean Air Act Amendments:** Emissions generated by this project are expected to be temporary and insignificant. The estimated emissions would not exceed San Luis Obispo County Air Pollution Control District quarterly thresholds or General Conformity de minimis thresholds.

17.0 LIST OF PREPARERS

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Appendix A

Kelp and Reef Survey Report (includes Pre-Dredge Eelgrass Survey Report for 2013 dredging)

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June 2, 2013
M&A# 05-024-31

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Draft Kelp and Reef Survey Report
In Support of the FY 2013-2014 Cycle of the Morro Bay Maintenance Dredging Project
W912PL-13-F-0005, Task D

Dear Ms. Campos:

This letter report serves to transmit information regarding the canopy kelp and subtidal reef survey completed for the Fiscal Year (FY) 2013-2014 Cycle of the Morro Bay Harbor Maintenance Dredging Project. It is intended to satisfy deliverable requirements of Task D of Order W912PL-13-F-0005.

PURPOSE AND INTRODUCTION

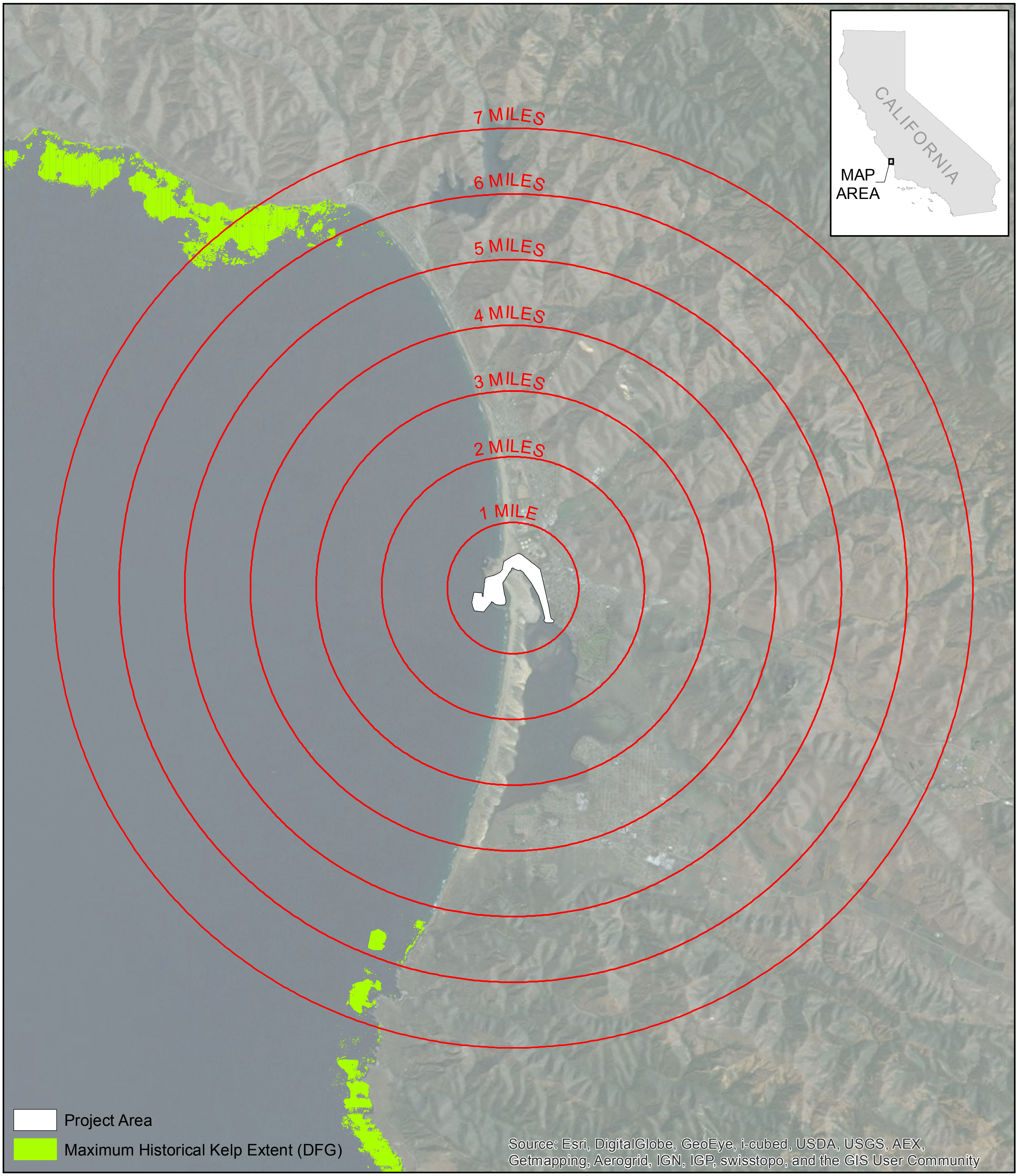
Merkel & Associates Inc. (M&A) was retained by the U.S. Army Corps of Engineers, Los Angeles District (Corps) to conduct a focused pre-dredge canopy kelp and subtidal reefs survey in the Federal navigation channel, which includes the entrance channel, transition area, sand trap, main channel Navy channel, and Morro channel and vicinity (Figure 1). The purpose of this survey was to accurately map and characterize the existing canopy kelp and subtidal reefs within this area.

STUDY AREA LOCATION

The study area is the northern portion of Morro Bay surrounding the Federal navigation channel. The site is located within the larger crescent shaped Estero Bay (Figure 1). Canopy kelp habitat has been mapped on the open coast by the California Department of Fish & Wildlife through regional monitoring efforts. The most proximate mapped canopy kelp beds in the area are found approximately 6 miles from Morro Bay on coastal rocks of the headlands off Cayucos to the north of the study area and off of Montana de Oro State Park south of Los Osos in the vicinity of Spooner's Cove. The sandy shoreline between these two rocky headland areas is typically not conducive to supporting offshore kelp communities.

SURVEY METHODOLOGY

The kelp and subtidal reef investigation was conducted from May 17-19, 2013. Prior to initiation of work, a search of the regional kelp mapping data prepared by the California Department of Fish & Wildlife was investigated for any offshore kelp beds located within the vicinity of Morro Bay. Data were acquired for this effort from the Department's data server FTP site located at ftp://ftp.dfg.ca.gov/R7_MR/BIOLOGICAL/Kelp/. The project scope called for identification of offshore kelp beds within 1 mile of the mouth of Morro Bay; however, since no kelp beds were found



Project Vicinity Map with Regional Kelp Distribution

Morro Bay Federal Channel Kelp and Reef Mapping

Figure 1

Merkel & Associates, Inc.

in the immediate vicinity, the mapped area was expanded radially from the mouth of Morro Bay until canopy kelp beds were identified both north and south of the study area. This kelp canopy is mapped by DFW 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*).

Within the Morro Bay study area, surveys were conducted using multiple methods including sidescan sonar to locate and map hard bottom habitat features and kelp beds, visual observations made during low tide to identify kelp and macroalgal species and to photograph habitats, and a drop camera and a remotely operated vehicle (ROV) to verify characteristics of the reefs and to identify additional algal species.

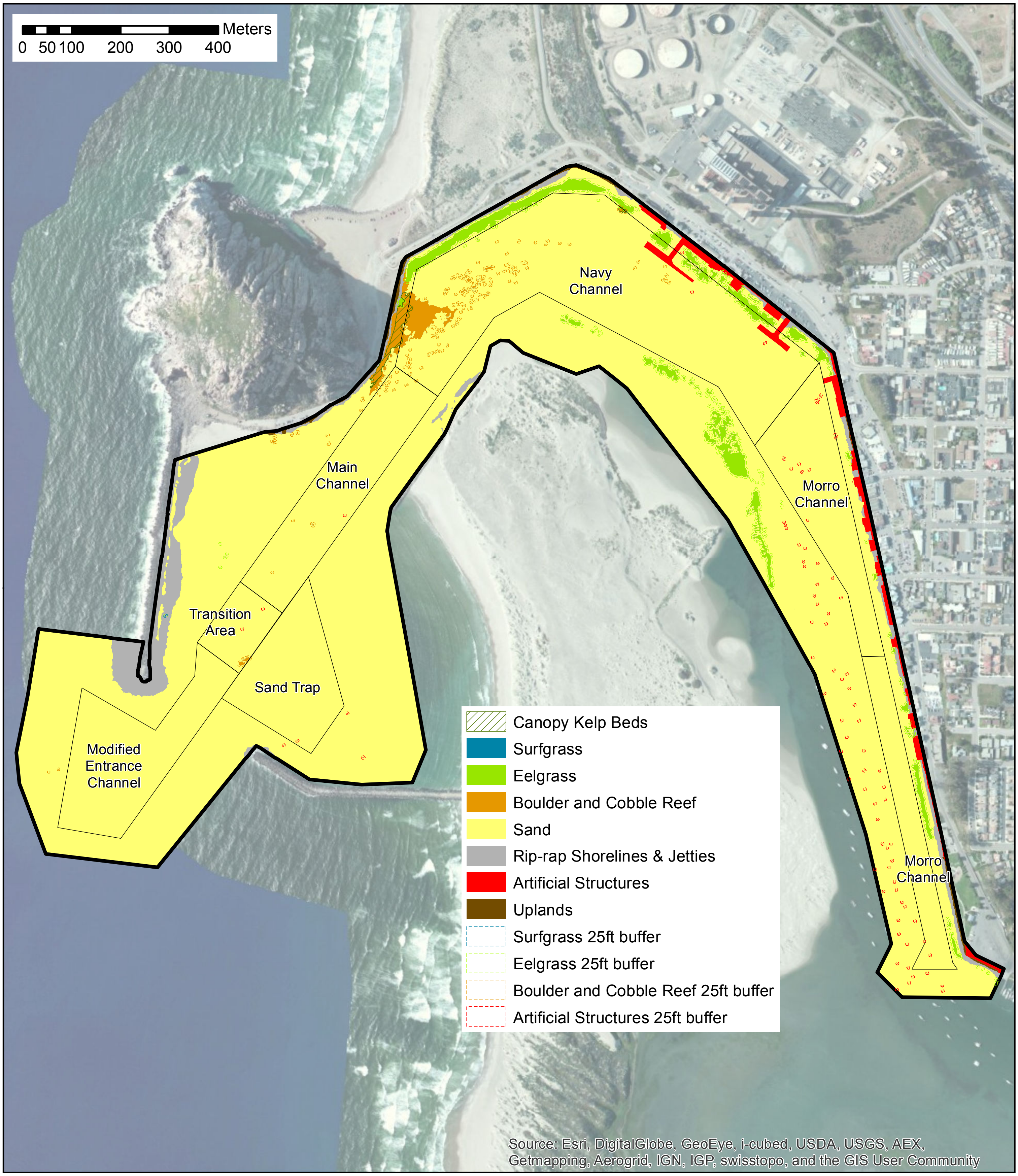
Reef and kelp distribution data were collected using sidescan sonar operating at 468 kHz scanning out 35 meters on both the starboard and port channels for a 70-m wide swath. Interpretation of the data allowed for an assessment of the distribution of the hard bottom habitat as well as kelp, identified by air filled stipes and pnematocysts that have high acoustic reflectivity in the water. The survey was conducted by running parallel transects that were spaced to allow for overlap between adjoining sidescan swaths. Parallel transects were performed until the entirety of the survey area was captured in the survey report. All data were collected in latitude and longitude using the North American Datum of 1983 (NAD 83) and reprojected to NAD 1983 State Plane feet. Data were then plotted on a geo-rectified aerial image of the project site. The same transect surveys completed for the FY 2013-2014 pre-dredging eelgrass surveys were interpreted for mapping reefs and kelp habitats.

Following completion of the survey, sidescan sonar traces were joined together and geographically registered. Features were then digitized as a theme over the aerial image. In order to provide spatial context to the reefs and kelp habitat, other habitat features were mapped on the overall sand bottom mosaic (Figure 2). This included mapping of surfgrass, eelgrass, rip-rap shoreline and jetties, and artificial structures. Because several of the features are extremely small, a 25-foot buffer was placed around habitat features in order to aid in location.

During the field investigation, reef areas were visited during high and low tides, and photographs were taken of the reefs and exposed algal communities. For examination of the subtidal reef environments, a combination of drop camera and ROV tools were used. The drop camera was drifted over the reef environments and allowed to settle occasionally to capture photo images and to document reef conditions. The ROV was maneuvered through the reef areas and was used to inspect bottom conditions on a broad scale. Using the visual and camera observations, an inventory of algae observed was developed. While the inventory is not expected to be exhaustive, it did capture all of the dominant species observed within the intertidal environments and encountered within subtidal camera and ROV surveys.

Sidescan survey control was provided by a dual antennae submeter differential GPS with positioning surveyed to the vessel. The accuracy of the antenna was verified using local benchmarks located on the waterfront in Morro Bay near the head of the bay. The identification and location of the benchmarks is as follows:

05-024-31



N W E S

Marine Habitat Map - May 2013

Morro Bay Federal Channel Kelp and Reef Mapping

Figure 2

Merkel & Associates, Inc.

NOS	**2298 B 1976**	**NOS**	**2298 C 1978**
ELEVATION	3.885 M	ELEVATION	4.698 M
LATITUDE:	35° 22' 15.7728" N	LATITUDE:	35° 22' 16.5634" N
LONGITUDE:	120° 51' 28.3651" W	LONGITUDE:	120° 51' 26.9807" W
HORIZ. DATUM:	NAD 83 epoch 2004.0	HORIZ. DATUM:	NAD 83 epoch 2004.0
VERT. DATUM:	MLLW epoch 83-01	VERT. DATUM:	MLLW epoch 83-01

Prior to initiation of survey on May 17, the survey vessel was trailered into the Harbor District driveway such that the main antenna was positioned directly over survey monument NOS 2298 B, a 3½" brass disk located next to the Harbor District offices and adjacent to the Coast Guard pier. This monument has been a primary benchmark for the Corps' maintenance dredging in the past. On the evening of May 17, access to this benchmark was blocked by vehicles, so the boat was positioned adjacent to NOS 2298 C, a 3½" brass disk located in the center concrete median of Embarcadero Street. Access to this disk was easier than NOS 2298 B, so it was used for verification of GPS at each subsequent survey period on May 18 and the evening of May 19. The results of the GPS verification are summarized in Table 1.

Table 1. GPS to benchmark verification.

DATE	BM STATION	STATION POSITION	DGPS POSITION	BM TO ANTENNA	CALCULATED ERROR
5/17/13_0734	NOS 2298 B	35° 22' 15.7728" N; 120° 51' 28.3651" W	35° 22' 15.784" N; 120° 51' 28.348" W	0.0 ft	3.0 ft
5/17/13_1852	NOS 2298 C	35° 22' 16.5634" N; 120° 51' 26.9807" W	35° 22' 16.568" N; 120° 51' 26.973" W	1.1 ft	0.2 ft
5/18/13_0722	NOS 2298 C	35° 22' 16.5634" N; 120° 51' 26.9807" W	35° 22' 16.582" N; 120° 51' 26.992" W	1.5 ft	2.0 ft
5/18/13_1919	NOS 2298 C	35° 22' 16.5634" N; 120° 51' 26.9807" W	35° 22' 16.568" N; 120° 51' 26.988" W	0.6 ft	0.7 ft
5/19/13_0919	NOS 2298 C	35° 22' 16.5634" N; 120° 51' 26.9807" W	35° 22' 16.570" N; 120° 51' 26.992" W	2.1 ft	0.2 ft
5/19/13_2113	NOS 2298 C	35° 22' 16.5634" N; 120° 51' 26.9807" W	35° 22' 16.566" N; 120° 51' 26.999" W	0.3 ft	2.2 ft

SURVEY RESULTS

At the time of the May 2013 survey, five substrates and three vegetation based habitats were identified and mapped. Vegetated habitats are developed on physical substrates and thus are not exclusive in area. The substrate mapped include: sand bottom, boulder and cobble reef, riprap shorelines and jetties, artificial structures, and uplands (Figure 2). The vegetated habitats mapped include canopy kelp beds, surfgrass, and eelgrass habitats. Hard bottom substrates within Morro Bay support non-canopy macroalgal dominated habitat on surfaces below approximately mean sea level. These features were not mapped as they are easier to characterize by substrate type and elevation ranges.

Algal species observed during the investigations are summarized in Table 2. The individual habitat areas are discussed below.

Sand Bottom

The dominant habitat within northern Morro Bay is soft sand bottom. The nature of the sand varies within the Bay due principally to the energy environment. Within the shallow portions of the north Bay, there are a number of beaches and sand flats that support both littoral sands as well as wind-deposited dune sands. These are very clean granular sands with a low silt content. In addition, the entrance channel, sand trap, transition area, main channel and portions of the Navy channel support highly mobile clean littoral sand on the surface. In more quiescent portions of the northern Morro Bay, sand bottom is characterized as a silty-sand or sandy-silt substrate. These areas exhibit no flow driven surface features, but rather support evidence of biological activities including burrows, fish foraging pits, and invertebrate tracks over the sediment.

Areas of sand bottom, both within partially stabilized channel areas, as well as outside of the higher velocity channels, are generally unvegetated. There are several areas that support intermittent high-density beds of small sand dollars (*Dendraster excentricus*). Where macroalgae is found, it is typically mobile or restricted to eddy areas that serve as algal traps. Macroalgae in these areas is predominantly ephemeral in nature and dominated by such opportunistic species as the green algae *Ulva lobata*, *Enteromorpha* and *Cheatomorpha* species. Also found on the soft bottom environments are red algae including *Gracilaria verrucosa* and *Porphyra perforata*. The brown alga, *Desmarestia ligulata* was also observed as a common algal constituent on the sand bottom. This species was typically associated with shells and small rock rubble found in the sand.

Table 2. Algal species observed during the May 2013 field investigations

Chlorophyta (green algae)	Phaeophyceae (brown algae)	Rhodophyta (red algae)
Ulva lobata	*Cystoseira osmundacea*	*Prionitis lanceolata*
Enteromorpha sp.	*Egregia menziesii*	*Rhodymenia pacifica*
Chaetomorpha sp.	*Macrocystis pyrifera*	*Rhodymenia californica*
	Nereocystis luetkeana	*Endocladia muricata*
	Desmarestia ligulata	*Chondracanthus exasperatus*
	Dictyopteris sp.	*Gigartina californica*
		Gigartina agardhii
		Gigartina tepida
		Cystoseira osmundacea
		Botryoglossum farlowianum
		Bossiella chiloensis
		Calliarthron tuberculosum
		Corallina officinalis
		Lithothamnion spp.
		Lithophyllum spp.
		Erythrophyllum sp.
		Farlowia conferta
		Hildenbrandia occidentalis
		Mazzaella flaccida (Iridaea f.)
		Halosaccion glandiforme
		Laurencia spectabilis
		Odonthalia sp.
		Gracilaria verrucosa
		Sargassum muticum
		Smithora naiadum
		Porphyra perforata

Eelgrass Beds

On the sand bottom, eelgrass beds are the only persistent vegetated habitat. The distribution of eelgrass in the northern portion of Morro Bay has been discussed extensively in other documents. Eelgrass is located within the shallower subtidal and low intertidal portions of Morro Bay within stabilized and partially stabilized soft bottom habitats. In northern Morro Bay, this habitat is found in a small population of a few individual plants located in the outer Morro Bay north of the Federal channel at approximately the dividing line between the transition area and the main channel (Figure 2). Further into the bay, eelgrass is found as fringing beds on both sides of the Navy channel segment of the Federal channel. Eelgrass continues to occur intermittently between docks and other piers along the shoulders and outside of the Federal channel along the Morro Bay Embarcadero, both along the Navy channel and the Morro Channel. To the west, eelgrass occurs on the shallow sand flats extending from intertidal to shallow subtidal depths.

Boulder and Cobble Reef

Boulder and cobble reef is principally located in the vicinity of Morro Rock and suggests a geologic feature extending eastward from Morro Rock into the Bay (Figures 2 and 3). Other small rock piles are found scattered to the south of Morro Rock; however, the various rocks in this portion of the Bay tend to be isolated and less definitively distributed as a natural formation. The reef is characterized by a combination of large and small rock that ranges from a continuous boulder field in the shadow of Morro Rock to widely scattered boulders within the Navy channel. Along the upper edge of the boulder and cobble reef, the natural stone has been supplemented by the placement of additional site-native rock to create a revetted shoreline along Coleman Drive as it extends out to Morro Rock. The transition between natural reef and revetted shoreline in this area is principally a matter of slope with little to no difference in algal community characteristics.

The boulder cobble reefs present within Morro Bay support a mix of algae dominated strongly by *Dictyopteris* sp. but also including *Gigartina tepida* near Target Rock, and *Desmarestia lingulata* as the visual dominants. *Halosaccion glandifome* and the ephemeral *Ulva lobata* were observed. In very shallow areas of the reef, *Chaetomorpha* sp. was observed extending over fucoid algae and limited *Sargassum muticum* was also present. In sand scoured lower portions of the reef, various coralline algal species are present including species of *Corallina*, *Calliarthron*, and *Bossiella*. In highly scoured areas near the sand/boulder interface encrusting coralline algae including *Lithothamniom* and *Lithophyllum* spp. were observed.

The reefs support populations of the corallimorph strawberry anemone *Corynactis californica* as well as scattered cup corals *Balanophyllia elegans*. Also visibly dominant on the rock are various encrusting bryozoa, with multiple stalked tunicates dominated by *Steyla clava* being present. Bat star (*Patiria miniata*), pink sea star (*Pisaster brevispinus*), and giant sea star (*Pisaster giganteus*) were common on the cobble reef.

Canopy kelp beds are found on the boulder and cobble reef as discussed below.

Canopy Kelp Beds

Canopy kelp beds within Morro Bay are found attached to the boulder and cobble reef rock located in the vicinity of Target Rock and near the Morro Bay Power Plant intake structure (Figure 3). The defining feature of this habitat is the presence of sporophyte giant kelp (*Macrocystis pyrifera*) that forms a surface reaching canopy structure. It should be noted that a single decaying stipe of the annual bull kelp (*Nereocystis luetkeana*) was observed floating in the Bay near the Target Rock kelp bed, but no actively growing bull kelp was observed during this survey. Understory algal communities within the kelp bed are described in the boulder cobble reef discussion.

While the kelp beds in Morro Bay are fairly small at the present time, a July 30, 2007 aerial photo available in the Google Earth historic images shows the canopy kelp extended over much of the reef, extending well out into the western portion of the Navy channel. This suggests that the bed may be highly dynamic from year to year and is capable of covering much of the available reef rock. The smaller bed located on rock near the power plant intake has not changed much between years as there is no expansion capacity in adjacent areas due to a lack of available rocky substrate.

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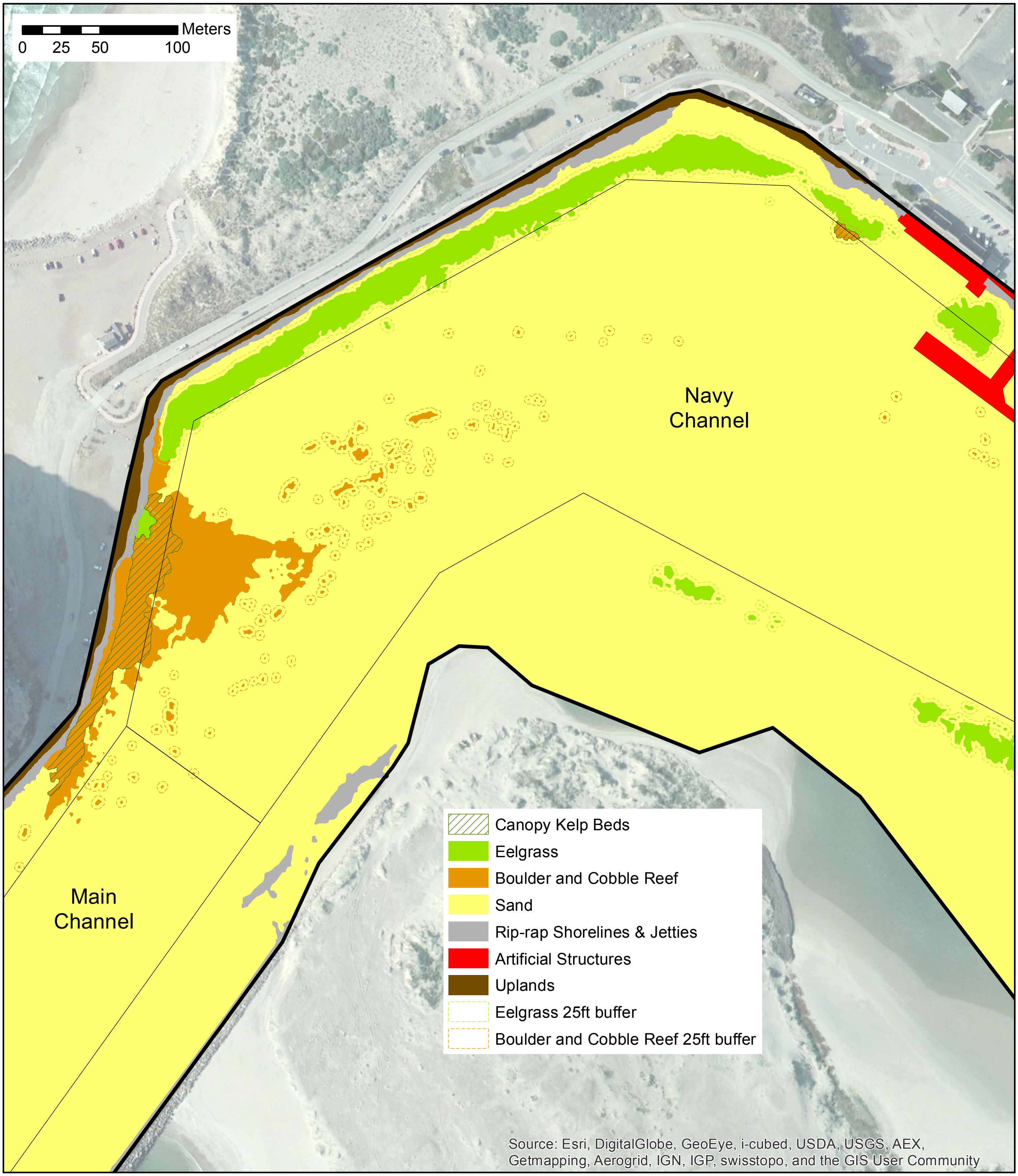

Morro Bay Canopy Kelp Beds - May 2013

Morro Bay Federal Channel Kelp and Reef Mapping

Figure 3

Merkel & Associates, Inc.

The canopy kelp beds provide a unique resource to the resident population of sea otters (*Enhydra lutris nereis*), which uses the algal canopy as moorings to hold position in Morro Bay while resting. The expanding otter population has made this species one of the most visible resources associated with the kelp canopy.

Rip-Rap Shoreline and Jetties

Outer Morro Bay is protected by two large jetty fingers that extend from Morro Rock on the north to the entrance channel and from the dune system on the south to the entrance channel (Figure 2). These jetties provide wave protection to outer Morro Bay and create a wave refraction pattern that maintains a broad crescent beach on the south side of the basin. An additional small rock groin is located at the northern end of the crescent beach, just outside of the study area and southeast of the main channel. A semi-linear strip of revetment stone is present to the southeast, and rip-rap shoreline is located along the shoreline east of the break between the main channel and Navy channel segments of the Federal channel (Figure 2 and 3). This rock alignment suggests the presence of a revetted channel bank now buried in sand from littoral accretion and dune blown sand origins. Further into the bay, rock revetment has been used to armor the peninsula extending out to Morro Rock along the edge of Coleman Drive back to Coleman Beach. Revetment also extends slightly north of the intake structure of the Morro Bay Power Plant. Revetment then extends from the southern edge of intake structures extending southward along the eastern shoreline of the Bay, often overshadowed by artificial structures that overhang or are constructed on the water.

The riprap revetment and more exposed jetty structures support variable communities of encrusting organisms and non-canopy macroalgae. Above elevations of approximately mean sea level, the rock is principally barren with limited mobile invertebrate use by lined shore crabs (*Pachygrapsis crassipes*), rock louse (*Ligia occidentalis*), various amphipods (principally *Orchestoidea* spp.) and kelp flies (*Coelopa frigida*) where kelp wrack has accumulated. Within the outer rock of the jetties, especially in cracks and crevices between rocks, various limpets, including *Collisella* spp., were observed above mean sea level. Below mean sea level, a narrow zone of barnacles (*Balanus glandula, B.* spp. and *Chthamalus fissus* and *C. dalli*) and mussels (*Mytilus edulis*) transitions to agal turfs including *Endocladia muricata* and *Odonthalia* sp. At increasingly lower elevations, turf algae gives way to more foliose species including *Mazzeaella flacida*, *Chondracanthus exasperatus*, *Gigartina* spp. Within low intertidal and subtidal zones on the outer jetties, feather boa kelp *(Egregia menziesii*) is common. Also common, mostly within the shallow subtidal, is lazy edges (*Botryoglossum farlowianum*) and *Cystoseira osmundacea*. The encrusting *Hildenbrandia occidentalis* coats the faces of some of the low intertidal rock where foliose algae are less dense. Coralline algae, including *Corallina*, *Calliarthron*, and *Lithophyllum,* were observed on the lower portions of the exposed jetty where high surf and sand scour occurs on a regular basis.

Away from the higher wave energy on the lower revetment stone along Coleman Drive, the most common subtidal alga is *Dictyopteris*. Also present within this area is *Desmarestia ligulata*. Along the Embarcadero shoreline, the invasive species *Sargassum muticum* is the dominant algal species on the rock. Also present are opportunistic chlorophytes including *Ulva lobata* and *Enteromorpha* sp.

Surfgrass

One single surfgrass (*Phylospadix scouleri*) plant of approximately 0.25 m^2 was identified within the study area on rock revetment located on the inside of the northern jetty (Figure 2). This plant is healthy but lacking other surfgrass in the area, may reflect a recent opportunistic establishment. There is a high expectation that surfgrass will remain on the jetty and would expand with time; however, at present it is not a significant habitat component within the Bay.

Artificial Structures

Artificial substrate consists of manufactured hard materials including concrete, metal, fiberglass, and other objects within the Bay. The majority of these structures are associated with the development along the embarcadero and include piles, docks, and debris on the bay bottom. Other artificial structures include mooring blocks that are found along the A-1 anchorage within the vicinity of the Morro channel, along the main channel where channel marker buoys are located, and within and adjacent to the sand trap near the entrance. For the most part, macroalgal communities are limited on the artificial structures as a result of either depth or the generally vertical surfaces or prior existing encrusting epifaunal growth, dominated by tunicates (*Styela clava* and others), sponges, rock jingles, and mussels. Spirorbid and serpulid worms are common on the concrete mooring blocks at the sand trap but less common on the more interior structures.

Uplands

A few areas of upland habitat were captured in defining the study area. Because the study area was intended to be within the areas of tidal influence, these areas are limited and are generally unvegetated, or vegetated by upland invasive species such as hottentot-fig iceplant (*Carpobrotus edulis*).

DISCUSSION

This project memorandum serves to transmit the pre-dredging focused kelp and reef survey results and is intended to satisfy the pre-construction report deliverable requirements of *Task D. Pre-Dredge Canopy Kelp and Subtidal Reef Survey and Reporting* (W912PL-13-F-0005). The document reveals a typical environment for protected and semiprotected environments. The general paucity of hard substrate restricts the potential for development of expansive kelp beds within northern Morro Bay. The work was conducted as an information document to assist the Corps of Engineers in planning and preparation of environmental documents. No specific action is being evaluated with respect to the data presented and therefore no recommendations are provided.

If you have any questions regarding these data, please do not hesitate to contact me.

Sincerely,

Keith W. Merkel
Principal Consultant

ATTACHMENT 1: PHOTO PAGES

Photo 1. Tip pf the northern jetty displaying typical intertidal zonage of barnacles, mussels transitioning to turf algae. Coralline algae can be seen on the lower rock.

Photo 1b. Partially protected shoreline of north jetty showing turf algae.

Photo 2a. Partially protected shoreline on north jetty showing small surfgrass patch.

Photo 2b. Transition on north jetty from rip-rap to sand beach.

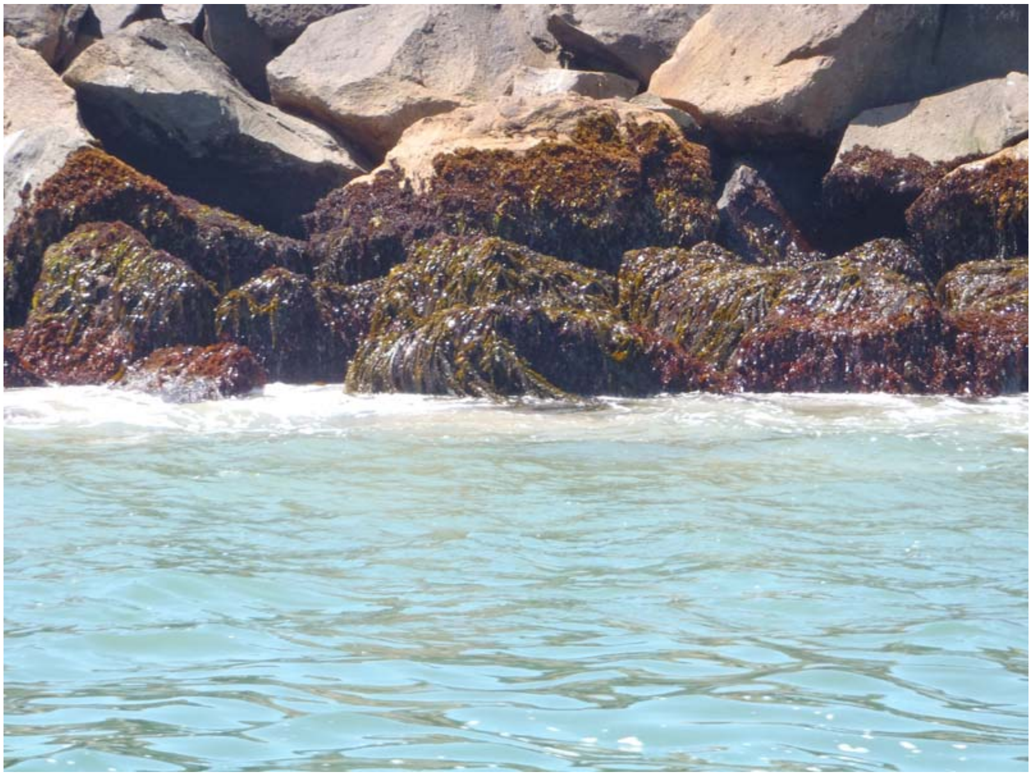

Photo 3a. Exposed algal zone on southern jetty transitioning from turf to foliose algae

Photo 3a. Closeup of diverse algal zone on inner portion of south jetty.

Photo 4a. Target Rock shoreline and small canopy kelp bed.

Photo 4b. Transition area from revetment to beach south of Morro Rock. The westerly end of the small kelp bed is visible in the foreground.

Photo 5a. Very small canopy kelp bed located near the Morro Bay Power Plant on a small rock pile.

Photo 5b. Sea otters in the small kelp bed near the power plant.

Appendix B

Post-Dredge Eelgrass Survey Report for 2013 dredging

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July 18, 2013
M&A# 05-024-31

Ms. Gail Campos
U.S. Army Corps of Engineers
Los Angeles District
CESPL-PD-RL
915 Wilshire Boulevard
Los Angeles, CA 90017

Draft Post-Dredge Eelgrass Survey Report
In Support of the 2013 Morro Bay Maintenance Dredging Project
W912PL-13-F-0005

Dear Ms. Campos:

This letter report serves to transmit information regarding the post-dredge eelgrass (*Zostera marina and Zostera pacifica*) survey completed in support of the 2013 Cycle of the Morro Bay Harbor Maintenance Dredging Project. It is intended to satisfy post-dredge deliverable requirements of Order W912PL-13-F-0005.

PURPOSE AND INTRODUCTION

Merkel & Associates Inc. (M&A) has been retained by the U.S. Army Corps of Engineers, Los Angeles District (Corps) to conduct a post-dredge eelgrass survey of the federal channel and vicinity in support of the 2013 Cycle of the Morro Bay Harbor Maintenance Dredging Project. The planned dredging for 2013 included the entrance channel, transition area, and the main channel (Blake Horita, pers. comm., May, 23, 2013). However, eelgrass surveys were conducted over the entire federal channel area for presence or absence data needed for a six-year environmental assessment (EA) for the Morro Bay Harbor Federal maintenance dredging program (Figure 1). The purpose of this survey was to provide a post-dredge quantitative assessment of the eelgrass communities within the vicinity of the project in conformance with the Southern California Eelgrass Mitigation Policy (SCEMP). The maintenance dredging project began on May 17, 2013 and was completed on June 3, 2013.

PROJECT LOCATION AND SURVEY AREA

The survey area was identical to the May 2013 pre-dredge survey and included the proposed 2013 dredging footprint, as well as areas with the potential to support eelgrass located within proximity of the federal channel (Figure 1).

REFERENCE SITES

While no eelgrass beds were located within or immediately adjacent to proposed dredging areas for the 2013 Cycle, four sites were selected for purposes of assessing bed density and vigor characteristics. These sites were selected along the edges of the Federal Channel and include Coleman Beach Site, Coleman Beach Reference Site, South Navy Channel Site, and the 2010 Corps

Post-dredge Eelgrass Survey - June 2013

Morro Bay Harbor Maintenance Dredging 2013

Figure 1

Merkel & Associates, Inc.

Transplant Reference Site (Figures 2 and 3). All four sites have been used as reference sites for the 2010, 2011, and 2012 dredge cycles. Because there were no eelgrass beds located within or immediately adjacent to the proposed 2013 dredging areas, no areas were considered to occur within the area of potential effect (APE).

SURVEY METHODOLOGY

The pre-dredge eelgrass survey was conducted from May 17-19, 2013, and the post-dredge eelgrass survey was conducted from June 29-30, 2013 (Figures 2 and 3). Both surveys consisted of eelgrass areal coverage and density investigations within the project footprint and surrounding areas.

Survey control was based on dual antennae submeter differential GPS with positioning surveyed to the vessel. The accuracy of the antenna was verified using local benchmarks located on the waterfront in Morro Bay near the head of the bay. The identification and location of the benchmarks is as follows:

NOS	**2298 C 1978**
ELEVATION	4.698 M
LATITUDE:	35° 22' 16.5634" N
LONGITUDE:	120° 51' 26.9807" W
HORIZ. DATUM:	NAD 83 epoch 2004.0
VERT. DATUM:	MLLW epoch 83-01

Prior to initiation and following completion of surveys on June 29 and 30, the survey vessel was trailered to the turn pocket on Embarcadero Street and was positioned such that the main GPS antenna was immediately adjacent to NOS 2298 C, a 3½" brass disk located in the center concrete median of the street. The absolute horizontal distance and bearing from the antenna from the benchmark was determined. The accuracy of the GPS was subsequently determined. The results of the GPS verification are as follows:

DATE	BM STATION	STATION POSITION	DGPS POSITION	BM TO ANTENNA	CALCULATED ERROR
6/29/13_1122	NOS 2298 C	35° 22' 16.5634" N; 120° 51' 26.9807" W	35° 22' 16.568" N; 120° 51' 26.980" W	0.4 ft	0.1 ft
6/29/13_2032	NOS 2298 C	35° 22' 16.5634" N; 120° 51' 26.9807" W	35° 22' 16.566" N; 120° 51' 26.101" W	0.8 ft	0.7 ft
6/30/13_1217	NOS 2298 C	35° 22' 16.5634" N; 120° 51' 26.9807" W	35° 22' 16.588" N; 120° 51' 26.969" W	1.2 ft	1.5 ft
6/30/13_2045	NOS 2298 C	35° 22' 16.5634" N; 120° 51' 26.9807" W	35° 22' 16.577" N; 120° 51' 26.982" W	0.7 ft	0.7 ft

Eelgrass distribution data were collected using sidescan sonar operating at 468 kHz scanning out 35 meters on both the starboard and port channels for a 70-m wide swath. Interpretation of the data allowed for an assessment of the distribution of the eelgrass. The survey was conducted by running parallel transects that were spaced to allow for overlap between adjoining sidescan swaths. Parallel transects were performed until the entirety of the survey area was captured in the survey report. All data were collected in latitude and longitude using the North American Datum of 1983 (NAD 83) and reprojected to NAD 1983 State Plane feet. Data were then plotted on a geo-rectified aerial image of the project site.

Following completion of the surveys, sidescan sonar traces were joined together and geographically registered. Eelgrass was then digitized as a theme over the aerial image to calculate the amount of eelgrass coverage within the broader survey area as well as the federal channel area and to illustrate

Pre-dredge Eelgrass Survey Enlargement - May 2013

Morro Bay Harbor Maintenance Dredging 2013

Figure 2

Merkel & Associates, Inc.

Post-dredge Eelgrass Survey Enlargement - June 2013

Morro Bay Harbor Maintenance Dredging 2013

Figure 3

its distribution in relationship to the dredge areas. All areas were calculated in square meters. For ease of reading, values have also been converted and presented as acreage values that are rounded to the nearest 100th acre. For precise area values, the square meter units are to be used.

A 100-foot mapping buffer was plotted around all eelgrass beds in order to aid in locating small patches of eelgrass on displayed maps and to provide information regarding the proximity of eelgrass to dredging areas (Figure 2). In addition, all eelgrass located within the federal channel was plotted as red polygons, irrespective of the location of eelgrass relative to the 2013 dredging area.

Eelgrass condition data were collected within four sites (Coleman Beach Site, South Navy Channel Site, Coleman Beach Reference Site, and the 2010 Corps Transplant Reference Site) to assess the density and health of eelgrass. Data were collected by randomly placing a 1/16th square meter quadrat within the eelgrass beds. Eelgrass turion (leaf-shoot) densities were calculated using an underwater video camera to count the numbers of turions within the sampled quadrats. Eelgrass bed density was calculated as turions per square meter by multiplying the turion count within each quadrat by 16 and calculating the mean density and standard deviation for the sampling performed. In addition, the overall condition of eelgrass was qualitatively assessed by consideration of epiphytic loading, the stature of eelgrass, extent of plant inflorescence (flowering stalks).

SURVEY RESULTS

At the time of the June 2013 post-dredge survey, a total of 27,438 m^2 (6.78 acres) of eelgrass was mapped within the survey area (Figure 2). This is an increase of just over 7 percent from the time of the May 2013 pre-dredge survey when 25,553 m^2 (6.31 acres) of eelgrass was mapped within the survey area (Figure 2). Of this total, 2,023 m^2 (0.50 acre) of eelgrass was mapped within the Navy Reach of the Federal Channel. This is a decrease of just over 3 percent from the time of the May pre-dredge survey when 2,096 m^2 (0.52 acre) of eelgrass was mapped within the Navy Reach of the Federal Channel. As with the pre-dredge survey, the majority of the eelgrass present in the study area occurs along the Coleman Drive shoreline and at Coleman Beach. A lesser amount of eelgrass occurs along the southern portion of the Navy Channel reach of the project. In the pre-dredge survey, eelgrass west of Morro Rock was observed to occur in four small patches consisting of what is believed to be four individual plants. During the post-dredge survey, eelgrass was represented by six individual patches within this area. The original four patches persist, and two additional patches are now present. All of these are considered to be individual plants.

Reference sites have discrete boundaries used for assessing natural changes in eelgrass cover within potential impact areas relative to natural changes. Two bounded reference sites were established; however, no dredging activities occurred within or immediately adjacent to existing eelgrass beds for the 2013 dredge cycle. The Coleman Beach Reference Site supported 566 m^2 (0.14 acre), up just over 7 percent from the 526 m^2 (0.13 acre) of eelgrass mapped during the pre-dredge survey. The defined reference portion of the 2010 Corps Transplant Reference Site supported 2,509m^2 (0.62 acre) of eelgrass at the time of the post-dredge survey (Figure 2). This is an increase of over 12 percent from the 2,226 m^2 (0.55 acre) of eelgrass mapping during the pre-dredge survey.

At the time of the post-dredge survey, eelgrass turion densities within all areas were down significantly from the time of the pre-dredge survey. Within the Coleman Beach Site, densities had declined from 399.2±169.8 (n=20) to 112.0±72.9 (n=20), and the South Navy Channel Site densities had declined from 293.6±192.9 (n=20) to 123.2±48.4 (n=20). Within the bounded reference sites, eelgrass turion densities for the Coleman Beach Reference Site declined from 251.2±92.7 (n=20) to 103.2±46.9 (n=20), and the densities within the 2010 Army Corps Transplant Reference Site had declined from 352.8±133.5 (n=20) to 209.6±112.2 (n=20). Such declines are not atypical early in the growing season when high-density shoot emergence ultimately thins out to sustainable taller, but less dense, mature leaves.

A red tide was present during the June 2013 post-dredge survey, such that waters in the northern portion of the bay had a brownish appearance that was greater in the northern portions of the bay and reduced at greater distances into the bay.

As was the case in the May 2013 pre-dredge surveys, eelgrass epiphytic loading was high during the post-dredging survey. Plants at Coleman Beach supported approximately 70 percent coverage of chain diatoms. Eelgrass at Coleman Beach was extremely tall, with individual leaves achieving heights of more than 2 meters in the reference site and 1.5 meters within the Coleman APE. At the South Navy Channel APE site, approximately 0.75-meter tall eelgrass supported similar diatom coverage of approximately 70 percent, up from about 30 percent coverage recorded in May. The South Navy Channel had an extremely high occurrence of opportunistic macroalgae dominated by *Ulva* (likely *U. lactuca*) and *Enteromorpha intestinalis*. Sand dollar (*Dendraster excentricus*) beds were found intermittently within the eelgrass bed, with high densities of juvenile sand dollars being present. In the 2010 Corps Eelgrass Transplant Reference Site, there was about 60 percent loading where only 10 percent epiphyte loading existed during the May 2013 survey. Eelgrass at the 2010 Corps Transplant Reference Site was approximately 0.75 meters in height. Sand dollar beds were interspersed in gaps between eelgrass, and there was a heavy occurrence of *Enteromorpha* and *Ulva* macroalgae. All beds exhibited both healthy green shoots and fresh leaves with very little senescent plant material.

DISCUSSION AND CONCLUSIONS

To explore potential impacts, changes in eelgrass distribution between the pre- and post-dredge surveys were determined and mapped (Figure 4). Changes were reported as areas of increased eelgrass, decreased eelgrass, and unchanged eelgrass from May to June 2013.

No eelgrass occurred within close proximity to the 2013 dredging area. However, the closest eelgrass was that occurring to the southwest of Morro Rock. In this area, what is believed to be four individual plants were mapped during the May 2013 pre-dredge survey; and in June 2013 during the post-dredge survey, six individual plants were mapped with all four of the May plants continuing to persist. Overall, within the Federal Channel, eelgrass showed an approximate 3 percent decline in coverage between May and June, while eelgrass outside of the channel showed a 7 percent increase. The increase in eelgrass overall is expected as a result of seasonal expansion. In reviewing the gains and losses of eelgrass between the surveys (Figure 4), it can be seen that most losses and gains that have occurred are along the fringes of the eelgrass beds.

Declines in eelgrass have been most expansive at the edge of the macroalgae and kelp habitat near Target Rock. In this area, a previously mapped patch of eelgrass that was integrated with a small giant kelp bed in May 2013 was not detected in June 2013. Extending easterly from this location, eelgrass has declined in the shallow margin between the riprap and the fringing beds. It is not clear why this reduction has occurred while other shallow areas have seen significant eelgrass expansion between pre-dredging and post-dredging surveys.

Eelgrass Change May 2013 - June 2013

Morro Bay Harbor Maintenance Dredging 2013

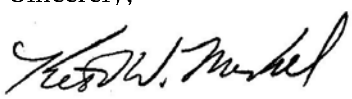
Figure 4

Within the federal channel, the majority of the loss is found at eelgrass beds behind the Coast Guard and municipal "T" Pier. In this area, it is believed that increased vessel traffic and expanded seasonal use by commercial vessels likely accounts for these localized declines.

Overall, the eelgrass within Morro Bay has not shown any changes in extent or density that are attributable to the most recent 2013 maintenance dredging.

This project memorandum serves to transmit the post-dredging eelgrass survey results and is intended to satisfy the post-dredge eelgrass report deliverable requirements of W912PL-13-F-0005.

Sincerely,



Keith W. Merkel
Principal Consultant

REFERENCES

Merkel & Associates. 2013. 24-Month Eelgrass Monitoring Report for the Morro Bay Dredging Project, Morro Bay, California. Prepared for U.S. Army Corps of Engineers Los Angeles District, February 2013.

Merkel & Associates. 2013. Final Pre-Dredge Eelgrass Survey Report in Support of the 2013 Morro Bay Maintenance Dredging Project, Morro Bay, California. Prepared for U.S. Army Corps of Engineers Los Angeles District, July 2013.

National Marine Fisheries Service 1991. Southern California Eelgrass Mitigation Policy. (1991, Revision 11). R.S. Hoffman, ed.

Appendix C

2009-2010 Morro Bay Maintenance Dredging Final Water Quality Report

TRANSMITTAL OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE (Read instructions on the reverse side prior to initiating this form)	DATE 3/25/2010	TRANSMITTAL NO. 01 35 43-1

SECTION I - REQUEST FOR APPROVAL OF THE FOLLOWING ITEMS (This section will be initiated by the contractor)

TO:	FROM:	CONTRACT NO.	CHECK ONE:
Vandenberg Resident Office 1318 New Mexico, Building 9360 Vandenberg Air Force Base, CA 93437	AIS CONSTRUCTION COMPANY 6420 Via Real, Suite 6 Carpinteria, CA 93013	W912PL-09-C-0018 NA	[X] THIS IS A NEW TRANSMITTAL [ ] THIS IS A RESUBMITTAL OF TRANSMITTAL ____

SPECIFICATION SEC. NO. (Cover only one section with each transmittal)	PROJECT TITLE AND LOCATION	CHECK ONE: THIS TRANSMITTAL IS FOR
01 35 43	01-Main Register AIS - Morro Bay Harbor Maint Dredging Vandenberg AFB, CA	[ ] FIO [X] GA [ ] DA [ ] CR

ITEM NO. a.	DESCRIPTION OF ITEM SUBMITTED (Type size, model number/etc.) b.	MFG OR CONTR. CAT., CURVE DRAWING OR BROCHURE NO. (See instruction no. 8) c.	NO. OF COPIES d.	CONTRACT REFERENCE DOCUMENT SPEC. PARA. NO. e.	CONTRACT REFERENCE DOCUMENT DRAWING SHEET NO. f.	FOR CONTRACTOR USE CODE g.	VARIATION (See Instruction No. 6) h.	FOR CE USE CODE i.
4	Draft Final Water Quality Report	TEST REPORTS	3	3.3.3.2		A	N	

REMARKS	I certify that the above submitted items have been reviewed in detail and are correct and in the strict conformance with the contract drawings and specifications except as otherwise stated.
	Alan Watson NAME AND SIGNATURE OF CONTRACTOR

SECTION II - APPROVAL ACTION

ENCLOSURES RETURNED (List by item No.)	NAME, TITLE AND SIGNATURE OF APPROVING AUTHORITY	DATE

ENG FORM 4025, MAR 95 (ER 415-1-10) EDITION OF SEP 93 IS OBSOLETE. SHEET 1 OF 1 (Proponent: CEMP-CE)

A I S Construction Company

General Engineering Contractor
License #759390A
6420 Via Real Suite 6
Carpinteria, CA 93013
Telephone (805) 684-4344 ♦ Fax (805) 566-0109
www.aisconstruction.com

Contractor Quality Control

Submittal Verification Form

Contract: W912PL-09-C-0018

Project: Morro Bay Maintenance Dredging

Submittal: 01 35 43 – 4 Draft Final Water Quality Report

___✓___ Approved

________ Approved with corrections as noted on submittal data and/or attached sheets.

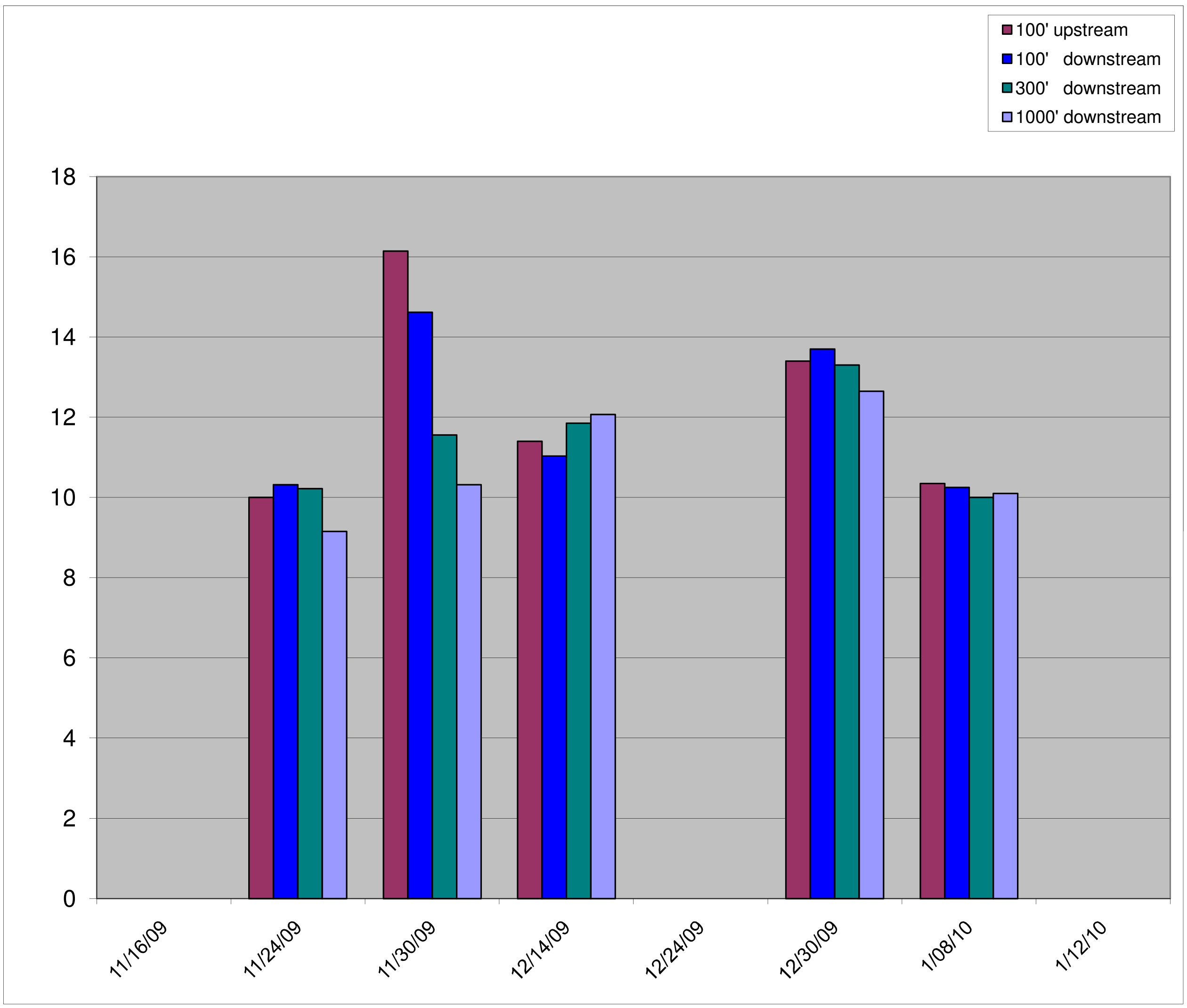
Signature: ____________________

Title: CQC Manager

Date: 3/25/10

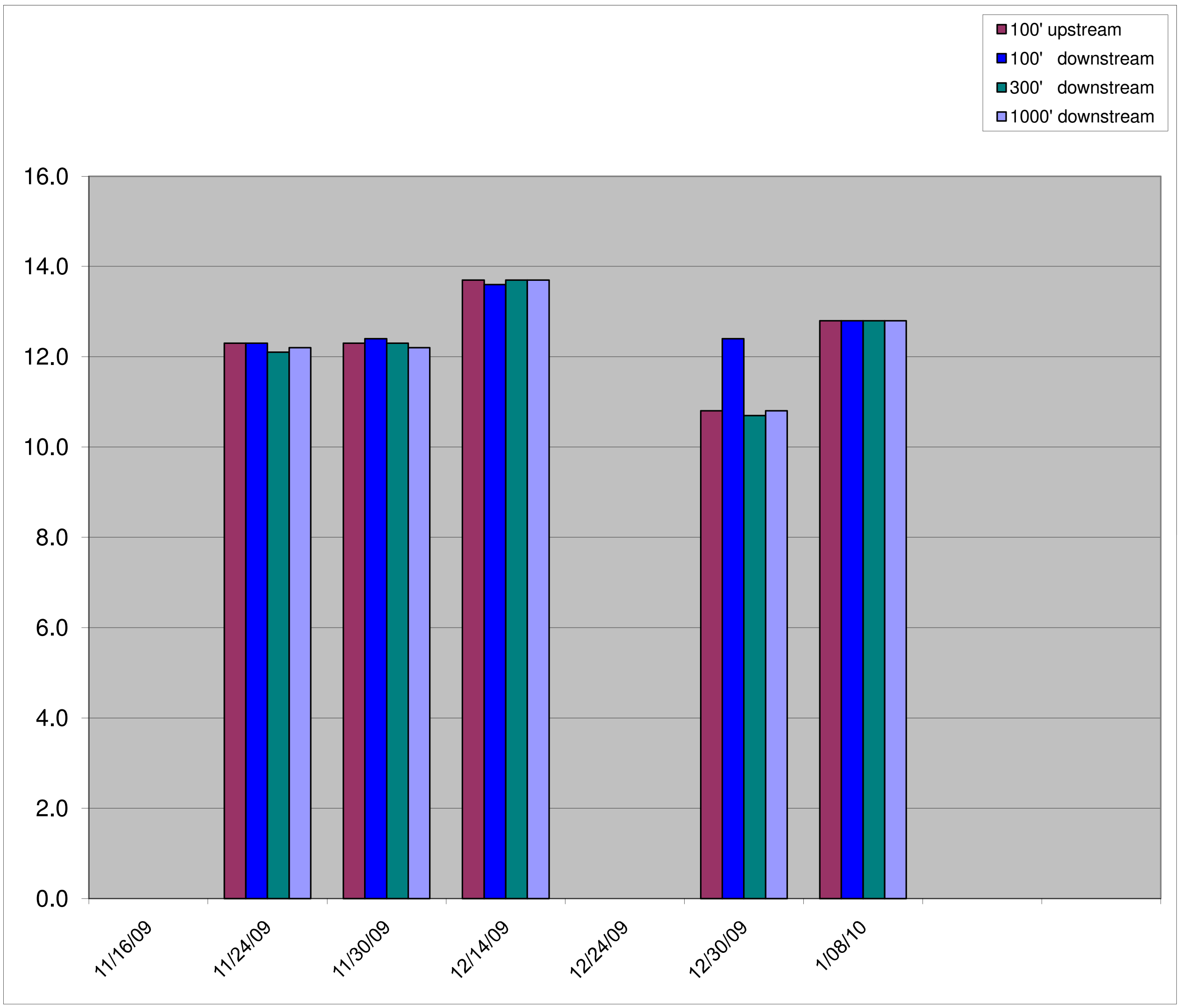
MORRO BAY HARBOR MAINTENANCE SAMPLING REPORT
MAIN CHANNEL - DISSOLVED OXYGEN

Date	11/16/09	11/24/09	11/30/09	12/14/09	12/24/09	12/30/09	1/08/10	1/12/10				
100' upstream		10	16.14	11.4		13.4	10.35					
100' downstream		10.32	14.62	11.03		13.7	10.25					
300' downstream		10.22	11.56	11.85		13.3	10					
1000' downstream		9.15	10.32	12.07		12.65	10.1					



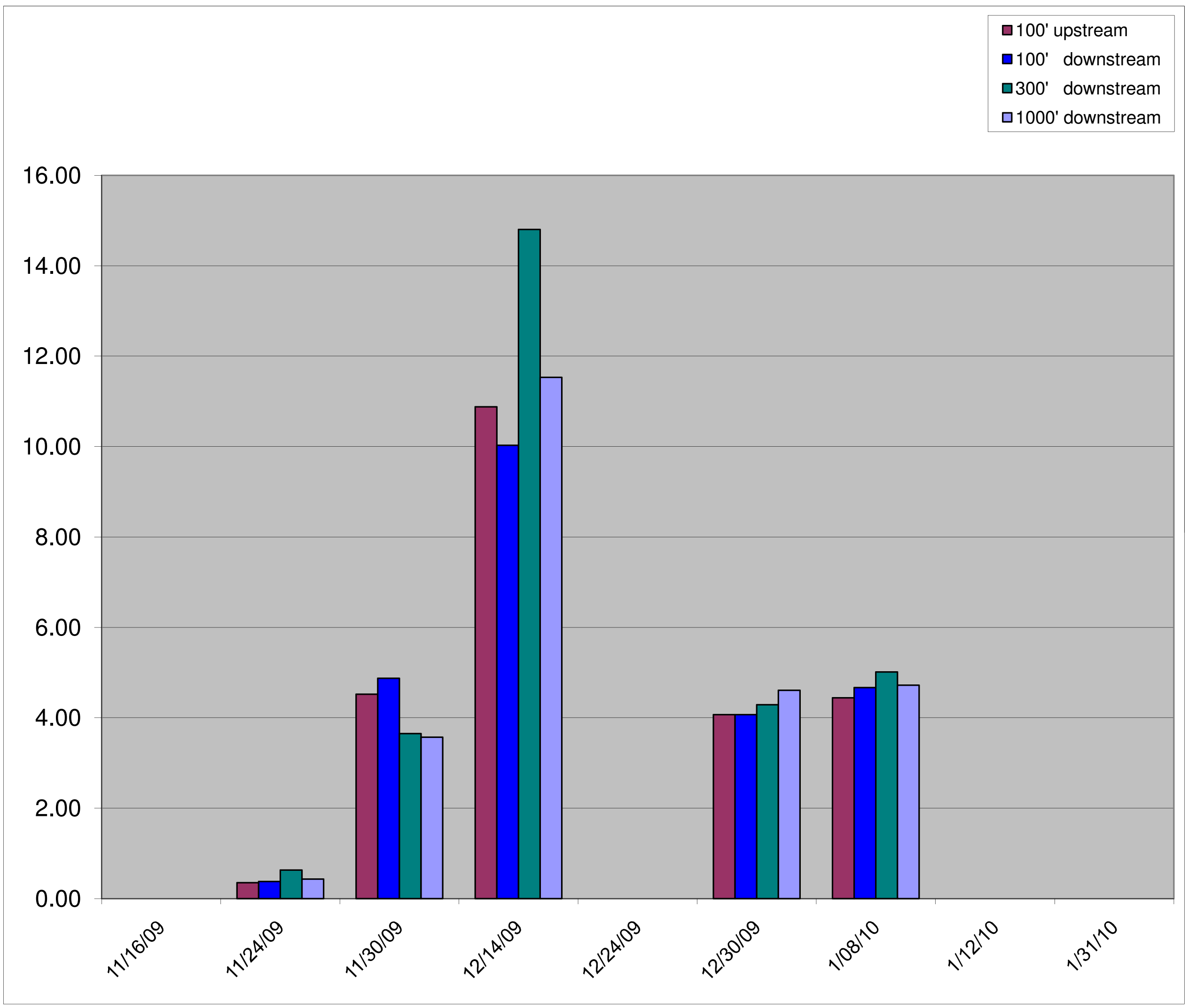
MORRO BAY HARBOR MAINTENANCE SAMPLING REPORT
MAIN CHANNEL - TEMPERATURE (Celcius)

Date	11/16/09	11/24/09	11/30/09	12/14/09	12/24/09	12/30/09	1/08/10					
100' upstream		12.3	12.3	13.7		10.8	12.8					
100' downstream		12.3	12.4	13.6		12.4	12.8					
300' downstream		12.1	12.3	13.7		10.7	12.8					
1000' downstream		12.2	12.2	13.7		10.8	12.8					



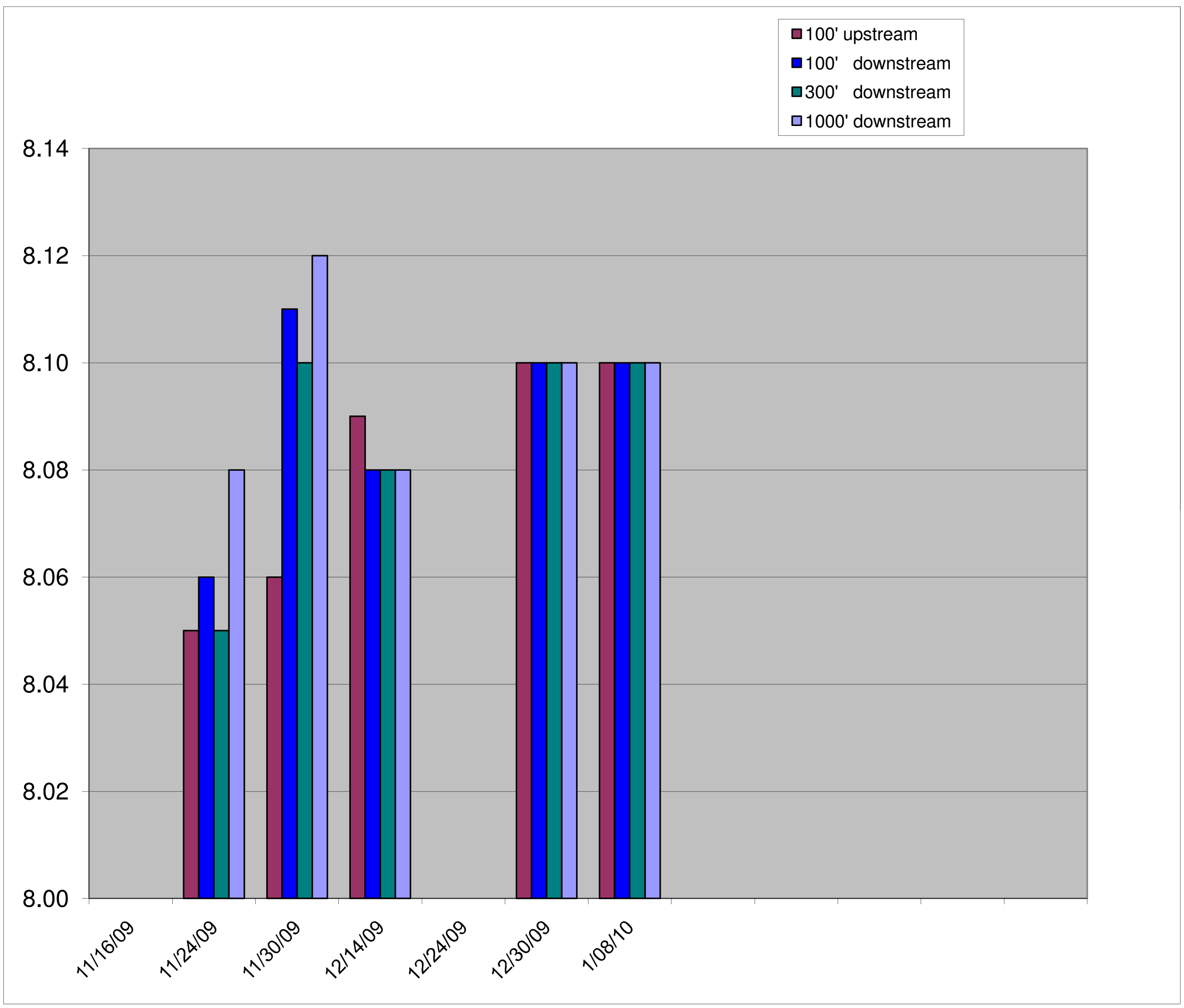
MORRO BAY HARBOR MAINTENANCE SAMPLING REPORT
MAIN CHANNEL - TURBIDITY (ntu)

Date	11/16/09	11/24/09	11/30/09	12/14/09	12/24/09	12/30/09	1/08/10	1/12/10	1/31/10			
100' upstream		0.35	4.52	10.88		4.07	4.44					
100' downstream		0.38	4.87	10.03		4.07	4.67					
300' downstream		0.63	3.65	14.80		4.29	5.01					
1000' downstream		0.43	3.57	11.53		4.61	4.72					



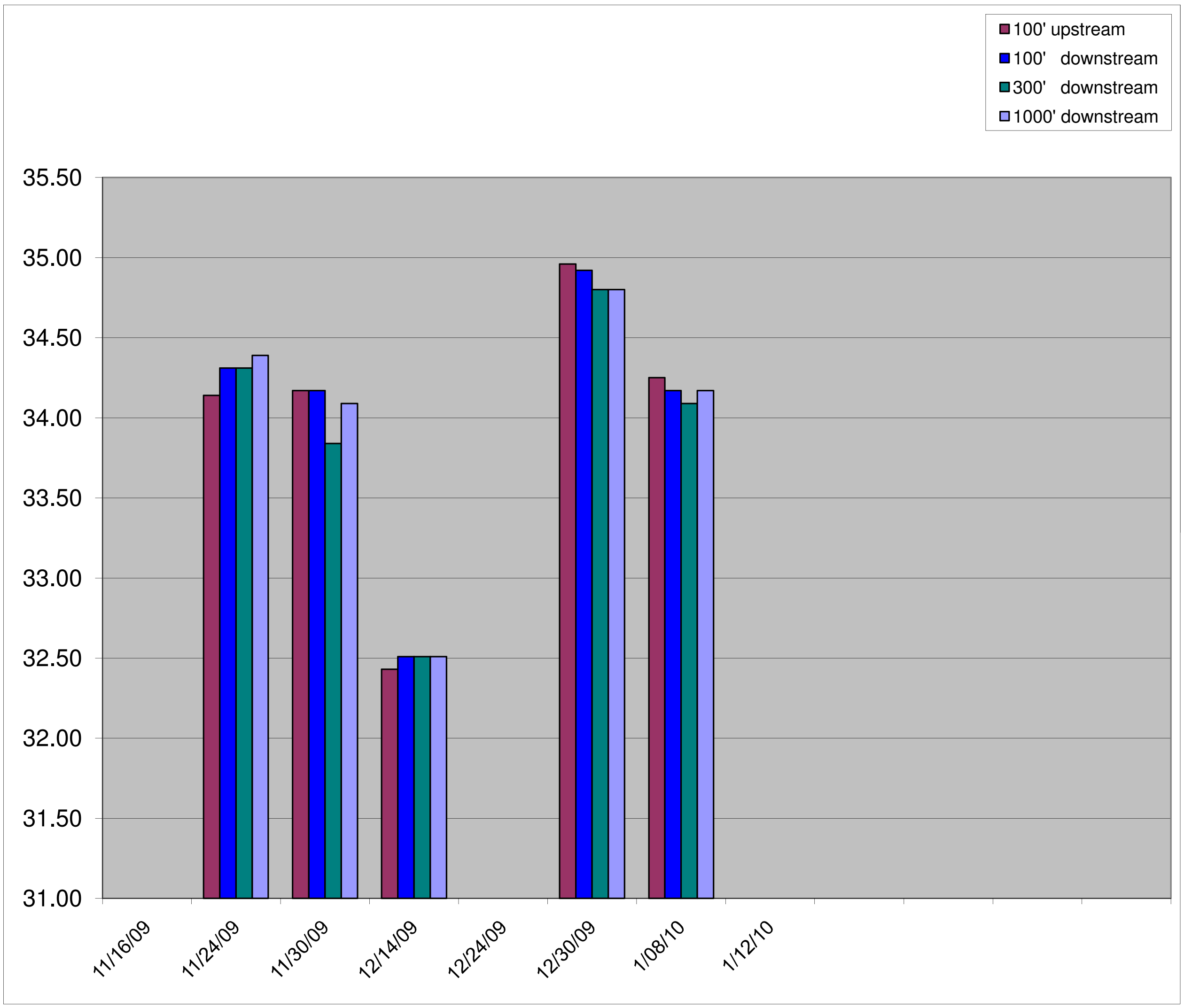
MORRO BAY HARBOR MAINTENANCE SAMPLING REPORT
MAIN CHANNEL - pH

Date	11/16/09	11/24/09	11/30/09	12/14/09	12/24/09	12/30/09	1/08/10					
100' upstream		8.05	8.06	8.09		8.10	8.10					
100' downstream		8.06	8.11	8.08		8.10	8.10					
300' downstream		8.05	8.1	8.08		8.10	8.10					
1000' downstream		8.08	8.12	8.08		8.10	8.10					



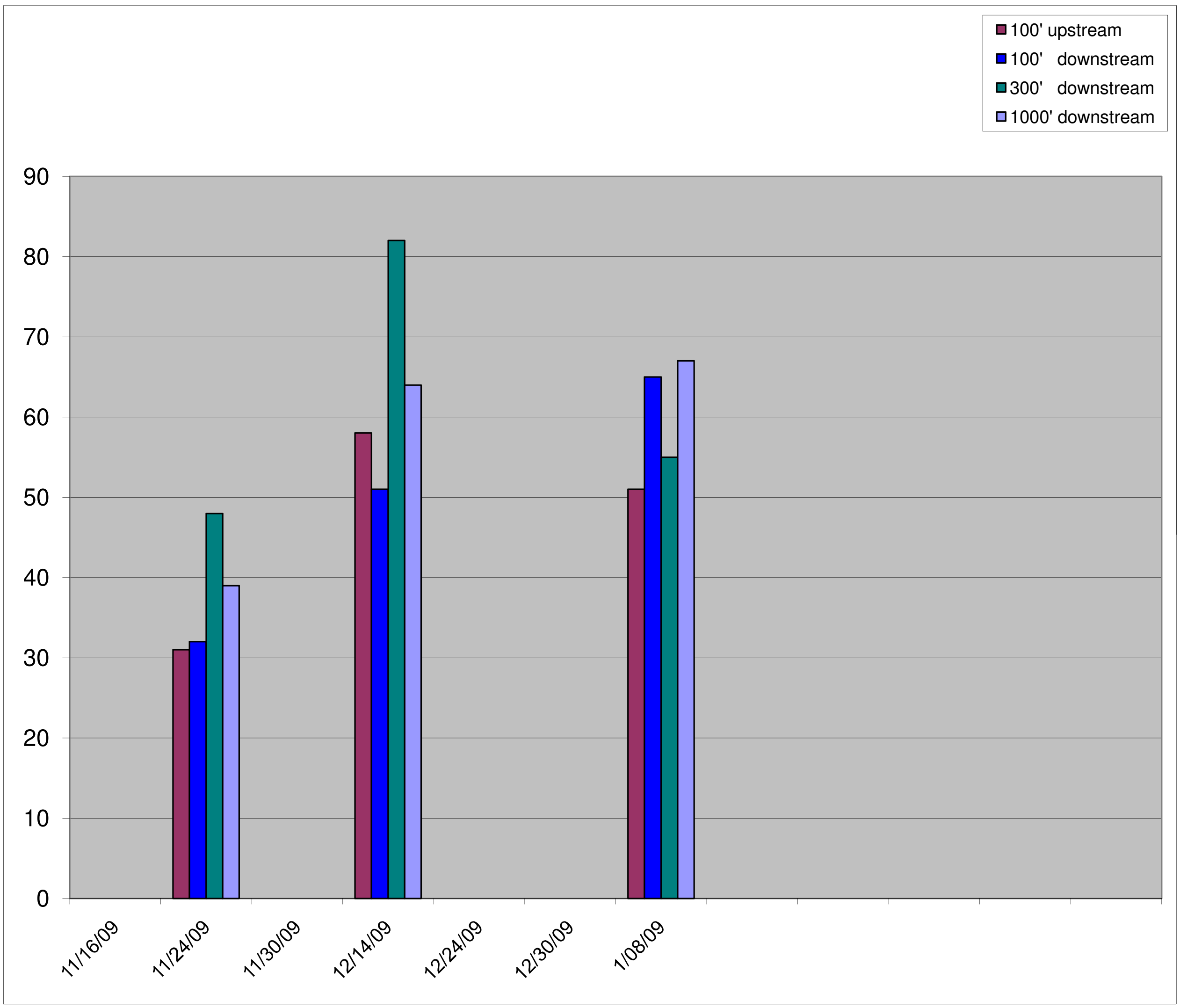
MORRO BAY HARBOR MAINTENANCE SAMPLING REPORT
MAIN CHANNEL - SALINITY (mg/L)

Date	11/16/09	11/24/09	11/30/09	12/14/09	12/24/09	12/30/09	1/08/10	1/12/10				
100' upstream		34.14	34.17	32.43		34.96	34.25					
100' downstream		34.31	34.17	32.51		34.92	34.17					
300' downstream		34.31	33.84	32.51		34.80	34.09					
1000' downstream		34.39	34.09	32.51		34.80	34.17					



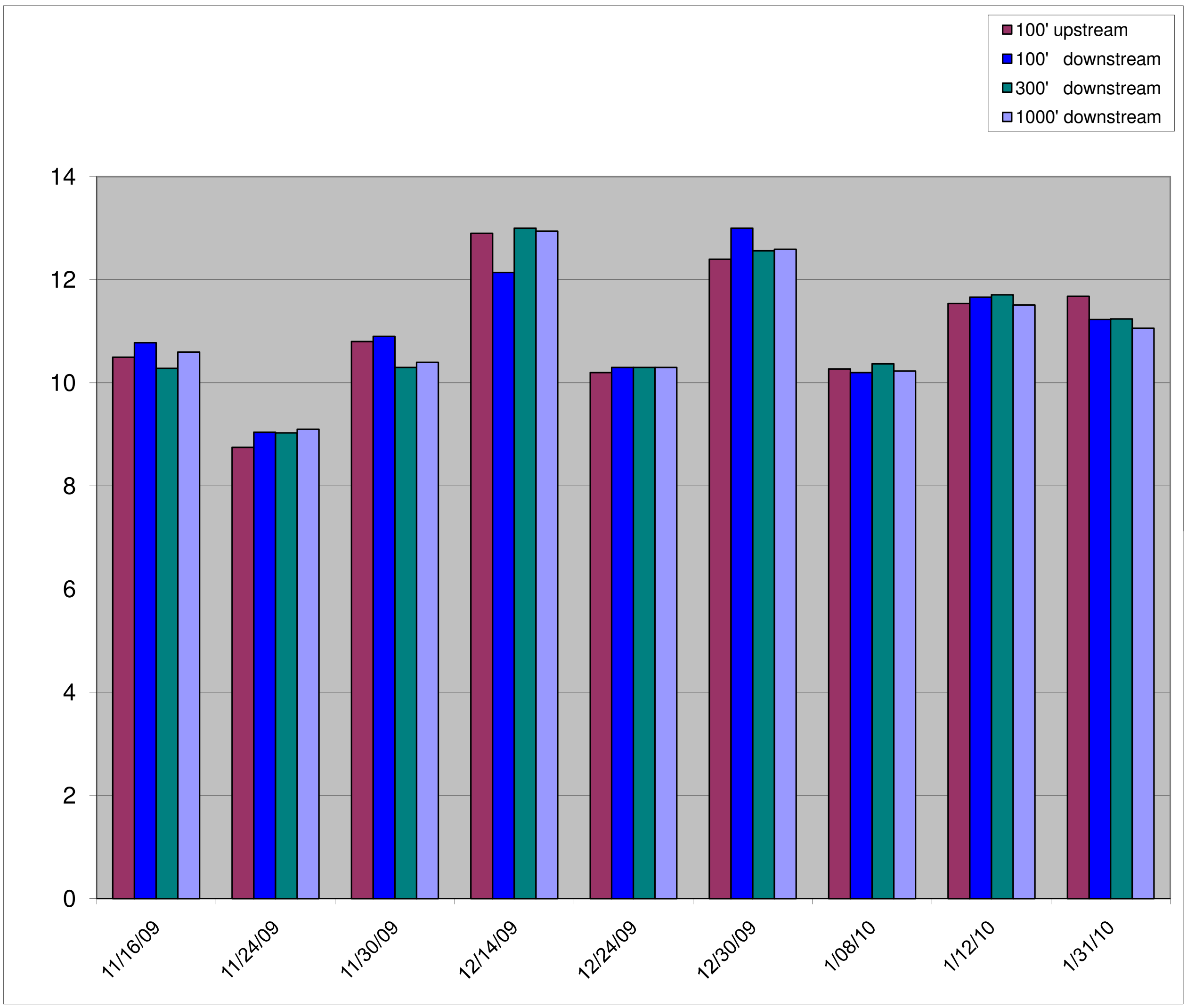
MORRO BAY HARBOR MAINTENANCE SAMPLING REPORT
MAIN CHANNEL - TSS (mg/L)

Date	11/16/09	11/24/09	11/30/09	12/14/09	12/24/09	12/30/09	1/08/09					
100' upstream		31		58			51					
100' downstream		32		51			65					
300' downstream		48		82			55					
1000' downstream		39		64			67					



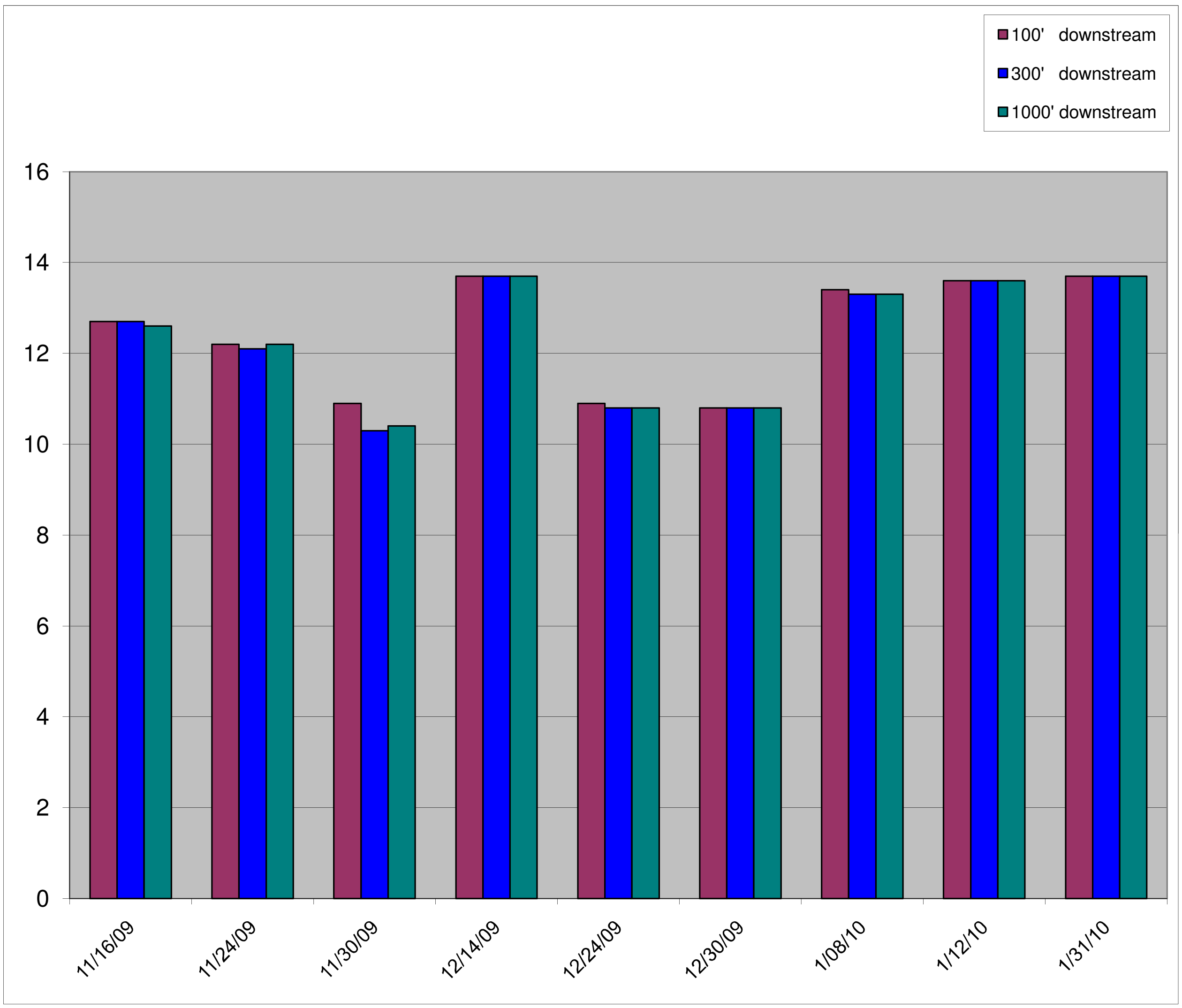
MORRO BAY HARBOR MAINTENANCE SAMPLING REPORT
HARBOR CHANNEL - DISSOLVED OXYGEN

Date	11/16/09	11/24/09	11/30/09	12/14/09	12/24/09	12/30/09	1/08/10	1/12/10	1/31/10			
100' upstream	10.5	8.75	10.8	12.9	10.2	12.4	10.27	11.54	11.68			
100' downstream	10.78	9.04	10.9	12.14	10.3	13	10.2	11.66	11.23			
300' downstream	10.28	9.03	10.3	13	10.3	12.56	10.37	11.71	11.24			
1000' downstream	10.6	9.1	10.4	12.94	10.3	12.59	10.23	11.51	11.06			



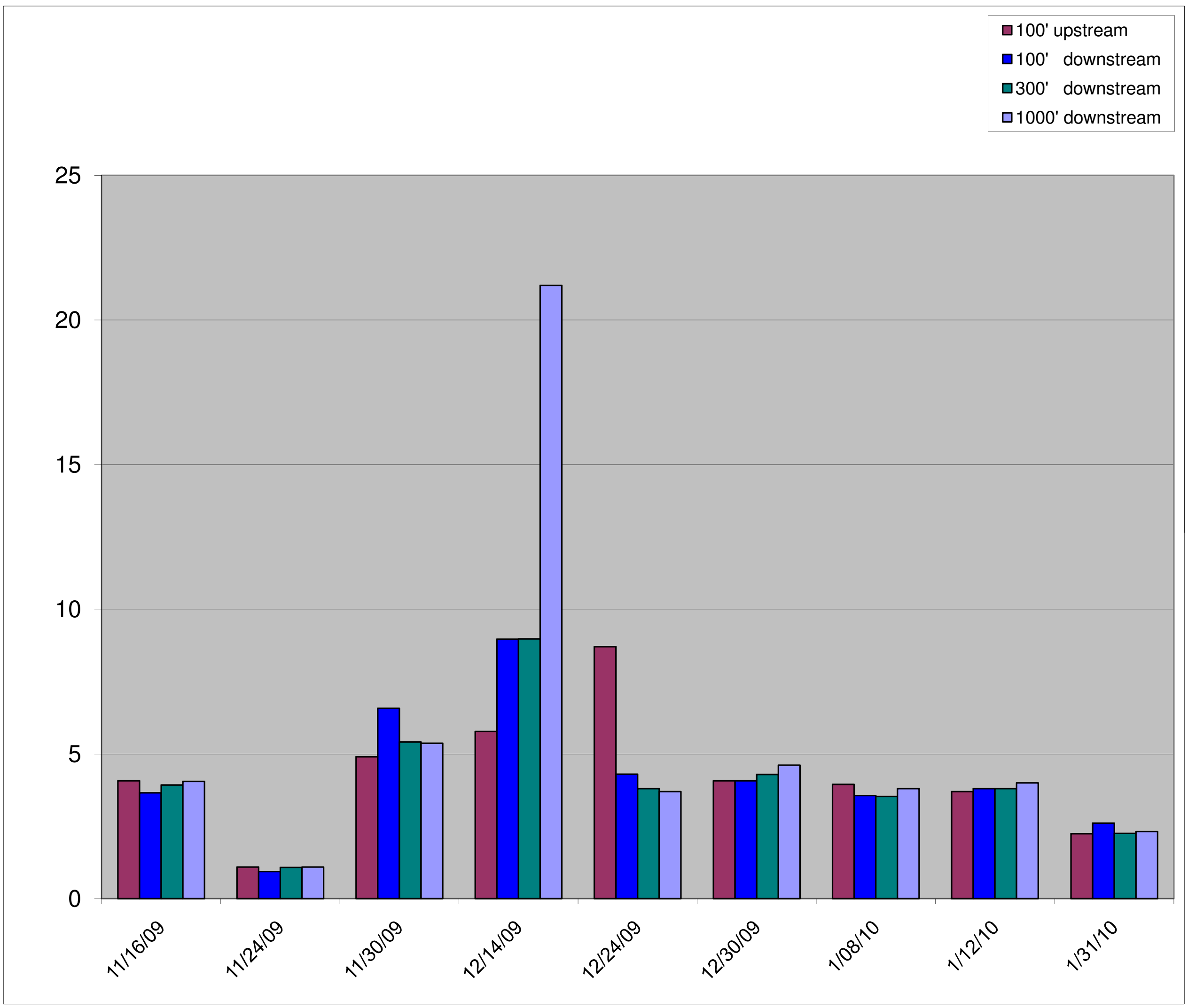
MORRO BAY HARBOR MAINTENANCE SAMPLING REPORT
HARBOR CHANNEL - TEMPERATURE (Celcius)

Date	11/16/09	11/24/09	11/30/09	12/14/09	12/24/09	12/30/09	1/08/10	1/12/10	1/31/10			
100' upstream	12.7	12.1	10.8	13.7	10.8	10.8	13.4	13.6	13.7			
100' downstream	12.7	12.2	10.9	13.7	10.9	10.8	13.4	13.6	13.7			
300' downstream	12.7	12.1	10.3	13.7	10.8	10.8	13.3	13.6	13.7			
1000' downstream	12.6	12.2	10.4	13.7	10.8	10.8	13.3	13.6	13.7			



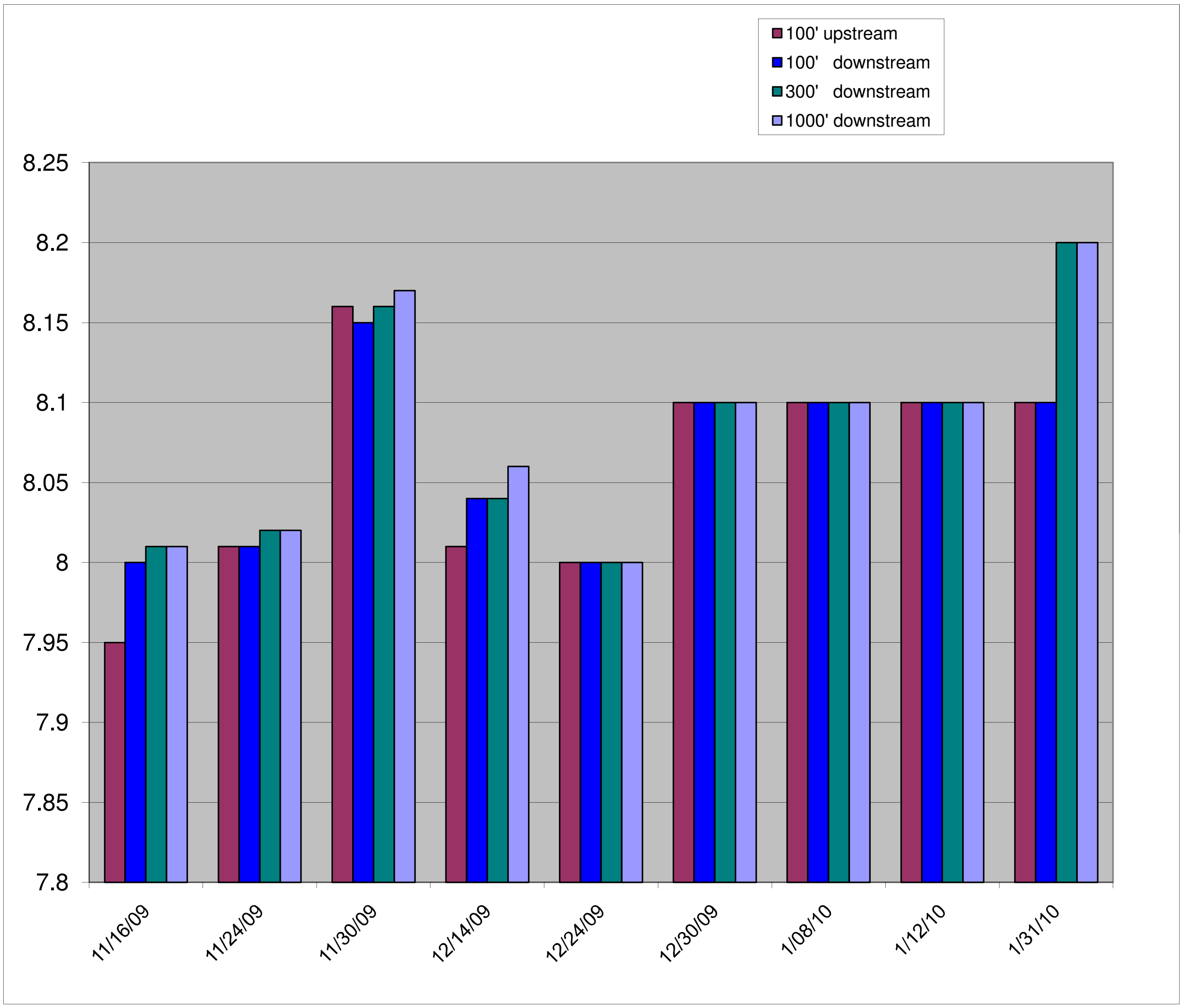
MORRO BAY HARBOR MAINTENANCE SAMPLING REPORT
HARBOR CHANNEL - TURBIDITY (ntu)

Date	11/16/09	11/24/09	11/30/09	12/14/09	12/24/09	12/30/09	1/08/10	1/12/10	1/31/10			
100' upstream	4.07	1.09	4.9	5.78	8.70	4.07	3.95	3.70	2.24			
100' downstream	3.65	0.93	6.58	8.97	4.30	4.07	3.56	3.80	2.61			
300' downstream	3.93	1.08	5.41	8.98	3.80	4.29	3.53	3.80	2.25			
1000' downstream	4.05	1.09	5.37	21.20	3.70	4.61	3.80	4.00	2.31			



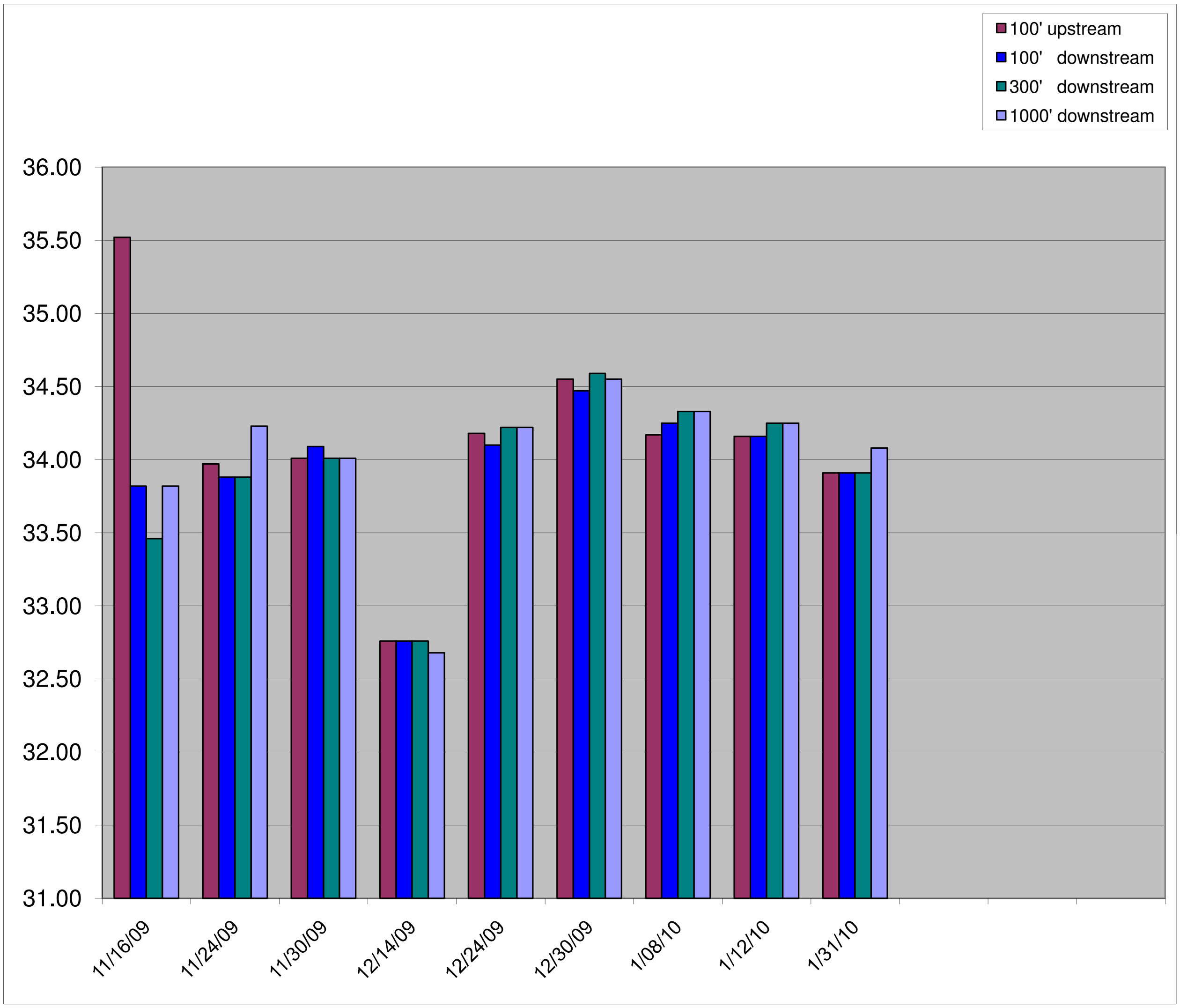
MORRO BAY HARBOR MAINTENANCE SAMPLING REPORT
HARBOR CHANNEL - pH

Date	11/16/09	11/24/09	11/30/09	12/14/09	12/24/09	12/30/09	1/08/10	1/12/10	1/31/10
100' upstream	7.95	8.01	8.16	8.01	8.00	8.10	8.10	8.10	8.10
100' downstream	8	8.01	8.15	8.04	8.00	8.10	8.10	8.10	8.10
300' downstream	8.01	8.02	8.16	8.04	8.00	8.10	8.10	8.10	8.20
1000' downstream	8.01	8.02	8.17	8.06	8.00	8.10	8.10	8.10	8.20



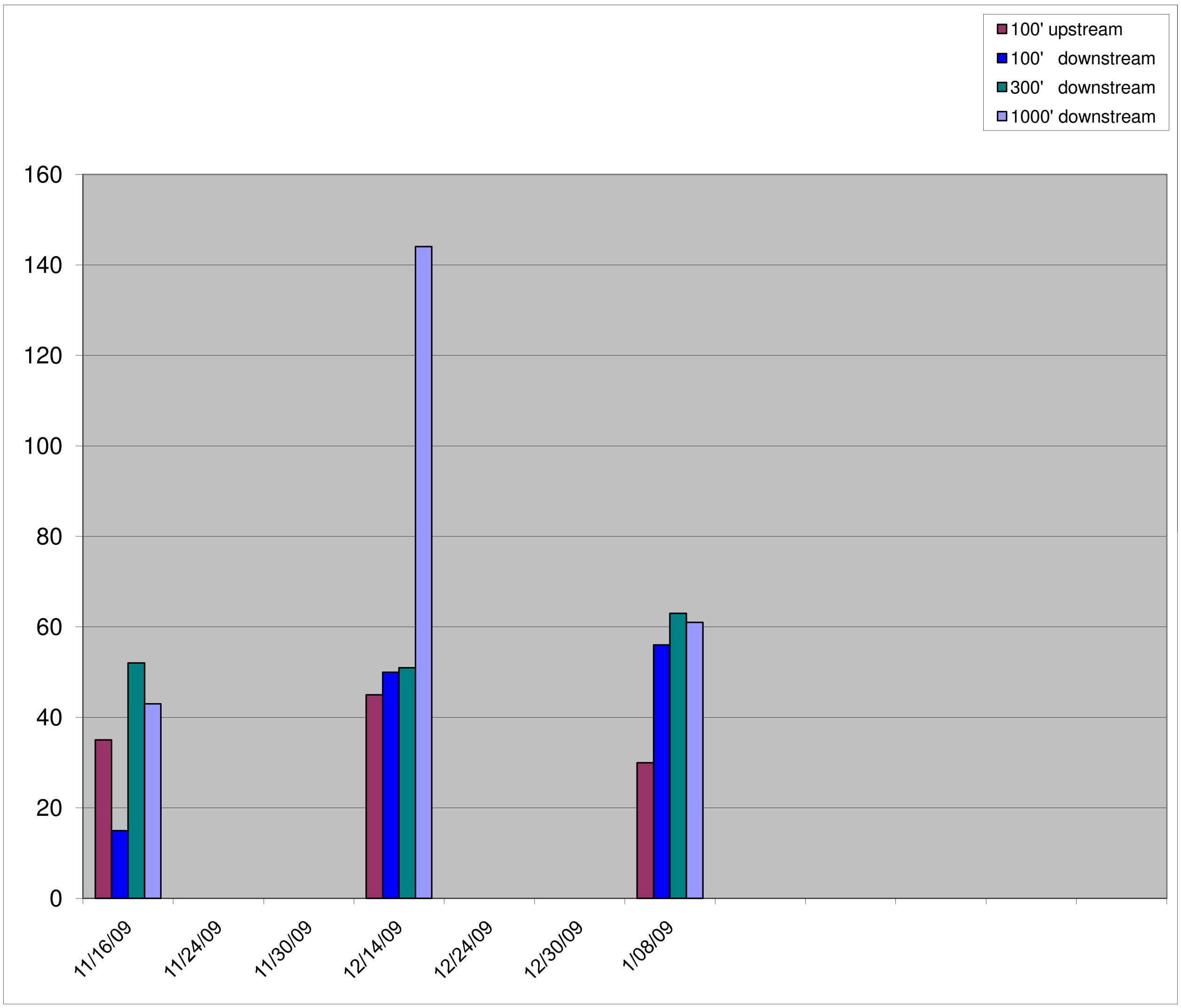
MORRO BAY HARBOR MAINTENANCE SAMPLING REPORT
HARBOR CHANNEL - SALINITY (mg/L)

Date	11/16/09	11/24/09	11/30/09	12/14/09	12/24/09	12/30/09	1/08/10	1/12/10	1/31/10			
100' upstream	35.52	33.97	34.01	32.76	34.18	34.55	34.17	34.16	33.91			
100' downstream	33.82	33.88	34.09	32.76	34.10	34.47	34.25	34.16	33.91			
300' downstream	33.46	33.88	34.01	32.76	34.22	34.59	34.33	34.25	33.91			
1000' downstream	33.82	34.23	34.01	32.68	34.22	34.55	34.33	34.25	34.08			



MORRO BAY HARBOR MAINTENANCE SAMPLING REPORT
HARBOR CHANNEL - TSS (mg/L)

Date	11/16/09	11/24/09	11/30/09	12/14/09	12/24/09	12/30/09	1/08/09					
100' upstream	35			45			30					
100' downstream	15			50			56					
300' downstream	52			51			63					
1000' downstream	43			144			61					



MORRO BAY HARBOR MAINTENANCE DREDGING WATER MONITORING

Date: **10/30/09**

Main Channel Dredge

Sample Site	Time	D.O.	Temp.	Turbidity	pH	Salinity	TSS	Weather	Operator
Units		**mg/L**	**Celcius**	**ntu**			**mg/L**		
(a) 100' upstream									
(b) 100' down stream									
(c) 300' down stream									
(d) 1000' down stream	**16:30**	**9.4**	**12.9**	**3.6**	**7.9**	**34.54**	**19**	**Clear and Warm**	**Nally**

Harbor Channel Dredge

Sample Site	Time	D.O.	Temp.	Turbidity	pH	Salinity	TSS	Weather	Operator
Units		**mg/L**	**Celcius**	**ntu**			**mg/L**		
(a) 100' upstream									
(b) 100' down stream									
(c) 300' down stream									
(d) 1000' down stream	**16:20**	**10.2**	**13.1**	**5.9**	**8**	**34.89**	**49**	**Clear and Warm**	**Nally**

No Dredging taking place, background sampling done at request of AIS.

Abalone Coast Bacteriology Lab
4149 Santa Fe Road, Suite 6 San Luis Obispo CA, 93401
Phone: 595-1080 Fax: 595-1080

Order # **09-2364**
Date/Time Rec'd **10/31/09 1130**

Fluid Resource Management
918 Highland Way
Grover Beach, CA. 93433

Contact: **Chris Nally**
Phone: **441-0212**
Sampler: **Chris Nally**

Project: Morro Harbor Dredge

Sample #	Sample description	Date / Time	Analysis	Method	Result	Units	DLR	Completed
-1	**Main Channel**	**10/30/09 1645**	Suspended Solids	SM 2540D	**19.**	mg/L	3	**10/31/09**
			Turbidity	SM 2130B	**3.6**	NTU	0.1	**10/31/09**
			pH*	SM 4500-HB	**7.9**		1	**10/31/09**
			SUB-salinity					
-2	**Morro Channel**	**10/30/09 1620**	Suspended Solids	SM 2540D	**49.**	mg/L	3	**10/31/09**
			Turbidity	SM 2130B	**5.9**	NTU	0.1	**10/31/09**
			pH*	SM 4500-HB	**8.0**		1	**10/31/09**
			SUB-salinity					

*EPA Method Update Rule (4/11/07) mandates 15 minute hold time.

Report Completion Date: 11/4/2009

Reviewed: Amanda Smith

Amanda Smith, Lab Director

MORRO BAY HARBOR MAINTENANCE DREDGING WATER MONITORING

Date: **11/16/09**

Main Channel Dredge

Sample Site	Time	D.O.	Temp.	Turbidity	pH	Salinity	TSS	Weather	Operator
Units		**mg/L**	**Celcius**	**ntu**			**mg/L**		
(a) 100' upstream									
(b) 100' down stream									
(c) 300' down stream									
(d) 1000' down stream									

Harbor Channel Dredge

Sample Site	Time	D.O.	Temp.	Turbidity	pH	Salinity	TSS	Weather	Operator
Units		**mg/L**	**Celcius**	**ntu**			**mg/L**		
(a) 100' upstream	1320	10.5	12.7	4.07	7.95	35.52	35	Clear and Warm	Nally
(b) 100' down stream	1312	10.78	12.7	3.65	8	33.82	15	Clear and Warm	Nally
(c) 300' down stream	1307	10.28	12.7	3.93	8.01	33.46	52	Clear and Warm	Nally
(d) 1000' down stream	1300	10.6	12.6	4.05	8.01	33.82	43	Clear and Warm	Nally

Abalone Coast Bacteriology Lab

4149 Santa Fe Road, Suite 6 San Luis Obispo CA, 93401
Phone: 595-1080 Fax: 595-1080

Order # **09-2487**

Date/Time Rec'd **11/17/09 1045**

Fluid Resource Management
918 Highland Way
Grover Beach, CA.

Contact: Chris Nally
Phone: 441-0212
Sampler: Chris Nally

Project: Harbor Channel-monthly

Sample #	Sample description	Date / Time	Analysis	Method	Result	Units	DLR	Completed
-1	**Site A**	**11/16/09 1320**	Turbidity	SM 2130B	**4.07**	NTU	0.1	**11/17/09**
	transmit- 94.2%		pH*	SM 4500-HB	**7.95**		1	**11/17/09**
			Suspended Solids	SM 2540D	**35.**	mg/L	3	**11/17/09**
			SUB-salinity					
-2	**Site B**	**11/16/09 1312**	Turbidity	SM 2130B	**3.65**	NTU	0.1	**11/17/09**
	transmit- 96.9%		pH*	SM 4500-HB	**8.00**		1	**11/17/09**
			Suspended Solids	SM 2540D	**15.**	mg/L	3	**11/17/09**
			SUB-salinity					
-3	**Site C**	**11/16/09 1307**	Turbidity	SM 2130B	**3.93**	NTU	0.1	**11/17/09**
	transmit- 94.2%		pH*	SM 4500-HB	**8.01**		1	**11/17/09**
			Suspended Solids	SM 2540D	**52.**	mg/L	3	**11/17/09**
			SUB-salinity					
-4	**Site D**	**11/16/09 1300**	Turbidity	SM 2130B	**4.05**	NTU	0.1	**11/17/09**
	transmit-93.7%		pH*	SM 4500-HB	**8.01**		1	**11/17/09**
			Suspended Solids	SM 2540D	**43.**	mg/L	3	**11/17/09**
			SUB-salinity					

*EPA Method Update Rule (4/11/07) mandates 15 minute hold time.

Report Completion Date: 11/18/2009

Reviewed: Amanda Smith

Amanda Smith, Lab Director

MORRO BAY HARBOR MAINTENANCE DREDGING WATER MONITORING

Date: 11/24

Main Channel Dredge

Sample Site	Time	D.O.	Temp.	Turbidity	pH	Salinity	TSS	Weather	Operator
Units	24 hr	mg/L	Celcius	ntu			mg/L		
(a) 100' upstream	2:40	10	12.3	0.35	8.05	34.14	31	Clear and Warm	Nally
(b) 100' down stream	2:34	10.32	12.3	0.38	8.06	34.31	32	Clear and Warm	Nally
(c) 300' down stream	2:31	10.22	12.1	0.63	8.05	34.31	48	Clear and Warm	Nally
(d) 1000' down stream	2:29	9.15	12.2	0.43	8.08	34.39	39	Clear and Warm	Nally

Harbor Channel Dredge

Sample Site	Time	D.O.	Temp.	Turbidity	pH	Salinity	TSS	Weather	Operator
Units	24 hr	mg/L	Celcius	ntu			mg/L		
(a) 100' upstream	2:16	8.75	12.1	1.09	8.01	33.97		Clear and Warm	Nally
(b) 100' down stream	2:15	9.04	12.2	0.93	8.01	33.88		Clear and Warm	Nally
(c) 300' down stream	2:13	9.03	12.1	1.08	8.02	33.88		Clear and Warm	Nally
(d) 1000' down stream	2:10	9.1	12.2	1.09	8.02	34.23		Clear and Warm	Nally

Abalone Coast Bacteriology Lab

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Order # **09-2555**

Date/Time Rec'd **11/24/09 1615**

Fluid Resource Management
918 Highland Way
Grover Beach, CA.

Contact: **Chris Nally**
Phone: **441-0212**
Sampler: **Chris Nally**

Project: Harbor Channel-weekly

Sample #	Sample description	Date / Time	Analysis	Method	Result	Units	DLR	Completed
-1	**Site A**	**11/24/09 1416**	Turbidity	SM 2130B	**1.09**	NTU	0.1	11/24/09
	transmitance - 97.8%		pH*	SM 4500-HB	**8.01**		1	11/24/09
			Salinity	SM 2520B	**33.97**			11/24/09
-2	**Site B**	**11/24/09 1415**	Turbidity	SM 2130B	**0.93**	NTU	0.1	11/24/09
	transmitance- 98%		pH*	SM 4500-HB	**8.01**		1	11/24/09
			Salinity	SM 2520B	**33.88**			11/24/09
-3	**Site C**	**11/24/09 1413**	Turbidity	SM 2130B	**1.08**	NTU	0.1	11/24/09
	transmitance- 97.5%		pH*	SM 4500-HB	**8.02**		1	11/24/09
			Salinity	SM 2520B	**33.88**			11/24/09
-4	**Site D**	**11/24/09 1410**	Turbidity	SM 2130B	**1.09**	NTU	0.1	11/24/09
	transmitance- 97.5%		pH*	SM 4500-HB	**8.02**		1	11/24/09
			Salinity	SM 2520B	**34.23**			11/24/09

*EPA Method Update Rule (4/11/07) mandates 15 minute hold time.

Report Completion Date: 11/30/2009

Reviewed: Amanda Smith

Amanda Smith, Lab Director

Abalone Coast Bacteriology Lab

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Order # **09-2556**
Date/Time Rec'd **11/24/09 1551**

Fluid Resource Management
918 Highland Way
Grover Beach, CA.

Contact: **Chris Nally**
Phone: **441-0212**
Sampler: **Chris Nally**

Project: Main Channel-monthly

Sample #	Sample description	Date / Time	Analysis	Method	Result	Units	DLR	Completed
-1	**Site A**	**11/24/09 1440**	Turbidity	SM 2130B	**0.35**	NTU	0.1	11/24/09
	transmitance- 99.8%		pH*	SM 4500-HB	**8.05**		1	11/24/09
			Suspended Solids	SM 2540D	**31.**	mg/L	3	11/25/09
			Salinity	SM 2520B	**34.14**			11/24/09
-2	**Site B**	**11/24/09 1434**	Turbidity	SM 2130B	**0.38**	NTU	0.1	11/24/09
	transmitance- 99.5%		pH*	SM 4500-HB	**8.06**		1	11/24/09
			Suspended Solids	SM 2540D	**32.**	mg/L	3	11/25/09
			Salinity	SM 2520B	**34.31**			11/24/09
-3	**Site C**	**11/24/09 1431**	Turbidity	SM 2130B	**0.63**	NTU	0.1	11/24/09
	transmitance- 99.2%		pH*	SM 4500-HB	**8.05**		1	11/24/09
			Suspended Solids	SM 2540D	**48.**	mg/L	3	11/25/09
			Salinity	SM 2520B	**34.31**			11/24/09
-4	**Site D**	**11/24/09 1429**	Turbidity	SM 2130B	**0.43**	NTU	0.1	11/24/09
	transmitance- 99.5%		pH*	SM 4500-HB	**8.08**		1	11/24/09
			Suspended Solids	SM 2540D	**39.**	mg/L	3	11/25/09
			Salinity	SM 2520B	**34.39**			11/24/09

*EPA Method Update Rule (4/11/07) mandates 15 minute hold time.

Report Completion Date: 11/30/2009

Reviewed: Amanda Smith

Amanda Smith, Lab Director

MORRO BAY HARBOR MAINTENANCE DREDGING WATER MONITORING

Date: 11/30/2009

Main Channel Dredge

Sample Site	Time	D.O.	Temp.	Turbidity	pH	Salinity	TSS	Weather	Operator
Units		mg/L	Celcius	ntu			mg/L		
(a) 100' upstream	1445	16.14	12.3	4.52	8.06	34.17		Fair	Little
(b) 100' down stream	1450	14.62	12.4	4.87	8.11	34.17		Fair	Little
(c) 300' down stream	1455	1156	12.3	3.65	8.1	33.84		Fair	Little
(d) 1000' down stream	1500	10.32	12.2	3.57	8.12	34.09		Fair	Little

Harbor Channel Dredge

Sample Site	Time	D.O.	Temp.	Turbidity	pH	Salinity	TSS	Weather	Operator
Units		mg/L	Celcius	ntu			mg/L		
(a) 100' upstream	1513	10.8	10.8	4.9	8.16	34.01		Fair	Little
(b) 100' down stream	1520	10.9	10.9	6.58	8.15	34.09		Fair	Little
(c) 300' down stream	1525	10.3	10.3	5.41	8.16	34.01		Fair	Little
(d) 1000' down stream	1530	10.4	10.4	5.37	8.17	34.01		Fair	Little

Abalone Coast Bacteriology Lab

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Order # **09-2601**

Date/Time Rec'd **11/30/09 1700**

Fluid Resource Management
918 Highland Way
Grover Beach, CA.

Contact: **Chris Nally**
Phone: **441-0212**
Sampler: **Joe Little**

Project: Main Channel-weekly

Sample #	Sample description	Date / Time	Analysis	Method	Result	Units	DLR	Completed
-1	**Site A 100 Up**	**11/30/09 1445**	Turbidity	SM 2130B	**4.52**	NTU	0.1	11/30/09
	%transmitance-99.0		pH*	SM 4500-HB	**8.06**		1	11/30/09
			Salinity	SM 2520B	**34.17**			11/30/09
-2	**Site B 100 down**	**11/30/09 1450**	Turbidity	SM 2130B	**4.87**	NTU	0.1	11/30/09
	%transmitance-98.8		pH*	SM 4500-HB	**8.11**		1	11/30/09
			Salinity	SM 2520B	**34.17**			11/30/09
-3	**Site C 300 Down**	**11/30/09 1455**	Turbidity	SM 2130B	**3.65**	NTU	0.1	11/30/09
	%transmitance-99.5		pH*	SM 4500-HB	**8.10**		1	11/30/09
			Salinity	SM 2520B	**33.84**			11/30/09
-4	**Site D 1000 Down**	**11/30/09 1500**	Turbidity	SM 2130B	**3.57**	NTU	0.1	11/30/09
	%transmitance-99.5		pH*	SM 4500-HB	**8.13**		1	11/30/09
			Salinity	SM 2520B	**34.09**			11/30/09

*EPA Method Update Rule (4/11/07) mandates 15 minute hold time.

Report Completion Date: 12/10/2009

Reviewed: Amanda Smith

Amanda Smith, Lab Director

Abalone Coast Bacteriology Lab

Order # **09-2602**

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Date/Time Rec'd **11/30/09 1700**

Fluid Resource Management
918 Highland Way
Grover Beach, CA.

Contact: **Chris Nally**
Phone: **441-0212**
Sampler: **Joe Little**

Project: Harbor Channel-weekly

Sample #	Sample description	Date / Time	Analysis	Method	Result	Units	DLR	Completed
-1	**Site A 100 Up**	**11/30/09 1513**	Turbidity	SM 2130B	**4.90**	NTU	0.1	11/30/09
	% transmitance-99.8		pH*	SM 4500-HB	**8.16**		1	11/30/09
			Salinity	SM2520B	**34.01**			11/30/09
-2	**Site B 100 Down**	**11/30/09 1520**	Turbidity	SM 2130B	**6.58**	NTU	0.1	11/30/09
	% transmitance-98.2		pH*	SM 4500-HB	**8.15**		1	11/30/09
			Salinity	SM2520B	**34.09**			11/30/09
-3	**Site C 300 Down**	**11/30/09 1525**	Turbidity	SM 2130B	**5.41**	NTU	0.1	11/30/09
	% transmitance-98.4		pH*	SM 4500-HB	**8.16**		1	11/30/09
			Salinity	SM2520B	**34.01**			11/30/09
-4	**Site D 1000 Down**	**11/30/09 1530**	Turbidity	SM 2130B	**5.37**	NTU	0.1	11/30/09
	% transmitance-98.6		pH*	SM 4500-HB	**8.17**		1	11/30/09
			Salinity	SM2520B	**34.01**			11/30/09

*EPA Method Update Rule (4/11/07) mandates 15 minute hold time.

Report Completion Date: 12/1/2009

Reviewed: Amanda Smith

Amanda Smith, Lab Director

MORRO BAY HARBOR MAINTENANCE DREDGING WATER MONITORING

Date: 12/14/2009

Main Channel Dredge

Sample Site	Time	D.O.	Temp.	Turbidity	pH	Salinity	TSS	Weather	Operator
Units		mg/L	Celcius	ntu			mg/L		
(a) 100' upstream	1515	11.4	13.7	10.88	8.09	32.43	58	Fair	Little
(b) 100' down stream	1510	11.03	13.6	10.03	8.08	32.51	51	Fair	Little
(c) 300' down stream	1505	11.85	13.7	14.8	8.08	32.51	82	Fair	Little
(d) 1000' down stream	1500	12.07	13.7	11.53	8.08	32.51	64	Fair	Little

Harbor Channel Dredge

Sample Site	Time	D.O.	Temp.	Turbidity	pH	Salinity	TSS	Weather	Operator
Units		mg/L	Celcius	ntu			mg/L		
(a) 100' upstream	1410	12.9	13.7	5.78	8.01	32.76	45	Fair	Little
(b) 100' down stream	1415	12.14	13.7	8.97	8.04	32.76	50	Fair	Little
(c) 300' down stream	1420	13	13.7	8.98	8.04	32.76	51	Fair	Little
(d) 1000' down stream	1425	12.94	13.7	21.2	8.06	32.68	144	Fair	Little

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Order # **09-2704**

Date/Time Rec'd **12/14/09 1620**

Fluid Resource Management
918 Highland Way
Grover Beach, CA.

Contact: **Chris Nally**
Phone: **441-0212**
Sampler: **Joe Little**

Project: Main Channel-monthly

Sample #	Sample description	Date / Time	Analysis	Method	Result	Units	DLR	Completed
-1	**Site A**	**12/14/09 1515**	Turbidity	SM 2130B	**10.88**	NTU	0.1	12/14/09
	% transmitance-96.5		pH*	SM 4500-HB	**8.08**		1	12/14/09
			Suspended Solids	SM 2540D	**58.**	mg/L	3	12/15/09
			Salinity	SM 2520B	**32.43**			12/14/09
								12/14/09
-2	**Site B**	**12/14/09 1510**	Turbidity	SM 2130B	**10.03**	NTU	0.1	12/14/09
	% transmitance-97.		pH*	SM 4500-HB	**8.09**		1	12/15/09
			Suspended Solids	SM 2540D	**51.**	mg/L	3	12/14/09
			Salinity	SM 2520B	**32.51**			12/14/09
								12/14/09
-3	**Site C**	**12/14/09 1505**	Turbidity	SM 2130B	**14.8**	NTU	0.1	12/14/09
	% transmitance-95.5		pH*	SM 4500-HB	**8.08**		1	12/15/09
			Suspended Solids	SM 2540D	**82.**	mg/L	3	12/14/09
			Salinity	SM 2520B	**32.51**			12/14/09
								12/14/09
-4	**Site D**	**12/14/09 1500**	Turbidity	SM 2130B	**11.53**	NTU	0.1	12/14/09
	%transmitance-96.5		pH*	SM 4500-HB	**8.08**		1	12/15/09
			Suspended Solids	SM 2540D	**64.**	mg/L	3	12/14/09
			Salinity	SM 2520B	**32.51**			12/14/09

*EPA Method Update Rule (4/11/07) mandates 15 minute hold time.

Report Completion Date: 12/15/2009

Reviewed: Amanda Smith

Amanda Smith, Lab Director

Abalone Coast Bacteriology Lab

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Order # **09-2703**
Date/Time Rec'd **12/14/09 1620**

Fluid Resource Management
918 Highland Way
Grover Beach, CA.

Contact: **Chris Nally**
Phone: **441-0212**
Sampler: **Joe Little**

Project: Harbor Channel-monthly

Sample #	Sample description	Date / Time	Analysis	Method	Result	Units	DLR	Completed
-1	**Site A**	**12/14/09 1410**	Turbidity	SM 2130B	**5.78**	NTU	0.1	12/14/09
	% transmitance- 98.		pH*	SM 4500-HB	**8.01**		1	12/14/09
			Suspended Solids	SM 2540D	**45.**	mg/L	3	12/15/09
			Salinity	SM 2520B	**32.76**			12/14/09
								12/14/09
-2	**Site B**	**12/14/09 1415**	Turbidity	SM 2130B	**8.97**	NTU	0.1	12/14/09
	% transmitance- 97.		pH*	SM 4500-HB	**8.04**		1	12/14/09
			Suspended Solids	SM 2540D	**50.**	mg/L	3	12/15/09
			Salinity	SM 2520B	**32.76**			12/14/09
								12/14/09
-3	**Site C**	**12/14/09 1420**	Turbidity	SM 2130B	**8.98**	NTU	0.1	12/14/09
	% transmitance- 97.		pH*	SM 4500-HB	**8.04**		1	12/14/09
			Suspended Solids	SM 2540D	**51.**	mg/L	3	12/15/09
			Salinity	SM 2520B	**32.76**			12/14/09
								12/14/09
-4	**Site D**	**12/14/09 1425**	Turbidity	SM 2130B	**21.2**	NTU	0.1	12/14/09
	%transmitance- 95.		pH*	SM 4500-HB	**8.06**		1	12/14/09
			Suspended Solids	SM 2540D	**144.**	mg/L	3	12/15/09
			Salinity	SM 2520B	**32.68**			12/14/09

*EPA Method Update Rule (4/11/07) mandates 15 minute hold time.

Report Completion Date: 12/15/2009

Reviewed: Amanda Smith

Amanda Smith, Lab Director

MORRO BAY HARBOR MAINTENANCE DREDGING WATER MONITORING

Date: **12/24/2009**

Main Channel Dredge Down due to mechanical problems.

Sample Site	Time	D.O.	Temp.	Turbidity	pH	Salinity	TSS	Weather	Operator
Units		**mg/L**	**Celcius**	**ntu**			**mg/L**		
(a) 100' upstream									
(b) 100' down stream									
(c) 300' down stream									
(d) 1000' down stream									

Harbor Channel Dredge

Sample Site	Time	D.O.	Temp.	Turbidity	pH	Salinity	TSS	Weather	Operator
Units		**mg/L**	**Celcius**	**ntu**			**mg/L**		
(a) 100' upstream	**900**	**10.2**	**10.8**	**8.7**	**8**	**34.18**		**Fair**	**Little**
(b) 100' down stream	**905**	**10.3**	**10.9**	**4.3**	**8**	**34.1**		**Fair**	**Little**
(c) 300' down stream	**910**	**10.3**	**10.8**	**3.8**	**8**	**34.22**		**Fair**	**Little**
(d) 1000' down stream	**915**	**10.3**	**10.8**	**3.7**	**8**	**34.22**		**Fair**	**Little**

Abalone Coast Bacteriology Lab

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Order # **09-2790**

Date/Time Rec'd **12/24/09 1230**

Fluid Resource Management
918 Highland Way
Grover Beach, CA.

Contact: Chris Nally
Phone: 441-0212
Sampler: Joe Little

Project: Harbor Channel-weekly

Sample #	Sample description	Date / Time	Analysis	Method	Result	Units	DLR	Completed
-1	**Site A**	**12/24/09 900**	Turbidity	SM 2130B	**8.7**	NTU	0.1	12/24/09
	% transmitance- 92.8		pH*	SM 4500-HB	**8.0**		1	12/24/09
			Salinity	SM 2520B	**34.18**		0.1	01/04/10
-2	**Site B**	**12/24/09 905**	Turbidity	SM 2130B	**4.3**	NTU	0.1	12/24/09
	% transmitance- 98.5		pH*	SM 4500-HB	**8.0**		1	12/24/09
			Salinity	SM 2520B	**34.10**		0.1	01/04/10
-3	**Site C**	**12/24/09 910**	Turbidity	SM 2130B	**3.8**	NTU	0.1	12/24/09
	% transmitance- 98.5		pH*	SM 4500-HB	**8.0**		1	12/24/09
			Salinity	SM 2520B	**34.22**		0.1	01/04/10
-4	**Site D**	**12/24/0*9 915**	Turbidity	SM 2130B	**3.7**	NTU	0.1	12/24/09
	% transmitance- 98.2		pH*	SM 4500-HB	**8.0**		1	12/24/09
			Salinity	SM 2520B	**34.22**		0.1	01/04/10

*EPA Method Update Rule (4/11/07) mandates 15 minute hold time.

Report Completion Date: 1/5/2010

Reviewed: Amanda Smith

Amanda Smith, Lab Director

MORRO BAY HARBOR MAINTENANCE DREDGING WATER MONITORING

Date: 12/30/2009

Main Channel Dredge

Sample Site	Time	D.O.	Temp.	Turbidity	pH	Salinity	TSS	Weather	Operator
Units		mg/L	Celcius	ntu			mg/L		
(a) 100' upstream	950	13.4	10.8	1.7	8.1	34.96		Fair	Little
(b) 100' down stream	1000	13.7	12.4	1.49	8.1	34.92		Fair	Little
(c) 300' down stream	1005	13.3	10.7	1.34	8.1	34.8		Fair	Little
(d) 1000' down stream	1010	12.65	10.8	1.85	8.1	34.8		Fair	Little

Harbor Channel Dredge

Sample Site	Time	D.O.	Temp.	Turbidity	pH	Salinity	TSS	Weather	Operator
Units		mg/L	Celcius	ntu			mg/L		
(a) 100' upstream	1040	12.4	10.8	4.07	8.1	34.55		Fair	Little
(b) 100' down stream	1035	13	10.8	4.07	8.1	34.47		Fair	Little
(c) 300' down stream	1030	12.56	10.8	4.29	8.1	34.59		Fair	Little
(d) 1000' down stream	1020	12.59	10.8	4.61	8.1	34.55		Fair	Little

Abalone Coast Bacteriology Lab

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Order # **09-2847**
Date/Time Rec'd **12/31/09 1300**

Fluid Resource Management
918 Highland Way
Grover Beach, CA.

Contact: **Chris Nally**
Phone: **441-0212**
Sampler: **Joe Little**

Project: Main Channel-weekly

Sample #	Sample description	Date / Time	Analysis	Method	Result	Units	DLR	Completed
-1	**Site A 13.4, 10.8**	**12/31/09 0950**	Turbidity	SM 2130B	**1.70**	NTU	0.1	12/31/09
	% transmitance- 98.2		pH*	SM 4500-HB	**8.1**		1	12/31/09
			Salinity	SM 2520B	**34.96**		0.1	01/04/10
-2	**Site B 13.7, 12.4**	**12/31/09 1000**	Turbidity	SM 2130B	**1.49**	NTU	0.1	12/31/09
	% transmitance- 98.5		pH*	SM 4500-HB	**8.1**		1	12/31/09
			Salinity	SM 2520B	**34.92**		0.1	01/04/10
-3	**Site C 13.3, 10.7**	**12/31/09 1005**	Turbidity	SM 2130B	**1.34**	NTU	0.1	12/31/09
	% transmitance- 98.5		pH*	SM 4500-HB	**8.1**		1	12/31/09
			Salinity	SM 2520B	**34.8**		0.1	01/04/10
-4	**Site D 12.65, 10.8**	**12/31/09 1010**	Turbidity	SM 2130B	**1.85**	NTU	0.1	12/31/09
	% transmitance- 98.0		pH*	SM 4500-HB	**8.1**		1	12/31/09
			Salinity	SM 2520B	**34.8**		0.1	01/04/10

*EPA Method Update Rule (4/11/07) mandates 15 minute hold time.

Report Completion Date: 1/5/2010

Reviewed: Amanda Smith

Amanda Smith, Lab Director

MORRO BAY HARBOR MAINTENANCE DREDGING WATER MONITORING

Date: **1/8/2010**

Main Channel Dredge

Sample Site	Time	D.O.	Temp.	Turbidity	pH	Salinity	TSS	Weather	Operator
Units		mg/L	Celcius	ntu			mg/L		
(a) 100' upstream	1130	10.35	12.8	4.44	8.1	34.25	51	Fair	Little
(b) 100' down stream	1135	10.25	12.8	4.67	8.1	34.17	65	Fair	Little
(c) 300' down stream	1140	10	12.8	5.01	8.1	34.09	55	Fair	Little
(d) 1000' down stream	1145	10.1	12.8	4.72	8.1	34.17	67	Fair	Little

Harbor Channel Dredge

Sample Site	Time	D.O.	Temp.	Turbidity	pH	Salinity	TSS	Weather	Operator
Units		mg/L	Celcius	ntu			mg/L		
(a) 100' upstream	1300	10.27	13.4	3.95	8.1	34.17	30	Fair	Little
(b) 100' down stream	1255	10.2	13.4	3.56	8.1	34.25	56	Fair	Little
(c) 300' down stream	1250	10.37	13.3	3.53	8.1	34.33	63	Fair	Little
(d) 1000' down stream	1245	10.23	13.3	3.8	8.1	34.33	61	Fair	Little

Abalone Coast Bacteriology Lab

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Order # **10-0061**

Date/Time Rec'd **01/08/10 1335**

Fluid Resource Management
918 Highland Way
Grover Beach, CA.

Contact: **Chris Nally**
Phone: **441-0212**
Sampler: **Joe Little**

Project: Harbor Channel-monthly

Sample #	Sample description	Date / Time	Analysis	Method	Result	Units	DLR	Completed
-1	**Site A**	**01/08/10 1300**	Turbidity	SM 2130B	**3.95**	NTU	0.1	01/08/10
	% transmitance- 98.5		pH*	SM 4500-HB	**8.1**		1	01/08/10
	10.27 DO; 13.4 degrees		Suspended Solids	SM 2540D	**30.**	mg/L	3	01/10/10
			Salinity	SM 2520B	**34.17**			01/08/10
-2	**Site B**	**01/08/10 1255**	Turbidity	SM 2130B	**3.56**	NTU	0.1	01/08/10
	% transmitance- 98.5		pH*	SM 4500-HB	**8.1**		1	01/08/10
	11.20 DO; 13.4 degrees		Suspended Solids	SM 2540D	**56.**	mg/L	3	01/10/10
			Salinity	SM 2520B	**34.25**			01/08/10
-3	**Site C**	**01/08/10 1250**	Turbidity	SM 2130B	**3.55**	NTU	0.1	01/08/10
	% transmitance- 98.5		pH*	SM 4500-HB	**8.1**		1	01/08/10
	10.37 DO; 13.3 degrees		Suspended Solids	SM 2540D	**63.**	mg/L	3	01/10/10
			Salinity	SM 2520B	**34.33**			01/08/10
-4	**Site D**	**01/08/10 1245**	Turbidity	SM 2130B	**3.80**	NTU	0.1	01/08/10
	% transmitance- 98.5		pH*	SM 4500-HB	**8.1**		1	01/08/10
	10.23 DO; 13.3 degrees		Suspended Solids	SM 2540D	**61.**	mg/L	3	01/10/10
			Salinity	SM 2520B	**34.33**			01/08/10

*EPA Method Update Rule (4/11/07) mandates 15 minute hold time.

Report Completion Date: 1/15/2010

Reviewed: Amanda Smith

Amanda Smith, Lab Director

Abalone Coast Bacteriology Lab

4149 Santa Fe Road, Suite 6 San Luis Obispo CA, 93401
Phone: 595-1080 Fax: 595-1080

Order # **10-0062**

Date/Time Rec'd **01/08/10 1338**

Fluid Resource Management
918 Highland Way
Grover Beach, CA.

Contact: **Chris Nally**
Phone: **441-0212**
Sampler: **Joe Little**

Project: Main Channel-monthly

Sample #	Sample description	Date / Time	Analysis	Method	Result	Units	DLR	Completed
-1	**Site A**	**01/08/10 1130**	Turbidity	SM 2130B	**4.44**	NTU	0.1	01/08/10
	% transmitance- 98.0		pH*	SM 4500-HB	**8.1**		1	01/08/10
	10.35 DO; 12.8 degrees		Suspended Solids	SM 2540D	**51.**	mg/L	3	01/10/10
			Salinity	SM 2520B	**34.25**			01/08/10
-2	**Site B**	**01/08/10 1135**	Turbidity	SM 2130B	**4.67**	NTU	0.1	01/08/10
	% transmitance- 98.0		pH*	SM 4500-HB	**8.1**		1	01/08/10
	10.25 DO; 12.8 degrees		Suspended Solids	SM 2540D	**65.**	mg/L	3	01/10/10
			Salinity	SM 2520B	**34.17**			01/08/10
-3	**Site C**	**01/08/10 1140**	Turbidity	SM 2130B	**5.01**	NTU	0.1	01/08/10
	% transmitance- 98.0		pH*	SM 4500-HB	**8.1**		1	01/08/10
	10.0 DO; 12.8 degrees		Suspended Solids	SM 2540D	**55.**	mg/L	3	01/10/10
			Salinity	SM 2520B	**34.09**			01/08/10
-4	**Site D**	**01/08/10 1145**	Turbidity	SM 2130B	**4.72**	NTU	0.1	01/08/10
	% transmitance- 98.0		pH*	SM 4500-HB	**8.1**		1	01/08/10
	10.10 DO; 12.8 degrees		Suspended Solids	SM 2540D	**67.**	mg/L	3	01/10/10
			Salinity	SM 2520B	**34.17**			01/08/10

*EPA Method Update Rule (4/11/07) mandates 15 minute hold time.

Report Completion Date: 1/15/2010

Reviewed: Amanda Smith

Amanda Smith, Lab Director

MORRO BAY HARBOR MAINTENANCE DREDGING WATER MONITORING

Date: **1/12/2010**

Main Channel Dredge down due to mechanical problems.

Sample Site	Time	D.O.	Temp.	Turbidity	pH	Salinity	TSS	Weather	Operator
Units		**mg/L**	**Celcius**	**ntu**			**mg/L**		
(a) 100' upstream									
(b) 100' down stream									
(c) 300' down stream									
(d) 1000' down stream									

Harbor Channel Dredge

Sample Site	Time	D.O.	Temp.	Turbidity	pH	Salinity	TSS	Weather	Operator
Units		**mg/L**	**Celcius**	**ntu**			**mg/L**		
(a) 100' upstream	1050	11.54	13.6	3.7	8.1	34.16	62	Fair	Little
(b) 100' down stream	1110	11.66	13.6	3.8	8.1	34.16	75	Fair	Little
(c) 300' down stream	1115	11.71	13.6	3.8	8.1	34.25	62	Fair	Little
(d) 1000' down stream	1120	11.51	13.6	4	8.1	34.25	61	Fair	Little

Abalone Coast Bacteriology Lab

Order # **10-0085**

4149 Santa Fe Road, Suite 6 San Luis Obispo CA, 93401
Phone: 595-1080 Fax: 595-1080

Date/Time Rec'd **01/12/10 1305**

Fluid Resource Management
918 Highland Way
Grover Beach, CA.

Contact: **Chris Nally**
Phone: **441-0212**
Sampler: **Joe Little**

Project: **Harbor Channel-monthly**

Sample #	Sample description	Date / Time	Analysis	Method	Result	Units	DLR	Completed
-1	**Site A**	**1/12/10 1050**	Turbidity	SM 2130B	**3.7**	NTU	0.1	01/12/10
	% transmitance-98.8		pH*	SM 4500-HB	**8.1**		1	01/12/10
	11.54 DO, 13.6 degrees		Suspended Solids	SM 2540D	**62.**	mg/L	3	01/15/10
			Salinity	SM 2520B	**34.16**			01/12/10
-2	**Site B**	**1/12/10 1110**	Turbidity	SM 2130B	**3.8**	NTU	0.1	01/12/10
	% transmitance-98.8		pH*	SM 4500-HB	**8.1**		1	01/12/10
	11.66 DO 13.6 degrees		Suspended Solids	SM 2540D	**75.**	mg/L	3	01/15/10
			Salinity	SM 2520B	**34.16**			01/12/10
-3	**Site C**	**1/12/10 1115**	Turbidity	SM 2130B	**3.8**	NTU	0.1	01/12/10
	% transmitance-98.8		pH*	SM 4500-HB	**8.1**		1	01/12/10
	11.71 DO 13.6 degrees		Suspended Solids	SM 2540D	**62.**	mg/L	3	01/15/10
			Salinity	SM 2520B	**34.25**			01/12/10
-4	**Site D**	**1/12/10 1120**	Turbidity	SM 2130B	**4.0**	NTU	0.1	01/12/10
	% transmitance-98.8		pH*	SM 4500-HB	**8.1**		1	01/12/10
	11.51 DO 13.6 degrees		Suspended Solids	SM 2540D	**61.**	mg/L	3	01/15/10
			Salinity	SM 2520B	**34.25**			01/12/10

*EPA Method Update Rule (4/11/07) mandates 15 minute hold time.

Report Completion Date: 1/15/2010

Reviewed: Amanda Smith

Amanda Smith, Lab Director

Appendix D

Morro Bay maintenance dredging parameters from 1986 to 2013

16-Jul-13
Joe Ryan
(213) 452-3679

Morro Bay Harbor Dredge History - 1986 to present

Start Date	End Date	Volume *cubic yards*	Notes	more notes
Dec-86	**Apr-87**	***460,400***	**Maintenance Dredging - Husky Construction**	
Sep-90	Nov-90	*475,300*	Hopper Yaquina	Nearshore Placement Site
Mar-92	**Mar-92**	***120,330***	**Emergency Maintenance Dredging - Dutra**	
Jan-94	**Feb-94**	*555,900*	**Maintenance - Manson**	**hopper dredge Westport**
Jan-95	**Apr-96**	***1,041,000***	**Navigation Improvements & O&M**	**Natco's Northerly Island hopper dredge and Ross Island's hydraulic dredge**
Sep-97	Oct-97	*63,000*	Hopper Yaquina	Nearshore Placement Site
Jan-98	**Apr-98**	***579,500***	**Maintenance - Manson**	**hopper dredges Westport & Newport - Nearshore Placement Site**
Aug-98	Aug-98	*115,390*	Hopper Yaquina	Nearshore Placement Site
Jun-99	Jul-99	*134,230*	Hopper Yaquina	Nearshore Placement Site
Jul-00	Aug-00	*236,900*	Hopper Yaquina	Nearshore Placement Site
Jun-01	Jul-01	*180,470*	Hopper Yaquina	Nearshore Placement Site
Oct-01	**Jul-02**	***868,500***	**Maintenance - Manson**	**H.R. Morris & Hopper dredge Westport, 657,000 cy placed on beach. 211,500 cy placed at Nearshore Placement site.**
Jun-03	Jul-03	*170,820*	Hopper Yaquina	Nearshore Placement Site
Jul-04	Jul-04	*155,700*	Hopper Yaquina	Nearshore Placement Site
May-05	Jun-06	*134,000*	Hopper Yaquina	Nearshore Placement Site
Jul-06	Jul-06	*196,250*	Hopper Yaquina	Nearshore Placement Site
Jun-07	Jul-07	*150,400*	Hopper Yaquina	Nearshore Placement Site
Jun-08	Jul-08	*140,800*	Hopper Yaquina	Nearshore Placement Site
Jun-09	Jul-09	*151,070*	Hopper Yaquina	Nearshore Placement Site
Nov-09	Sep-10	***574,000***	**Maintenance - AIS Construction**	**16-inch cutterhead dredge La Encina and excavator dredge Gretajean Lind. 375,000 cy placed on beach. 199,000 cy placed at Nearshore Placement site.**
May-10	Jun-10	*249,780*	Hopper Yaquina	Nearshore Placement Site
Jun-11	Jun-11	*120,920*	Hopper Yaquina	Nearshore Placement Site
May-12	May-12	*125,000*	Hopper Yaquina	Nearshore Placement Site
May-13	Jun-13	*122,850*	Hopper Yaquina	Nearshore Placement Site

Appendix E

Air quality analysis calculations

Table 4.5.1
Current Diesel Technology Available to Dredges

Technology	Affected Parameter		Anticipated Control Efficiency
	Increase	Decrease	
Fuel Modifications			
Sulfur content decrease		SOx, PM, wear	
Aromatic content decrease		PM, NOx	
Cetane number		PM, NOx	
Fuel additive		PM, NOx	
Water injection		NOx	NOx: 25-35%
Engine Modifications			
Injection timing retard	PM, fuel consumption	NOx, power	NOx: 15->45%
Fuel injection pressure		PM, NOx	PM: >80%
Injection rate control		PM, NOx	
Rapid spill nozzles		PM	
Electronic timing and metering		PM, NOx	
Injector nozzle geometry		PM	
Combustion chamber modifications		NOx, PM	
Turbocharging	Power	NOx	
Inner/after cooling	Power	NOx	NOx: 20-30%
Exhaust gas recirculation	PM, power, wear	HC	
Oil consumption control		PM, wear	
Exhaust after-treatment			
Particulate traps		PM	PM: <90%
Selective catalytic reduction (SCR)		NOx, HC	NOx: 80-95%, HC: 50-60%
Oxidation catalysts		HC, CO, PM	

Based on USEPA AP-42, A Compilation of Air Pollutant Emission Factors (1985, with updates through 2007); California Air Resources Board (CARB), Initial Statement of Reasons for Proposed Rulemaking (January 9, 1992, staff report).

Table 4.5-2
Emission Factors for Dredges

Source	CO	NOx	ROC	PM_{10}/ SOx [6]
Traditional AP-42 Large-Bore Diesel Emission Factors				
Uncontrolled diesel emission factors (Lb/hp-hr)[1]	0.0055	0.024	0.0006	0.0007/ 0.00809
Controlled diesel emission factors (Lb/hp-hr)[2]	0.0055	0.013	0.0006	0.0007/ 0.00809
Caterpillar 3516B Emission Factors[3]				
Lb/hp-hr	0.0008	0.18	0.0003	0.0002/ 0.0004
H.R. Morris Emission Factors				
Lb/hp-hr	0.0001	0.0004	0.0002[4]	0.0002[3]/ 0.0002
Traditional AP-42 Emissions for a 2,600 Horsepower Diesel[5]				
Uncontrolled diesel emission factors (Lb/hr)	7.2	31.2	0.8	0.9/ 10.5
Controlled diesel emission factors (Lb/hr)[2]	7.2	16.9	0.8	0.9/ 10.5
Caterpillar 3516B Emissions for a 2,600 Horsepower Diesel[5]				
Lb/hr	1.0	23.8	0.4	0.2/ 0.5
H.R. Morris Emission Factors[5]				
Lb/hr	0.1	0.5	0.2	0.2/ 0.3

[1] Based on Table 3.4-1 of USEPA AP-42, A Compilation of Air Pollutant Emission Factors (1985,with updates through 2007).
[2] NOx controlled by injection timing retard.
[3] Based on data provided by Caterpillar for this engine.
[4] Assumes 50 percent control efficiency for use of selective catalytic reduction (SCR).
[5] A 50 percent load factor used for this engine per discussion with Caterpillar Diesel.
[6] SOx values are separate emission factors from PM10.
[7] There is no Federal emission factor for Pb-lead.

Table 4.5-3
Emissions for Dredges (lb/day) [1]

Source	CO	NOx	ROC	PM_{10} / SOx [2]
Traditional AP-42 Emissions for a 2,600 Horsepower Diesel				
Uncontrolled diesel emission	129.6	561.6	14.4	16.2/189.0
Controlled diesel emission	129.6	304.2	14.4	16.2/189.0
Caterpillar 3516B Emissions for a 2,600 Horsepower Diesel				
	18.0	428.4	7.2	3.6/9.0
H.R. Morris Emissions				
	1.8	9.0	3.6	3.6/5.4

[1] Based on 24 hour per day maintenance dredging operation.
[2] SOx values are separate emission calculations from PM10.

<u>Project Information for Air Quality Calculation Analysis:</u>

1. Maintenance dredging of approximately 850,000 cubic meters (m^3) clean sediment from the proposed Morro Bay Harbor project area.

2. Type, Number of Maintenance (construction) Equipment to be used, dredging time period . All equipment will use diesel fuel.

    1 – Dredge
    1 – Tug Boat; 2 – Crew Boats;
    1 – bulldozer
    36– Vehicles (On-road)
    Maintenance dredging time period: 1 month (30 working day per month, for 24 hours per day).

3. The following calculations are based on the cited Sources:
1) SCAQMD 1993 California Environmental Quality Act (CEQA) Handbook (with revisions through 2007) for emission factors and other activity assumptions (SCAQMD, 1993, with revisions through 2007);
2) US EPA Best Practices in Preparing Port Emission Inventories (USEPA, 2005).

Table 4.5.4
Ancillary Equipment Operations and Horsepower Ratings

Emission Source	Number	Horsepower	Total Hours per Day
Tugboat	1	1,600	2
Crew Boats	2	50	4

Table 4.5.5
Tug Boat Fuel Data

Fuel Type	Diesel
Fuel Density, lb/gal	7.12
Specific Fuel Consumption, lb/hp/hr	0.40
Idle Load Factor	0.20
Maneuver Load Factor	0.50
Cruise Load Factor	0.80

4. Estimating Fugitive emissions for Vehicle Miles Traveled (VMT) for construction laborers (Table A9-9-A). It is assumed that 36 personnel will work and 36 Vehicles used. Personnel will commute from approximately 6.25 miles one-way on-road. Note: No off-road work.

V=W x (X/Y) x Z; Where V=VMT, W=Distance, X=number of vehicles, Y=1 hour, Z= estimated travel time

VMT= 12.5 miles/day x (36 vehicles/hr) x 0.5 hr = $\boxed{\text{225 miles per day}}$

5. Estimating fugitive emissions from passenger (commuter) Vehicle Travel on Paved Roads (Table A9-9-B).

E = V x G (with street cleaning and is dependent on type of road); where E= emissions for passenger vehicles; V= VMT; **and** G = 0.00065 for freeways **(Table A9-9-B-1).**

E = 225 miles/day x 0.00065 lbs/mile = $\boxed{\text{0.15 lbs/day}}$
Note: No off-road work = no off-road fugitive emissions/day.

6. Total Fugitive Emissions (Vehicles) = 0.15 lb/day

TYPE OF VEHICLE	NUMBER OF VEHICLES	VMT/DAY (on-road)	VMT/DAY (off-road)	EMISSIONS (on-road) (lbs/day)	EMISSIONS (off-road) (lbs/day)
Passenger (commuter)	36	225	0	0.15	0
Total on-road fugitive emissions	na	na	na	0.15	na

"na" means "Not Applicable"

7. Vehicle Exhaust Emissions: Dredge of Morro Bay Harbor maintenance dredging sediment material to be Placement of Dredged Material Site. Note: values are approximate.

Volume of Material dredged (m^3) = 850,000 Total # of Days Required = 30
Vol. of material dredged per day = 32,692 m^3
Truck Weigh > 6K # of trips required each day/truck= 1
Number of Trucks used 36 trucks
Project time in Months (days) 1 months (30 days)

VMT per day = 225 miles per day
On-Road = 12.5 miles/day
Off-road = na
Travel Distance (miles/truck trip)
On-Road (one way) = 6.25 miles

Speed (mph)
On-Road 40
Work Area: 2 (Los Angeles County; similar to San Luis Obispo County)
Year: 2013 (use Calendar Year 2013)
Table(s): A9-5-K-9; A9-5-L
Cold Starts: 100%
Hot Start 0%

On – Road Vehicle (Truck) Emission Factor: 40 mph

Activity	CO	NOx	ROC	PM-10	SOx	Pb – lead
Exhaust + Evaporative (grams/mile)	4.72	3.73	0.55	0.195	0.29	0.0004
Tire Wear	Na	Na	Na	0.195	Na	Na
Cold Start (grams/trip)	25.24	1.92	1.39	Na	Na	Na
Hot Start (grams/trip)	2.81	0.90	0.34	Na	Na	Na
Hot Soak (grams/trip)	Na	Na	0.40	Na	Na	Na
Diurnal (grams/vehicle/ day)	Na	Na	1.30	Na	Na	Na

Appendix E

On-Road Vehicle (Truck) Emission (lb/day)

Activity	CO	NOx	ROC	PM-10	SOx	Pb – lead
Travel Emissions	2.34	1.85	0.27	0.10	0.14	0.00002
Cold Start	2.00	0.15	0.11	na	Na	Na
Hot Start	0	0	0	na	Na	Na
Hot Soak	Na	Na	0.03	na	Na	Na
Diurnal	Na	Na	0.10	na	Na	Na
Totals	4.34	2.00	0.51	0.10	0.14	0.00002

On-Road Emission (lb/day): 40 mph

a. Travel emission formula= [(emission factors (Exhaust+Tire wear)) x (Distance traveled(VMT))]/(454 grams/lbs)
PM10 = [0.195 grams/mile x 225 miles/day]/454 grams/lb = [43.88 grams/day]/454 grams/lb = 0.10 lbs/day PM10
CO = [4.72 grams/mile x 225 miles/day]/454 grams/lb = [1062 grams/day]/454 grams/lb = 2.34 lbs/day CO
ROC = [0.55 grams/mile x 225 miles/day]/454 grams/lb = [123.75 grams/day]/454 grams/lb = 0.27 lbs/day ROC
NOx = [3.73 grams/mile x 225 miles/day]/454 grams/lb = [839.25 grams/day]/454 grams/lb = 1.85 lbs/day NOx
SOx = [0.29 grams/mile x 225 miles/day]/454 grams/lb = [65.25 grams/day]/454 grams/lb = 0.14 lbs/day SOx
Pb = [0.0004 grams/mile x 225 miles/day]/454 grams/lb = [0.09 grams/day]/454 grams/lb = 0.0002 lb/day Pb

b. Cold start formula = [(#vehicles) x (Cold start emission factor)]/454 gram/lbs)
CO = [36 trucks x 25.24 grams/trip]/454 grams/lb = [908.64 grams/day]/454 grams/lb = 2.00 lbs/day CO
ROC = [36 trucks x 1.39 grams/trip]/454 grams/lb = [50.04 grams/day]/454 grams/lb = 0.11 lbs/day ROC
NOx = [36 trucks x 1.92 grams/trip]/454 grams/lb = [69.12 grams/day]/454 grams/lb = 0.15 lbs/day NOx

c. Hot Start emission formula: [(# daily trips) –(# of vehicles)] x (Hot start emission factor)/454 gram/lbs)
[36 truck trips – 36 trucks trips] x (2.81 grams/trip/454 grams/lb] = 0.00 lbs/day CO
[36 truck trips – 36 trucks trips] x (0.34 grams/trip/454 grams/lb] = 0.00 lbs/day ROC
[36 truck trips – 36 trucks trips] x (0.90 grams/trip/454 grams/lb] = 0.00 lbs/day NOx

d. Hot soak emission formula: (# daily trips) x (Hot soak emission factor)/454 grams/lb)
36 daily trips x (0.40 grams/trip)/454 grams/lb = 14.4 daily grams/454 grams/lb = 0.03 lbs/day ROC

e. Diurnal emission formula: (#Vehicles) x (Diurnal emission factor)/454 grams/lbs)
36 trucks x (1.30 grams/vehicle/day)/454 grams/lb = 0.10 lbs/day ROC

8. Total Vehicle (On-road) project emissions (lbs/day).

Source	CO	NOx	ROC	PM-10	SOx	Pb
Exhaust	4.34	2.00	0.51	0.10	0.14	0.00002
Fugitives	na	Na	na	0.15	na	Na
Daily Total	4.34	2.00	0.51	0.25	0.14	0.00002

Table 4.5.6
Daily Emissions for Ancillary Vessels and Vehicles Associated With Dredging Operations (lb/day)

Emission Source	CO	NOx	ROC[5]	PM_{10}	SOx[4]
Tug Boats[1]	6.80	9.50	5.20	2.20	2.40
Crew Boats[2]	0.70	1.70	0.90	0.20	0.22
Worker Vehicles[3]	4.68	2.05	0.58	0.36	0.15

[1] Note tug boat data above for HP (horsepower) and hours of operation. Emission factors for CO, NOx, and ROC are as per AP-42, 1985, Table II-3.3, w/updates through 2013. Emission factors for PM_{10} are as per AP-42, A Compilation of Air Pollutant Emission Factors (1985) 1985, Table II-7.1 for a miscellaneous piece of diesel-powered, heavy-duty construction equipment. Pb - lead not cited in AP-42 Table II-3.3 or II-7.1.
[2] See crew boat data above for HP and hours of operation. Emission factors for CO, NOx, and ROC are as per AP-42, 1985, Table II-3.5. Emission factors for PM_{10} are as per AP-42, 1985, Table II-7.1 for a miscellaneous piece of diesel-powered, heavy-duty construction equipment. Pb - lead not cited in AP-42 Table II-3.5.
[3] Based on 36 laborers and 36 vehicles (light duty truck). Emission data taken from SCAQMD CEQA Air Quality Handbook Estimations (1993, with revisions through 2013), Table A9-5-K-9 (Calendar Year 2013, Area 2), 40 miles per hour, 1 trip per day. PM_{10} calculations include determination for PM_{10} exhaust and plus PM_{10} fugitive. See calculations above for CO, NOx, ROC, PM10 and SOx.
[4] NAAQS and California AQS have been established for SOx.
[5] ROC, ROG and VOC are used interchangeably.

Bulldozer (1) Emissions:

Maintenance Dredging								
Emission Source Data for Maintenance Dredging								
Construction Activity/Equipment Type	Power Rating	Load Factor	# Active	Hourly Hp-Hrs	Fuel Use GPH	Hrs per Day (1)	Total Work Days (2)	DailyTotal Hp-Hrs (1)
Bulldozer-D8	335	0.50	2	335	18.8	8	21	2,680

Emission Factors for Construction Equipment					
Equipment Type	ROG	CO	NOx	SOx	PM10
Bulldozer (grms/HP-HR)	1.7	4.8	10.3	0.9	1.1

TABLE 4.5.7
Morro Bay Harbor Maintenance Dredging Total Emissions In Pounds/Day (Lbs/Day), Tons/Yr, Tons/Qtr, and Metric Tons/Yr

Type of Equipment	No.	CO	NOx	ROG	PM10	PM2.5	SOx	Pb- lead	DPM	GHG
2,600 HP Diesel Dredge w/SCR Ammonia	1	1.8	9	3.6	3.6	0.9	5.4	na	3.1	0.1
Injection, Controlled Emission										
Tug Boat	1	6.8	9.5	5.2	2.2	0.5	2.4	na	0.7	<0.1
Crew Boats	2	0.7	1.7	0.9	0.2	0.05	0.22	na	0.2	<0.1
Workers (Laborers) Vehicles	36	4.34	2	0.51	0.25	0.06	0.14	0.00002	0.1	<0.1
Bulldozer	1	4.8	10.3	1.7	1.1	0.26	0.9	0.0000001	0 .6	0.1
Total Emissions In Lbs/Day		18.44	32.5	11.91	7.35	1.77	9.06	0.00002	4.7	na
Total Emissions In (Tons/Yr)		0.28	0.49	0.18	0.11	0.03	0.14	0.0000003	.07	0.2 metric tons
SLOCACPD Construction Threshold, Lbs/Day		na	ROG[1]+NOx= 137		na	na	na	na	7	Amortized
SLOCACPD Construction Threshold, Tier 1,Tons/Qtr		na	ROG[1]+NOx= 2.5		2.5	na	na	na	0.13	Amortized
SLOCACPD Construction Threshold, Tier 2,Tons/Qtr		na	ROG[1]+NOx= 6.3		na	na	na	na	0.32	Amortized
SCAQMD/SCAB Construction Threshold, Lbs/Day		550	100	75	150	55	150	3	na	na
SCAQMD/SCAB Construction Threshold, GHG Metric Tons/Yr		na	Na	na	na	na	na	na	na	10,000
Exceeds SLOCAPCD Construction Threshold, Lbs/Day?		na	11.44+32.5 =44.41 No	No	na	na	na	na	na	na
Exceeds SLOCAPCD Const.		na	0.18+0.49= 0.67	No	0.028 No	na	na	na	na	na

Threshold Tier 1,Tons/Qtr?			No							
Exceeds SLOCAPCD Const. Threshold Tier 2,Tons/Qtr?		na	0.18+0.49= 0.67 No	No	na	na	na	na	na	na
Exceeds SCAB Construction Threshold, Lbs/Day?		18.44 No	32.5 No	11.91 No	7.35 No	1.77 No	9.06 No	0.00002 No	4.7 No	na
Exceeds SCAB Construction Threshold, GHG MetricTons/Yr?		na	na	na	na	na	na	na	na	0.2 No
Total Emissions, Tons/Year (Tons/Yr)		0.28	0.49	0.18	0.11	0.03	0.14	0.0000003	.07	0.2 metric tons
Federal Standard Threshold, Tons/Yr		100	25	10	70	100	100	Na	na	na
Federal Standard Threshold, GHG Metric Tons/Yr		na	na	na	na	na	na	Na	na	25,000
Exceeds Federal Standard Threshold, Tons/Yr?		0.28 No	0.49 No	0.18 No	0.11 No	0.03 No	0.14 No	0.0000003 na	.07 na	na
Exceeds Federal Standard Threshold, GHG Metric Tons/Yr?		na	na	na	na	na	na	na	na	0.2 metric tons No

Calculations: Total Emissions in Lbs/Day and Tons/Qtr (SLOCAPCD) - ROG, NOx, PM10

ROG + NOX (Lbs/Day)
11.91 + 32.5 = 44.41 Lbs/Day

ROG + NOX (Tons/Yr**)**
0.18 + 0.49 = 0.67 Tons/Yr

ROG = 11.91 lbs/day x 30 days/Qtr x 1 ton/2000 lbs = 0.18 tons/yr of ROG

NOx = 32.5 lbs/day x 30 days/Qtr x 1ton/2000 lbs = 0.49 tons/yr of NOx

PM10 = 7.35 lb/day x 30 days/Qtr x 1 ton/2000 lbs = 0.1 tons/yr = 0.11 tons/qtr
DPM = 3.1 lbs/day (dredge) + .7 lbs/day (tug boat) + .2 lbs/day (crew boat) + .1 lbs/day (laborers commuter vehicles) + .6 lbs/day (bulldozer) = 4.7 lbs/day DPM (or .07 tons/quarter).

Calculations: Total Emissions in Tons/Yr (Federal)

CO = 18.44 lb/day x 30 days/yr x 1 ton/2000 lbs = 0.28 tons/yr of CO

NOx = 32.50 lb/day x 30 days/yr x 1 ton/2000 lbs = 0.49 tons/yr of NOx

VOC = 11.91 lb/day x 30 days/yr x 1 ton/2000 lbs = 0.18 tons/yr of ROC

PM10 = 7.35 lb/day x 30 days/yr x 1 ton/2000 lbs = 0.11 tons/yr of PM10
PM2.5 = 1.77 lb/day x 30 days/yr x 1 ton/2000 lbs = 0.03 tons/yr of PM10
SOx = 9.06 lb/day x 30 days/yr x 1 ton/2000 lbs = 0.14 tons/yr of SOx

Pb-lead = 0.00002 lb/day x 30 days/yr x 1 ton/2000 lbs = 0.0000003 tons/yr of Pb-lead

Table 4.5.8 Green House Gases (GHG) Calculations

GHG Emissions								
Maintenance Dredging								
Emission Source Data for Maintenance Dredging								
Construction Activity/Equipment Type	Power Ra	Load Fac	# Active	Hourly H	Fuel Use GP	Hrs per Day	Total Worl	Daily Total Hp-Hrs (1)
Clamshell dredge	1,890	1.0	1	1,890	N/A	22	123	41,580
Tug boat-clamshell dredge	800	0.20	1	160	8.0	22	123	176
Hydraulic Dredge	2,600	NA	1	NA	NA	22	18	NA
Crew Boat	50	NA	1	NA	NA	4	141	NA
Tug boat-hydraulic dredge	1,600	NA	1	NA	NA	2	18	NA
Worker vehicles	NA	NA	18	NA	NA	12.5	141	NA
Hopper Dredge	2,000	NA	1	NA	NA	22	21	22,000
Bulldozer-D8	335	0.50	2	335	18.8	8	18	2,680

Table 4.5.8 Green House Gases (GHG) Calculations (continued)

Emission Factors for Construction Equipment	
	Grams per HP-HR
Equipment Type	**CO2**
Clamshell dredge	568
Tugboat	509
Hydraulic Dredge	183
Crew Boat	75
Tug boat-hydraulic dredge	93.9
Worker vehicles	1.1
Hopper Dredge	183
Bulldozer	390

Table 4.5.8 Green House Gases (GHG) Calculations (continued)

Estimated Emissions from Construction Equipment		
	CO2	
Equipment Type	lbs/day	tons total
Clamshell dredge	27.6	0.3
Tugboat	24.7	0.3
Hydraulic Dredge	8.9	0.1
Crew Boat	0.7	0.0
Tug boat-hydraulic dredge	0.4	0.0
Worker vehicles	0.5	0.0
Hopper Dredge	8.9	0.1
Bulldozer	6.9	0.1
Total		
Hydraulic Dredge	17.4	0.2
Clamshell dredge	53.5	0.6
Hopper Dredge	10.1	0.1
Total Equivalent CO2		
Hydraulic Dredge	17.5	0.2
Clamshell dredge	53.9	0.6
Hopper Dredge	10.2	0.1
CO2 Equivalent = CO2*1.008		

Appendix F

2013-2014 Morro Bay SAPR analysis and suitability determination

FINAL SAMPLING AND ANALYSIS REPORT

Morro Bay Harbor Geotechnical and Environmental Investigation Project
Sampling, Bulk Sediment Chemistry, Geotechnical and Suitability Determination Results

Task Order No. 0004, USACE Contract No. W912PL-11-D-0015

Prepared for:
U.S. Army Corps of Engineers
Los Angeles District
Los Angeles, California

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January 2014

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Appendix F

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FINAL SAMPLING AND ANALYSIS REPORT

Morro Bay Harbor Geotechnical and Environmental Investigation Project Sampling, Bulk Sediment Chemistry, Geotechnical and Suitability Determination Results

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ASTM	American Society for Testing and Materials	**MSD**	Minimum Significant Difference
BLK	Method or Procedural Blank	**ND**	Not Detected
BMP	Best Management Practice	**NOAA**	National Oceanic and Atmospheric Administration
BS	Blank Spike	**OEHA**	Office if Environmental Hazard Assessment
BSD	Blank Spike Duplicate	**PAH**	Polyaromatic Hydrocarbon
Cal/EPA	California Environmental Protection Agency	**PCB**	Polychlorinated Biphenyl
CD	Compact Disc	**PDS**	Post Digestion Spike
CDFG	California Department of Fish and Game	**PDSD**	Post Digestion Spike Duplicate
CESPD	Corps of Engineers South Pacific Division	**PPB**	Parts Per Billion
CHHSL	California Human Health screening Level	**PPM**	Parts Per Million
COC	Chain of Custody	**PRG**	Preliminary Remediation Goals
CSLC	California State Lands Commission	**PVC**	Polyvinyl Chloride
CV	Coefficient of Variation	**RBC**	Risk-Based Concentration
cy	Cubic Yards	**RL**	Reporting Limit
CRM	Certified Reference Material	**RPD**	Relative Percent Difference
DDD	Dichlorodiphenyldichloroethane	**RSLs**	Regional Screening Levels for Cleanup of Superfund Sites
DDE	Dichlorodiphenyldichloroethylene	**SC-DMMT**	Southern California Dredge Material Management Team
DDT	Dichlorodiphenyltrichloroethane	**SCOUP**	Sand Compatibility and Opportunistic Use Plan
DGPS	Differential Global Positioning Satellite	**SOPs**	Standard Operating Procedures
DTSC	Department of Toxic Substances Control	**SRM**	Standard Reference Material
DUP	Laboratory Replicates	**STLC**	Title 22 Soluble Threshold Limit Concentration
ERL	NOAA Effects Range Low	**SURR**	Surrogate Analysis
ERM	NOAA Effects Range Medium	**SWQCB**	State Water Resources Control Board
GPS	Global Positioning Satellite	**TMDL**	Total Maximum Daily Log
HHMSSL	Human Health Medium – Specific Screening Levels	**TOC**	Total Organic Carbon
HDPE	High-density Polyethylene	**TRPH**	Total Recoverable Hydrocarbons
ITM	Inland Testing Manual	**TTLC**	Title 22 Total Threshold Limit Concentration
LCL	Lower Control Limit	**UCL**	Upper Control Limit
LCS	Laboratory Control Spike	**USACE**	U.S. Army Corps of Engineers
LDPE	Low-density Polyethylene	**USEPA**	U.S. Environmental Protection Agency
LSD	Least Significant Difference	**QA**	Quality Assurance
MDL	Method Detection Limit	**QC**	Quality Control
MLLW	Mean Lower Low Water	**QUAL**	Qualifier
MS	Matrix Spike	**USCS**	Unified Soil Classification System
MSD	Matrix Spike Duplicate		

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FINAL SAMPLING AND ANALYSIS REPORT

Morro Bay Harbor Geotechnical and Environmental Investigation Project Sampling, Bulk Sediment Chemistry, Geotechnical and Suitability Determination Results

Task Order No. 0004, USACE Contract No. W912PL-11-D-0015

January 2014

EXECUTIVE SUMMARY

The United States Army Corps of Engineers (USACE) will be conducting annual routine maintenance dredging of the federal channels in Morro Bay Harbor in order to restore the channels back to their design depths between -12 to -40 feet Mean Lower Low Water (MLLW). The volume of shoaled material based on a 2012 survey is 450,056 cubic yards (cy) with a two-foot overdredge allowance for non-advanced maintenance dredging areas only. This study was undertaken to evaluate the physical and chemical properties of the sediments within the Morro Bay Harbor channels in order to support planning and permitting for dredging and reuse. It is desired to reuse all of the Morro Bay Harbor sediments for beach replenishment at either the nearshore site immediately off of Montana de Oro State Beach or in the surf zone along Morro Strand State Beach.

Vibracore sampling was carried out off the 38-foot vessel the *Bonnie Marietta to* collect subsurface sediment samples during the period of August 12 through 15, 2013. The vibracore was used at twenty-seven (27) locations throughout six (6) channel areas (Areas A through F). Each channel area represents a composite area except Areas C and D which were combined into one composite sample. Thus the 27 core locations sampled were combined into five composite samples.

Subsamples were combined with like subsamples in a composite area to form the five sediment composite samples. Each composite sample formed was analyzed for volatile solids, pH, TOC, oil & grease, TRPH, ammonia, sulfides, metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, zinc), butyltins, pyrethroid pesticides, chlorinated pesticides, PCB congeners, phenols, phthalates, and PAH compounds. In addition, samples for grain size analyses and for archiving were collected from each of the individual cores prior to compositing. These grain size and archive samples represented the entire core length from the mudline to project depth for Areas A and B, and from the mudline to the two foot overdredge elevation for Areas C through E. No significant vertical grain size stratification was present in any of the individual cores (above the bottom sampling elevation).

To assist in evaluating beach suitability, a series of surface grab reference samples for physical observations and testing were collected on August 15, 2013 at eight locations at the nearshore placement site immediately offshore of Montana de Oro State Beach and along three transects at Morro Strand State Beach. Samples along each of the three transects were collected at eight elevations (+12, +6, 0, -6, -12, -18, -24, and -30 ft MLLW). All reference samples were tested for grain size distribution. These grain size gradation data were compared with grain size gradation data from the Morro Harbor samples by the Los Angeles District USACE to determine if the Harbor sediments are physically compatible with sand and sediment from the nearshore placement site immediately offshore of Montana de Oro State Beach and from the Morro Strand State Beach. The USACE report (Appendix C) concluded that all of the sediments within the five channel areas are compatible for placement at the two preselected placement sites based on the weighted average of both the individual and composite sediment grain size curves for all core samples collected amongst each of the footprint areas.

Bulk sediment chemistry results were evaluated against NOAA effects-based screening levels and human health objectives. Only nickel in all five composite samples was elevated above NOAA's lower effects-based screening values and only arsenic was elevated above human health objectives. The arsenic exceedances were investigated further to see if the Morro Bay Harbor sediment concentrations were elevated above an estimated background arsenic concentration for local beaches. This investigation came up with a local beach background concentration of 4.37 mg/kg (Appendix D), which is higher than the arsenic concentrations in the five composite samples (2.8 to 3.4 mg/kg). Furthermore, the position of the California Department of Toxic Substances Control (Dr. William Bosan, personnel communication) is that the risk to human health is minimal for arsenic concentrations below 12.0 mg/kg. Therefore, arsenic excursions above screening levels appear to be minor and the overall dataset indicates that there is little chance of increased adverse biological or human health effects from the placement of Morro Bay Harbor sediments in the nearshore area of Montana de Oro State Beach and in the surf zone along Morro Strand State Beach.

1.0 INTRODUCTION

Routine maintenance dredging is required on an annual basis for the federal channels of Morro Bay Harbor, California (Figure 1) in order to maintain the channels to design depths. Sediments to be dredged require an environmental evaluation of sediment quality in order to support planning and permitting for dredging and reuse. This project is authorized by 1958 Rivers and Harbors Act (H. DOC. 356, 90TH CONG. 2nd SESS).

This report has been prepared on behalf of the U.S. Army Corps of Engineers, Los Angeles District to describe results from the sampling and testing of sediments from Morro Bay Harbor identified for placement at two potential beach nourishment areas. This work is being performed under Task Order No. 0004, USACE Contract No. W912PL-11-D-0015. All work described in this report was done in accordance to the approved SAP (Diaz Yourman and Associates, GeoPentech and Kinnetic Laboratories Joint Venture, 2013).

The SC-DMMT reviewed the 2013 preliminary draft SAP during the SC-DMMT's February 27, 2013 monthly meeting, and review comments from the USEPA were incorporated into the 2013 preliminary draft SAP. The SC-DMMT also reviewed the draft SAP with Appendices during the SC-DMMT July 24, 2013 meeting with no review comments received on the 2013 draft SAP or its appendices. During the July 24, 2013 SC-DMMT monthly meeting, the USEPA requested additional time for review of the appendices for the 2013 draft SAP, and agreed to submit their comments by July 31, 2013. These appendices included an appendix of previous 2008 summary test results from the 2008 Morro Bay Soils Log and Geotechnical Data. The USEPA responded on August 1 and stated the grain size data looked fine from 2008 sampling episode, and as such, the USEPA stated the compositing scheme is acceptable and no further comments were issued. As no new comments on the 2013 draft SAP or its appendices were received from the SC-DMMT, and since the SC-DMMT did not request an out of cycle meeting to approve the 2013 draft SAP with its appendices, the draft 2013 SAP with its appendices was finalized as the final SAP with its appendices on August 1, 2013. A copy of the final SAP dated August 2013 can be requested from the U.S. Army Corps of Engineers (USACE), Los Angeles District (LAD) from point of contact (POC) Kirk Brus, at e-mail address kirk.c.brus@usace.army.mil or by phone number (213) 452-3876.

1.1 Project Summary

The purpose of this project was to sample and test sediments from within the federal channels proposed for annual maintenance dredging to provide sediment quality data for evaluation of dredging and beach nourishment. This report is to fulfill requirements of the Army Corps of Engineers South Pacific Division Regulation No. 1110-1-8 (CESPD, 2000), the Inland Testing Manual (ITM) (USACE and USEPA, 1998), the Clean Water Act (CWA), Southern California Dredge Material Management Team (SC-DMMT) draft guidelines, and in support of the new six year Environmental Assessment for the Morro Bay Harbor Federal Maintenance Dredging Project. Since arsenic is commonly found at elevated concentrations in ambient soils and dredged sediments, a secondary purpose of this project is to determine background arsenic concentrations for area beaches and determine if the Morro Bay Harbor sediments are elevated above beach background concentrations.

Based on a hydrographic survey conducted in the spring of 2012, the estimated volume of sediments needing to be dredged from the approximately 118 acres of Morro Bay Harbor Federal Navigation Channels at that time was 450,056 cubic yards (cy) including overdredge allowance. This quantity most likely has not changed much due to the offshore littoral drift of sediments into the Harbor despite annual dredging of the Modified Entrance Channel.

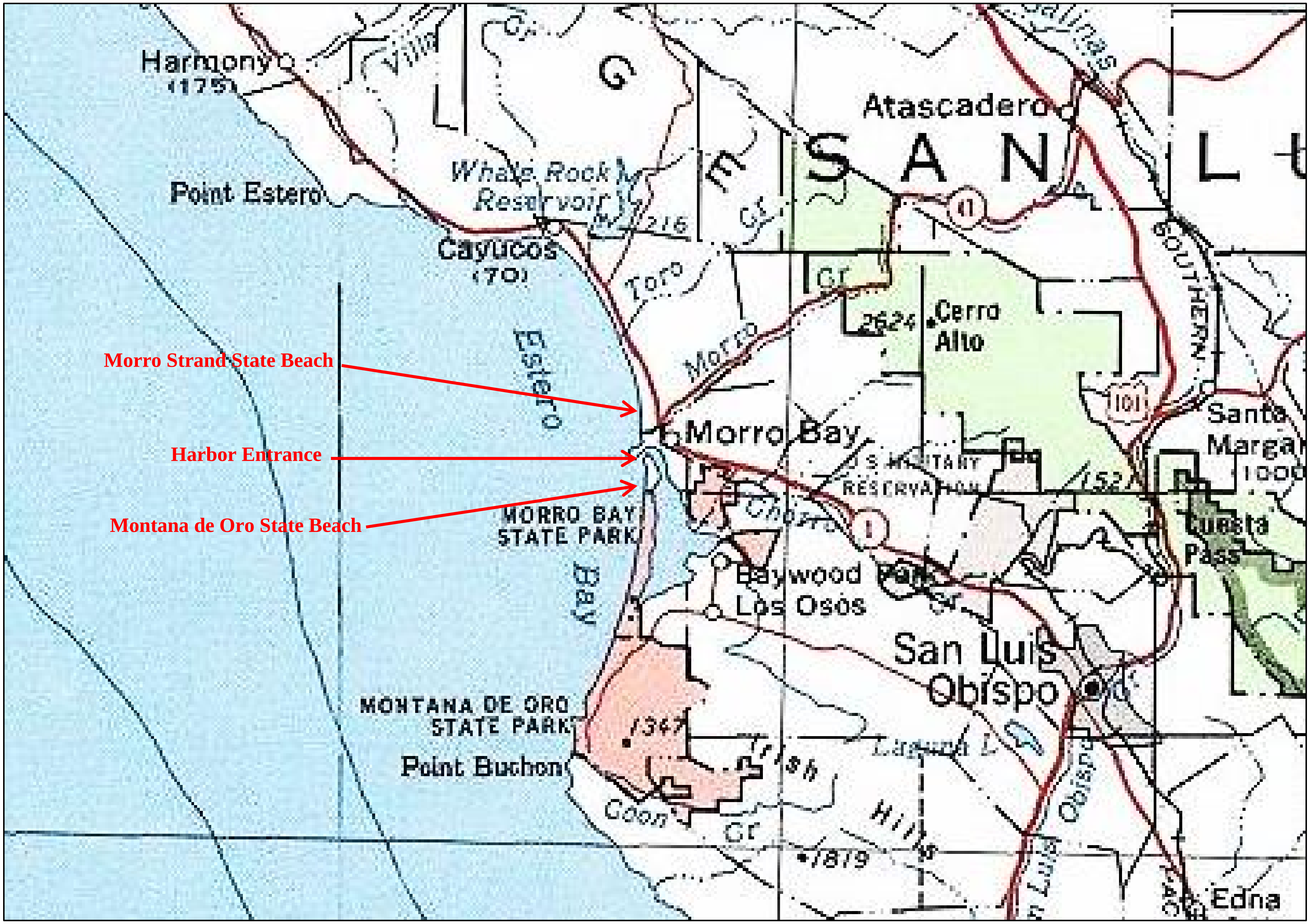

Figure 1. Location of Morro Bay Harbor and Approximate Locations of Receiving Beaches.

There are two areas in the vicinity of Morro Bay Harbor that have been used in the past for the placement of material dredged by the Corps of Engineers from this harbor. The area that has been most routinely used is Montana de Oro State Beach, located just south of Morro Bay Harbor. Placement here has been in the nearshore. Morro Strand State Beach is the other placement area and it has been used occasionally in the past. Placement at Morro Strand State Beach has been in the surf zone. Approximate locations of both beaches are depicted on Figure 1. Placement of Morro Bay Harbor sediments in the nearshore or surf zone counteracts natural beach erosion and has historically improved the overall integrity of these beaches as this.

Morro Bay Harbor has been divided into six dredge areas based on location and design depths. These areas are the Modified Entrance Channel, Sand Trap, Transition Channel, Main Channel, Navy Channel and Morro Channel. Design depths for these channels range from -12 feet mean lower low water (MLLW) for the Morro Channel to -40 feet MLLW for the Modified Entrance Channel. The Modified Entrance Channel and Sand Trap are actually areas of advanced maintenance dredging to ward off more significant shoaling that could endanger vessels entering and leaving the Harbor.

A hopper dredge is used to dredge the Modified Entrance Channel, Transition Channel, Main channel, and portions of the Navy Channel on a mostly yearly basis. The Morro Channel and Sand Trap are dredged less frequently using a variety of means depending on the dredge contractor. In the past, these remaining areas have been dredged using hopper dredges, cutterhead dredges and other hydraulic dredges, and excavator dredges, or a combination of these dredges.

Portions of Morro Bay Harbor adjacent to the federal channels are inhabited by giant kelp and eelgrass. These important habitats provide food and sanctuary for a variety of marine species and must be avoided by leaving a 100 foot berth during dredging and sampling activities. Sea otters also frequent Morro Bay Harbor and must also be avoided.

1.2 Site Location

Morro Bay Harbor is located in San Luis Obispo County, California (Figure 1). Geographic coordinates (NAD 83) for the Entrance to Morro Bay Harbor are 35° 21' 4" N and 120° 52' 07" W. The approximate center of the Harbor in front of the Coast Guard Pier is 35° 22' 0" N and 120° 51' 32" W. Geographic coordinates of the approximate center of the Montana de Oro State Beach nearshore placement area are 35° 20' 47" N and 120° 52' 21" W, and geographic coordinates of the approximate center of the Morro Strand State Beach placement are 35° 23' 20" N and 120° 51' 59" W.

1.3 Roles and Responsibilities

Project responsibilities and key contacts for this sediment characterization program are listed in Tables 1 and 2. Kinnetic Laboratories Inc. provided sampling and reporting services. Diaz Yourman and Associates provided core logging and geotechnical testing. Analytical chemical testing of sediments for this project was primarily carried out by Calscience Laboratories (NELAP No. 03220CA; Cal-ELAP No. 2803).

Table 1. Project Team and Responsibilities.

Responsibility	Name	Affiliation
Project Planning and Coordination	Jeffrey Devine Blake Horita Christopher Diaz Ken Kronschnabl	USACE USACE Diaz-Yourman Kinnetic Laboratories
SAP Preparation	Ken Kronschnabl Christopher Diaz	Kinnetic Laboratories Diaz-Yourman
Field Sample Collection and Transport	Spencer Johnson Dale Parent	Kinnetic Laboratories Kinnetic Laboratories
Geotechnical Investigation	Chris Diaz Krista Van Eyck	Diaz-Yourman Diaz-Yourman
Health and Safety Officer and Site Safety Plan	Jon Toal	Kinnetic Laboratories
Laboratory Chemical Analyses	Danielle Gonsman Katie Scott	Calscience Kinnetic Laboratories
QA/QC Management Analytical Laboratory QA/QC	Marty Stevenson Danielle Gonsman	Kinnetic Laboratories Calscience
Technical Review	Pat Kinney Jeffrey Devine Christopher Diaz Jeremy Jackson Kirk Brus Joe Ryan	Kinnetic Laboratories USACE Diaz-Yourman USACE USACE USACE
Final Report	Ken Kronschnabl Christopher Diaz	Kinnetic Laboratories Diaz-Yourman
Agency Coordination	Jeffrey Devine Kirk Brus Gail Campos Jeremy Jackson Joe Ryan	USACE USACE USCAE USACE USACE

USACE = United States Army Corps of Engineers

Table 2. Key Project Contacts.

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2.0 SITE HISTORY AND HISTORICAL DATA REVIEW

This section provides a brief history of Morro Bay Harbor, potential sources of contamination, dredging history, and most recent previous testing and sampling results.

2.1 Harbor Construction, Site Setting and Potential Sources of Contamination

Morro Bay Harbor is located in San Luis Obispo County (Figure 1) at the mouth of a natural embayment. It was first established as a Port in 1870 to export dairy and ranch products. It is now an artificial harbor constructed by the U.S. Army Corps of Engineers (USACE). Morro Rock, bordering the northwest corner of the Harbor, was originally an island until USACE constructed a causeway connecting the island to the mainland starting in 1933. Prior to the causeway, the entrance to the Harbor was from the north, east of Morro Rock. Morro Rock was quarried from 1889 to 1969 and some of that material was used to build the causeway. During World War II, the USACE built the outer breakwater to protect the new entrance to the Harbor. To improve safety for vessels entering and leaving the Harbor, the Entrance Channel was deepened and extended in 1995.

The Harbor is bounded by a long sand spit with no development to the west and the City of Morro Bay to the east. Most of the surrounding land use to the east of Morro Bay Harbor is residential and commercial. There is a 300 megawatt power plant operated by Dynegy along the northern shore of Morro Bay Harbor east of Morro Rock. The plant pumps cooling water from the Harbor and discharges it to the Pacific Ocean north of Morro Rock. The power plant currently only operates during periods of peak energy demand. There are no other major industrial facilities in the Morro Bay Harbor watersheds, and it is not known if such facilities existed in the past.

Chorro Creek is Morro Bay's largest tributary. It forms an estuary in the back bay between Morro Bay Harbor and the town of Los Osos. Los Osos Creek empties into the far south end of the back bay and is the second largest and only other significant tributary. The Chorro Creek watershed, which is dominated by rangeland with areas of woodland, cropland, and urban land use, has been issued total maximum daily loads (TMDLs) for nutrients and dissolved oxygen. Morro Bay itself, which includes Chorro Creek and Los Osos Creek, also has TMDLs for sediment and pathogens.

There are several marinas in Morro Bay Harbor with the largest operated by the City of Morro Bay. The City manages 50 slips, approximately 125 moorings, a boat launch facility, and couple of city piers. As many as 50 liveaboards are permitted to stay in Morro Bay Harbor. The Harbor also contains a fuel dock, a couple boat yards with haul out facilities, and fish processing facilities.

According to the City of Morro Bay's Storm Water Management Plan (City of Morro Bay, 2011) there are about 18 small storm drains (<36 inches in diameter) that discharge into Morro bay Harbor. These discharges are spread out fairly evenly along the entire waterfront.

Portions of Morro Bay Harbor adjacent to the federal channels are inhabited by giant kelp and eelgrass. These important habitats provide food and sanctuary for a variety of marine species. As such, it is important to avoid damage to these habitats during dredging and sampling activities by leaving a 100 foot berth.

The proposed receiving beaches: nearshore immediately off of Montana de Oro State Beach and in the surf zone along Morro Strand State Beach, are directly to the north and south of Morro Bay Harbor as shown in Figure 1. Both beaches are west facing and receive considerable wave energy. Placement of Morro Bay Harbor sediments on or nearshore of the receiving beaches has historically improved the overall integrity of these beaches by counteracting natural erosion.

2.2 Previous Morro Bay Harbor Dredging and Testing Episodes

USACE maintains the federal channels of Morro Bay Harbor to their design depths. Portions of the channels have been dredged almost annually for the past 30 years. Table 3 describes the dredging history from 1986 to the present. The Entrance Channel, Transition Channel, Main channel and portions of the Navy Channel are dredged most often while the Morro Channel and Sand Trap are dredged only occasionally with the last harbor-wide dredging occurring in 2009/2010.

The most recent full array of physical and chemical sampling and analyses for the Morro Bay Harbor federal channels occurred in 2008. A total of 19 core samples were collected to project depths plus two feet and analyzed for grain size distribution. Data from these analyses were compared to the grain size distribution of sediments from the nearshore placement area immediately offshore of Montana de Oro State Beach and along three transects at Morro Strand State Beach to determine the physical suitability of Morro bay Harbor sediments for beach nourishment. In addition, representative portions of the 19 cores were combined into six composite samples for bulk sediment chemical testing to determine if the Harbor sediments are environmentally suitable for beach nourishment. Results of this study are summarized in a report by Kinnetic Laboratories and Diaz-Yourman and Associates (2008). Summary sampling and chemical testing data from this study are provided in Appendix A. Geotechnical testing data and soils logs from this study are provided in Appendix B.

In 2008, the Morro Bay Harbor sediments consisted primarily of sand and only low levels of contaminants were evident. Most organic contaminants were not detected above reporting limits in any samples. The only detectable organic contaminates were low levels of PAH compounds. With the exception of nickel, all metal concentrations were below NOAA lower effects based screening levels (ERL values from Long et. al., 1995). Nickel levels exceeded the lower effects based screening value in five of the six composite samples. The NOAA upper effects based screening value (ERM) for nickel was also exceeded in one of the Navy Channel composite samples. Note that the confidence in NOAA screening values for nickel is low. It was found that the incidence of toxic effects do not increase appreciably with increasing concentrations of nickel (Long et al., 1995). Based on the high sand content and low levels of contaminants found, these sediments were determined to be acceptable for beach replenishment. The dredged material from 2008 to the present has annually been discharged to the nearshore area immediately offshore of Montana Do Oro State Beach. Material was discharged to the surf zone along Morro Strand State Beach during the Harbor-wide maintenance dredging episode in 2009/2010.

A study conducted in 2001 (Kinnetic Laboratories, 2001) also showed that the Morro Bay Harbor sediments were coarse grained and generally clean and this study also resulted in a positive suitability determination. The dredged material was discharged to both placement areas.

Table 3. Site Maintenance Dredging History.

Period	Location	Design Depths (ft. MLLW)	Volume Removed (cy)	Placement Location	Dredge Type
May – June 2013	M.E., S.T., Trans., Main, Navy	-40, -24, -16	122,850	Montana de Oro SB Nearshore	Hopper
May 2012	M.E., S.T., Trans., Main, Navy	-40, -24, -16	125,000	Montana de Oro SB Nearshore	Hopper
May – June 2011	M.E., S.T., Trans., Main, Navy	-40, -24, -16	120,920	Montana de Oro SB Nearshore	Hopper
Aug. – Sept. 2010	M.E., S.T., Trans., Main	-40, -24, -16	135,170	Montana de Oro SB Nearshore	Hydraulic
May – June 2010	M.E., S.T., Trans., Main, Navy	-40, -24, -16	249,780	Montana de Oro SB Nearshore	Hopper
2009/2010	M.E., S.T., Trans., Main, Navy	-40, -25, -16	375,000	Morro Strand SB	Hydraulic
	Morro	-12	199,000	Montana de Oro SB Nearshore	Excavator (Bucket)
June 2009	M.E., S.T., Trans., Main, Navy	-40, -24, -16	151,070	Montana de Oro SB Nearshore	Hopper
June – July 2008	M.E., S.T., Trans., Main, Navy	-40, -24, -16	140,800	Montana de Oro SP Nearshore	Hopper
July 2007	M.E., S.T., Trans., Main, Navy	-40, -24, -16	150,400	Montana de Oro SB Nearshore	Hopper
July 2006	M.E., S.T., Trans., Main, Navy	-40, -24, -16	196,250	Montana de Oro SB Nearshore	Hopper
July 2005	M.E., S.T., Trans., Main, Navy	-40, -24, -16	134,000	Montana de Oro SB Nearshore	Hopper
July 2004	M.E., S.T., Trans., Main, Navy	-40, -24, -16	155,700	Montana de Oro SB Nearshore	Hopper
July 2003	M.E., S.T., Trans., Main, Navy	-40, -24, -16	170,820	Montana de Oro SB Nearshore	Hopper
2001/2002	M.E., S.T., Trans., Main, Navy	-40, -24, -16	657,000	Montana de Oro SB Nearshore	Hopper
	Morro	-12	211,500	Morro Strand SB	Cutterhead
July 2001	M.E., S.T., Trans., Main, Navy, Moro	-40, -25, -24, -16, -12	180,470	Montana de Oro SB Nearshore	Hopper
July – Aug. 2000	M.E., Trans., Main	-40, -24, -16	236,900	Montana de Oro SB Nearshore	Hopper
June – July 1999	M.E., Trans., Main	-40, -24, -16	134,230	Montana de Oro SB Nearshore	Hopper
Aug. 1998	M.E., Trans., Main	-40, -24, -16	115,390	Montana de Oro SB Nearshore	Hopper
Jan. – April, 1998	M.E., S.T., Trans., Main, Navy, Moro	-40, -25, -24, -16, -12	555,900	Montana de Oro SB Nearshore & Morro Strand SB	Hopper
1997	M.E.	-40	63,000	Montana de Oro SB Nearshore	Hopper

Table 3. Site Maintenance Dredging History.

Period	Location	Design Depths (ft. MLLW)	Volume Removed (cy)	Placement Location	Dredge Type
1995 -1996	M.E., S.T., Trans., Main, Navy	-40, -24, -16	1,041,000	Montana de Oro SB Nearshore & Morro Strand SB	Hopper
1994	M.E., Trans., Main, Navy	-40, -24, -16	555,900	Montana de Oro SB Nearshore & Morro Strand SB	Hopper/ Cutterhead
1992[a]	M.E.	-40	120,330	Montana de Oro SB Nearshore & Morro Strand SB	Cutterhead
1990	M.E., Trans., Main, Navy, Morro	-40, -24, -16, -12	475,300	Montana de Oro SB Nearshore	Hopper
1986/1987			460,400		

* This dredging episode was done on an emergency basis and was not considered maintenance dredging.
M.E. = Modified Entrance Channel
S.T. = Sand Trap (advanced maintenance dredge area)
Trans. = Transition Channel
Main = Main Channel
Navy = Navy Channel
Morro = Morro Channel
SB = State Beach

3.0 METHODS

This section describes the dredging design, study design and field and analytical methods for this testing program.

3.1 Dredge Design

Contoured and point bathymetric data from the spring of 2012 are shown on Figures 2a and 2b and 3a and 3b. These figures identify each of the channel areas described in Section 1.1 along with their design depths. Figures 4a through 9a and 4b through 9b are additional close-up maps showing more legible bathymetric data from the spring of 2012 for each of the channel areas in relationship to proposed sampling locations. Design depths and dredge volumes for each area identified for dredging are provided in Table 4.

The Morro Bay Harbor kelp and eelgrass beds have been mapped over the past several years and these maps can be used to assist contractors in avoiding damage to these areas. Mapping data are included in Figures 2 and 3. The distribution of the main kelp bed also known as the Target Rock kelp bed is primarily adjacent to Morro Rock and along the northwest side of the Main Channel, with scatterings of kelp to the north and south of the Target Rock bed. The distribution of the main eelgrass beds extends from Morro Rock to the Morro Channel along the north and south sides of the Navy Channel.

3.2 Study Design

The study design for this project covers data collection tasks for Morro Bay Harbor sediment collection and testing and Montana de Oro State Beach nearshore area and Morro Strand State Beach sampling and geotechnical testing. Evaluation guidelines are also discussed.

The main approach used was to sample Morro Bay Harbor sediments to dredge depth plus overdredge, composite them by area, and subject the composite samples to chemical testing to determine if they are suitable for beach nourishment. The approach was also to determine the physical properties of the sediments at each location and at different depths. Testing followed requirements and procedures detailed in the ITM (USEPA/USACE, 1998) with further guidance from Los Angeles District USACE guidelines (CESPL, undated) and from SC-DMMT draft guidelines. Acceptability guidelines published in these documents were used to evaluate the suitability of Morro Bay Harbor maintenance-dredged sediments for beach nourishment.

3.2.1 Morro Bay Harbor Sediment Collection and Chemical Testing

Vibracore sampling, as described in Section 3.4.2 (Vibracore Sampling Methods), was carried out during the period of August 12 to August 15, 2013 to collect subsurface sediment data at four (4) locations within Area A (Modified Entrance Channel), four (4) locations within Area B (Sand Trap), one (1) location within Area C (Transition Area), two (2) locations within Area D (Main Channel), nine (9) locations within Area E (Navy Channel), and seven (7) locations in Area F (Morro Channel). In total, there were 27 separate vibracore sampling locations for the Morro Bay Harbor federal maintenance dredging channel areas. The prefix for all locations is "MBHVC13-#-##." Figures 2a through 9a are maps showing final sampling locations in relation to point bathymetry data. Figures 2b through 9b are maps showing final sampling locations relative to composite boundaries and no point bathymetry. All cores were advanced to project elevations or overdepth elevations, depending on the area. Date and time of collection, final coordinates, approximate seafloor elevations, and sampling elevations for the sample locations are listed in Table 5. Note that some sample locations were moved to target more shoaled areas and avoid kelp beds and eelgrass beds. Best Management Practices (BMPs) during sampling activities were used to avoid the kelp and eelgrass habitats to the extent practicable.

Table 4. Dredging Depths and Volumes.

Dredge Area	Composite Area	Location	Physical Area (Acres)	Design Depth (ft., MLLW)	Design Depth + Overdredge (ft., MLLW)	Approximate 2012 Design Depth Volume (Cubic Yards)	Allowable Overdepth Volume (Cubic Yards)	Dredge Volume with Allowable Overdredge (Cubic Yards)
A	A	Modified Entrance Channel	15.1	-40	-40	230,300	0	230,300
B	B	Sand Trap	8.0	-25	-25	34,520	0	34,520
C	C/D	Transition Area	4.0	-16 to -40	-18 to -42	9,160	5,930	15,100
D		Main Channel	14.4	-16	-18	22,410	8,570	30,980
E	E	Navy Channel	45.4	-16	-18	60,490	39,500	100,000
F	F	Morro Channel	30.7	-12	-14	11,790	27,350	39,140
					Total Volume	368,670	81,350	450,040

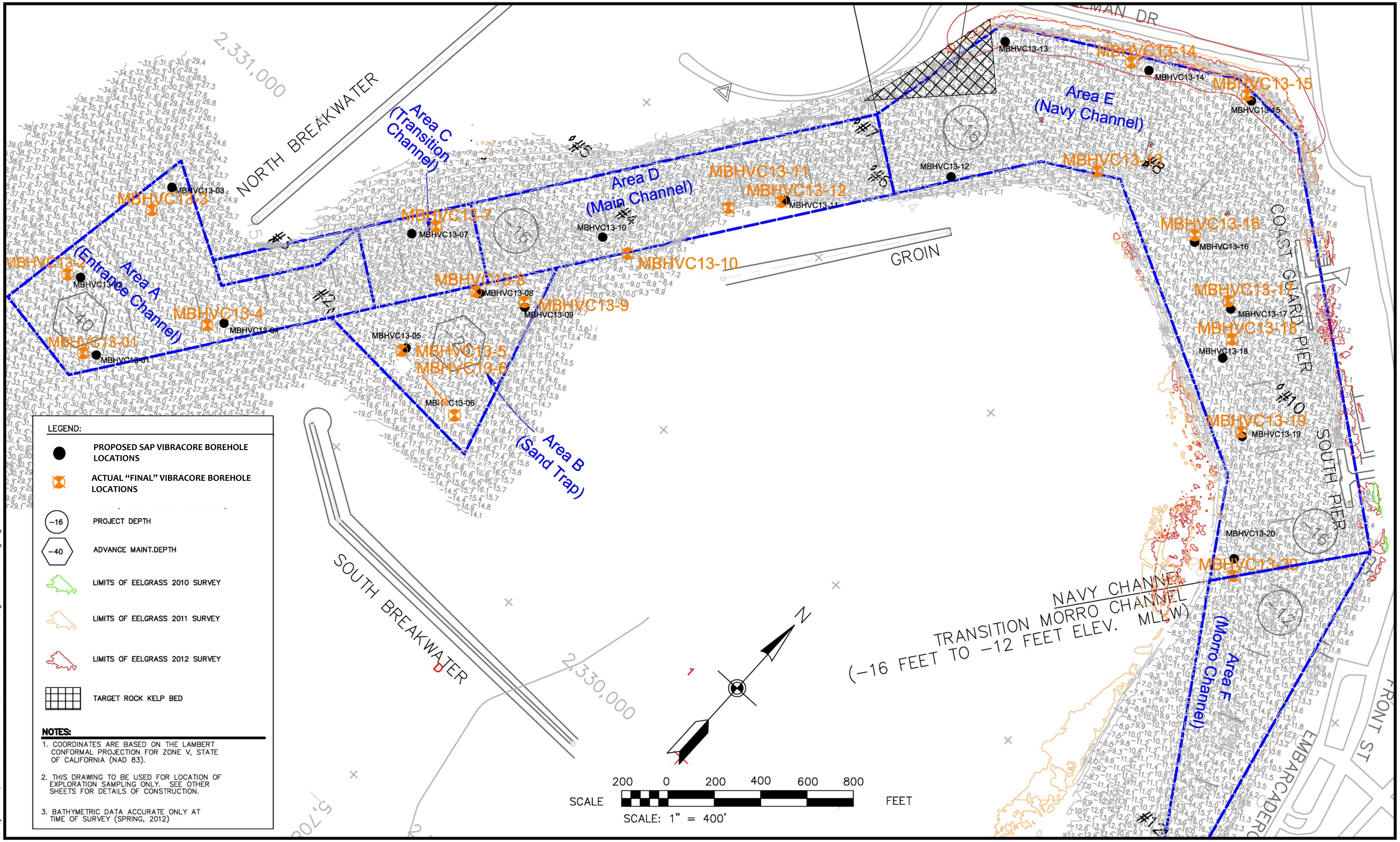


Figure 2a. Spring 2012 Point Bathymetric Data, 2013 Actual Sampling Locations, Proposed SAP Sampling Locations, and Limits of Kelp and Eelgrass Beds for all Dredge Areas Except the Southern Extent of the Morro Channel.

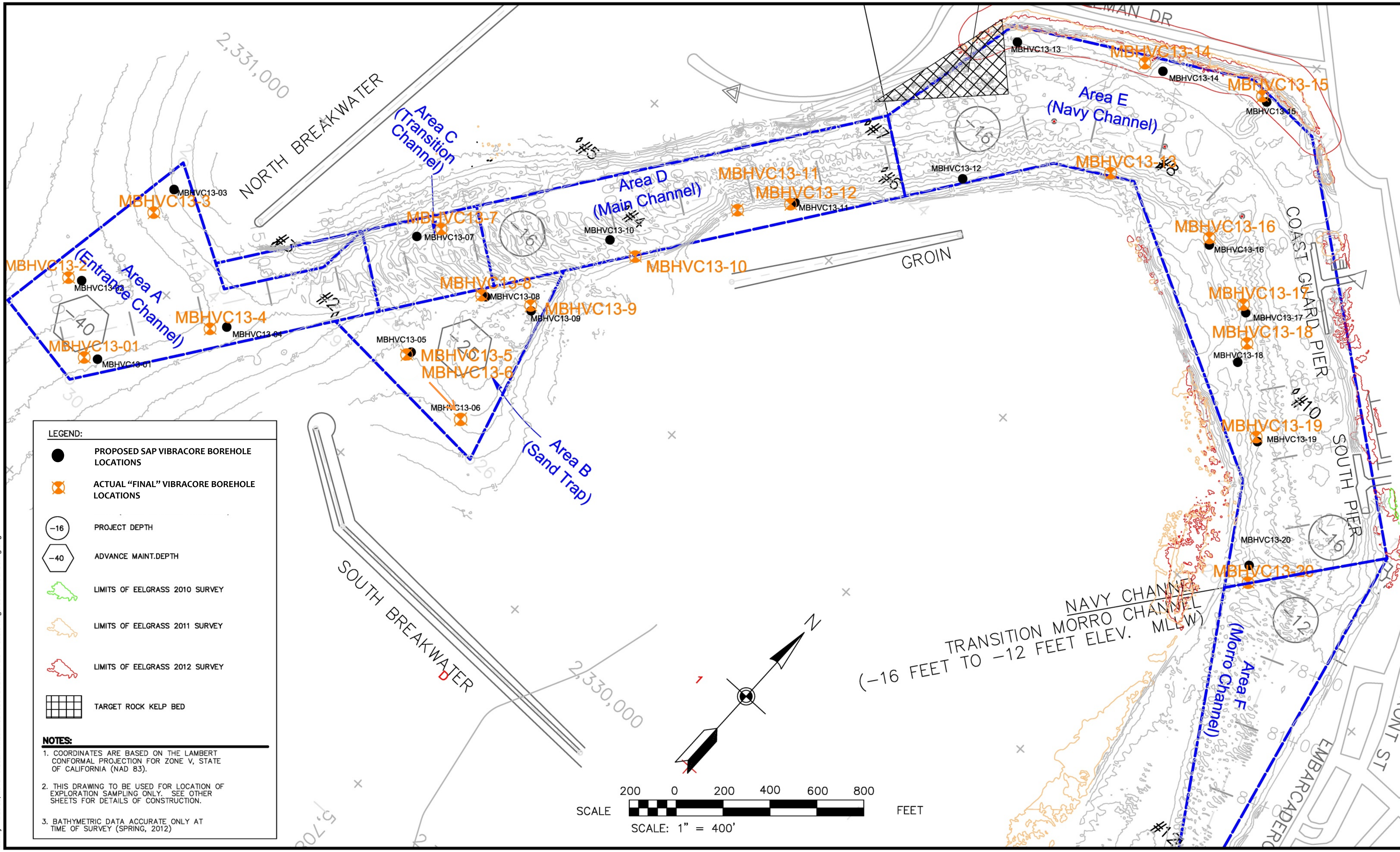


Figure 2b. Morro Bay Harbor Composite Area Boundaries and 2013 Actual Sampling Locations along with Proposed Sampling Locations in the Project SAP for all Dredge Areas Except the Southern Extent of the Morro Channel.

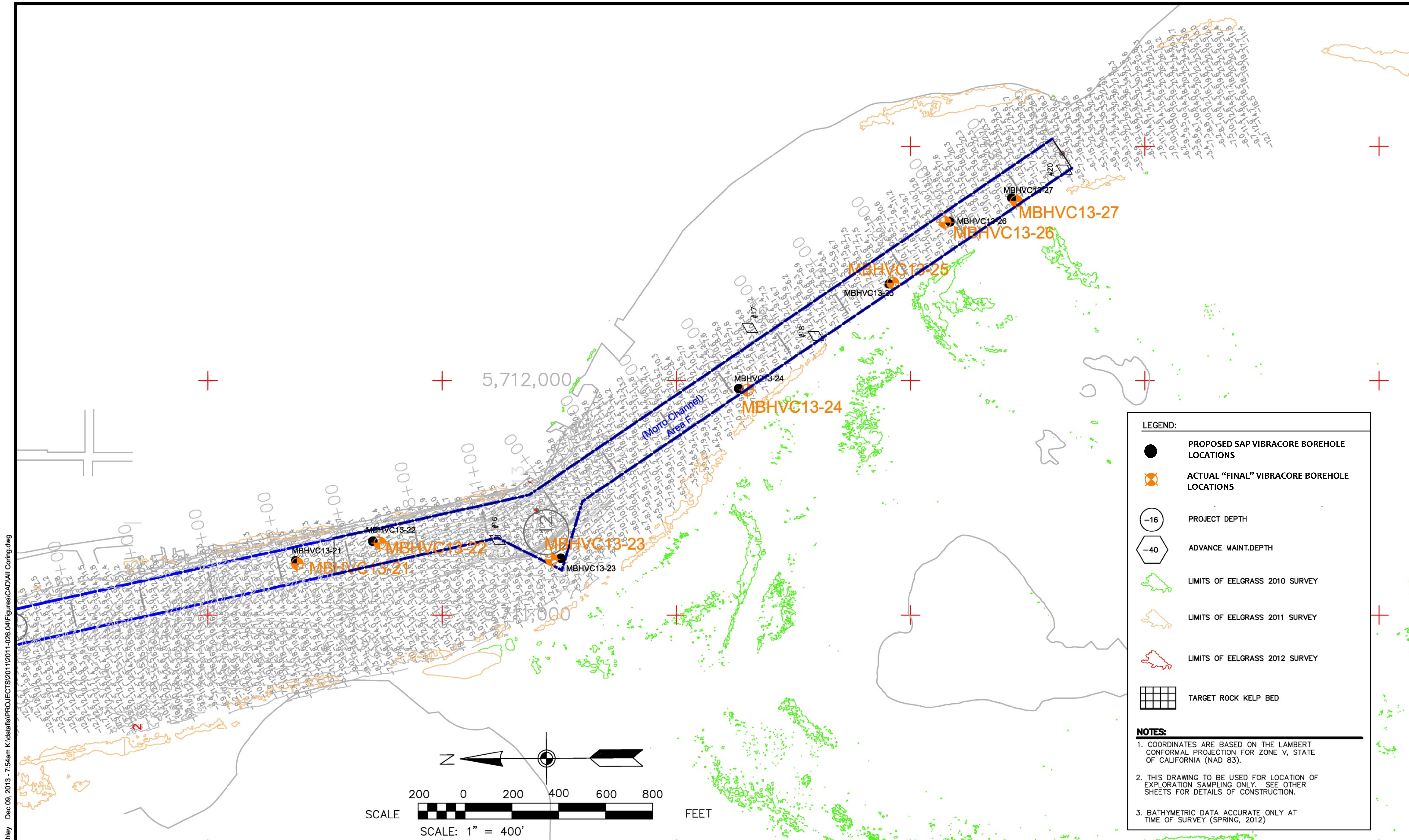


Figure 3a. Spring 2012 Point Bathymetric Data, 2013 Actual Sampling Locations, Proposed SAP Sampling Locations, and Limits of Eelgrass Beds for the Southern Extent of the Morro Channel, Morro Bay Harbor.

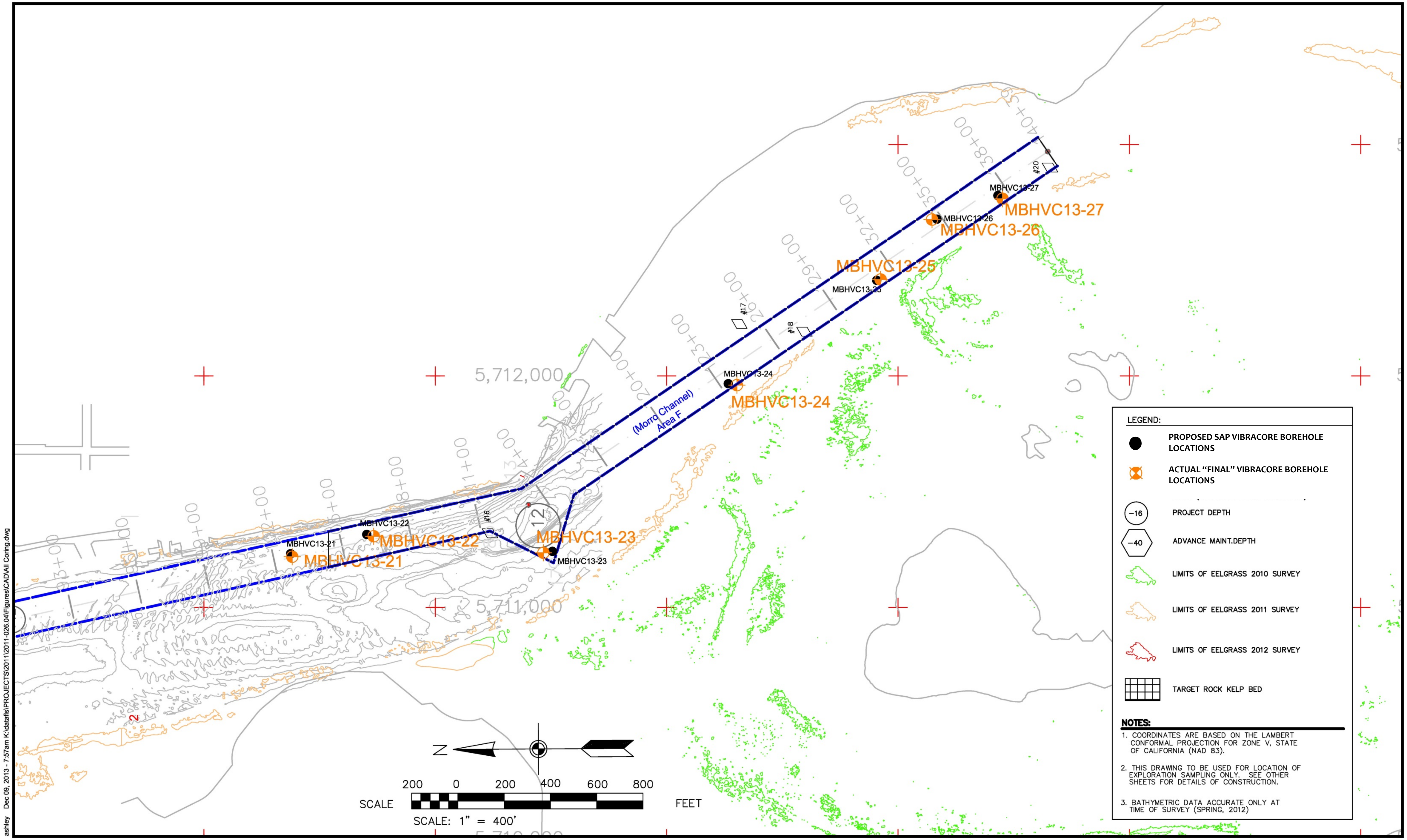


Figure 3b. Composite Area Boundaries and 2013 Actual Sampling Locations along with Proposed Sampling Locations in the Project SAP for the Southern Extent of the Morro Channel, Morro Bay Harbor.

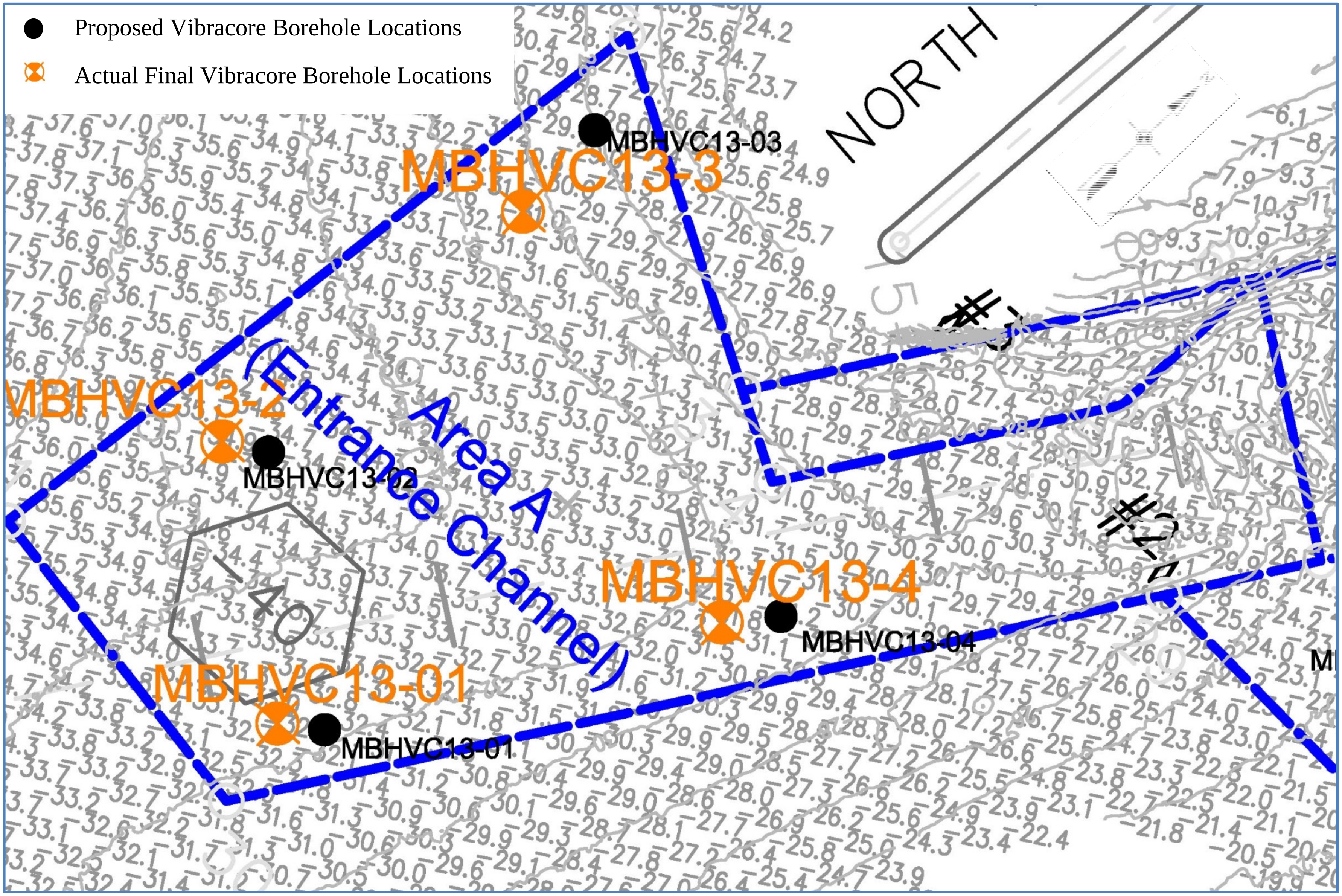


Figure 4a. April 2012 Point Bathymetric Data and Proposed and Actual Sampling Locations in the Modified Entrance Channel (Area A).

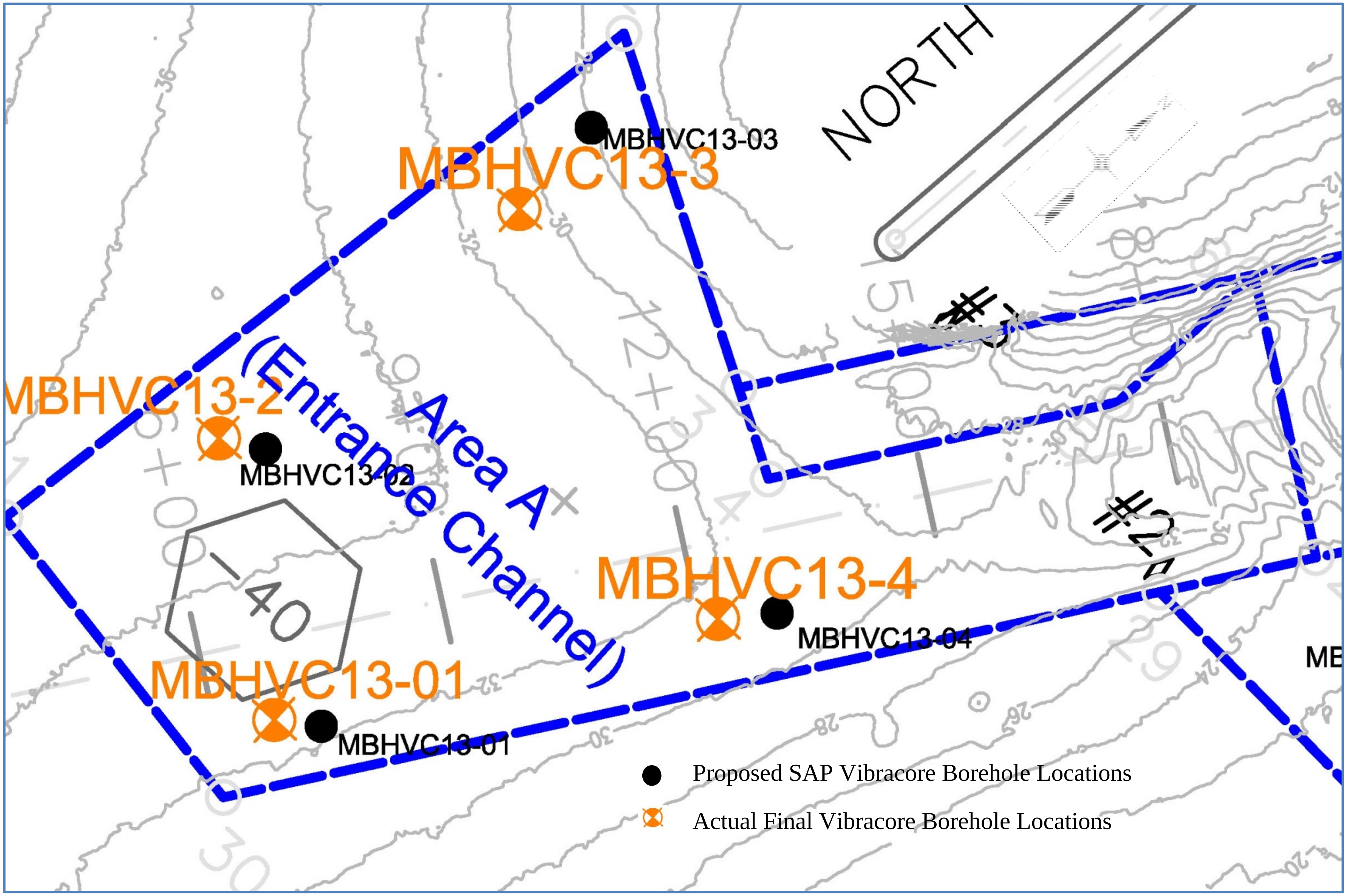


Figure 4b. Proposed and Actual Sampling Locations in the Modified Entrance Channel (Area A).

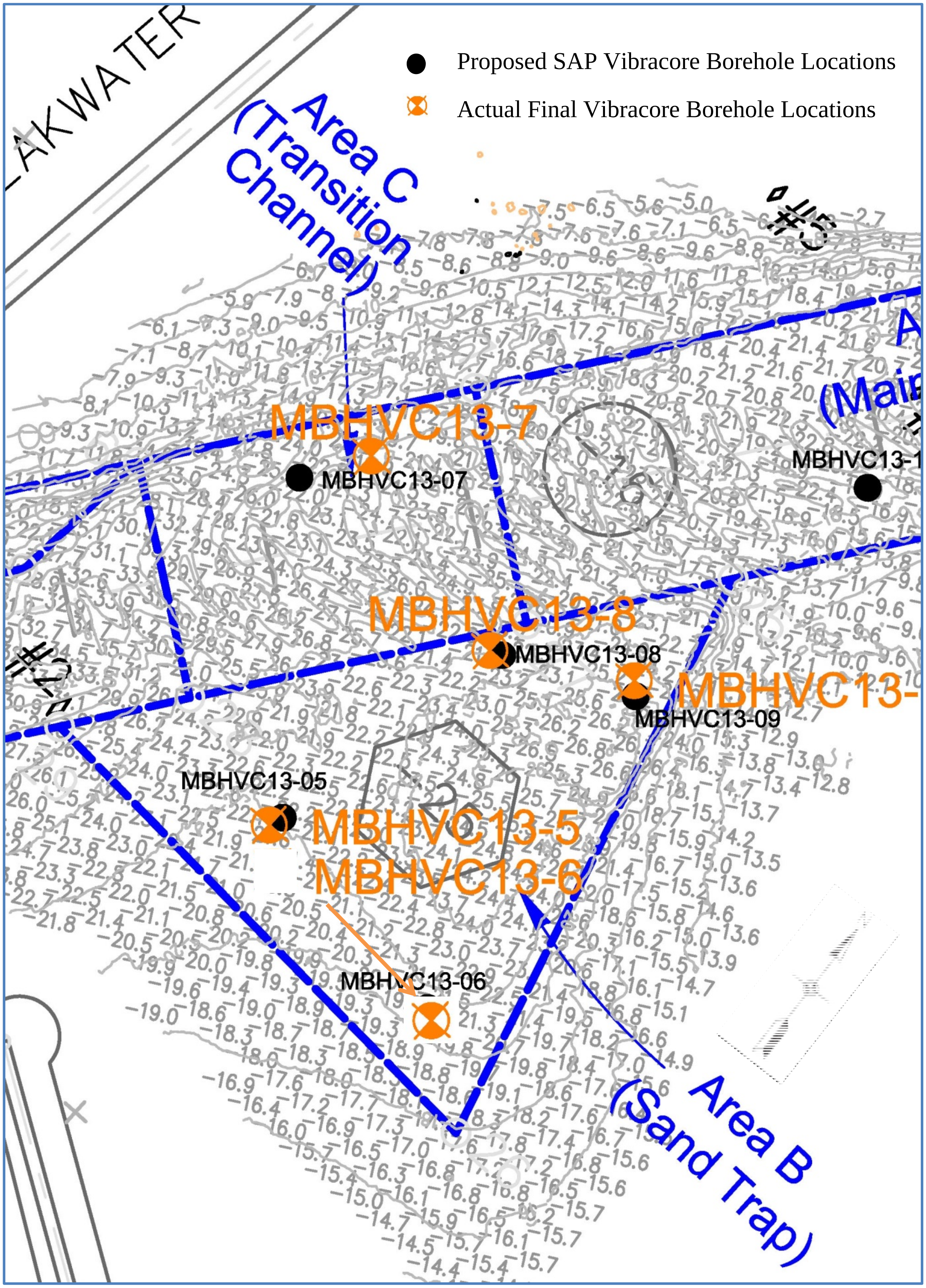


Figure 5a. April 2012 Point Bathymetric Data and Proposed and Actual Sampling Locations in the Sand Trap and Transition Areas (Areas B and C).

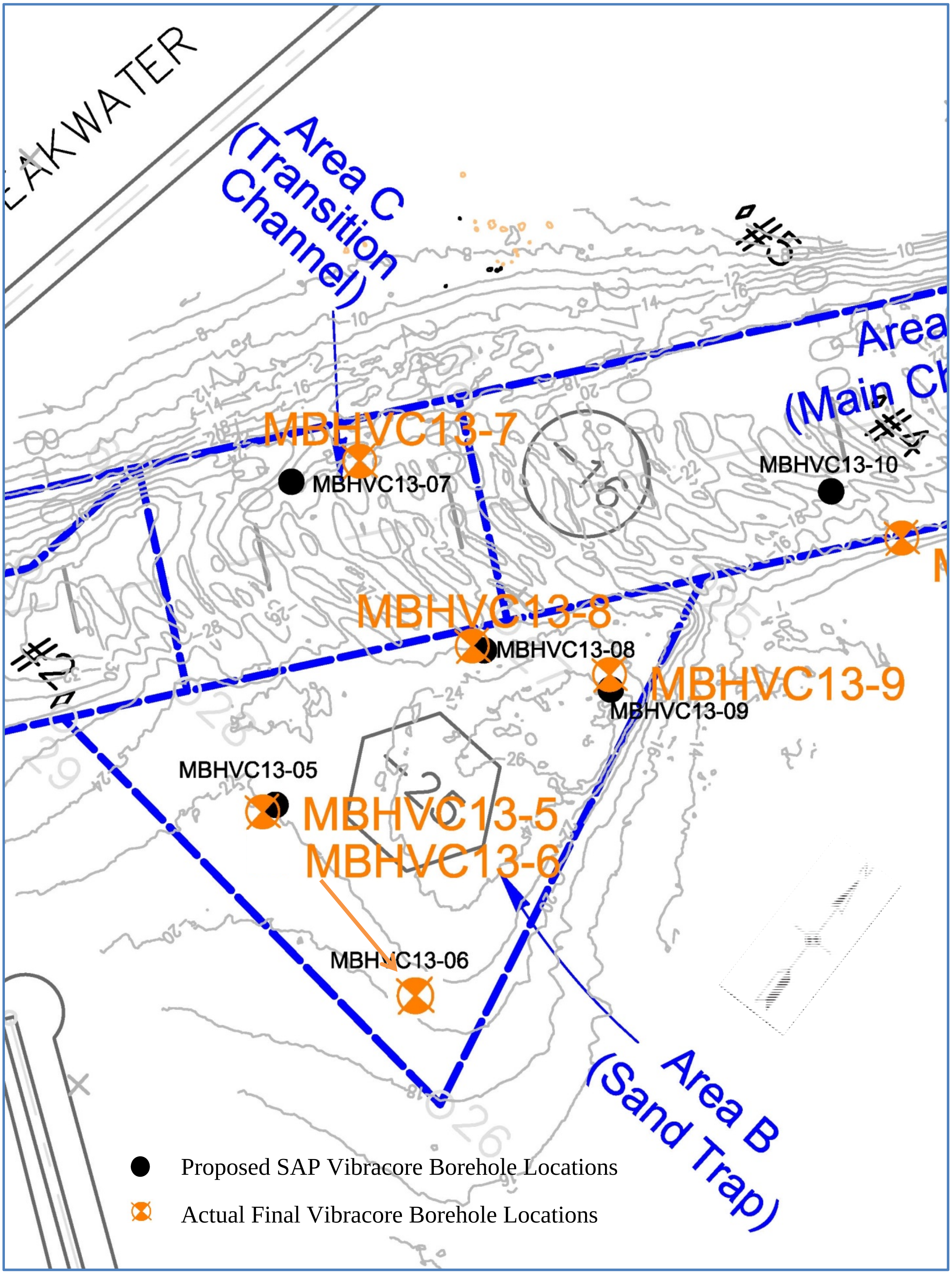


Figure 5b. Proposed and Actual Sampling Locations in the Sand Trap and Transition Areas (Areas B and C).

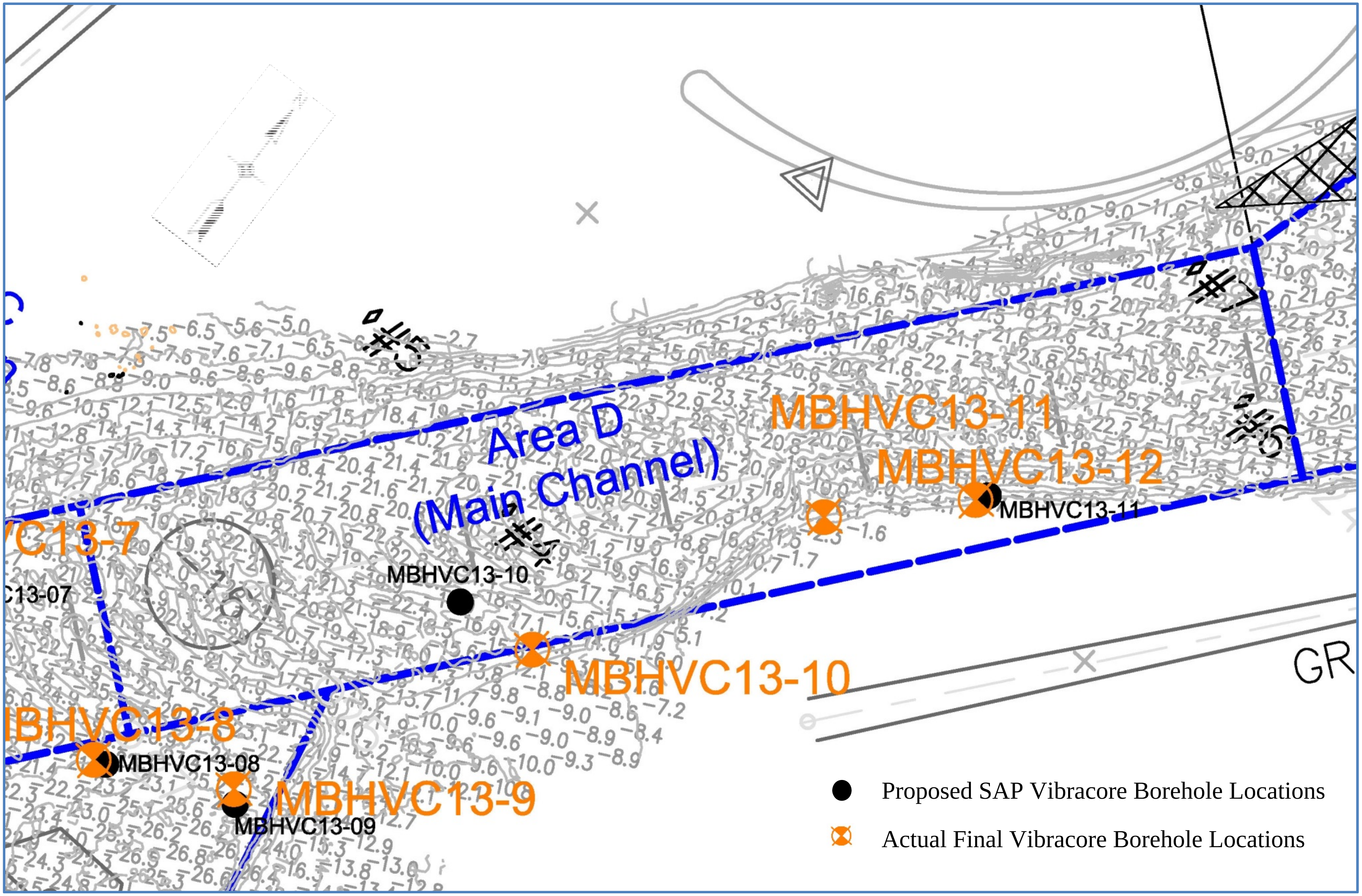


Figure 6a. April 2012 Bathymetric Data and Proposed and Actual Sampling Locations in the Main Channel (Area D).

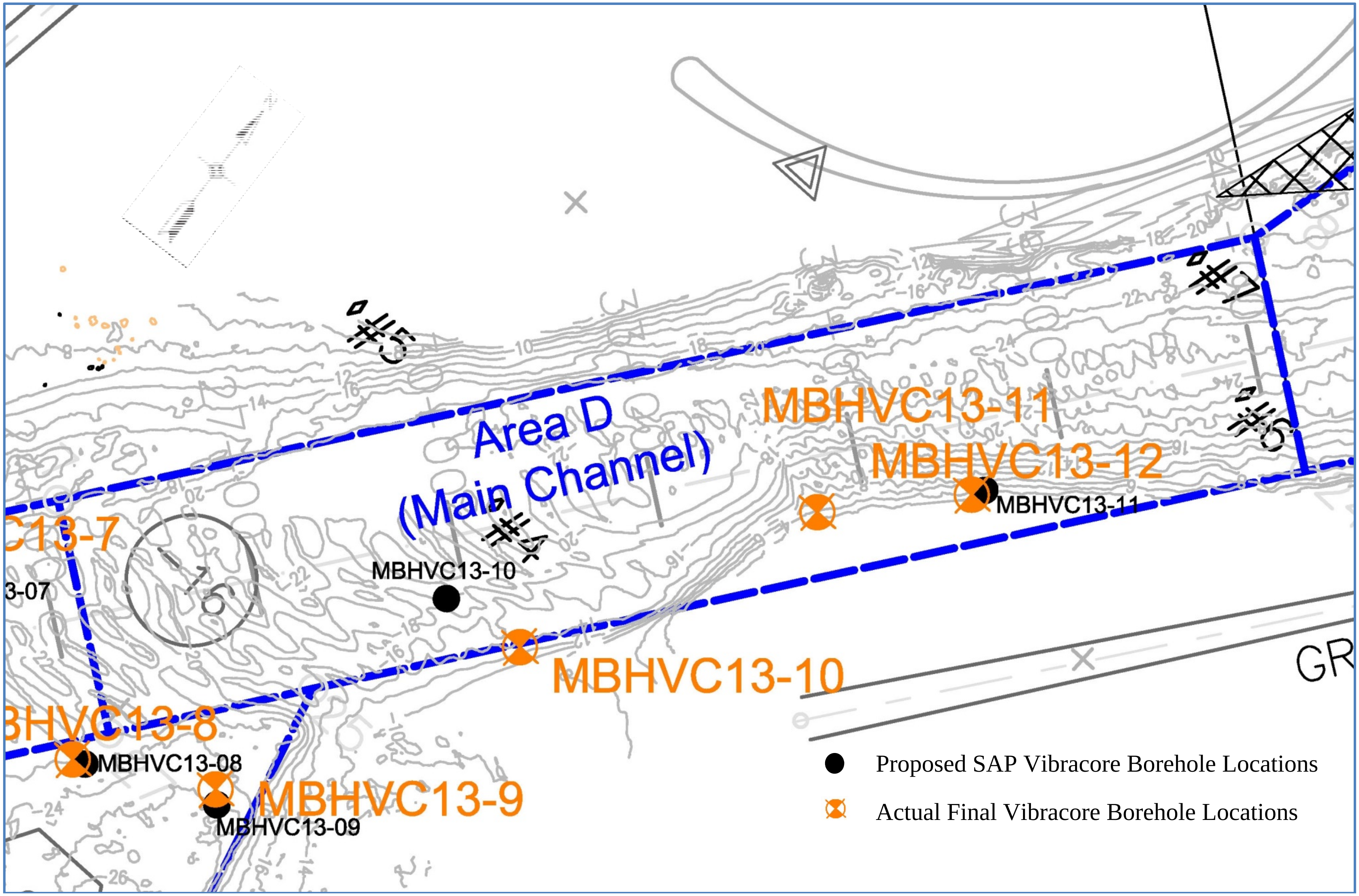


Figure 6b. Proposed and Actual Sampling Locations in the Main Channel (Area D).

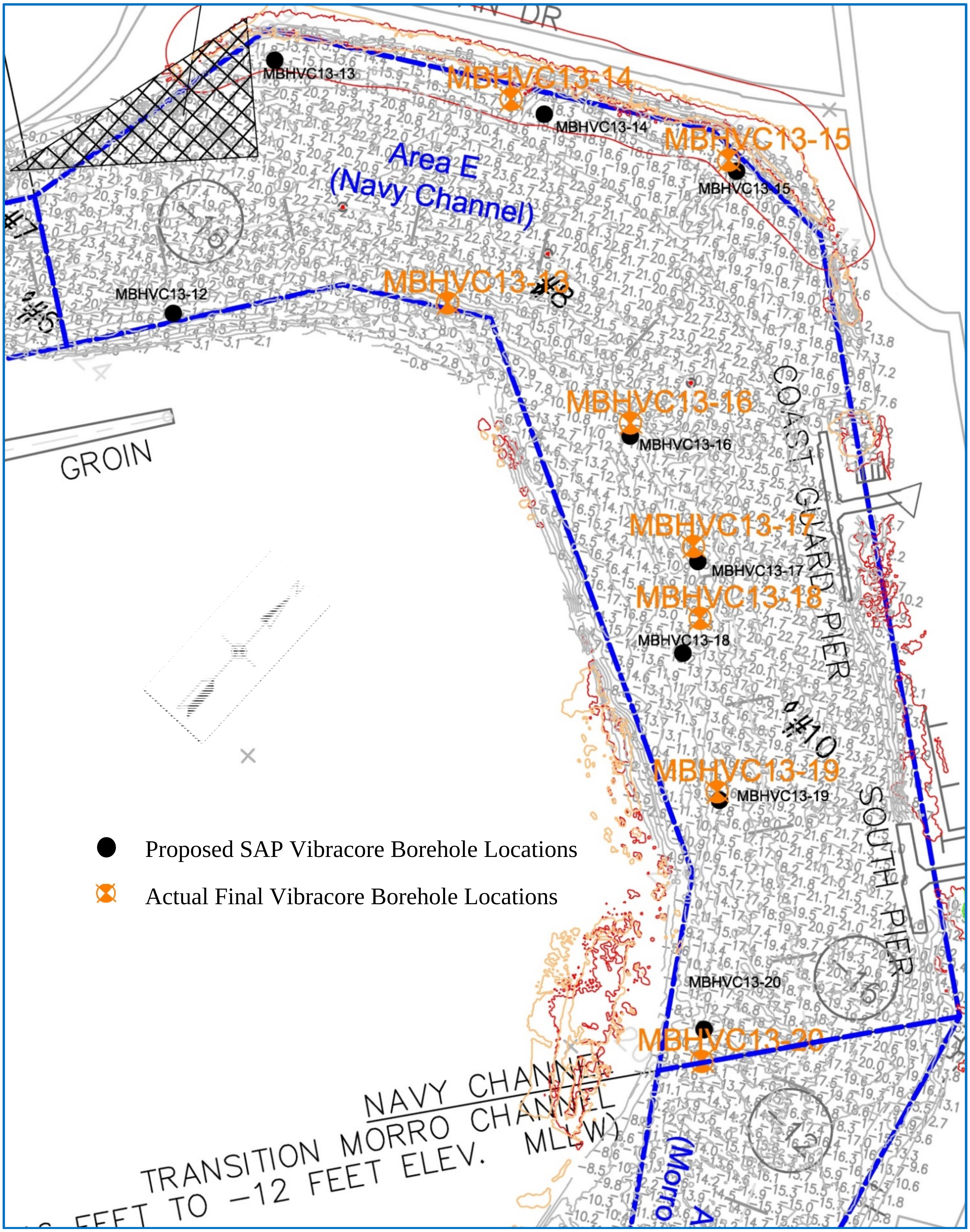


Figure 7a. April 2012 Point Bathymetric Data and Propose and Actual Sampling Locations in the Navy Channel (Area E).

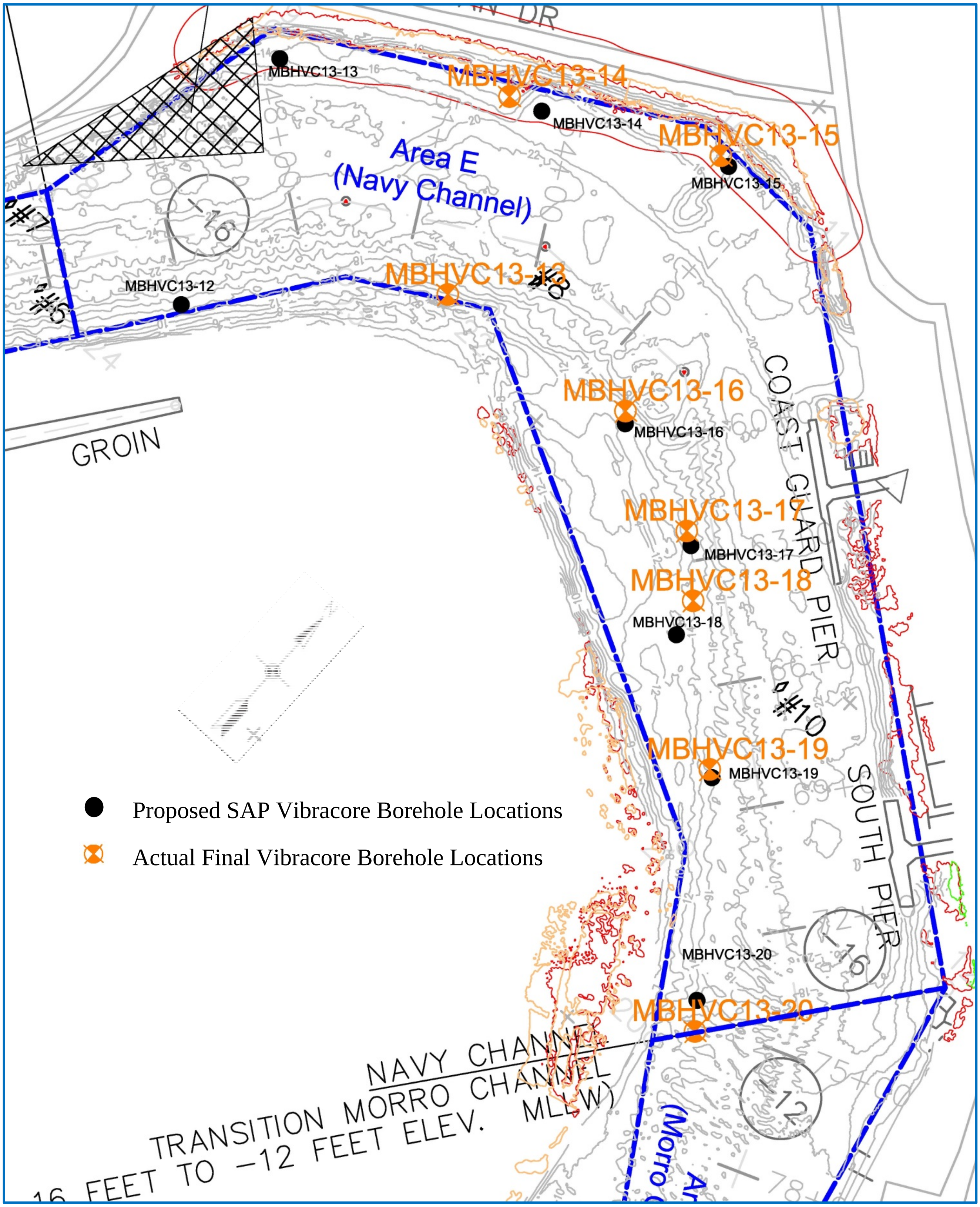


Figure 7b. Proposed and Actual Sampling Locations in the Navy Channel (Area E).

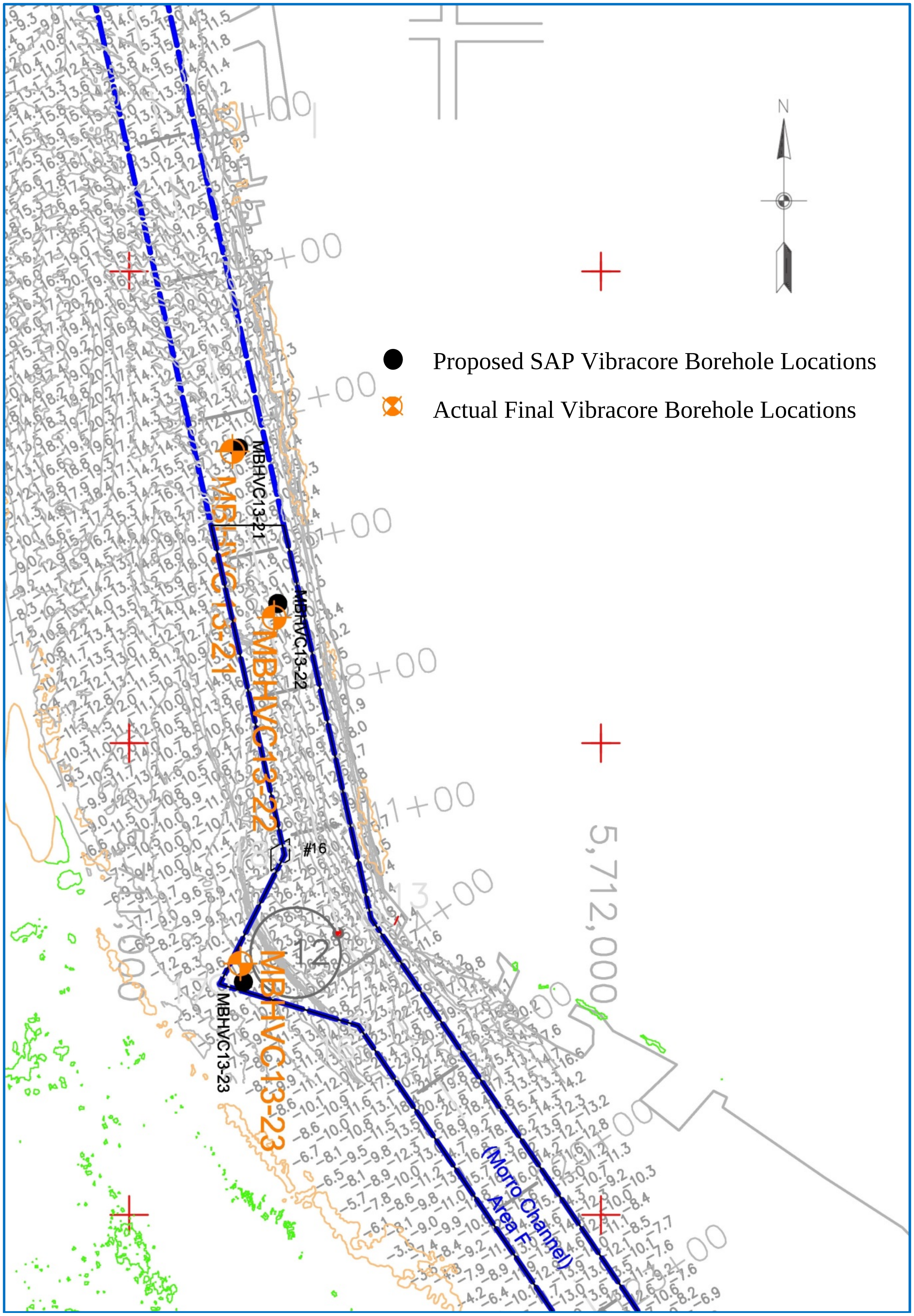


Figure 8a. April 2012 Point Bathymetric Data and Proposed and Actual Sampling Locations, Northern Morro Channel (Area F).

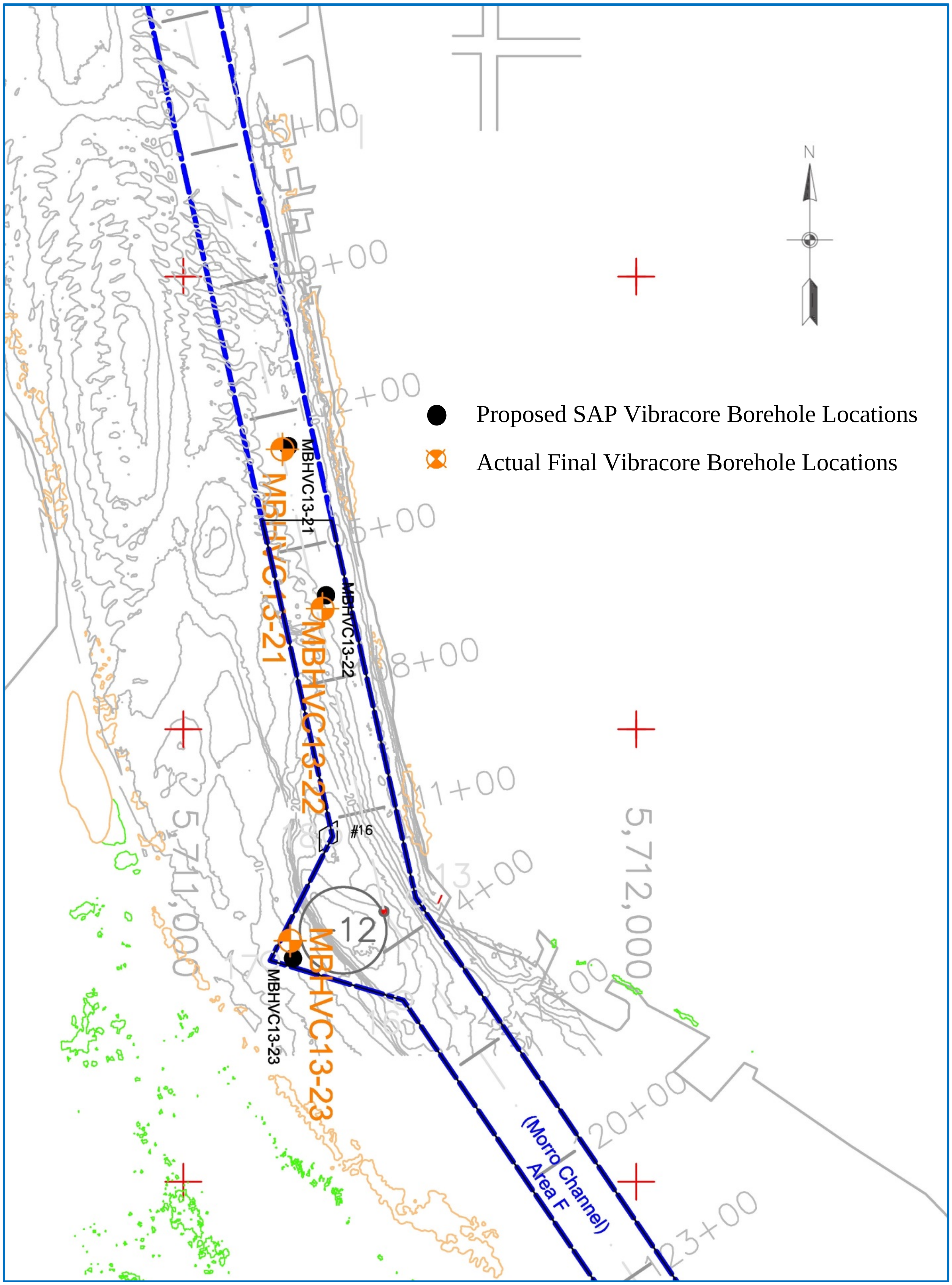


Figure 8b. Proposed and Actual Sampling Locations in the Northern Morro Channel (Area F).

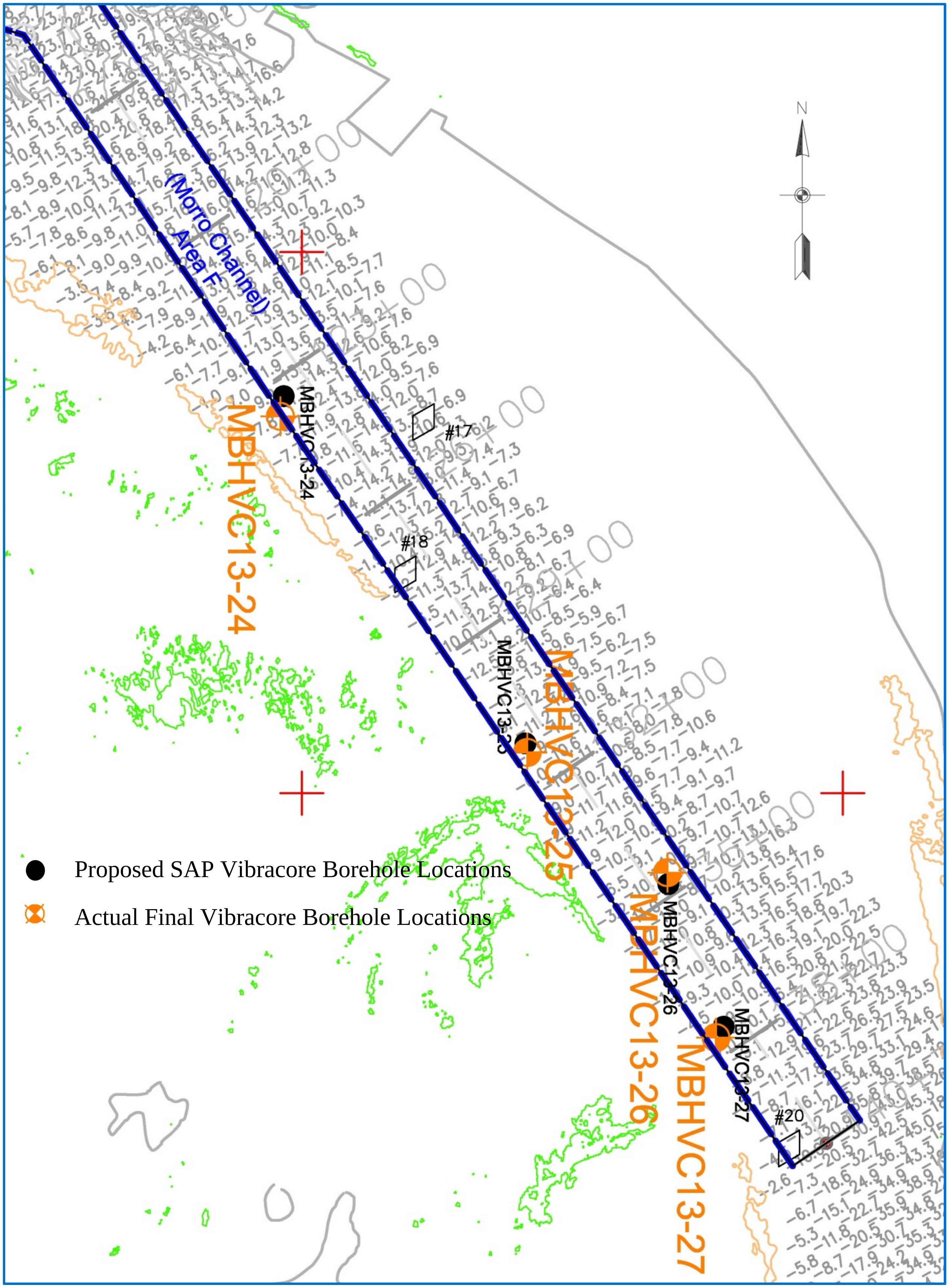


Figure 9a. April 2012 Point Bathymetric Data and Proposed and Actual Sampling Locations in the Southern Morro Channel (Area F).

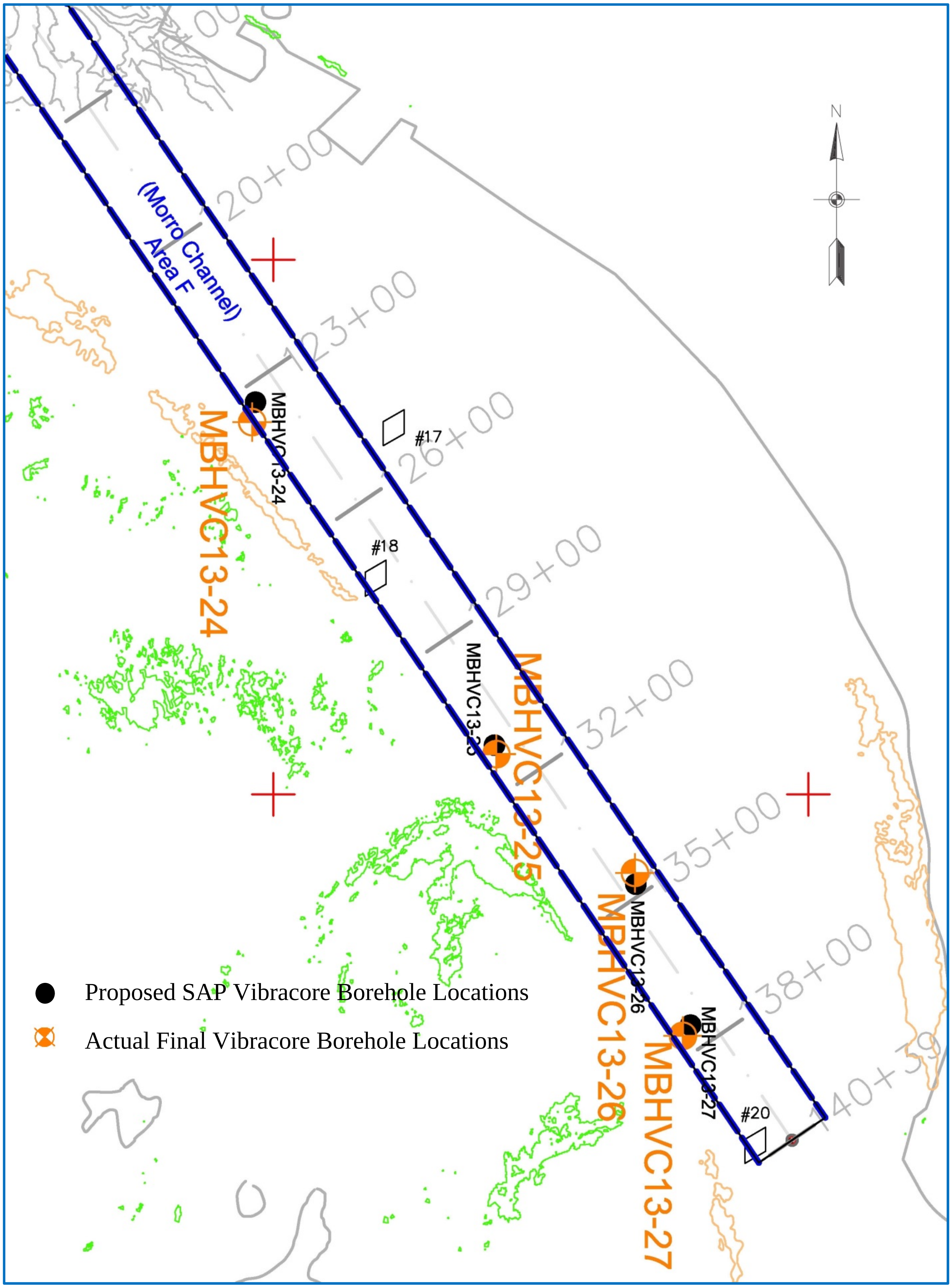


Figure 9b. Proposed and Actual Sampling Locations in the Southern Morro Channel (Area F).

Table 5. Sampling Locations, Core Depths, Mudline Elevations, and Sampling Elevations, Morro Bay Harbor.

Composite Area	Core Designation	Composite ID	Sampling Date	Sampling Time	Latitude North	Longitude West	Mudline Elevation (ft., MLLW)	Design Depth + Overdepth (ft., MLLW)	Core Recovery (ft.)	Core Intervals Sampled (ft., MLLW)
Area A Modified Entrance Channel	MBHVC13- 1	MBHVC13- A	8/15/13	0956	35.36003°	120.87033°	-33.5	-40	10	-33.5 to -40
	MBHVC13-2		8/15/13	0827	35.36058°	120.87128°	-36.1	-40	9	-36.1 to -40
	MBHVC13-3		8/15/13	0907	35.36182°	120.87104°	-34.8	-40	8.9	-34.8 to -40
	MBHVC13-4		8/15/13	1043	35.36129°	120.86931°	-33.5	-40	8.1	-33.5 to -40
Area B Sand Trap	MBHVC13-5	MBHVC13- B	8/13/13	0915	35.36266°	120.86702°	-19	-25	14	-19 to -25
	MBHVC13-6		8/13/13	0800	35.36255°	120.86686°	-19.3	-25	14.5	-19.3 to -25
	MBHVC13-8		8/13/13	1020	35.36377°	120.86683°	-19	-25	13.7	-19 to -25
	MBHVC13-9		8/13/13	1104	35.36408°	120.86622°	-22	-25	13.3	-22 to -25
Areas C/D Transition Area/Main Channel	MBHVC13-7	MBHVC13- C/D	8/12/13	1545	35.36401°	120.86790°	-25	-26	13.2	-25 to -26
	MBHVC13-10		8/12/13	1816	35.36534°	120.86562°	-15	-18	13.0	-15 to -18
	MBHVC13-11		8/13/13	1328	35.36656°	120.86502°	-15.1	-18	10.6	-15.1 to -18
Area E Navy Channel	MBHVC13-12	MBHVC13- E	8/13/13	1204	35.36704°	120.86453°	-15.5	-18	12.4	-15.5 to -18
	MBHVC13-13		8/13/13	1536	35.36989°	120.86152°	-17.2	-18	13.8	-17.2 to -18
	MBHVC13-14		8/13/13	1449	35.37110°	120.86225°	-14.2	-18	9.9	-14.2 to -18
	MBHVC13-15		8/13/13	1628	35.37177°	120.86071°	-15.1	-18	12.6	-15.1 to -18
	MBHVC13-16		8/13/13	1732	35.37014°	120.85986°	-12.9	-18	13.6	-12.9 to -18
	MBHVC13-17		8/13/13	1810	35.36985°	120.85885°	-16.1	-18	9.5	-16.1 to -18
	MBHVC13-18		8/14/13	0812	35.36955°	120.85843°	-15.2	-18	13.0	-15.2 to -18
	MBHVC13-19		8/14/13	0846	35.36883°	120.85741°	-13.2	-18	11.8	-13.2 to -18
	MBHVC13-20		8/14/13	0936	35.36753°	120.85606°	-13.0	-18	8.6	-13.0 to -18
Area F Morro Channel	MBHVC13-21	MBHVC13- F	8/14/13	1538	35.36058°	120.85256°	-10	-14	10.0	-10.0 to -14
	MBHVC13-22		8/14/13	1449	35.35962°	120.85223°	-11.3	-14	12.7	-11.3 to -14
	MBHVC13-23		8/14/13	1401	35.35760°	120.85240°	-12.6	-14	8.3	-12.6 to -14
	MBHVC13-24		8/14/13	1318	35.35536°	120.84989°	-10.8	-14	12.2	-10.8 to -14
	MBHVC13-25		8/14/13	1234	35.35369°	120.84830°	-10.6	-14	11.8	-10.6 to -14
	MBHVC13-26		8/14/13	1107	35.35310°	120.84741°	-9.3	-14	15.0	-9.3 to -14
	MBHVC13-27		8/14/13	1039	35.35227°	120.84708°	-8.5	-14	10.1	-8.5 to -14

A total of five (5) area composite samples were created from the six (6) channel areas shown on Figures 2b and 3b and analyzed for bulk sediment chemistry. Areas C and D (Transition Area and Main Channel) were combined into one of the composite sample as historically both channel areas have similar physical and chemical characteristics, are in close proximity to each other, and are relatively small in physical area (Area C is approximately four acres and Area D is approximately 14.4 acres). One composite sample was formed from each of the remaining areas. For primary beach placement suitability evaluations, continuous samples from the mudline to project depths plus two feet for overdredge testing were collected from locations within Areas C through F, and continuous samples from the mudline to project depths only (no overdredge) were collected from locations within Areas A and B. There is no overdredge allowance for Areas A and B since these are areas of advanced maintenance dredging. All primary core intervals were homogenized and then combined with like core intervals in a composite area for bulk sediment chemistry analyses. Sediments below overdepth or advanced maintenance elevations were not included in any sediment composite samples for chemistry. Composite and overdepth elevations are summarized in Table 5.

In addition to the composite samples, a sample for arsenic and one archive bulk sediment chemistry sample were collected from each core location. The arsenic sample and one archive sample represented the entire primary core interval (mudline to project or overdepth elevations). All archive samples are being stored frozen for at least six months from the time of sampling unless directed otherwise by the USACE Technical Manager.

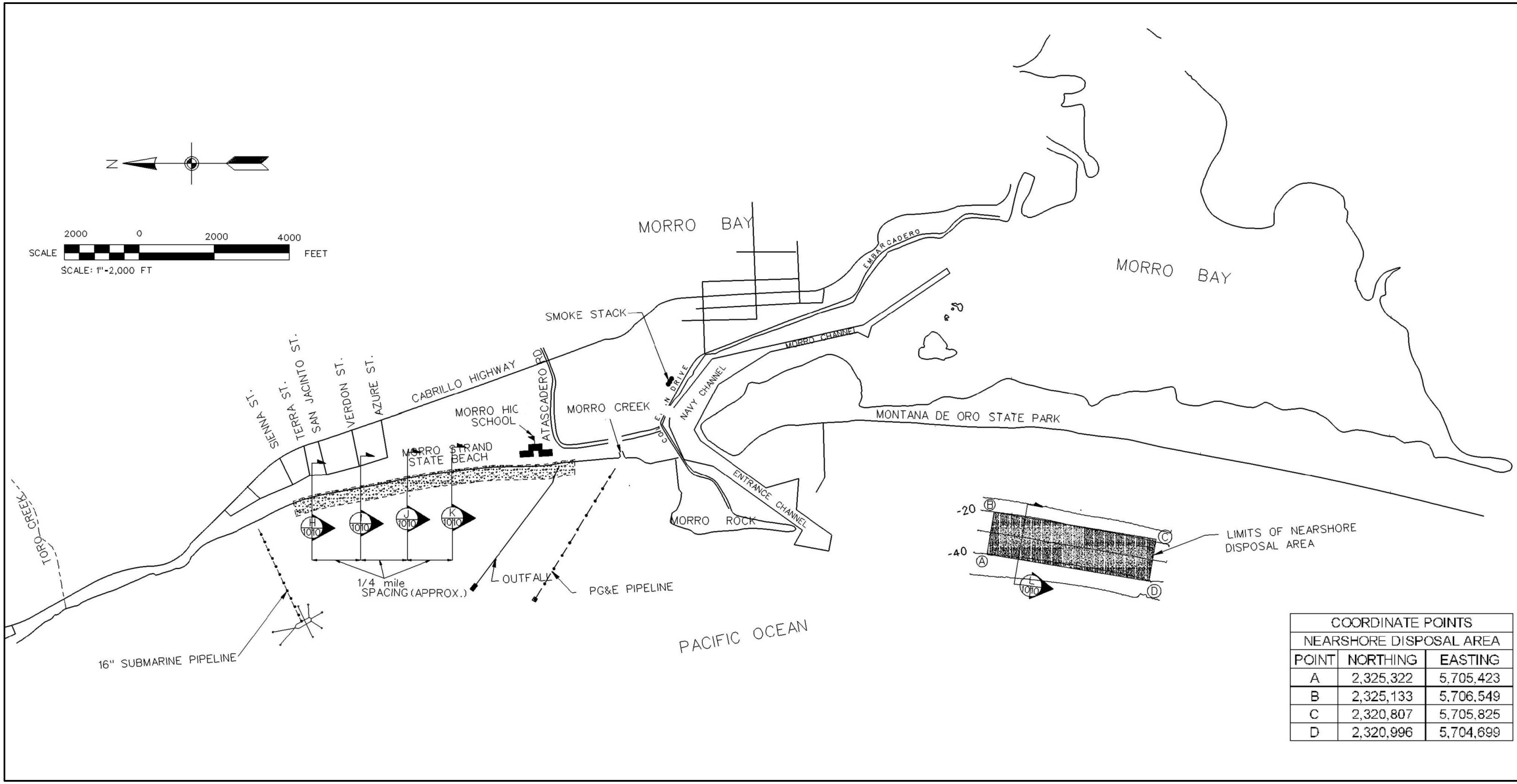
Core subsamples for geotechnical testing were from any geo-physically different layer of material not already being analyzed for grain size distribution as described below in Section 3.2.3.

3.2.2 Nearshore Area immediately Off of Montana de Oro State Beach and Morro Strand State Beach Reference Samples

A series of surface grabs were collected on August 15, 2013 at eight (8) randomly placed locations nearshore immediately offshore of Montana de Oro State Beach and along three (3) transects at Morro Strand State Beach. These placement areas are shown on Figure 10. The eight randomly placed locations at the nearshore placement area were between mudline elevations of -20 and -40 MLLW. These locations are shown on the Google Earth™ image represented by Figure 11. The beach transect sampling consisted of collecting surface grab samples at eight elevations (+12, +6, 0, -6, -12, -18, -24 and -30 feet MLLW) along the three perpendicular transects. The three transects were located equidistance apart as shown on the Figure 12 Google Earth™ image of the sampling locations. Table 6 provides a list of the final locations for the nearshore placement area and beach transect samples.

3.2.3 Geotechnical Samples and Testing

A sufficient quantity of sediment was collected from each location within Morro Bay Harbor so that a representative amount of sediment was included in each geotechnical sample. A minimum of one primary grain size sample was formed and analyzed from each core. This sample represented the material from the mudline to the advanced maintenance depth for Areas A and B and to project overdredge depth for Areas C through F. If it existed, a separate sample was also collected from the "fluff" layer (top layer of finer grained material). Additional grain size samples representing layers of physically different material greater than six inches thick were selected amongst all the cores and also tested as needed or archived (set aside). Some of the finer-grained samples also underwent hydrometer and plasticity analyses. Decisions on which samples to analyze were made with input from the USACE Project Technical Manager.



COORDINATE POINTS		
NEARSHORE DISPOSAL AREA		
POINT	NORTHING	EASTING
A	2,325,322	5,705,423
B	2,325,133	5,706,549
C	2,320,807	5,705,825
D	2,320,996	5,704,699

Figure 10. Location of the Nearshore Placement Area Immediately Offshore of Montana de Oro State Beach and the Morro Strand State Beach Placement Area.

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Figure 11. Sampling Locations at the Montana de Oro State Beach Nearshore Placement Area.

Figure 12. Sampling Transect Locations at Morro Strand State Beach.

Table 6. Dates, Times and Sampling Coordinates for Samples Collected from the Montana de Oro State Beach Nearshore Area and Morro Strand State Beach.

Area	Site Designations	Date	Time	Sampling Elevations (feet, MLLW)	Latitude North	Longitude West
Morro Strand Beach Transect A (MBBGS13-A)	A+12 (A1)	8/15/2013	15:01	+12	35° 23.763'	120° 52.032'
	A+6 (A2)	8/15/2013	15:04	+6	35° 23.76'	120° 52.07'
	A0 (A3)	8/15/2013	15:07	0	35° 23.758'	120° 52.103'
	A-6 (A4)	8/15/2013	14:15	-6	35° 23.75'	120° 52.2'
	A-12 (A5)	8/15/2013	15:05	-12	35° 23.733'	120° 52.25'
	A-18 (A6)	8/15/2013	14:59	-18	35° 23.733'	120° 52.317'
	A-24 (A7)	8/15/2013	14:48	-24	35° 23.717'	120° 52.383'
	A-30 (A8)	8/15/2013	14:26	-30	35° 23.733'	120° 52.433'
Morro Strand Beach Transect B (MBBGS13-B)	B+12 (B1)	8/15/2013	15:53	+12	35° 23.333'	120° 51.947'
	B+6 (B2)	8/15/2013	15:55	+6	35° 23.333'	120° 51.97'
	B0 (B3)	8/15/2013	16:03	0	35° 23.33'	120° 52.008'
	B-6 (B4)	8/15/2013	15:35	-6	35° 23.317'	120° 52.117'
	B-12 (B5)	8/15/2013	15:30	-12	35° 23.333'	120° 52.167'
	B-18 (B6)	8/15/2013	15:25	-18	35° 23.317'	120° 52.217'
	B-24 (B7)	8/15/2013	15:20	-24	35° 23.317'	120° 52.267'
	B-30 (B8)	8/15/2013	15:10	-30	35° 23.317'	120° 52.317'
Morro Strand Beach Transect C (MBBGS13-C)	C+12 (C1)	8/15/2013	16:50	+12	35° 22.927'	120° 51.887'
	C+6 (C2)	8/15/2013	16:53	+6	35° 22.927'	120° 51.915'
	C0 (C3)	8/15/2013	16:55	0	35° 22.925'	120° 51.988'
	C-6 (C4)	8/15/2013	16:05	-6	35° 22.9'	120° 52.1'
	C-12 (C5)	8/15/2013	16:10	-12	35° 22.917'	120° 52.117'
	C-18 (C6)	8/15/2013	15:58	-18	35° 22.917'	120° 52.2'
	C-24 (C7)	8/15/2013	15:50	-24	35° 22.917'	120° 52.233'
	C-30 (C8)	8/15/2013	15:45	-30	35° 22.917'	120° 52.267'
Morro Strand Beach Nearshore (MBNGS13-B)	B1	8/15/2013	13:12	23*	35° 20.845'	120° 52.089'
	B2	8/15/2013	12:53	24.7*	35° 20.589'	120° 52.137'
	B3	8/15/2013	12:58	36.2*	35° 20.659'	120° 52.289'
	B4	8/15/2013	12:27	39.4*	35° 20.189'	120° 52.373'
	B5	8/15/2013	13:03	31.5*	35° 20.807'	120° 52.197'
	B6	8/15/2013	12:44	33.7*	35° 20.503	120° 52.278'
	B7	8/15/2013	12:36	27.4*	35° 20.373'	120° 52.193'
	B8	8/15/2013	12:32	30.5*	35° 20.296'	120° 52.262'

*Non-tidally adjusted water depth.

Grain size analyses were also run on each sampling location for the Montana de Oro State Beach nearshore area and Morro Strand State Beach for a total of thirty-two (32) additional samples.

All mechanical grain size tests were run according to ASTM D 422 (1963). Hydrometer tests were run according to ASTM D 422 and Atterberg Limits tests were run according to ASTM D 4318 (2005).

3.2.4 Summary of Morro Bay Harbor Testing and Evaluation Sequence

The testing and evaluation sequence used for the Morro Bay Harbor composite samples is described in detail in the next subsection and is outlined as follows:

1) Bulk sediment chemical analyses on each composite sample.
2) Grain size analyses on each primary core interval from the mudline to the overdredge depth plus from a select number of other core intervals.
3) Grain size compatibility analyses with the receiving beaches to determine if the Harbor sediments are physically compatible with the receiving areas.
4) Analytical results were evaluated using the sediment quality guidelines consisting of NOAA Effects Range Low (ERL) and Effects Range Medium (ERM) values developed by Long, *et al*. (1995) that correlate concentrations of selected contaminants with likelihood of adverse biological effects. Table 7 and the chemistry summary table list available ERL and ERM values. Please note that ERLs and ERMs have not been developed for all analytes.
5) Analytical results were also evaluated using the USEPA's RSL (Regional Screening Levels) and the State of California's CHHSL (California Human Health Screening Levels) for potential effects to humans. Table 7 and the chemistry summary table list the available RSL and CHHSL values.

3.2.5 Physical Evaluation Guidelines

All geotechnical data gathered were used to do physical beach compatibility analyses between the dredged sediments and the receiving beaches. Grain size compatibility analyses between the dredge footprint and placement areas were conducted by the Los Angeles District USACE Geotechnical Branch according to Branch guidelines. These guidelines are the same as the SCOUP (Sand Compatibility and Opportunistic Use Plan) prepared for the California Coastal Sediments Management Workgroup (CSMWG) for small beach nourishment projects (Moffatt & Nichol, 2006). The CSMWG is an interagency group of which the USCAE is part of. A report describing the results of the compatibility analyses can be found Appendix C.

If the grain size characteristics of each core are compatible with the grain size characteristics of the placement areas and contaminant levels are low compared to lower effects based screening levels and human health screening levels, then the composite sediment samples are suitable for beach nourishment and no further testing should be required. If the agencies believe elevated concentrations of contaminants exist, then further testing may be required by the Southern California Dredge Material Management Team (SC-DMMT).

3.2.6 Chemical Evaluation Guidelines

As mentioned above, to aid in the evaluation of sediment test data, chemical concentrations of contaminants found within the sediments were compared to sediment quality guidelines (Long et. al., 1995) developed by NOAA (Table 7). These guidelines can be used to screen sediments for contaminant concentrations that might cause biological effects and to identify sediments for further toxicity testing. For any given contaminant, ERL guidelines represent the 10^{th} percentile concentration value in the NOAA database that might be expected to cause adverse biological effects and ERM guidelines reflect the 50^{th} percentile value in the database. Note that ERL and ERM values were only used as a screening tool. They were not used to determine suitability for beach replenishment.

Table 7. Morro Bay Harbor Sediment Screening Values for Selected Analytes.

Analyte Name	Units	NOAA Screening[1]		Human RSLs[2]		Human CHHSLs[3]	
		Salt ERL	Salt ERM	Residential	Industrial	Residential	Commercial/ Industrial
Arsenic	mg/kg	8.2	70	0.39	1.6	0.07	0.24
Cadmium	mg/kg	1.2	9.6	70	800	1.7	7.5
Chromium	mg/kg	81	370			100,000	1,000,000
Copper	mg/kg	34	270	3,100	41,000	3,000	38,000
Lead	mg/kg	46.7	218	400	800	18	180
Mercury	mg/kg	0.15	0.71	10	43	1,600	16,000
Nickel	mg/kg	20.9	51.6	1,500	20,000	150	3,500
Selenium	mg/kg			390	5,100	380	4,800
Silver	mg/kg	1	3.7	390	5,100	380	4,800
Zinc	mg/kg	150	410	23,000	310,000	23,000	100,000
1-Methylnaphthalene	µg/kg			22,000	99,000		
2-Methylnaphthalene	µg/kg	70	670	310,000	4,100,000		
Acenaphthene	µg/kg	16	500	3,400,000	33,000,000		
Acenaphthylene	µg/kg	44	640				
Anthracene	µg/kg	85.3	1100	17,000,000	170,000,000		
Benzo (a) Anthracene	µg/kg	261	1600	150	2100		
Benzo (a) Pyrene	µg/kg	430	1600	15	210	38	130
Benzo (b) Fluoranthene	µg/kg			150	2100		
Benzo (k) Fluoranthene	µg/kg			1500	21,000		
Biphenyl	µg/kg						
Chrysene	µg/kg	384	2800	15,000	210,000		
Dibenz (a,h) Anthracene	µg/kg	63.4	260	15	210		
Fluoranthene	µg/kg	600	5100	2,300,000	22,000,000		
Fluorene	µg/kg	19	540	2,300,000	22,000,000		
Indeno (1,2,3-c,d) Pyrene	µg/kg			150	2100		
Naphthalene	µg/kg	160	2100	3600	18,000		
Phenanthrene	µg/kg	240	1500				
Pyrene	µg/kg	665	2600	1,700,000	17,000,000		
Total Low Weight PAHs	µg/kg	552	3160				
Total High Weight PAHs	µg/kg	1700	9600				
Total PAHs[4]	µg/kg	4022	44792				
Benzyl butyl phthalate	µg/kg			260,000	910,000		
bis-(2-Ethylhexyl)phthalate	µg/kg			35,000	120,000		
Diethyl phthalate	µg/kg			49,000,000	490,000,000		
Di-n-butyl phthalate	µg/kg			6,100,000	62,000,000		
2,4,6-Trichlorophenol	µg/kg			44,000	160,000		
2,4-Dichlorophenol	µg/kg			180,000	1,800,000		
2,4-Dimethylphenol	µg/kg			1,200,000	12,000,000		
2,4-Dinitrophenol	µg/kg			120,000	1,200,000		
2-Chlorophenol	µg/kg			390,000	5,100,000		
Bisphenol A	µg/kg			3,100,000	31,000,000		
Pentachlorophenol	µg/kg			890	2,700	4,400	13,000
Phenol	µg/kg			18,000,000	180,000,000		
4,4'-DDD	µg/kg	2	20	2,000	7,200	2,300	9,000
4,4'-DDE	µg/kg	2.2	27	1,400	5,100	1,600	6,300
4,4'-DDT	µg/kg	1	7	1,700	7,000	1,600	6,300
Total DDT	µg/kg	1.58	46.1				
Aldrin	µg/kg			29	100	33	130
Chlordane	µg/kg			1,600	6,500	430	1,700

Table 7. Morro Bay Harbor Sediment Screening Values for Selected Analytes.

Analyte Name	Units	NOAA Screening[1]		Human RSLs[2]		Human CHHSLs[3]	
		Salt ERL	Salt ERM	Residential	Industrial	Residential	Commercial/ Industrial
Cis-nonachlor	µg/kg						
DCPA (Dacthal)	µg/kg	0.02	8	610,000	6,200,000		
Dieldrin	µg/kg			30	110	35	130
Endosulfan I	µg/kg			370,000	3,700,000		
Endrin	µg/kg			180,000	1,800,000	21,000	230,000
Heptachlor	µg/kg			110	380	130	520
Heptachlor Epoxide	µg/kg			53	190		
Methoxychlor	µg/kg			310,000	3,100,000	340,000	3,800,000
Mirex	µg/kg			27	96	31	120
Toxaphene	µg/kg			440	1600	460	1,800
PCB077	µg/kg			34	110		
PCB081	µg/kg			11	38		
PCB105	µg/kg			110	380		
PCB114	µg/kg			110	380		
PCB118	µg/kg			110	380		
PCB123	µg/kg			110	380		
PCB126	µg/kg			0.034	0.11		
PCB156	µg/kg			110	380		
PCB157	µg/kg			110	380		
PCB167	µg/kg			110	380		
PCB169	µg/kg			0.11	0.38		
PCB170	µg/kg			30	99		
PCB180	µg/kg			300	990		
PCB189	µg/kg			110	380		
Total PCB Congeners	µg/kg	22.7	180			89	300

1. Effects Range Low (ERL) and Effects Range Median (ERM) sediment quality objectives from Long *et al.* (1995).
2. Regional Screening Levels for Chemical Contaminants at Superfund Sites" (USEPA Region 9, 2010).
3. California Human Health Screening Levels for Soil (Cal/EPA, 2005).

As an additional measure of potential toxicity, mean ERM quotients (ERMqs) for the composite samples were calculated according to Long et al. (1998a) and Hyland et al. (1999). ERMqs are calculated by dividing each contaminant concentration by its respective ERM value and then summing the results and dividing through by the number of contaminants as shown in the following equation:

$$ERMQuotien\ t = \frac{1}{24}\sum \frac{SampleConc\ entration}{ERM}$$

In cases where concentrations of measured contaminants were below the method detection limit (MDL), a value of ½ the MDL was used for the ERMq calculations. For a general overall indication of toxicity, a quotient less than 0.1 is indicative of a low probability (<12%) of a highly toxic response to marine amphipods (Long et al., 1998b). If there are no ERL exceedances in a sample, there is less than a 10% probability of a highly toxic response to marine amphipods. The probability of a highly toxic response increases to 71% for quotients greater than 1.0.

If there are particularly elevated concentrations of chemical contaminants, then the dredge material may be assessed to whether or not it is suitable for human contact. To do so, the chemical results were compared to “Regional Screening Levels for Chemical Contaminants at Superfund Sites" (USEPA Region 9, 2010), formerly known as Preliminary Remediation Goals (PRGs). These screening levels (RSLs) were developed for Superfund/RCRA programs and are a consortium of EPA Region 9 PRGs, EPA Region 3 RBCs and EPA Region 6 HHMSSLs. RSLs are risk-based concentrations derived from standardized equations combining exposure information assumptions with EPA toxicity data. RSLs are considered by the EPA to be protective for humans (including sensitive groups) over a lifetime. However, RSLs are not always applicable to a particular site and do not address non-human health endpoints, such as ecological impacts. The RSLs in Table 7 have been calculated without site-specific information. They are used for site "screening" and as initial cleanup goals. RSLs are not cleanup standards and were not applied as such. The RSL's primary role in site "screening" is to help identify areas, contaminants, and conditions that require further federal attention at a particular site, and is also useful in determining risks to human exposure at non-superfund sites. RSLs may be lower than the California Title 22 TTLC values, but often are much higher. Material with excessive RSL exceedances should be re-used as buried fill instead of topsoil or beach cover provided it can be shown that the material will not leach contaminants at detrimental concentrations into groundwater and receiving waters.

Human health risks were also evaluated using CHHSLs. CHHSLs (Cal/EPA, 2005) are concentrations of 54 hazardous chemicals in soil or soil gas that are considered to be below thresholds for risks to human health. The CHHSLs were developed by the Office of Environmental Health Hazard Assessment (OEHHA) on behalf of Cal/EPA. CHHSLs were developed using standard exposure assumptions and chemical toxicity values published by the USEPA and Cal/EPA. CHHSLs listed in Table 7 were developed separately for industrial/commercial settings and for residential settings. If there are particularly elevated concentrations of chemical contaminants, then the dredge material may be assessed to whether or not it is suitable for human contact. To do so, the chemical results would be compared to “Regional Screening Levels for Chemical Contaminants at Superfund Sites" (USEPA Region 9, 2010), formerly known as Preliminary Remediation Goals (PRGs).

3.3 Background Arsenic Samples

Beach background arsenic concentrations were estimated for Morro Strand State Beach just north of Morro Bay Harbor and further up coast beach between Toro Creek and Cayucos. A total of fifteen (15) beach samples were randomly collected from Morro Strand State Beach near Morro Bay and twelve (12) beach samples were randomly collected from Morro Strand State Beach near Cayucos. All samples collected were within the top two feet of beach material. All samples were analyzed for total solids and total recoverable arsenic with a reporting limit less than the California Human Health Screening Level (CHHSL) for arsenic on residential soils of 0.07 mg/kg (see Section 3.2.5 above). Material sampled from each location were also logged in accordance to the Unified Soil Classification System (ASTM). In addition to samples for arsenic, samples for grain size analyses were collected from all 27 locations to verify visual descriptions. Sampling and statistical methods are described further in Appendix D.

3.4 Field Sampling Protocols

Vibracore sampling, grab sampling, decontamination, sample processing and documentation procedures are discussed in this section.

3.4.1 Positioning and Depth Measurements

Positioning at sampling locations was accomplished using a differential GPS (DGPS) navigation system with positioning accuracies of 1 to 3 meters. Records were maintained during fieldwork to confirm the accuracy of the DGPS. Locations were recorded in both Geographic coordinates (NAD 83) and State Plane Coordinates (CA Zone V, NAD 83). Water depths were measured with a graduated lead line and corrected to mean lower low water (MLLW). Beach elevations were approximated. Tidal stage was determined using NOAA predicted tide tables checked against a local tide gage on the Morro Bay Coast Guard Dock. These tables were used to calculate the seafloor elevation/mudline for each site. DGPS and tidal elevation verification data are provided in daily field activity reports that are available upon request.

All sampling sites were located within Federal Channel limits. Target locations provided in the SAP may have been moved to another spot in the general area if the shoaling was minimal and more significant shoaling could be represented in the composite sample, or to avoid kelp and eelgrass habitats.

3.4.2 Vibracore Sampling Methods

All Morro Bay Harbor dredge footprint sediment samples were collected using an electric vibracore that was able to penetrate and obtain samples down to project sample elevations (project elevations plus two feet for overdredge testing where applicable plus one to seven additional feet for geotechnical purposes).

Vibracore sampling was conducted from the 38-foot vessel *Bonnie Marietta*. This vessel was fully equipped with all necessary navigation, safety, and lifesaving devices per Coast Guard requirements and was capable of three point anchoring. A 17-foot Boston whaler was used to assist in anchoring.

Kinnetic Laboratories' vibracore consists of a 4-inch diameter aluminum coring tube, a stainless steel cutting tip, and a stainless-steel core catcher. Inserted into the core tubes were food-grade clean polyethylene liners. The vibrating unit has two counter-rotating motors encased in waterproof aluminum housing. A three-phase, 240-volt generator powers the motors. The vibracore head and tube were lowered overboard from a davit onboard the sampling vessel. The unit was then vibrated until it reached the target sampling elevation.

When penetration of the vibracore was complete, power was shut off to the vibra-head, and the vibracore was brought back aboard the vessel. A check valve located on top of the core tube reduced or prevented sediment loss during pull-out. The length of sediment recovered was noted by measuring down the interior of the core tube to the top of the sediment. The core tube was then detached from the vibra-head, and the core cutting tip and catcher are removed. Afterwards, the core liners were removed and sealed on both ends until processed directly onboard the sampling vessel.

A stand was used to support the vibracore in waters unprotected from wave action. The vibracore and stand or cage was lowered overboard from the sampling vessel as one unit. Use of a stand allowed the vibracore sampler to remain vertical while coring. A stand also prevents the coring apparatus from being pulled up from waves while trying to penetrate, thus alleviating multiple penetrations of the same material.

As mentioned previously, extensive eelgrass and kelp beds are located within Morro Bay Harbor. All efforts were made to avoid traversing, anchoring and coring within eelgrass and kelp beds. Furthermore, BMPs were used during vessel operations from August 12 thru August 15, 2013 to prevent unnecessary damage to these beds and avoid contact with sea otters. BMPs that were used are as follows:

- Dropped anchors once vertically and recovered anchors once vertically.
- Anchors were not dragged across the seafloor.
- Crown buoys were used to retrieve anchors vertically from the seafloor.
- The vessel did not traverse through a visible kelp bed canopy or through visible eel grass beds, and these beds were avoided to the extent practical.
- Sea otters were avoided at all times. The vessel did not travel though areas where one or more

sea otters were present and the vessel was not used to encourage sea otters to move. The vessel maintained a minimum of 50 yards distance from any sea otter.

3.4.3 Vibracore Decontamination

All sample contact surfaces were stainless steel, polyethylene or Teflon® coated. Compositing tools were stainless steel. Except for the core liners, all contact surfaces of the sampling devices and the coring tubes were cleaned between sampling areas. The cleaning protocol consisted of a site water rinse, a Micro-90® soap wash, and then was finished with deionized water rinses. All rinseate was collected in containers and disposed of properly. New polyethylene core liners of food grade quality were used for each sampling location. The vibracore equipment was thoroughly rinsed between locations in within a composite area after the initial cleaning.

3.4.4 Core Processing

Whole cores were processed aboard the *Bonnie Marietta*. Cores were placed in a PVC core rack that was cleaned and covered in clean plastic between cores. After placement in the core rack, core liners were split lengthwise to expose the recovered sediment. Once exposed, sediment that came in contact with the core liner was removed by scraping with a pre-cleaned stainless steel spoon. Each core was photographed, measured, and lithologically logged in accordance with the Unified Soil Classification System (USCS) as outlined in ASTM Standards D-2488 (2006) and D-2487 (2006). Additional sediment characteristics including likely sediment origin and other observations were also recorded. A geologist from Diaz Yourman and Associates did the lithologic logging along with collection of sample splits for geophysical testing.

Photographs were taken of each core (each photograph covered about maximum two-foot interval), and of sampling equipment and procedures. Pictures of the cores are provided in Appendix E.

Following logging, vertical composite samples were formed from each core. Each vertical composite sample represented the material from the mudline to the project depth or two feet below project depth depending on the composite area. An archive sample, a grain size sample, an arsenic sample and a subsample for horizontal compositing for chemical testing were formed from each vertical composite subsample. There was no distinct geologic stratification observed or layers of fine material. Therefore, no additional archive samples were formed. Care was taken during sample processing to avoid contamination and to minimize the loss of sediment porewater. A representative sample for grain size analyses was collected directly from each core. Vertical archive samples, arsenic samples and subsamples for horizontal compositing were formed and homogenized in a pre-cleaned stainless steel tray. A portion of each vertical composite was placed in a 0.5-liter pre-cleaned and certified glass jar with a Teflon®-lined lid for archival material, and an additional portion was placed in a similar 125 ml glass jar for arsenic analysis. Individual core archives may be analyzed as directed by the SC-DMMT to identify potential hotspots or pockets of fine-grained material within a problematic composite area. The remaining portion of each vertical composite within each sampling interval identified for chemical composite sample formation was placed in another pre-cleaned tray for area compositing with other cores from the same sampling interval in the same composite area. Homogenized material from each area compositing tray was placed in the same type of glass jars used for the archives. One 0.5- liter jar was filled for bulk sediment chemical analyses, and one 125 ml glass jar with zinc acetate preservative was filled for water soluble sulfide analysis. All samples for grain size analyses were transferred to pre-labeled sample containers (sealed plastic bags) and stored appropriately until they were ultimately transferred to Diaz-Yourman and Associates for analysis.

Except for archival material, jars for chemical analyses were completely filled to minimize air bubbles being trapped in the sample container. A small amount of headspace was allowed for archived samples to prevent container breakage during freezing. For the preservation of all sediment composite samples, filled containers were placed on ice immediately following sampling and maintained at ±2 to 4°C until analyzed. Chemical archive samples were placed on ice initially and then frozen as soon as possible. The sample containers were sealed and placed in Ziploc bags to prevent any moisture loss and possible contamination.

3.4.5 Beach Transect and Nearshore Area Grab Samples

The three Morro Strand State Beach transects were approximately perpendicular to the existing water line and offshore bathymetry as shown in Figure 12. Beach transect sampling consisted of collecting surface grab samples of sediment at six foot increments in elevation between +12 and -30 feet MLLW (eight samples per transect). Beach transect locations identified in the project SAP were adjusted in the field to match existing conditions and landmarks. Reference points/coordinates used to maintain position along each transect were included in the Field Logs. Each transect location was individually logged and analyzed for physical properties.

Positioning at all transect and nearshore sampling locations was accomplished using DGPS navigation systems. Water depths at intertidal and subtidal stations were measured with a graduated lead line (or other approved method) and corrected to MLLW. Records were maintained during fieldwork to confirm the accuracy of the navigation systems.

The top six inches of sand or sediment was collected at all beach transect and nearshore sampling locations. The three highest locations along each beach transect were sampled on land or in the intertidal area using a hand held scoop. All other offshore stations were sampled from the *Bonnie Marietta* using a Ponar Grab. Grab samples in the Montana de Oro State Beach nearshore area were collected at random locations.

At each offshore station, the grab sampler was deployed, and upon retrieval, the grab was visually inspected to ensure the sample is acceptable according to SOPs. A subsample of each grab was collected using a sampling scoop.

All samples for grain size analyses were transferred to pre-labeled sample containers (sealed plastic bags) and stored appropriately until they are ultimately transferred to Diaz-Yourman and Associates for analysis.

3.4.6 Detailed Soils Log

A detailed soils log was prepared for each sampling location, including beach transects, nearshore sampling areas, and beach arsenic sampling locations. At a minimum, this log included the project name, hole or transect number or designation, date, time, location, water depth, estimated tide, mudline elevation, type and size of sampling device used, depth of penetration, length of recovery, name of person(s) taking samples, depths below mudline of samples, and a description and condition of the sediment. Descriptions of the sediment were in accordance with ASTM D 2488 (2006) and included grain size estimation, color, maximum particle size, estimation of density (sand) or consistency (silts and clays), odor (if present), and description of amount and types of organics and trash present. In cohesive soils, pocket penetrometer and miniature vane shear devices (torvane) were used to collect estimated strength/consistency data. Copies of the soils logs are provided in Appendix F.

3.4.7 Documentation and Sample Custody

All samples had their containers physically marked as to sample location. All chemistry samples were handled under Chain of Custody protocols beginning at the time of collection. Samples were considered to be “in custody” if they were (1) in the custodian’s possession or view, (2) in a secured place (locked) with restricted access, or (3) in a secure container. Standard Chain of Custody procedures were used for all samples collected, transferred, and analyzed as part of this project. Chain of Custody forms were used to identify the samples, custodians, and dates of transfer. Each person who had custody of the samples signed the Chain of Custody form and ensure samples were stored properly and not left unattended unless properly secured. Chemistry samples were hand delivered to the laboratory. Standard information on Chain of Custody forms includes:

- Sample Identification
- Sample Collection Date and Time
- Sample Matrices (e.g., marine sediment)
- Analyses to be Performed
- Container Types
- Preservation Method
- Sampler Identification
- Dates of Transfer
- Names of Persons with Custody

Copies of the Chain of Custodies are included with the laboratory reports in Appendix G. Redundant sampling data were also recorded on field data log sheets. Copies of the field data logs are included in this report as Appendix H.

A daily field activity log was maintained listing the beginning and ending time for every and all phases of operation, the names and responsibilities of all field personnel present, description and length of any delays, and weather and sea conditions.

As described in Sections 3.4, detailed soil logs were prepared from each sampling location, including beach transect locations.

3.5 Laboratory Testing Methods

Analytical chemistry testing of sediments for this project was primarily carried out by Calscience Laboratories; a State certified testing laboratory (Cal-ELAP No. 03220CA) using USEPA and USACE approved methodologies. Extraction and analysis of the sediments occurred between the period of August 16 and September 5, 2013. Diaz-Yourman and Associates carried out all geotechnical analyses during the period of August 19 to October 25, 2013.

3.5.1 Geotechnical Testing

Sieve analyses and hydrometer testing were performed according to ASTM D 422 (1963), and Atterberg Limits were determined according to ASTM D 4318 (2005). Required U.S. standard sieve sizes included No. 4, 7, 10, 14, 18, 25, 35, 45, 60, 80, 120, 170, 200, and 230 sieves. All sediment samples were classified in accordance with the Unified Soil Classification System (ASTM D 2487-06 and ASTM D 2488-06). Grain size compatibility of the proposed dredge material with the reuse areas was evaluated by the Los Angeles District USACE. This evaluation is provided in Appendix C.

3.5.2 Bulk Sediment Chemical Analyses

The five sediment composite samples collected from within Morro Bay Harbor were analyzed for the parameters and quantification limits specified in Table 8. The results were reported in dry weight unless noted otherwise. All analyses were conducted in a manner consistent with guidelines for dredge material testing methods in the USEPA/USACE (1998) Inland Testing Manual. Samples were extracted and analyzed within specified EPA holding times, and all analyses were accomplished with appropriate quality control measures.

Discrete samples from each location are being archived frozen for at least 180 days from collection. If required, additional direction will be provided for analysis.

Table 8. Analytical Methods and Quantitation Limits for Achieved for the Sediment Samples.

Analyte	Method	Method Detection Limits (Dry Weight)	Laboratory Reporting Limits (Dry Weight)	USACE Target Detection Limits (Dry Weight)
CONVENTIONALS (mg/kg dry except where noted)				
Ammonia (mg/kg)	SM 4500-NH3 B/C (M)	0.14 - 0.15	0.25 - 0.26	0.11
Percent Solids (%)	Plumb 1981 or SM2540 B	0.1	0.1	0.1
pH (pH Units)	EPA 9045D	0.01	0.01	0.1
Sulfides-dissolved (mg/L)	EPA 376.2M	0.017	0.10	0.3
Sulfides-total	EPA 9030B/9034	0.48 – 0.51	25 – 26	0.3
Total Organic Carbon (%)	EPA 9060A	0.015 – 0.016	0.063 – 0.066	0.012
Total Volatile Solids (%)	SM 2540E	0.10	0.10	0.1
Oil & Grease (mg/kg)	EPA 1664A (M) HEM	9.9 - 10	13	9.07
TRPH	EPA 1664A (M) HEM-SGT	10 - 11	13	10
METALS (mg/kg dry)				
Arsenic	EPA 6020	0.056 – 0.067	0.12 – 0.14	0.07
Cadmium	EPA 6020	0.036 – 0.038	0.13	0.2
Chromium	EPA 6020	0.024 – 0.025	0.025 – 0.026	2
Copper	EPA 6020	0.026 – 0.028	0.13	1
Lead	EPA 6020	0.042 – 0.043	0.13	1
Mercury	EPA 7471A	0.0074 – 0.0076	0.025 – 0.026	0.05
Nickel	EPA 6020	0.032 – 0.033	0.13	2
Selenium	EPA 6020	0.11	0.13	2
Silver	EPA 6020	0.02	0.13	1
Zinc	EPA 6020	0.50 – 0.52	1.26 – 1.32	4
ORGANICS-CHLORINATED PESTICIDES (µg/kg dry)				
2,4' DDD	EPA 8081A	0.43 – 0.45	1.3	2
2,4' DDE	EPA 8081A	0.38 – 4.0	1.3	2
2,4' DDT	EPA 8081A	0.38 – 4.0	1.3	2
4,4' DDD	EPA 8081A	0.40 – 0.42	1.3	2
4,4' DDE	EPA 8081A	0.38 – 0.39	1.3	2
4,4' DDT	EPA 8081A	0.42 – 0.44	1.3	2
Total DDT	EPA 8081A			2
Aldrin	EPA 8081A	0.40 – 0.41	1.3	2
BHC-alpha	EPA 8081A	0.41 – 0.43	1.3	2
BHC-beta	EPA 8081A	0.33 – 0.35	1.3	2
BHC-delta	EPA 8081A	0.32 – 0.34	1.3	2

Table 8. Analytical Methods and Quantitation Limits for Achieved for the Sediment Samples.

Analyte	Method	Method Detection Limits (Dry Weight)	Laboratory Reporting Limits (Dry Weight)	USACE Target Detection Limits (Dry Weight)
BHC-gamma (Lindane)	EPA 8081A	0.44 – 0.46	1.3	2
Chlordane-alpha	EPA 8081A	0.40 – 0.42	1.3	0.5
Chlordane-gamma	EPA 8081A	0.40 – 0.42	1.3	0.5
Oxychlordane	EPA 8081A	0.35 – 0.37	1.3	0.5
Chlordane (Technical)	EPA 8081A	4.1 – 4.3	13	0.5
Cis-nonachlor	EPA 8081A	0.37 – 0.39	1.3	2
DCPA (Dacthal)	EPA 8270C (SIM)	3.0 – 3.1	13	3.2
Dieldrin	EPA 8081A	0.42 – 0.43	1.3	2
Endosulfan sulfate	EPA 8081A	0.43 – 0.45	1.3	2
Endosulfan I	EPA 8081A	0.33 – 0.35	1.3	2
Endosulfan II	EPA 8081A	0.35 – 0.37	1.3	2
Endrin	EPA 8081A	0.45 – 0.47	1.3	2
Endrin aldeyde	EPA 8081A	0.31 – 0.32	1.3	2
Endrin ketone	EPA 8081A	0.44 – 0.46	1.3	2
Heptachlor	EPA 8081A	0.41 – 0.42	1.3	2
Heptachlor epoxide	EPA 8081A	0.45 – 0.47	1.3	2
Methoxychlor	EPA 8081A	0.41 – 0.43	1.3	2
Mirex	EPA 8081A	0.39 – 0.41	6.3 – 6.6	2
Perthane	EPA 8270 SIM	1.6 – 1.7	13	3.3
Toxaphene	EPA 8081A	8.0 – 8.3	25 -26	26
trans-Nonachlor	EPA 8081A	0.36 – 0.38	1.3	2
4,4'-Dichlorobenzophenone	EPA 8081A	2.6 – 2.7	32 – 33	
ORGANICS-BUTYLTINS (µg/kg dry)				
Monbutyltin	Krone et al., 1989	0.82 – 0.86	3.8 – 4.0	4
Dibutyltin	Krone et al., 1989	0.82 – 0.86	3.8 – 4.0	4
Tributyltin	Krone et al., 1989	0.73 – 0.76	3.8 – 4.0	2
Tetrabutyltin	Krone et al., 1989	0.97 – 1.0	3.8 – 4.0	4
ORGANICS-PHTHALATES (µg/kg dry)				
bis(2-ethylhexyl) phthalate	EPA 8270C (SIM)	5.1 – 5.3	13	20
Butyl benzyl phthalate	EPA 8270C (SIM)	5.6 – 5.8	13	20
Diethyl Phthalate	EPA 8270C (SIM)	6.3 – 6.6	13	20
Dimethyl Phthalate	EPA 8270C (SIM)	6.8 – 7.1	13	20
Di-n-butyl Phthalate	EPA 8270C (SIM)	6.5 – 6.8	13	20
Di-n-octyl Phthalate	EPA 8270C (SIM)	6.0 – 6.2	13	20
ORGANICS-PHENOLS (µg/kg dry)				
2,3,4,6-Tetrachlorophenol	EPA 8270D (M)/TQ	4.9 – 5.1	13	
2,4,5-Trichlorophenol	EPA 8270D (M)/TQ	4.1 – 4.3	13	10
2,4,6-Trichlorophenol	EPA 8270D (M)/TQ	4.6 – 4.8	13	10
2,4-Dichlorophenol	EPA 8270D (M)/TQ	3.4 – 3.5	13	20
2,4-Dimethylphenol	EPA 8270D (M)/TQ	3.9 – 4.0	13	20
2,4-Dinitrophenol	EPA 8270D (M)/TQ	68 - 70	630 – 660	1000
2,6-Dichlorophenol	EPA 8270D (M)/TQ	7.5 – 7.8	13	
2-Chlorophenol	EPA 8270D (M)/TQ	4.2 – 4.4	13	20
2-Methyl-4,6-dinitrophenol	EPA 8270D (M)/TQ	87 - 91	630 – 660	1000
2-Methylphenol	EPA 8270D (M)/TQ	6.6 – 6.9	13	20
2-Nitrophenol	EPA 8270D (M)/TQ	3.0 – 3.1	13	20
3+4-Methylphenol	EPA 8270D (M)/TQ	3.2 – 3.4	13	
4-Chloro-3-methylphenol	EPA 8270D (M)/TQ	4.5 – 4.7	13	20

Table 8. Analytical Methods and Quantitation Limits for Achieved for the Sediment Samples.

Analyte	Method	Method Detection Limits (Dry Weight)	Laboratory Reporting Limits (Dry Weight)	USACE Target Detection Limits (Dry Weight)
4-Nitrophenol	EPA 8270D (M)/TQ	81 - 84	630 – 660	
Benzoic Acid	EPA 8270D (M)/TQ	16	130	
Pentachlorophenol	EPA 8270D (M)/TQ	1.6 – 1.7	630 - 660	1000
Phenol	EPA 8270D (M)/TQ	4.6 – 4.9	13	30
ORGANICS-PCBs (µg/kg dry)				
PCB Aroclors of: 1016, 1221, 1232, 1242, 1248, 1254, 1260, and sum of all.	8082	2.7 – 3.8	13	20
PCB congeners of: 008, 018, 028, 037, 044, 049, 052, 066, 070, 074, 077, 081, 087, 099, 101, 105, 110, 114, 118, 119, 123, 126, 128, 138/158, 149, 151, 153, 156, 157, 167, 168, 169, 170, 180, 183, 184, 187, 189, 189, 194, 195, 201, 206 and 209.	EPA 8270C (SIM)	0.066 – 0.27	0.63 – 1.3	20
Total PCBs as sum of all individual PCB congeners	EPA 8270C (SIM)			20
ORGANICS-PAHs (µg/kg dry)				
1-Methylnaphthalene	EPA 8270C (SIM)	4.7 – 4.9	13	20
1-Methylphenanthrene	EPA 8270C (SIM)	4.5 – 4.7	13	20
2,3,5-Trimethylnaphthalene	EPA 8270C (SIM)	3.8 – 4.0	13	20
2,6-Dimethylnaphthalene	EPA 8270C (SIM)	4.3 – 4.5	13	20
2-Methylnaphthalene	EPA 8270C (SIM)	4.5 – 4.7	13	20
Acenaphthene	EPA 8270C (SIM)	5.9 – 6.2	13	20
Acenaphthylene	EPA 8270C (SIM)	5.7 – 6.0	13	20
Anthracene	EPA 8270C (SIM)	6.8 – 7.1	13	20
Benzo[a]anthracene	EPA 8270C (SIM)	5.9 – 6.2	13	20
Benzo[a]pyrene	EPA 8270C (SIM)	6.4 – 6.7	13	20
Benzo[b]fluoranthene	EPA 8270C (SIM)	6.5 – 6.8	13	20
Benzo[e]pyrene	EPA 8270C (SIM)	3.0 – 3.2	13	20
Benzo[g,h,i]perylene	EPA 8270C (SIM)	5.3 – 5.6	13	20
Benzo[k]fluoranthene	EPA 8270C (SIM)	8.3 – 8.7	13	20
Biphenyl	EPA 8270C (SIM)	5.1 – 5.3	13	20
Chrysene	EPA 8270C (SIM)	6.4 – 6.7	13	20
Dibenzo[a,h]anthracene	EPA 8270C (SIM)	4.7 – 4.9	13	20
Dibenzothiophene	EPA 8270C (SIM)	7.3 – 7.6	13	20
Fluoranthene	EPA 8270C (SIM)	7.3 – 7.7	13	20
Fluorene	EPA 8270C (SIM)	6.4 – 6.7	13	20
Indeno[1,2,3-c,d]pyrene	EPA 8270C (SIM)	5.7 – 6.0	13	20
Naphthalene	EPA 8270C (SIM)	4.8 – 5.0	13	20
Perylene	EPA 8270C (SIM)	4.5 – 4.7	13	20
Phenanthrene	EPA 8270C (SIM)	7.3 – 7.6	13	20
Pyrene	EPA 8270C (SIM)	6.8 – 7.1	13	20
Total Low Weight PAHs	EPA 8270C (SIM)		13	20
Total High Weight PAHs	EPA 8270C (SIM)		13	20
Total Detectable PAHs	EPA 8270C (SIM)		13	20

Table 8. Analytical Methods and Quantitation Limits for Achieved for the Sediment Samples.

Analyte	Method	Method Detection Limits (Dry Weight)	Laboratory Reporting Limits (Dry Weight)	USACE Target Detection Limits (Dry Weight)
ORGANICS-Pyrethroid Pesticides (µg/kg dry)				
Allethrin (Bioallethrin)	EPA 8270D (M)/TQ/EI	0.32 – 0.34	0.63 – 0.66	1
Bifenthrin	EPA 8270D (M)/TQ/EI	0.12	0.63 – 0.66	1
Cyfluthrin-beta (Baythroid)	EPA 8270D (M)/TQ/EI	0.11	0.63 – 0.66	1
Cyhalothrin-Lamba	EPA 8270D (M)/TQ/EI	0.055 – 0.058	0.63 – 0.66	1
Cypermethrin	EPA 8270D (M)/TQ/EI	0.087 – 0.091	0.63 – 0.66	1
Deltamethrin:Tralomethrin	EPA 8270D (M)/TQ/EI	0.26 – 0.28	0.63 – 0.66	1
Esfenvalerate:Fenvalerate	EPA 8270D (M)/TQ/EI	0.045 – 0.047	0.63 – 0.66	1
Fenpropathrin (Danitol)	EPA 8270D (M)/TQ/EI	0.046 – 0.048	0.63 – 0.66	1
Fluvalinate	EPA 8270D (M)/TQ/EI	0.072 – 0.076	0.63 – 0.66	1
Permethrin (cis and trans)	EPA 8270D (M)/TQ/EI	0.14 – 0.15	1.3	1
Resmethrin:Bioresmethrin	EPA 8270D (M)/TQ/EI	0.12	0.63 – 0.66	1
Sumithrin (Phenothrin)	EPA 8270D (M)/TQ/EI	0.087 – 0.090	0.63 – 0.66	1
Tetramethrin	EPA 8270D (M)/TQ/EI	0.048 – 0.050	0.63 – 0.66	1

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4.0 RESULTS

As summarized in Tables 9, 10 and 11 below, results of all physical and chemical and testing of the Morro Bay Harbor and reference beach samples are provided. These tables do not include analytical quality assurance/quality control (QA/QC) data. Complete analytical results including all associated QA/QC data are provided in Appendix G. A complete set of physical results is included in Appendix I.

4.1 Sediment Physical Results

Grain size analyses were performed on multiple layers from each of the 27 cores collected and on each individual transect sample. Sieve analysis data for material above project depth and associated overdepths for the Morro Bay Harbor cores are provided in Table 9, and the results show that the sediments are comprised primarily of sand (i.e., poorly graded sand with little or no fines). Proposed dredging would be conducted according to the project dredge depths categorized in Table 9. For informational purposes only, sieve analysis data for material below project overdepths are provided in Table 10. These data show that all locations are primarily sand below project overdepths with the exception of thin strata (~0.5 feet thick) from vibracore location MBHVC13-20 (classification: lean clay with sand (CL); LL = 39; PL = 18) in Area 2 (Navy channel) and from vibracore location MBHVC13-23 (classification: lean clay with sand (CL); LL = 37; PL = 19) in Area F (Morro Channel). Sieve analysis data for the individual beach transect and nearshore samples are provided in Table 11 and show that sediments collected in 2013 in the nearshore area of Montana de Oro State Beach and along the transects at Morro Strand State Beach are poorly graded sand with very little or no fines. Individual grain size distribution curves for each individual grain size sample analyzed above associated project overdepths are provided in Appendix I along with plasticity index plots and hydrometer data for a select number of samples.

Summaries of the grain size results for each of the Morro Bay Harbor dredge areas sampled as well as the receiving beach samples are also provided in Appendix C along with placement site compatibility (suitability determination) of the Morro Bay Harbor maintenance dredging sediments.

4.2 Sediment Chemical Results

Summaries of the chemical testing results are provided in Table 12 for the five composite samples. Included in these tables are biological affects screening values consisting of ERLs and ERMs and human health criteria for residential and industrial settings consisting of RSLs and CHHSLs. Values that exceed ERLs are bolded. Values exceeding ERMs are bolded and underlined. Values that exceed one or more of the human health criteria are shaded.

Data contained in Table 12 are often coded. Values that were not detected above the method detection limit were assigned a “<” prefix symbol. Values estimated between the MDL and reporting limit were tagged with a “J”. A “J” code may also indicate an estimated value due to that values being outside of certain QA/QC objectives. Definitions of all other symbols are described in the QA/QC report in Appendix J and in table footnotes.

4.3 Sediment and Receiving Beach Arsenic Results

Results and a discussion of the arsenic analyses from the individual cores and reference beaches are provided in Appendix D.

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Table 9. 2013 Moro Bay Harbor Sieve Analysis Data above Project or Overdredge Depth for Each Individual Core.

Location	Mudline	Elevation (ft, MLLW)		Gravel			Coarse Sand		Medium Sand				Fine Sand						Silt	Classification
				Sieve No./Sieve Size/% Passing																
					3/8	4	7	10	14	18	25	35	45	60	80	120	170	200	230	
		Top	Bottom	19 mm	9.5 mm	4.75 mm	2.8 mm	2 mm	1.4 mm	1.0 mm	0.71 mm	0.50 mm	0.355 mm	0.250 mm	0.18 mm	0.125 mm	0.09 mm	0.075 mm	0.063 mm	
Area A - Entrance Channel																				
MBHVC13-01	-33.5	-33.5	-40	100	100	100	99	99	98	97	96	95	93	87	60	5.8	0.6	0.3	0.1	POORLY GRADED SAND (SP)
MBHVC13-02	-36.1	-36.1	-40	100	100	98	98	98	97	97	97	96	94	89	65	6.1	0.2	0.2	0.0	POORLY GRADED SAND (SP)
MBHVC13-03	-34.8	-34.8	-40	100	100	100	100	100	100	99	99	98	98	94	71	6.4	0.4	0.1	0.0	POORLY GRADED SAND (SP)
MBHVC13-04	-33.5	-33.5	-40	100	100	100	99	99	98	97	96	95	94	89	68	6.2	0.6	0.2	0.1	POORLY GRADED SAND (SP)
Area B – Sand Trap																				
MBHVC13-05	-19	-19	-25	100	100	100	100	100	100	100	100	99	99	96	81	9.1	0.4	0.0	0.0	POORLY GRADED SAND (SP)
MBHVC13-06	-19.3	-19.3	-25	100	100	100	100	100	100	100	100	99	99	96	77	8.8	0.8	0.1	0.1	POORLY GRADED SAND (SP)
MBHVC13-08	-19	-19	-25	100	100	100	99	99	97	96	94	92	89	77	51	4.8	0.4	0.1	0.0	POORLY GRADED SAND (SP)
MBHVC13-09	-22	-22	-25	100	100	100	100	100	99	99	98	96	91	79	58	13	2.9	1.2	0.4	POORLY GRADED SAND (SP)
Area C/D – Transition Area/Main Channel																				
MBHVC13-07	-25	-25	-26	100	100	100	99	98	95	86	74	65	60	50	32	2.1	0.3	0.0	0.0	POORLY GRADED SAND (SP)
MBHVC13-10	-15	-15	-18	100	100	100	100	100	99	99	98	97	95	85	51	3.5	0.3	0.1	0.0	POORLY GRADED SAND (SP)
MBHVC13-11	-15.1	-15.1	-18	100	100	100	99	99	99	98	98	96	94	85	52	2.4	0.2	0.0	0.0	POORLY GRADED SAND (SP)
Area E – Navy Channel																				
MBHVC13-12	-15.5	-15.5	-18	100	100	100	100	100	100	100	99	99	97	89	53	2.7	0.4	0.3	0.2	POORLY GRADED SAND (SP)
MBHVC13-13	-17.2	-17.2	-18	100	100	100	100	100	100	100	99	99	98	88	45	2.9	0.3	0.2	0.1	POORLY GRADED SAND (SP)
MBHVC13-14	-14.2	-14.2	-18	100	100	100	100	100	100	100	99	97	94	86	62	10	2.1	0.5	0.4	POORLY GRADED SAND (SP)
MBHVC13-15	-15.1	-15.1	-18	100	100	100	100	100	100	100	99	98	95	87	65	12	3.1	0.8	0.3	POORLY GRADED SAND (SP)
MBHVC13-16	-12.9	-12.9	-18	100	100	100	100	100	100	100	99	99	98	95	71	6.7	1.3	0.3	0.1	POORLY GRADED SAND (SP)
MBHVC13-17	-16.1	-16.1	-18	100	100	100	100	100	100	100	100	99	98	93	67	5.4	0.8	0.3	0.2	POORLY GRADED SAND (SP)
MBHVC13-18	-15.2	-15.2	-18	100	100	100	100	100	100	99	99	97	95	90	63	5.5	0.8	0.4	0.3	POORLY GRADED SAND (SP)
MBHVC13-19	-13.2	-13.2	-18	100	100	100	100	100	100	100	100	99	99	93	66	6.3	0.6	0.2	0.2	POORLY GRADED SAND (SP)
MBHVC13-20	-13	-13	-18	100	100	100	100	100	100	99	99	98	94	71	36	0.0	0.0	0.0	0.0	POORLY GRADED SAND (SP)
Area F – Morro Channel																				
MBHVC13-21	-10	-10	-14	100	100	100	100	100	100	100	100	99	98	87	43	2.9	0.5	0.3	0.3	POORLY GRADED SAND (SP)
MBHVC13-22	-11.3	-11.3	-14	100	100	100	100	100	100	100	100	99	98	94	69	5.9	1.3	0.3	0.1	POORLY GRADED SAND (SP)
MBHVC13-23	-12.6	-12.6	-14	100	100	100	100	100	100	100	100	99	98	92	70	7.6	1.4	0.4	0.2	POORLY GRADED SAND (SP)
MBHVC13-24	-10.8	-10.8	-14	100	100	100	100	100	100	100	100	99	98	95	70	7.4	0.9	0.3	0.1	POORLY GRADED SAND (SP)
MBHVC13-25	-10.6	-10.6	-14	100	100	100	100	100	100	100	99	99	98	96	90	17	3.1	1.0	0.3	POORLY GRADED SAND (SP)
MBHVC13-26	-9.3	-9.3	-14	100	100	100	100	100	100	100	100	99	99	93	62	4.1	0.4	0.2	0.1	POORLY GRADED SAND (SP)
MBHVC13-27	-8.5	-8.5	-14	100	100	100	100	100	100	100	99	98	97	96	89	15	2.3	0.8	0.3	POORLY GRADED SAND (SP)

Table 10. Vibracore Sample Location Gradation Test Results for Specific Sample Depth Intervals Collected Below Project Depth or Overdepth, Morro Bay Harbor 2013 Sediment Investigation.

Location	Project or Overdepth Elevation	Elevation (ft, MLLW)		Gravel			Coarse Sand		Medium Sand				Fine Sand						Silt	Classification
				Sieve No./Sieve Size/% Passing																
					3/8	4	7	10	14	18	25	35	45	60	80	120	170	200	230	
		Top	Bottom	19 mm	9.5 mm	4.75 mm	2.8 mm	2 mm	1.4 mm	1.0 mm	0.71 mm	0.50 mm	0.355 mm	0.250 mm	0.18 mm	0.125 mm	0.09 mm	0.075 mm	0.063 mm	
Area A - Entrance Channel																				
MBHVC13-01	-40	-40.0	-43.5	87	76	66	62	60	57	56	54	52	49	43	34	5	1	0	0	POORLY GRADED SAND WITH GRAVEL (SP)
MBHVC13-01	-40	-41.7	-43.5	69	55	35	27	23	20	18	16	14	11	6	3	1	0	0	0	WELL-GRADED GRAVEL WITH SAND (GW)
MBHVC13-02	-40	-40.0	-45.1	100	100	100	100	100	100	100	100	99	99	96	76	10	1	0	0	POORLY GRADED SAND (SP)
MBHVC13-03	-40	-40.0	-43.7	94	78	60	50	43	34	30	28	26	24	22	16	2	0	0	0	WELL GRADED SAND WITH GRAVEL (SP)
MBHVC13-04	-40	-40.0	-41.6	100	100	100	99	99	98	97	96	95	94	89	68	6	1	0	0	POORLY GRADED SAND (SP)
Area B – Sand Trap																				
MBHVC13-05	-25	-25.0	-32.0	100	100	100	100	100	100	100	99	99	98	93	76	10	1	0	0	POORLY GRADED SAND (SP)
MBHVC13-06	-25	-25.0	-32.0	100	97	96	95	94	93	91	91	89	86	74	50	6	1	0	0	POORLY GRADED SAND (SP)
MBHVC13-08	-25	-25.0	-32.0	100	98	91	84	81	78	76	75	74	72	65	46	5	1	0	0	POORLY GRADED SAND (SP)
MBHVC13-09	-25	-25.0	-32.0	100	97	84	73	66	60	57	55	53	50	44	34	7	2	1	1	POORLY GRADED SAND WITH GRAVEL (SP)
Area C/D – Transition Area/Main Channel																				
MBHVC13-07	-26	-26.0	-33.0	100	100	97	92	89	81	68	53	42	41	30	18	2	1	1	1	POORLY GRADED SAND (SP)
MBHVC13-10	-18	-18.0	-25.0	100	99	96	88	79	71	68	67	66	65	60	38	3	0	0	0	POORLY GRADED SAND (SP)
MBHVC13-11	-18	-18.0	-25.0	100	100	100	100	100	100	99	99	97	95	88	58	3	0	0	0	POORLY GRADED SAND (SP)
Area E – Navy Channel																				
MBHVC13-12	-18	-16.0	-23.5	100	100	100	99	99	99	98	97	96	94	86	49	2	0	0	0	POORLY GRADED SAND (SP)
MBHVC13-13	-18	-18.0	-25.8	100	100	100	100	100	100	100	99	98	96	88	47	3	1	0	0	POORLY GRADED SAND (SP)
MBHVC13-14	-18	-18.0	-24.1	97	90	84	80	78	75	73	71	67	60	39	18	3	1	0	0	POORLY GRADED SAND WITH GRAVEL (SP)
MBHVC13-14	-18	-20.0	-21.2	63	47	32	23	19	16	14	12	10	8	4	2	1	0	0	0	WELL GRADED GRAVEL WITH SAND (GW)
MBHVC13-15	-18	-18.0	-25.0	94	77	71	68	66	64	63	62	60	58	54	41	8	3	2	1	POORLY GRADED SAND WITH GRAVEL (SP)
MBHVC13-15	-18	-22.6	-25.0	76	53	39	29	25	23	21	20	19	17	14	8	1	0	0	0	POORLY GRADED GRAVEL WITH SAND (GP)
MBHVC13-16	-18	-18.0	-25.0	100	100	100	100	100	100	100	99	99	98	96	78	9	1	0	0	POORLY GRADED SAND (SP)
MBHVC13-17	-18	-180	-25.0	100	98	95	92	89	86	83	80	75	71	62	41	3	1	0	0	POORLY GRADED SAND (SP)
MBHVC13-17	-18	-24.1	-25.0	100	85	61	38	24	15	11	9	8	8	7	5	1	1	1	1	POORLY GRADED SAND WITH GRAVEL (SP)
MBHVC13-18	-18	-18.0	-20.0	100	100	100	98	97	95	94	93	92	91	88	67	8	1	0	0	POORLY GRADED SAND (SP)
MBHVC13-19	-18	-18.0	-25.0	100	100	100	100	99	99	99	98	97	96	91	66	7	1	0	0	POORLY GRADED SAND (SP)
MBHVC13-20	-18	-18.0	-21.0	100	100	100	100	100	100	100	99	98	96	80	47	5	1	1	0	POORLY GRADED SAND (SP)
MBHVC13-20	-18	-21.0	-21.6	100	100	100	100	100	100	99	99	99	97	94	89	79	75	72	71	LEAN CLAY WITH SAND (CL): LL=39, PL=19
Area F – Morro Channel																				
MBHVC13-21	-14	-14.0	-20.0	100	100	99	98	97	95	95	94	93	91	83	47	3	1	0	0	POORLY GRADED SAND (SP)
MBHVC13-22	-14	-14.0	-21.0	100	100	100	100	100	100	100	100	99	98	96	71	6	1	0	0	POORLY GRADED SAND (SP)
MBHVC13-23	-14	-14.0	-20.9	100	97	92	89	88	87	86	85	84	81	74	49	7	3	1	0	POORLY GRADED SAND (SP)
MBHVC13-23	-14	-15.9	-17.1	100	88	70	58	51	47	45	44	43	41	37	29	4	1	1	1	POORLY GRADED SAND (SP)
MBHVC13-23	-14	-17.1	-20.4	100	100	100	99	98	98	98	98	98	97	96	76	26	21	20	20	SILTY SAND (SM): LL=NP, PL=NP
MBHVC13-23	-14	-20.4	-20.9	100	100	100	100	99	99	99	99	99	99	98	87	60	57	55	55	SANDY LEAN CLAY (CL): LL=37, PL=18
MBHVC13-24	-14	-14.0	-21.0	100	100	100	100	100	100	100	100	99	98	95	70	8	1	1	0	POORLY GRADED SAND (SP)
MBHVC13-25	-14	-14.0	-21.0	100	100	100	100	100	100	100	99	99	98	93	71	7	1	0	0	POORLY GRADED SAND (SP)
MBHVC13-26	-14	-14.0	-21.0	100	100	100	100	100	100	100	100	99	98	92	61	4	0	0	0	POORLY GRADED SAND (SP)
MBHVC13-27	-14	-14.0	-18.6	100	100	100	100	100	100	99	98	97	96	94	79	17	6	3	2	POORLY GRADED SAND (SP)

Table 11. 2013 Sieve Analysis Data for Montana de Oro State Beach Nearshore Area Locations and Morro Strand State Beach Transect Locations.

Location	Sampling Depth (ft, MLLW)	Gravel			Coarse Sand		Medium Sand				Fine Sand						Silt	Classification
		Sieve No./Sieve Size/% Passing																
			3/8	4	7	10	14	18	25	35	45	60	80	120	170	200	230	
		19 mm	9.5 mm	4.75 mm	2.8 mm	2 mm	1.4 mm	1.0 mm	0.71 mm	0.50 mm	0.355 mm	0.250 mm	0.18 mm	0.125 mm	0.09 mm	0.075 mm	0.063 mm	
Montana de Oro State Beach Nearshore Area																		
MBNGS13-B1	23*	100	99	97	95	94	92	91	90	89	88	84	64	9.0	1.2	0.2	0.0	POORLY GRADED SAND (SP)
MBNGS13-B2	24.7*	100	100	100	100	100	99	99	98	97	96	88	57	5.1	0.5	0.0	0.0	POORLY GRADED SAND (SP)
MBNGS13-B3	36.2*	100	100	100	100	99	99	99	98	97	95	88	57	5.1	0.5	0.0	0.0	POORLY GRADED SAND (SP)
MBNGS13-B4	39.4*	100	100	100	100	100	100	100	99	99	98	95	78	14	1.7	0.1	0.0	POORLY GRADED SAND (SP)
MBNGS13-B5	31.5*	100	100	100	100	100	100	100	99	99	97	89	58	4.9	0.6	0.2	0.1	POORLY GRADED SAND (SP)
MBNGS13-B6	33.7*	100	100	100	99	99	98	96	94	91	86	68	32	1.9	0.2	0.1	0.1	POORLY GRADED SAND (SP)
MBNGS13-B7	27.4*	100	100	99	98	98	97	96	96	95	94	89	60	5.9	0.7	0.1	0.0	POORLY GRADED SAND (SP)
MBNGS13-B8	30.5*	100	100	100	100	100	100	100	99	98	95	79	40	2.2	0.0	0.0	0.0	POORLY GRADED SAND (SP)
Morro Strand State Beach Transect A																		
MBBGS13-A1	+12	100	100	100	100	100	100	100	100	100	100	93	52	3.2	0.3	0.0	0.0	POORLY GRADED SAND (SP)
MBBGS13-A2	+6	100	100	100	100	100	100	100	100	100	100	96	60	2.5	0.3	0.2	0.2	POORLY GRADED SAND (SP)
MBBGS13-A3	0	100	100	100	100	100	100	100	99	98	96	90	58	2.5	0.2	0.1	0.1	POORLY GRADED SAND (SP)
MBBGS13-A4	-6	100	100	100	100	100	99	99	98	98	96	91	75	15	1.4	0.3	0.3	POORLY GRADED SAND (SP)
MBBGS13-A5	-12	100	100	99	99	99	99	99	98	98	97	75	12	0.6	0.0	0.0	0.0	POORLY GRADED SAND (SP)
MBBGS13-A6	-18	100	100	100	100	100	100	100	100	99	99	97	87	17	1.6	0.5	0.2	POORLY GRADED SAND (SP)
MBBGS13-A7	-24	100	100	100	100	100	100	100	99	99	98	96	85	16	1.0	0.2	0.0	POORLY GRADED SAND (SP)
MBBGS13-A8	-30	100	100	99	99	99	99	99	99	99	98	95	80	13	1.2	0.3	0.0	POORLY GRADED SAND (SP)
Morro Strand State Beach Transect B																		
MBBGS13-B1	+12	100	100	100	100	100	100	100	100	100	99	89	52	2.3	0.1	0.0	0.0	POORLY GRADED SAND (SP)
MBBGS13-B2	+6	100	100	100	100	100	100	100	100	100	100	98	73	3.6	0.1	0.0	0.0	POORLY GRADED SAND (SP)
MBBGS13-B3	0	100	100	100	100	100	100	100	99	98	97	92	68	3.9	0.2	0.1	0.1	POORLY GRADED SAND (SP)
MBBGS13-B4	-6	100	100	100	100	99	99	99	98	97	96	92	77	16	1.5	0.1	0.0	POORLY GRADED SAND (SP)
MBBGS13-B5	-12	100	100	100	100	100	100	100	99	99	98	95	77	10	0.7	0.1	0.1	POORLY GRADED SAND (SP)
MBBGS13-B6	-18	100	100	100	100	100	100	99	99	98	98	94	74	11	0.8	0.0	0.0	POORLY GRADED SAND (SP)
MBBGS13-B7	-24	100	100	100	100	100	100	99	99	98	98	96	85	17	1.3	0.0	0.0	POORLY GRADED SAND (SP)
MBBGS13-B8	-30	100	100	100	100	100	100	100	100	99	99	96	81	16	1.8	0.4	0.1	POORLY GRADED SAND (SP)
Morro Strand State Beach Transect C																		
MBBGS13-C1	+12	100	100	100	100	100	100	100	100	99	98	97	89	52	1.8	0.1	0.1	POORLY GRADED SAND (SP)
MBBGS13-C2	+6	100	100	100	100	100	100	100	100	100	98	86	45	1.4	0.1	0.1	0.1	POORLY GRADED SAND (SP)
MBBGS13-C3	0	100	100	100	100	100	100	99	99	98	96	89	58	2.2	0.2	0.1	0.1	POORLY GRADED SAND (SP)
MBBGS13-C4	-6	100	100	100	100	100	100	99	99	98	97	91	71	19	1.9	0.2	0.0	POORLY GRADED SAND (SP)
MBBGS13-C5	-12	100	100	100	100	100	100	99	99	98	98	93	71	11	1.0	0.2	0.2	POORLY GRADED SAND (SP)
MBBGS13-C6	-18	100	100	100	100	100	100	100	100	99	99	97	86	20	2.5	0.8	0.3	POORLY GRADED SAND (SP)
MBBGS13-C7	-24	100	100	100	100	100	100	100	100	99	99	96	80	17	2.1	0.5	0.1	POORLY GRADED SAND (SP)
MBBGS13-C8	-30	100	100	100	100	100	100	100	100	99	99	97	88	22	2.8	0.7	0.2	POORLY GRADED SAND (SP)

*Non-tidally corrected water depth.

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Table 12. 2013 Morro Bay Harbor Bulk Sediment Chemistry Results.

Valid Analyte Name	Units	Morro Bay Harbor Composite Samples					NOAA Screening		Human RSLs[2]		Human CHHSLs[3]	
		A	B	C/D	E	F	Salt ERL[1]	Salt ERM[1]	Residential	Industrial	Residential	Commercial Industrial
SEDIMENT CONVENTIONALS												
Percent Solids	%	79.3	76.4	78.1	75.9	76.3						
Total Volatile Solids	%	0.3	0.44	0.43	0.53	0.27						
pH	pH Units	8.23	8.17	8.29	8.17	8.11						
Total Organic Carbon	%	0.088	0.17	<0.016	0.21	0.079						
Oil and Grease	mg/kg dry	30	51	24	38	21						
TRPH	mg/kg dry	23	35	20	30	17						
Total Ammonia	mg/kg dry	3.5	1.1	4.7	3.7	1.3						
Water Soluble Sulfides	mg/L	<0.017	<0.017	<0.017	<0.017	<0.017						
Total Sulfides	mg/kg dry	37	220	110	430	120						
METALS												
Arsenic	mg/kg dry	2.81	3.43	2.81	3.38	2.8	8.2	70	0.39	1.6	0.07	0.24
Cadmium	mg/kg dry	0.0903J	0.0922J	0.0693J	0.083J	0.104J	1.2	9.6	70	800	1.7	7.5
Chromium	mg/kg dry	23.1	33.1	28	29.1	33.2	81	370			100,000	1,000,000
Copper	mg/kg dry	2.23	3.06	2.94	3.26	3.19	34	270	3,100	41,000	3,000	38,000
Lead	mg/kg dry	1.35	1.52	1.27	1.58	1.32	46.7	218	400	800	150	3,500
Mercury	mg/kg dry	0.0141J	0.0264	0.0211J	0.0315	0.0199J	0.15	0.71	10	43	18	180
Nickel	mg/kg dry	**25**	**31.4**	**24.6**	**29**	**31.6**	20.9	51.6	1,500	20,000	1,600	16,000
Selenium	mg/kg dry	<0.105	<0.109	<0.107	<0.11	<0.109			390	5,100	380	4,800
Silver	mg/kg dry	<0.0197	<0.0205	<0.02	<0.0206	<0.0205	1	3.7	390	5,100	380	4,800
Zinc	mg/kg dry	10.2	12.3	9.73	10.8	12.5	150	410	23,000	310,000	23,000	100,000
BUTYLTINS												
Dibutyltin	µg/kg dry	<0.82	<0.86	<0.84	<0.86	<0.86			18,000	180,000		
Monobutyltin	µg/kg dry	<0.82	<0.85	<0.84	<0.86	<0.86						
Tetrabutyltin	µg/kg dry	<0.97	<1	<0.99	<1	<1						
Tributyltin	µg/kg dry	<0.73	<0.75	<0.74	<0.76	<0.75			18,000	180,000		
POLYAROMATIC HYDROCARBONS												
1-Methylnaphthalene	µg/kg dry	<4.7	<4.9	<4.8	<4.9	<4.9			22,000	99,000		
1-Methylphenanthrene	µg/kg dry	<4.5	<4.7	<4.6	<4.7	<4.7						
2,3,5-Trimethylnaphthalene	µg/kg dry	<3.8	<4	<3.9	<4	<4						
2,6-Dimethylnaphthalene	µg/kg dry	<4.3	<4.5	<4.4	<4.5	<4.5						
2-Methylnaphthalene	µg/kg dry	<4.5	<4.7	<4.6	<4.7	<4.7	70	670	310,000	4,100,000		
Acenaphthene	µg/kg dry	<5.9	<6.1	<6	<6.2	<6.1	16	500	3,400,000	33,000,000		
Acenaphthylene	µg/kg dry	<5.7	<5.9	<5.8	<6	<5.9	44	640				
Anthracene	µg/kg dry	<6.8	<7.1	<6.9	<7.1	<7.1	85.3	1100	17,000,000	170,000,000		

Table 12. 2013 Morro Bay Harbor Bulk Sediment Chemistry Results.

Valid Analyte Name	Units	Morro Bay Harbor Composite Samples					NOAA Screening		Human RSLs[2]		Human CHHSLs[3]	
		A	B	C/D	E	F	Salt ERL[1]	Salt ERM[1]	Residential	Industrial	Residential	Commercial Industrial
Benzo (a) Anthracene	µg/kg dry	<5.9	<6.1	<6	<6.2	<6.2	261	1600	150	2100		
Benzo (a) Pyrene	µg/kg dry	<6.4	<6.6	<6.5	<6.7	<6.6	430	1600	15	210	38	130
Benzo (b) Fluoranthene	µg/kg dry	<6.5	<6.8	<6.6	<6.8	<6.8			150	2100		
Benzo (e) Pyrene	µg/kg dry	<3	<3.2	<3.1	<3.2	<3.2						
Benzo (g,h,i) Perylene	µg/kg dry	<5.3	<5.5	<5.4	<5.6	<5.5						
Benzo (k) Fluoranthene	µg/kg dry	<8.3	<8.6	<8.4	<8.7	<8.6			1500	21,000		
Biphenyl	µg/kg dry	<5.1	<5.3	<5.2	<5.3	<5.3						
Chrysene	µg/kg dry	<6.4	<6.7	<6.5	<6.7	<6.7	384	2800	15,000	210,000		
Dibenz (a,h) Anthracene	µg/kg dry	<4.7	<4.9	<4.8	<4.9	<4.9	63.4	260	15	210		
Dibenzothiophene	µg/kg dry	<7.3	<7.6	<7.4	<7.6	<7.6						
Fluoranthene	µg/kg dry	<7.3	<7.6	<7.5	<7.7	<7.6	600	5100	2,300,000	22,000,000		
Fluorene	µg/kg dry	<6.4	<6.7	<6.5	<6.7	<6.7	19	540	2,300,000	22,000,000		
Indeno (1,2,3-c,d) Pyrene	µg/kg dry	<5.7	<6	<5.8	<6	<6			150	2100		
Naphthalene	µg/kg dry	<4.8	<5	<4.9	<5	<5	160	2100	3600	18,000		
Perylene	µg/kg dry	<4.5	<4.7	<4.6	<4.7	<4.7						
Phenanthrene	µg/kg dry	<7.3	<7.5	<7.4	<7.6	<7.5	240	1500				
Pyrene	µg/kg dry	<6.8	<7	<6.9	12J	<7	665	2600	1,700,000	17,000,000		
Total Low Weight PAHs	µg/kg dry	0	0	0	0	0	552	3160				
Total High Weight PAHs	µg/kg dry	0	0	0	12	0	1700	9600				
Total PAHs	µg/kg dry	0	0	0	12	0	4022	44792				
PHTHALATES												
Benzyl butyl phthalate	µg/kg dry	<5.6	<5.8	6.7J	7.4J	<5.8			260,000	910,000		
bis-(2-Ethylhexyl)phthalate	µg/kg dry	<5.1	<5.3	10J	<5.3	<5.3			35,000	120,000		
Diethyl phthalate	µg/kg dry	<6.3	<6.5	<6.4	<6.6	<6.5			49,000,000	490,000,000		
Dimethyl phthalate	µg/kg dry	<6.8	<7	<6.9	<7.1	<7						
Di-n-butyl phthalate	µg/kg dry	<6.5	<6.7	<6.6	<6.8	<6.7			6,100,000	62,000,000		
Di-n-octyl phthalate	µg/kg dry	<6	<6.2	<6.1	<6.2	<6.2						
PHENOLS												
2,3,4,6-Tetrachlorophenol	µg/kg dry	<4.9	<5.1	<5	<5.1	<5.1						
2,4,5-Trichlorophenol	µg/kg dry	<4.1	<4.3	<4.2	<4.3	<4.3						
2,4,6-Trichlorophenol	µg/kg dry	<4.6	<4.7	<4.6	<4.8	<4.7			44,000	160,000		
2,4-Dichlorophenol	µg/kg dry	<3.4	<3.5	<3.4	<3.5	<3.5			180,000	1,800,000		
2,4-Dimethylphenol	µg/kg dry	<3.9	<4	<3.9	<4	<4			1,200,000	12,000,000		
2,4-Dinitrophenol	µg/kg dry	<68	<71	<69	<71	<71			120,000	1,200,000		
2,6-Dichlorophenol	µg/kg dry	<7.5	<7.8	<7.6	<7.8	<7.8						

Table 12. 2013 Morro Bay Harbor Bulk Sediment Chemistry Results.

Valid Analyte Name	Units	Morro Bay Harbor Composite Samples					NOAA Screening		Human RSLs[2]		Human CHHSLs[3]	
		A	B	C/D	E	F	Salt ERL[1]	Salt ERM[1]	Residential	Industrial	Residential	Commercial Industrial
2-Chlorophenol	µg/kg dry	<4.2	<4.4	<4.3	<4.4	<4.4			390,000	5,100,000		
2-Methylphenol	µg/kg dry	<6.6	<6.9	<6.7	<6.9	<6.9						
2-Nitrophenol	µg/kg dry	<3	13UJ-	<3.1	13UJ-	13UJ-						
3/4-Methylphenol	µg/kg dry	<3.2	<3.4	<3.3	<3.4	<3.4						
4,6-Dinitro-2-Methylphenol	µg/kg dry	<87	<91	<89	<91	<91						
4-Chloro-3-Methylphenol	µg/kg dry	<4.5	<4.6	<4.5	<4.7	<4.7						
4-Nitrophenol	µg/kg dry	<81	<84	<82	<84	<84						
Benzoic Acid	µg/kg dry	<16	<16	<16	<16	<16						
Pentachlorophenol	µg/kg dry	<1.6	<1.7	<1.6	3.9J	<1.7			890	2,700	4,400	13,000
Phenol	µg/kg dry	<4.6	<4.8	<4.7	<4.9	<4.8			18,000,000	180,000,000		
CHLORINATED PESTICIDES												
2,4'-DDD	µg/kg dry	<0.43	<0.44	<0.43	<0.45	<0.44						
2,4'-DDE	µg/kg dry	<0.38	<0.4	<0.39	<0.4	<0.4						
2,4'-DDT	µg/kg dry	<0.38	<0.39	<0.38	<0.4	<0.39						
4,4'-DDD	µg/kg dry	<0.4	<0.41	<0.4	<0.42	<0.41	2	20	2,000	7,200	2,300	9,000
4,4'-DDE	µg/kg dry	<0.38	<0.39	<0.38	<0.39	<0.39	2.2	27	1,400	5,100	1,600	6,300
4,4'-DDT	µg/kg dry	<0.42	<0.44	<0.43	<0.44	<0.44	1	7	1,700	7,000	1,600	6,300
Total DDT	µg/kg dry	0	0	0	0	0	1.58	46.1				
Aldrin	µg/kg dry	<0.4	<0.41	<0.4	<0.41	<0.41			29	100	33	130
BHC-alpha	µg/kg dry	<0.41	<0.42	<0.41	<0.43	<0.42						
BHC-beta	µg/kg dry	<0.33	<0.35	<0.34	<0.35	<0.35						
BHC-delta	µg/kg dry	<0.32	<0.33	<0.33	<0.34	<0.34						
BHC-gamma	µg/kg dry	<0.44	<0.45	<0.44	<0.46	<0.45						
Chlordane-alpha	µg/kg dry	<0.4	<0.42	<0.41	<0.42	<0.42						
Chlordane-gamma	µg/kg dry	<0.4	<0.42	<0.41	<0.42	<0.42						
Chlordane (Technical)	µg/kg dry	<4.1	<4.3	<4.2	<4.3	<4.3			1,600	6,500	430	1,700
Cis-nonachlor	µg/kg dry	<0.37	<0.38	<0.38	<0.39	<0.38						
DCPA (Dacthal)	µg/kg dry	<3	<3.1	<3.1	<3.1	<3.1	0.02	8	610,000	6,200,000		
Dieldrin	µg/kg dry	<0.42	<0.43	<0.42	<0.43	<0.43			30	110	35	130
Endosulfan Sulfate	µg/kg dry	<0.43	<0.44	<0.43	<0.45	<0.44						
Endosulfan I	µg/kg dry	<0.33	<0.34	<0.34	<0.35	<0.34			370,000	3,700,000		
Endosulfan II	µg/kg dry	<0.35	<0.37	<0.36	<0.37	<0.37						
Endrin	µg/kg dry	<0.45	<0.47	<0.46	<0.47	<0.47			180,000	1,800,000	21,000	230,000
Endrin Aldehyde	µg/kg dry	<0.31	<0.32	<0.31	<0.32	<0.32						
Endrin Ketone	µg/kg dry	<0.44	<0.45	<0.44	<0.46	<0.46						

Table 12. 2013 Morro Bay Harbor Bulk Sediment Chemistry Results.

Valid Analyte Name	Units	Morro Bay Harbor Composite Samples					NOAA Screening		Human RSLs[2]		Human CHHSLs[3]	
		A	B	C/D	E	F	Salt ERL[1]	Salt ERM[1]	Residential	Industrial	Residential	Commercial Industrial
Heptachlor	µg/kg dry	<0.41	<0.42	<0.41	<0.42	<0.42			110	380	130	520
Heptachlor Epoxide	µg/kg dry	<0.45	<0.47	<0.46	<0.47	<0.47			53	190		
Methoxychlor	µg/kg dry	<0.41	<0.42	<0.42	<0.43	<0.43			310,000	3,100,000	340,000	3,800,000
Mirex	µg/kg dry	<0.39	<0.4	<0.39	<0.41	<0.4			27	96	31	120
Oxychlordane	µg/kg dry	<0.35	<0.37	<0.36	<0.37	<0.37						
Perthane	µg/kg dry	<1.6	<1.7	<1.7	<1.7	<1.7						
Toxaphene	µg/kg dry	<8	<8.3	<8.1	<8.3	<8.3			440	1600	460	1,800
Trans-nonachlor	µg/kg dry	<0.36	<0.38	<0.37	<0.38	<0.38						
4,4'-Dichlorobenzophenone	µg/kg dry	<2.6	<2.7	<2.6	<2.7	<2.7						
Total Chlordane	µg/kg dry	0	0	0	0	0						
PCB Aroclors												
Aroclor 1016	µg/kg dry	<3.6	<3.7	<3.7	<3.8	<3.7						
Aroclor 1221	µg/kg dry	<3.3	<3.4	<3.3	<3.4	<3.4						
Aroclor 1232	µg/kg dry	<2.7	<2.8	<2.7	<2.8	<2.8						
Aroclor 1242	µg/kg dry	<3.1	<3.3	<3.2	<3.3	<3.3						
Aroclor 1248	µg/kg dry	<3.6	<3.8	<3.7	<3.8	<3.8						
Aroclor 1254	µg/kg dry	<3	<3.2	<3.1	<3.2	<3.2						
Aroclor 1260	µg/kg dry	<2.9	<3	<3	<3	<3						
Aroclor 1262	µg/kg dry	<3.1	<3.2	<3.2	<3.2	<3.2						
Total Aroclors	µg/kg dry	0	0	0	0	0						
PCB CONGENERS												
PCB003	µg/kg dry	<0.15	<0.16	<0.15	<0.16	<0.16						
PCB008	µg/kg dry	<0.11	<0.11	<0.11	<0.11	<0.11						
PCB018	µg/kg dry	<0.2	<0.21	<0.2	<0.21	<0.21						
PCB028	µg/kg dry	<0.13	<0.13	<0.13	<0.13	<0.13						
PCB031	µg/kg dry	<0.15	<0.15	<0.15	<0.15	<0.15						
PCB033	µg/kg dry	<0.14	<0.14	<0.14	<0.14	<0.14						
PCB037	µg/kg dry	<0.17	<0.17	<0.17	<0.17	<0.17						
PCB044	µg/kg dry	<0.17	<0.17	<0.17	<0.17	<0.17						
PCB049	µg/kg dry	<0.15	<0.15	<0.15	<0.16	<0.15						
PCB052	µg/kg dry	<0.12	<0.13	<0.12	<0.13	<0.13						
PCB056	µg/kg dry	<0.17	<0.18	<0.18	<0.18	<0.18						
PCB060	µg/kg dry	<0.13	<0.14	<0.14	<0.14	<0.14						
PCB066	µg/kg dry	<0.12	<0.12	<0.12	<0.12	<0.12						
PCB070	µg/kg dry	<0.1	<0.11	<0.11	<0.11	<0.11						

Table 12. 2013 Morro Bay Harbor Bulk Sediment Chemistry Results.

Valid Analyte Name	Units	Morro Bay Harbor Composite Samples					NOAA Screening		Human RSLs[2]		Human CHHSLs[3]	
		A	B	C/D	E	F	Salt ERL[1]	Salt ERM[1]	Residential	Industrial	Residential	Commercial Industrial
PCB074	µg/kg dry	<0.12	<0.12	<0.12	<0.12	<0.12						
PCB077	µg/kg dry	<0.12	<0.13	<0.12	<0.13	<0.13			34	110		
PCB081	µg/kg dry	<0.15	<0.16	<0.16	<0.16	<0.16			11	38		
PCB087	µg/kg dry	<0.13	<0.13	<0.13	<0.13	<0.13						
PCB095	µg/kg dry	<0.21	<0.22	<0.21	<0.22	<0.22						
PCB097	µg/kg dry	<0.17	<0.18	<0.17	<0.18	<0.18						
PCB099	µg/kg dry	<0.11	<0.11	<0.11	<0.11	<0.11						
PCB101	µg/kg dry	<0.1	<0.11	<0.1	<0.11	<0.11						
PCB105	µg/kg dry	<0.13	<0.14	<0.13	<0.14	<0.14			110	380		
PCB110	µg/kg dry	<0.13	<0.13	<0.13	<0.14	<0.14						
PCB114	µg/kg dry	<0.13	<0.13	<0.13	<0.13	<0.13			110	380		
PCB118	µg/kg dry	<0.17	<0.17	<0.17	<0.17	<0.17			110	380		
PCB119	µg/kg dry	<0.11	<0.11	<0.11	<0.11	<0.11						
PCB123	µg/kg dry	<0.11	<0.11	<0.11	<0.11	<0.11			110	380		
PCB126	µg/kg dry	<0.17	<0.18	<0.18	<0.18	<0.18			0.034	0.11		
PCB128	µg/kg dry	<0.13	<0.13	<0.13	<0.14	<0.13						
PCB132	µg/kg dry	<0.21	<0.22	<0.21	<0.22	<0.22						
PCB138+158	µg/kg dry	<0.26	<0.27	<0.26	<0.27	<0.27						
PCB141	µg/kg dry	<0.14	<0.15	<0.14	<0.15	<0.15						
PCB149	µg/kg dry	<0.11	<0.12	<0.11	<0.12	<0.12						
PCB151	µg/kg dry	<0.13	<0.14	<0.13	<0.14	<0.14						
PCB153	µg/kg dry	<0.13	<0.14	<0.13	<0.14	<0.14						
PCB156	µg/kg dry	<0.12	<0.13	<0.13	<0.13	<0.13			110	380		
PCB157	µg/kg dry	<0.12	<0.13	<0.12	<0.13	<0.13			110	380		
PCB167	µg/kg dry	<0.13	<0.13	<0.13	<0.13	<0.13			110	380		
PCB168	µg/kg dry	<0.11	<0.11	<0.11	<0.11	<0.11						
PCB169	µg/kg dry	<0.1	<0.11	<0.1	<0.11	<0.11			0.11	0.38		
PCB170	µg/kg dry	<0.12	<0.12	<0.12	<0.12	<0.12			30	99		
PCB174	µg/kg dry	<0.13	<0.14	<0.14	<0.14	<0.14						
PCB177	µg/kg dry	<0.16	<0.16	<0.16	<0.16	<0.16						
PCB180	µg/kg dry	<0.077	<0.08	<0.078	<0.081	<0.08			300	990		
PCB183	µg/kg dry	<0.14	<0.15	<0.14	<0.15	<0.15						
PCB184	µg/kg dry	<0.071	<0.073	<0.072	<0.074	<0.073						
PCB187	µg/kg dry	<0.13	<0.14	<0.13	<0.14	<0.14						
PCB189	µg/kg dry	<0.11	<0.11	<0.11	<0.11	<0.11			110	380		

Table 12. 2013 Morro Bay Harbor Bulk Sediment Chemistry Results.

Valid Analyte Name	Units	Morro Bay Harbor Composite Samples					NOAA Screening		Human RSLs[2]		Human CHHSLs[3]	
		A	B	C/D	E	F	Salt ERL[1]	Salt ERM[1]	Residential	Industrial	Residential	Commercial Industrial
PCB194	µg/kg dry	<0.12	<0.13	<0.12	<0.13	<0.13						
PCB195	µg/kg dry	<0.066	<0.069	<0.067	<0.069	<0.069						
PCB200	µg/kg dry	<0.12	<0.12	<0.12	<0.12	<0.12						
PCB201	µg/kg dry	<0.072	<0.075	<0.073	<0.075	<0.075						
PCB203	µg/kg dry	<0.14	<0.14	<0.14	<0.14	<0.14						
PCB206	µg/kg dry	<0.1	<0.11	<0.11	<0.11	<0.11						
PCB209	µg/kg dry	<0.13	<0.14	<0.14	<0.14	<0.14						
Total PCB Congeners	µg/kg dry	0	0	0	0	0	22.7	180			89	300
PYRETHROIDS												
Allethrin	µg/kg dry	<0.32	<0.34	<0.33	<0.34	<0.34						
Bifenthrin	µg/kg dry	<0.12	<0.12	<0.12	<0.12	<0.12						
cis-Permethrin:trans-Permethrin	µg/kg dry	<0.14	<0.14	<0.14	<0.15	<0.14						
Cyfluthrin	µg/kg dry	<0.11	<0.11	<0.11	<0.11	<0.11						
Cypermethrin	µg/kg dry	<0.087	<0.09	<0.088	<0.091	<0.09						
Deltamethrin:Tralomethrin	µg/kg dry	<0.26	<0.27	<0.27	<0.28	<0.27						
Esfenvalerate:Fenvalerate	µg/kg dry	<0.045	<0.047	<0.046	<0.047	<0.047						
Fenpropathrin	µg/kg dry	<0.046	<0.048	<0.047	<0.048	<0.048						
Fluvalinate	µg/kg dry	<0.072	<0.075	<0.073	<0.076	<0.075						
Lambda-Cyhalothrin	µg/kg dry	<0.055	<0.057	<0.056	<0.058	<0.057						
Phenothrin	µg/kg dry	<0.087	<0.09	<0.088	<0.09	<0.09						
Resmethrin:Bioresmethrin	µg/kg dry	<0.12	<0.12	<0.12	<0.12	<0.12						
Tetramethrin	µg/kg dry	<0.048	<0.05	<0.048	<0.05	<0.05						
ERM Quotient		0.007	0.01	0.008	0.01	0.009						

1. Effects Range Low (ERL) and Effects Range Median (ERM) sediment quality objectives from Long *et al.* (1995).
2. Regional Screening Levels for Chemical Contaminants at Superfund Sites" (USEPA Region 9, 2010).
3. California Human Health Screening Levels for Soil (Cal/EPA, 2005).

Bolded values exceed ERL values.
Bolded and underlined values exceed ERM values.
Green shaded values exceed one or more of the corresponding human health values.
< = Not detected at the corresponding Method Detection Limit. J = Estimated between the Reporting Limit and the Method Detection Limit. J-=Possible underestimation of a value. U=undetected at the RL

5.0 DISCUSSION

Subsections that follow describe chemical and physical testing results, as summarized in Tables 9, 10 and 11, in terms of sediment screening levels and objectives for beach nourishment.

5.1 Sediment Observations

Observed sediment characteristics were somewhat similar among cores. According to soils logs (Appendix E), sediments from all but one of the cores down to the dredge depth or overdepth were described as poorly graded sand (SP) or poorly graded sand with gravel (SP). Similarly, all reference beach and offshore placement area samples were described as poorly graded sand (SP).

There were no noxious odors, trash, and other non-organic debris observed in any of the cores. There were also no obvious layers of elevated contamination or layers of fine grained material.

5.2 Sediment Grain Size

As summarized in Tables 9, results indicate that all Morro Bay Harbor primary core intervals (mudline to project depth and associated overdepths) consisted of 99 to 100% sand and gravel. Most of the sediment was fine sand (<0.18 mm). Proposed dredging would be conducted according to the project dredge depths categorized in Table 9.

For informational purposes only, Table 10 provides sieve analysis data for material below project overdepths (i.e., advance maintenance depths). These data show that all locations are primarily sand below project overdepths with the exception of thin strata (~0.5 feet thick) from vibracore location MBHVC13-20 (classification: lean clay with sand (CL); LL = 39; PL = 18) in Area 2 (Navy channel) and from vibracore location MBHVC13-23 (classification: lean clay with sand (CL); LL = 37; PL = 19) in Area F (Morro Channel).

Sieve analysis data for the individual beach transect and nearshore samples, provided in Table 11, show that sediments collected in 2013 in the nearshore area of Montana de Oro State Beach and along the transects at Morro Strand State Beach are poorly graded sand with very little or no fines. Summaries of the grain size results for each of the Morro Bay Harbor dredge areas sampled as well as the receiving beach samples are also provided in Appendix C along with placement site compatibility (suitability determination) of the Morro Bay Harbor maintenance dredging sediments.

5.3 Bulk Sediment Chemistry

Overall, contaminant concentrations, as summarized in Table 12, in the Morro Bay Harbor composite samples were below detection limits or low compared to effects based screening values. In fact, the only contaminant detected above a NOAA ERL value, but less than the ERM value, was nickel in all five composite samples. As mentioned previously, the confidence in NOAA screening values for nickel is low. It was found that the incidence of toxic effects do not increase appreciably with increasing concentrations of nickel (Long et al., 1995). The elevated nickel concentration is probably due to natural sources from serpentine soils common in the Morro Bay watershed [Regional Water Quality Control Board (RWQCB) Area 3 (Central California Coast), 2007].

The only organic contaminant detected in the Morro Bay Harbor sediments was a trace amount of pyrene in the Composite E sample at a concentration well below the ERL value. Pyrene is formed from incomplete combustion and is often found occurring naturally in soils. As expected, mean ERM quotients among all contaminants with ERM values were very low (<0.01). With an ERMq of 0.1, there is less than a 12% probability of a toxic response.

Except for arsenic, all contaminants detected in the Morro Bay Harbor sediments were well below RSLs and CHHSLs for residential soils developed for human protection. However, arsenic concentrations in the Morro Bay Harbor composite samples were actually lower than the calculated background arsenic concentration in reference beaches (4.37 mg/kg) to the north of Morro Bay Harbor (see Appendix D). Additionally, elevated arsenic concentrations occur commonly from natural as well as from anthropogenic sources in California dredge sediments and soils, and the concentrations of arsenic in the Morro Bay Harbor composite samples were less than the background concentration (3.5 mg/kg) for soils throughout California (Bradford et al., 1996), and less than the concentration (12 mg/kg) that the DTSC considers dangerous to human health (Dr. William Bosan, Personnel Communication). Arsenic concentrations in the Morro Bay Harbor individual cores were generally similar to the composite samples.

5.4 Conclusions

According to USACE-LA District's grain size suitability analysis (Appendix C), all sediments within Morro Bay Harbor are compatible for placement at the nearshore area immediately offshore of Montana de Oro State Beach and in the surf zone along Morro Strand State Beach. This is based on both the weighted average individual and composite sediment grain size curves of each area. This and the fact that inorganic contaminant concentrations were low compared to screening levels and organic contaminants were virtually not present, Morro Bay Harbor sediments should be suitable for placement at the receiving beaches.

6.0 QUALITY CONTROL SUMMARY

Kinnetic Laboratories conducts its activities in accordance with formal QA/QC procedures. The objectives of the QA/QC Program are to fully document the field and laboratory data collected, to maintain data integrity from the time of field collection through storage and archiving, and to produce the highest quality data possible. Quality assurance involves all of the planned and systematic actions necessary to provide confidence that work performed by Kinnetic Laboratories conforms to contract requirements, laboratory methodologies, state and federal regulation requirements, and corporate Standard Operating Procedures (SOPs). The program is designed to allow the data to be assessed by the following parameters: Precision, Accuracy, Comparability, Representativeness, and Completeness. These parameters are controlled by adhering to documented methods and procedures (SOPs), and by the analysis of quality control (QC) samples on a routine basis.

6.1 Field Sampling Quality Management

Field Quality Control procedures are summarized in Table 13 and include adherence to SOPs and formal sample documentation and tracking.

Table 13. Quality Control Summary for Field Sediment Sampling

Sediment Sampling
• Vibracore Sampling SOP • Field Duplicates • Protocol Cleaning/Low Detection Limits • Certified Clean Laboratory Containers • Horizontal and Vertical Controls • Core Logging & Subsampling Protocols • Sample Control/ Chain of Custody Procedures • Field Logs and Core Logs • Sample Preservation & Shipping Procedures

6.2 Analytical Chemistry QA/QC

Analytical chemistry Quality Control is formalized by EPA and State Certification agencies, and involves internal quality control checks for precision and accuracy. Any issues associated with the quality control check are summarized in Appendix J

QA/QC findings presented are based on the validation of the data according to the quality assurance objectives detailed in the SAP (Diaz•Yourman, GeoPentech and Kinnetic Laboratories/ Joint Venture, 2012) and in Appendix J, and using guidance from EPA National Functional Guidelines for inorganic and organic data review (USEPA, 2001 and 2002).

As the first step in the validation process, all results were carefully reviewed to check that the laboratories met project reporting limits and that chemical analyses were completed within holding times. Except for TOC and technical chlordane, detection limits and reporting limits for this project, as defined in the project SAP, were met. The elevated reporting limit for TOC had little impact on the data since most concentrations were above the reporting limits. The target detection limit and report limit for technical chlordane was unrealistically low for the method. All analyses were completed within holding times.

QA/QC records (830 total) for the sediment analyses included method blanks, laboratory duplicates, laboratory control samples and their duplicates (LCS/LCSDs), matrix spikes and matrix spike duplicates (MS/MSDs), and surrogates. Total numbers of QC records by type are summarized in Table 14. Data, for the most part, were shown to be both accurate and precise and free of contamination. Only 2-nitrophenol required qualification to indicate a possible false non-detection. MS/MSD and surrogate recoveries for this compound were low compared to objectives. This affected three out of the five sample results.

Table 14. Counts of QC records per Chemical Category.

QC Counts per Analyte	BLK	DUP	LCS	MS	PDS	SURR	Total
Conventionals							
Oil and Grease	2	1	4				7
Percent Solids	3	4					7
pH		3					3
Total Ammonia (as N)	1	1	2	2			6
Total Organic Carbon	2	1	4	4			11
TRPH	2	1	4				7
Total Sulfides	1	1	2	2			6
Total Volatile Solids	1	2					3
Water Soluble Sulfides	1	2					3
Total Metals	19	10	38	38	38		143
Butyltins	4	4	2	4		7	21
Chlorinated Pesticides	32	32	20	40		14	138
Aroclors	8	8	2	4		14	36
PCB Congeners	56	56	19	38		14	183
Phenolic Compounds	16	16	6	12			50
Phthalates	6	6	2	4			18
Pyrethroids	13	13	13	26		7	72
PAHs	25	25	8	16		42	116
Totals	**192**	**186**	**126**	**190**	**38**	**98**	**830**

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Appendix G

36-Month Eelgrass Mitigation Report

Draft 36-Month Post-Transplant Eelgrass Survey for the Morro Bay Fiscal Year 2010 Maintenance Dredging Project, Morro Bay, CA

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September 2013

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Draft 36-Month Post-Transplant Eelgrass Survey for the Morro Bay Fiscal Year 2010 Maintenance Dredging Project, Morro Bay, CA

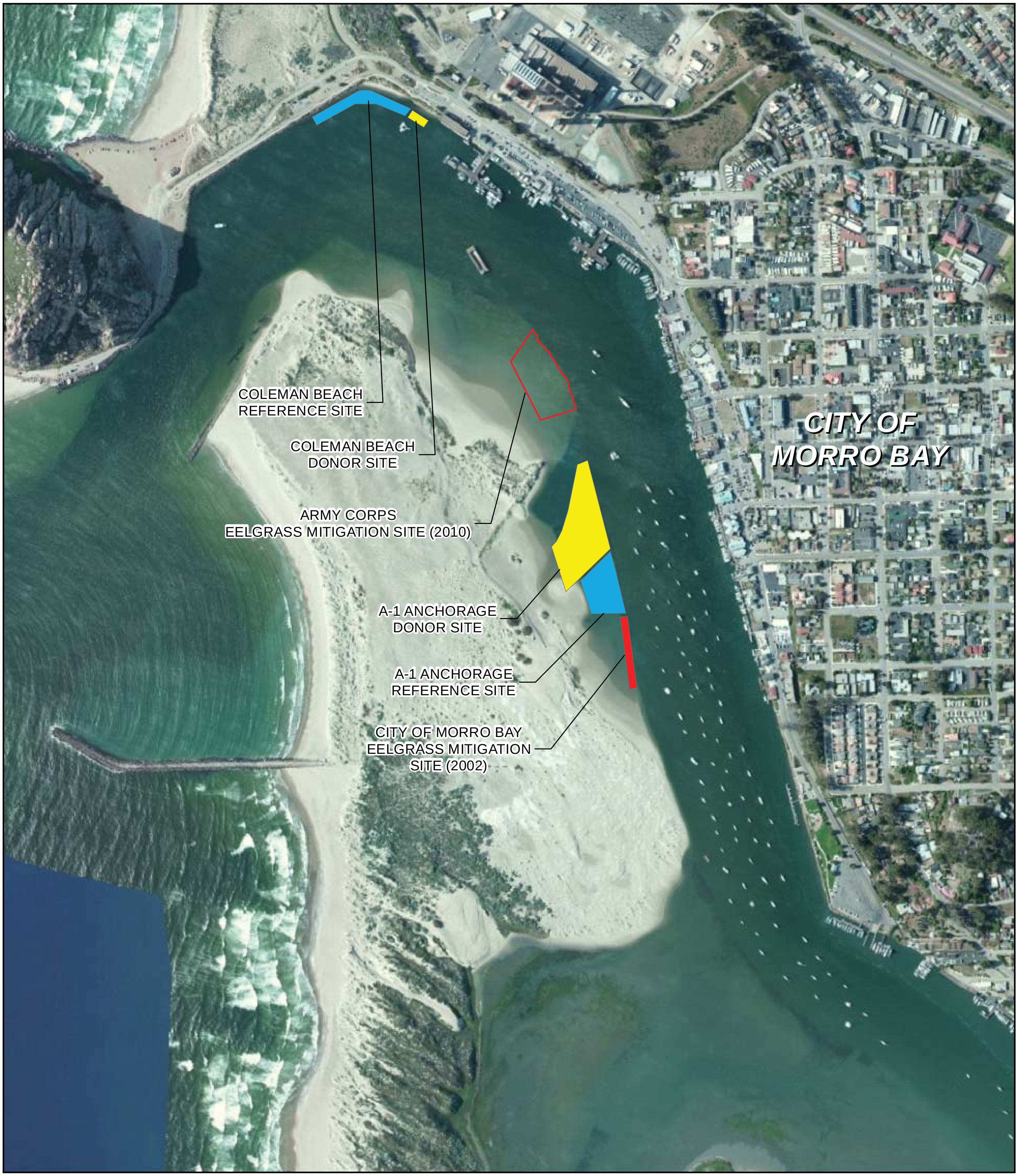
INTRODUCTION

Merkel & Associates, Inc. (M&A) was retained by the U.S. Army Corps of Engineers, Los Angeles District (Corps) to conduct an eelgrass (*Zostera marina*) transplant along the western shoreline of Morro Bay, north of the A-1 Anchorage Area, as mitigation for unavoidable impacts to eelgrass resources resulting from completion of the 2009-2010 maintenance dredging of the Morro Bay entrance bar and navigation channel by the Corps at Morro Bay, California. Dredging was conducted between November 2009 and February 2010. Based on a mitigation agreement between the Corps and National Marine Fisheries Service (NMFS), it was determined that eelgrass impacts to approximately 4,047 m^2 (1 acre) of eelgrass occurred as a result of the Corps' dredging project. The mitigation requirements for the project work require the successful establishment of 1.2:1 replacement for eelgrass loss due to project implementation. The restoration of eelgrass at the eelgrass mitigation site, therefore, is required to achieve a total area of 4,856 m^2 (1.2 acres) of eelgrass compliant with the area, density, and milestone development standards of the Southern California Eelgrass Mitigation Policy (SCEMP, Rev. 11, NMFS 1991).

MITIGATION SITE HISTORY AND LAYOUT

A Corps mitigation transplant site was excavated from an unvegetated intertidal sand flat located on the west side of the northern portion of the Bay in accordance with an eelgrass restoration site dredging plan (Figure 1) (M&A 2010a). The Corps' dredging contractor prepared the eelgrass mitigation site in accordance with the project's Final Eelgrass Mitigation Dredging Template (Merkel &Associates 2010a). The site was excavated to suitable eelgrass growth elevation over an area of 2.4 acres that was expected to stabilize at over 2 acres within suitable depth ranges and slopes to support eelgrass habitat. The grading work for the eelgrass site preparation was completed on June 5, 2010, and a one-month period was allotted for site stabilization prior to the commencement of eelgrass transplant work. The site ranges in depth from 0.0 ft MLLW down to –1.6 ft MLLW. The substrate is clean sand sloping to silty sand at the deeper end of the site. To achieve the contractual transplant requirements and the planting minimum required under the Final Eelgrass Mitigation and Monitoring Plan in support of the Morro Bay Maintenance Dredging Project, Morro Bay, California (Merkel & Associates 2010b), a total of 4,858 eelgrass planting units were required to be planted over an area of 4,856 m^2 (1.2 acres) on 1-meter centers. However, to supplement the transplant program to ensure a total of 4,856 m^2 (1.2 acres) of eelgrass mitigation after 5 years, a total of 5,584 eelgrass-planting units (15 percent more units) were prepared and planted at the eelgrass mitigation site. While a small number of the supplemental units were used to expand the 1-meter on center planting to 5,270 m^2 (1.3 acres), the majority of the supplemental units were planted on approximately 3-meter centers to effectively double the planting area creating a planting area of 9,720 m^2 (2.4 acres). The eelgrass transplanting program was conducted between July 6 and July 9, 2010. At the time of the transplant, the planting units appeared to be healthy and secure in the substrate.

05-024-20



Eelgrass Mitigation, Donor, and Reference Sites

Morro Bay Maintenance Dredging Project

Morro Bay, CA

Figure 1

Merkel & Associates, Inc.

The transplant made use of biodegradable soft anchors to fasten bare-root units to the bottom. Eelgrass was harvested from two natural donor beds along the shorelines southeast and northwest of the mitigation site, where less than 10% of the bed was harvested. Eelgrass was harvested by hand and processed into planting units of 6-10 leaf-shoots per unit. These planting units were processed the same day that harvesting was completed and were planted within 24 hours. Harvesting and planting were accomplished by SCUBA divers, planting each unit on 1-meter centers over 5,270 m^2 (1.3 acres) of the site and on approximately 3-meter centers over 4,454 m^2 (1.1 acres) of the site.

Two eelgrass reference sites were established along the shorelines southeast and northwest of the mitigation site (Figure 2). These sites are located adjacent to the donor sites at Coleman Beach and A-1 Anchorage. The sites were selected based on proximity to and similarity in biological characteristics to the restoration site. Monitoring of the reference sites will be conducted coincident with the monitoring of the mitigation site. Changes in the reference site over time will be considered to represent natural environmental variability when evaluating the performance of the mitigation site (see Monitoring Program sections).

The initial mitigation site was monitored and showed good early establishment where densely planted, but areas of more open planting were slow to fill in and even declined due to expanding and heavy algal loads that favored areas of lower eelgrass density. In addition, minor damage was suffered by the mitigation site as a result of a tsunami that struck Morro Bay following the March 11, 2011 Japanese earthquake. This tsunami resulted in development of two sand chutes off of the planting area. This chutes cut slightly into the developing eelgrass bed and were likely the result of concentrated discharge across the site during the tsunami. Because these chutes were located at the lowest portion of the site, it was not expected to experience significant additional erosion or expansion due to the differences in energy levels between the tsunami and normal bay tide and current regimes. By the 24-month survey in July 2012, the mitigation site had declined to 3,687 m^2 (0.91 acres) of eelgrass, while the A-1 Anchorage reference site had similarly declined by an even more significant level and the more northerly reference site at Coleman Beach had retained its full scale (Merkel & Associates 2013a).

Concurrent with the efforts to establish eelgrass for dredging impacts, significant but unrelated eelgrass declines within Morro Bay have been observed over the past many years since sometime after 2007 and continuing through the present. The eelgrass declines have been advancing from south to north and intertidal to subtidal through the bay. Efforts to understand this eelgrass decline were initiated in 2011. In 2012, it was determined that a biological disease agent was, at a minimum, participatory in the decline and may likely be the primary agent in eelgrass losses within the bay. The role of the biological agent in eelgrass decline continues to be investigated at this time.

SUPPLEMENTAL TRANSPLANT

In November 2010, NMFS brought to the attention of the Corps that the impacts from the FY2010 dredging extended beyond the planned dredging footprint and the area for which mitigation had been determined. Following investigations into the likely cause and extent of these unanticipated impacts to eelgrass, it was determined that there was some amount of eelgrass lost due to indirect impacts from dredging, specifically at the lower margins of the eelgrass beds, caused by the collapse of slopes adjacent to the Federal Channels. The Corps, in consultation with resource agencies, determined the indirect impacts to be 1,821 m^2 (0.45 acre). Calculations to determine this acreage are included in the February 1, 2012 Plan of Action Letter to NMFS (ACOE 2012). The Corps then developed a plan of action to mitigate this additional impact at a ratio of 1.2:1, per the SCEMP, for a total of an additional 2,185 m^2

(0.54 acre) of eelgrass mitigation (ACOE 2012). This plan called for the infill of eelgrass within bare portions of the initial 2.4-acre mitigation planting area as well as the transplant of 0.5 acre of eelgrass within 10 pilot plots located within the barren central and southern Morro Bay areas, where eelgrass has naturally declined over the past five years. These pilot plots should serve as a source for eelgrass re-colonization of eelgrass within areas within which eelgrass has been lost.

To satisfy the Corps' plan of action, a supplemental eelgrass transplant was conducted between September 16 and 20, 2012. A total of 4,187 eelgrass planting units were planted. A total of 2,187 planting units from Coleman Beach donor sites were planted into gaps within the beds in the original 2.4-acre mitigation site (Figure 2). In addition, 2,000 additional planting units were planted into 10 central bay pilot plots (Figure 3). This September 2012 transplant was documented in the supplemental transplant report (Merkel & Associates 2013b).

Concurrent with the initiation of the Corps pilot plot restoration program, a local volunteer program, organized through the Morro Bay National Estuary Program (MBNEP) and funded by the Black Brant Group and Morro Coast Audubon Society, was initiated to expand upon the federal efforts to foster recovery of eelgrass within Morro Bay. This effort, the Morro Bay Eelgrass Recovery Program, expanded pilot plantings in the central and southern portion of Morro Bay to 21 plots in 2012 by planting 11 additional plots. The Morro Bay Eelgrass Recovery Program has continued the planting efforts into 2013. The goal of the community-based program is to continue the restoration effort into the future. This volunteer program has benefited significantly as a result of the Corps efforts. M&A is serving as a technical and scientific consultant to the volunteer program.

This document reports on the 36-month post-transplant eelgrass survey for the Morro Bay Fiscal Year 2010 Maintenance Dredging Project. Because of the staggered nature of the restoration effort starts and the integration of supplemental plantings into the original planting area, this report does not separate performance of eelgrass based on planting date, but rather treats the planting program as a whole. Where timing of planting is pertinent to understanding of the restoration status, narrative discussions are provided.

MITIGATION SUCCESS CRITERIA

The supplemental planting program included two differing standards for evaluation of success. For the supplemental transplant to the original mitigation site, the added eelgrass would contribute to the initial objectives of the restoration to develop eelgrass within the formal restoration site without extending the monitoring program beyond the initial 5-year monitoring period. The goal of the original mitigation site has thus been increased from 4,856 m^2 (1.2 acres) of new eelgrass to 7,042 m^2 (1.74 acres) with the ultimate requirement being based on reference site performance adjustments as outlined in the SCEMP. Based on the performance of the natural reference sites, eelgrass mitigation may be determined to be successful at a coverage area and density that is less than the initial mitigation requirement where the declines are proportional to the natural bed declines observed within the reference sites.

For the pilot plots introduced to assist in eelgrass recovery, no success criteria have been applied. These pilot plots were intentionally placed in previously existing eelgrass beds that have recently experienced extirpation unrelated to dredging. The function of the pilot plots is to contribute to a more rapid recovery than would otherwise occur, rather than to achieve specific mitigation coverage or density goals. The Corps has committed to monitor these pilot plots for the remaining years of the post-transplant monitoring period set by the initial transplant program.

Supplemental Planting within Original Mitigation Site
Morro Bay Maintenance Dredging Project
Morro Bay, CA

Figure 2

Merkel & Associates, Inc.

Supplemental Mitigation Site Planting and Pilot Planting Transects
Morro Bay Maintenance Dredging Project
Morro Bay, CA

Figure 3

Merkel & Associates, Inc.

EELGRASS MONITORING

As outlined in the project's original Eelgrass Mitigation Plan (M&A 2010b), upon completion of the initial FY2010 planting effort, a monitoring program was initiated and will continue for a 60-month (5-year) period as required by the SCEMP. Along with the eelgrass coverage measurements, leaf shoot density in the mitigation and reference sites are being measured using a 1/16 square meter quadrat.

The monitoring program has currently completed monitoring events at 3, 6, 12 (1 year), 24 (2 year), and 36 (3 year) months post-planting. The program will continue with a monitoring event at 48 (4 year) and 60 (5 year) months post-planting. The Corps has committed to include monitoring of the pilot plots and the supplemental planting in the original mitigation site for the final three years (Years 3, 4, and 5) of the monitoring program already in progress (ACOE 2012). To coincide with the Year 3, 4, and 5 monitoring events for the original mitigation site, the monitoring of supplemental planting areas will be conducted in June/July of each year 2013-2015.

SUCCESS STANDARDS

For the supplemental transplant to the original eelgrass mitigation site, the success objectives are adopted from the original restoration plan. Specifically, the mitigation sites and natural reference sites at Coleman Beach (north) and near the A-1 Anchorage (south) will be monitored annually through the remainder of the original 5-year monitoring period (Years 3-5, commencing in June-July 2013), along with natural reference sites located at Coleman Beach (north) and near the A-1 Anchorage (south). The eelgrass-monitoring program includes milestone success monitoring to verify that minimum coverage and density requirements are achieved per the requirements of SCEMP. The coverage and leaf shoot density of eelgrass within the restoration and reference sites will be mapped and measured at each monitoring interval. Mitigation will be deemed successful when it has met the success criteria outlined in the SCEMP for the area of mitigation required. Criteria for determination of transplant success will be based upon a comparison of vegetation coverage (area) and density (leaf shoots per square meter) between the reference sites and the mitigation site. Extent of vegetation cover is defined as the area where eelgrass is present and where gaps in coverage are less than one meter between individual leaf shoot clusters. Density of shoots is identified as the number of leaf shoots per square meter, as measured from representative areas within the reference or mitigation beds.

The mitigation site restoration target, including the supplemental infill planting effort, is 2,185 m^2 (0.54 acre) of eelgrass beyond the initial 4,856 m^2 (1.20 acre) of eelgrass intended to be established at the site. This brings the restoration objective to 7,042 m^2 (1.74 acre) as adjusted against the cover and density performance of the natural reference sites. The Corps has committed to monitoring the supplemental planting for the remaining three years of the original five-year monitoring program. The original mitigation monitoring will continue to meet the success objectives of the original restoration plan. The monitoring for the original mitigation has already been completed for years one and two. The SCEMP goals for the supplemental infill plantings have been adjusted to maintain the standards for the remaining three years as follows:

A) A minimum of 70 percent areal coverage and 30 percent density should be achieved after the first year.

B) A minimum of 85 percent areal coverage and 70 percent density should be achieved after the second year.

C) A minimum of 100 percent areal coverage and 85 percent density should be achieved for the third, fourth, and fifth years.

Pilot plantings within the central and southern portions of Morro Bay are to be reported on for the remaining three years of the initial monitoring program using a presence/absence and mapped extent methodology. However, neither qualitative nor quantitative success standards are applied to the plots.

During the monitoring years (summers 2013-2015), data on eelgrass coverage and density in the pilot and paired plots will be collected and submitted to NMFS and MBNEP.

MONITORING METHODS

The 36-month post-transplant survey was conducted on June 30 and July 1, 2013. Eelgrass distribution data were collected using interferometric sidescan sonar, which provided an acoustic backscatter image of the seafloor within the project area. Interpretation of the data allowed for an assessment of the distribution of the eelgrass. Sidescan backscatter data were acquired at a frequency of 468 kHz scanning out 35 meters on both the starboard and port channels for a 70-m wide swath. The survey was conducted by running parallel transects that were spaced to allow for overlap between adjoining sidescan swaths. Transects were performed until the entirety of the survey area was captured in the survey report. All data were collected in latitude and longitude using the North American Datum of 1983 (NAD 83), converted to the Universal Transverse Mercator system in meters (UTM), and plotted on a geo-rectified aerial image of the project site.

Within the mitigation planting area, eelgrass density data were collected at the mitigation and reference sites. Data were collected by randomly placing a 1/16th square meter quadrat within the eelgrass beds. Eelgrass turion (leaf-shoot) densities were determined using an underwater video camera to count the numbers of turions within the sampled quadrats. Twenty replicate quadrat counts were collected in each of the sampled areas. Eelgrass bed density was calculated as turions per square meter by multiplying the turion count within each quadrat by 16 and calculating the mean density and standard deviation for the sampling performed. In addition, the overall condition of eelgrass was qualitatively assessed by consideration of epiphytic loading, the stature of eelgrass, extent of plant inflorescence (flowering stalks).

Following completion of the surveys, sidescan sonar traces were joined together and geographically registered. Eelgrass was then digitized as a theme to calculate the amount of eelgrass coverage and show its distribution. This method of eelgrass distribution calculation allows for monitoring eelgrass trends at the project site with a substantial degree of accuracy and repeatability over time.

All areas were calculated in square meters. For ease of reading, all areas have also been converted and presented as acreage values that are rounded to the nearest 100th acre. For precise area values, the square meter numbers are to be used.

RESULTS

EELGRASS MITIGATION SITE

The current 36-month survey revealed a total of 6,354 m^2 (1.57 acres) within the eelgrass mitigation site (Figures 4). This represents an increase in eelgrass coverage of over 70 percent from the July 2012 24-

month coverage. A portion of this increase may be accounted for by the September 2012 supplemental planting of 2,185 m^2 (0.54 acre) of additional eelgrass to the site. Macroalgae within the bed continues to be a factor of concern; however, the overall abundance of algae was lower in 2013 than had been observed in the prior 2012 survey. Epiphytic loading on the eelgrass leaves was moderate to low with approximately 20 percent leaf cover and no substantive silting of the top of the leaves. The 36-month eelgrass turion density ($\pm$ 1 SD) within the mitigation site was 209.6$\pm$112.2 (n=20) shoots per square meter.

Reference Site

The project makes use of two reference sites bracketing the mitigation site. These are used as a collective response indicator for comparison to the mitigation site. The two reference sites have performed very differently since shortly after completion of the initial transplant; and as a result, the data for each is reported separately followed by the composite results to be used for reference site comparison.

During the current 36-month survey, the Coleman Beach reference site supported 2,388 m^2 (0.59 acre) of eelgrass. This is a decrease of just under 5 percent from the 24-month survey coverage. Eelgrass turion densities within the Coleman Beach reference site were 112.0$\pm$72.9 (n=20). The Coleman Beach site supported heavy epiphytic loading on the upper portions of the leave with the core of the tall and dense canopy being relatively free of epiphytes and algae. The Coleman Beach reference site was free of macroalgal mats as were seen further south in the bay. Notably, deeper portions of the Coleman Beach reference site supported eelgrass leaves in excess of 2 meters in height. This height is not particularly unique, but it is uncommon and may account for the generally lower turion densities than observed at the mitigation site.

During the current 36-month survey, the A-1 Anchorage reference site supported 283 m^2 (0.07 acre) of eelgrass. This coverage is unchanged from the coverage during the July 2012 24-month monitoring event. The A-1 Anchorage reference site eelgrass turion densities were 136.0$\pm$75.0 (n=20). The epiphytic loading of the A-1 Anchorage reference site was approximately 60 percent, with a considerable amount of macroalgae (*Gracilaria* and *Ulva*) interspersed in the bed and a moderate sediment load being encountered on the leaves of the eelgrass. The upper elevation portions of the A-1 Anchorage reference site are devoid of eelgrass and supported intermittent occurrence of Gracilaria on otherwise unvegetated flats.

When combined for use as a single reference, the two reference sites bracketing the mitigation site supported a combined total of 2,671 m^2 (0.66 acres), which represents a decrease of just over four percent cover from the 24-month survey coverage. The eelgrass turion densities ($\pm$ 1 SD) within the combined reference sites were 124.0$\pm$74.0 (n=40) shoots per square meter.

Pilot Plot Transplants

In September 2012, the Corps transplanted 10 pilot plots. The sites were reviewed using sidescan sonar during the July 2013 survey, and it was determined that, 8 of the 10 plots planted by the Corps held eelgrass plants (Figure 5). None of the plots supported the full extent of planting initially conducted. In all cases, eelgrass remaining on the transplant plots was subtidal or located in low intertidal plots that were within pooling depressions that do not go dry even during extreme low tides.

36-Month Eelgrass Distribution, June, 2013
Morro Bay Maintenance Dredging Project
Morro Bay, CA

Figure 4

Merkel & Associates, Inc.

2012 Pilot Eelgrass Transplant Plots - July 2013

Morro Bay Maintenance Dredging Project
Morro Bay, CA

Figure 5

Merkel & Associates, Inc.

DISCUSSION

The 36-month survey revealed that the existing eelgrass mitigation site, including both the initial mitigation planting and the supplemental planting, is achieving all success criteria under the SCEMP. This status has as much to do with the performance of the reference site as the mitigation site. Figure 6 summarizes the areal coverage requirements and status of the mitigation site performance over the life of the monitoring program. The figure identifies both the raw requirement for mitigation performance as well as the reference adjusted requirement for eelgrass coverage. In 2012, the mitigation requirement was increased from 4,856 m^2 (1.2 acres) to 7,042 m^2 (1.74 acres) by commitment of the Corps (ACOE 2012). This is reflected as a change in requirements between 2012 and 2013.

The unadjusted eelgrass area requirement for the mitigation site is 7,042 m^2 (1.74 acres). Presently, the site supports 6,354 m^2 (1.57 acres) of eelgrass, which is 90 percent of the unadjusted mitigation need. However, large-scale baywide declines in eelgrass cover have decimated one of the two reference sites (A-1 Anchorage) for the mitigation site, driving the reference adjusted mitigation requirement down to 3,246 m^2 (0.80 acre) (Figure 6). As a result, the moderate performance of the mitigation site combined with regional declines that have not hit the mitigation site as hard as areas to the south of the site, have resulted in the continued success of the Corps' mitigation site for the full obligation of the initial 4,856-m^2 (1.20-acre) commitment and the subsequent 2,185-m^2 (0.54-acre) mitigation commitment.

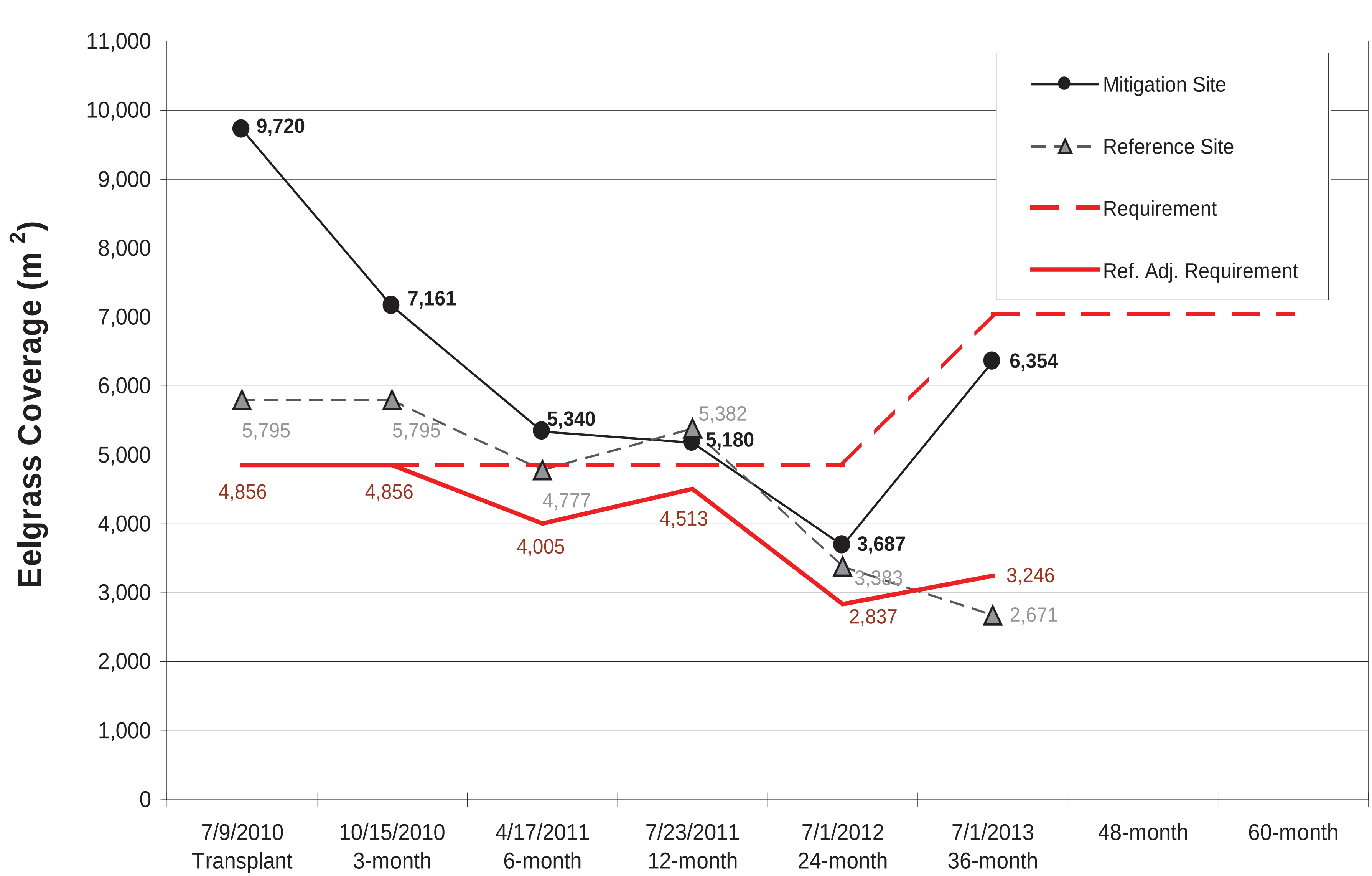
With respect to eelgrass turion density, the mitigation site has continued to outperform the reference sites over the history of the monitoring program (Figure 7). At the present time, the mitigation site is 169 percent more dense than the composite of the reference sites. The spread between eelgrass density within the mitigation and the reference beds has continued to broaden with time as the A-1 Anchorage reference site has declined and is now represented only by eelgrass beds located at deeper fringes of the site. Similarly, the Coleman Beach reference site has always supported a broader depth range than the mitigation site, and the average eelgrass bed density is drawn down at this site by inclusion of deeper portions of the reference site that naturally have lower turion densities than shallower portions of the bed.

While the mitigation site is performing acceptably overall, there remains concern for long-term success. During the course of the monitoring program, the restored eelgrass bed has suffered declines in cover that in great measure have mirrored declines in the natural beds in Morro Bay and that of the combined reference sites. Notably, declines in both reference beds and the restoration site were principally observed along the upper margins of the site, similar to that which has been occurring for the past few years in the southern bay and which is seemingly spreading from the south to the northern portions of the bay. It is now known that a biological agent is involved in the losses of eelgrass that have been observed in Morro Bay.

The mitigation bed has been noted to support diseased plants similar to those observed in beds located further south in the bay. These plants were first noted in 2012, and conditions within the beds have not worsened since their 2012 detection. Conversely, the 2013 conditions observed in the mitigation bed appear to be better than 2012 and less diseased plants were noted during the current surveys than were noted in the prior year. This observation is very positive and bodes well for the mitigation site. However, it should be kept in mind that the condition of eelgrass in Morro Bay is overall very precarious. In 2007, approximately 344 acres of eelgrass were mapped in the bay. In 2009 and 2010, the mapped eelgrass had fallen to 240 acres and 176 acres, respectively. At the present time, preliminary data suggest that there is less than 20 acres of eelgrass remaining in Morro Bay in 2013 (Merkel & Associates 2013c, MBNEP, unpublished data).

The Corps' eelgrass pilot plantings in 2012 have had several positive outcomes. The first is that these plots have demonstrated that eelgrass from north bay donor sites can be reintroduced to the central portions of Morro Bay where eelgrass has been lost. Second, the pilot planting has supported the initiation of a local volunteer effort to restore eelgrass within Morro Bay. This effort would not have been as readily initiated had it not been for the infrastructure of the restoration program being developed for the Corps' pilot restoration program. Finally, the successes observed in the plots planted by the Corps have helped to identify suitable conditions for eelgrass and have aided in targeting additional pilot plot establishment under the Morro Bay Eelgrass Recovery Program, which is being headed up by the MBNEP.

The next scheduled monitoring event is the 48-month monitoring to be performed in June/July 2014.



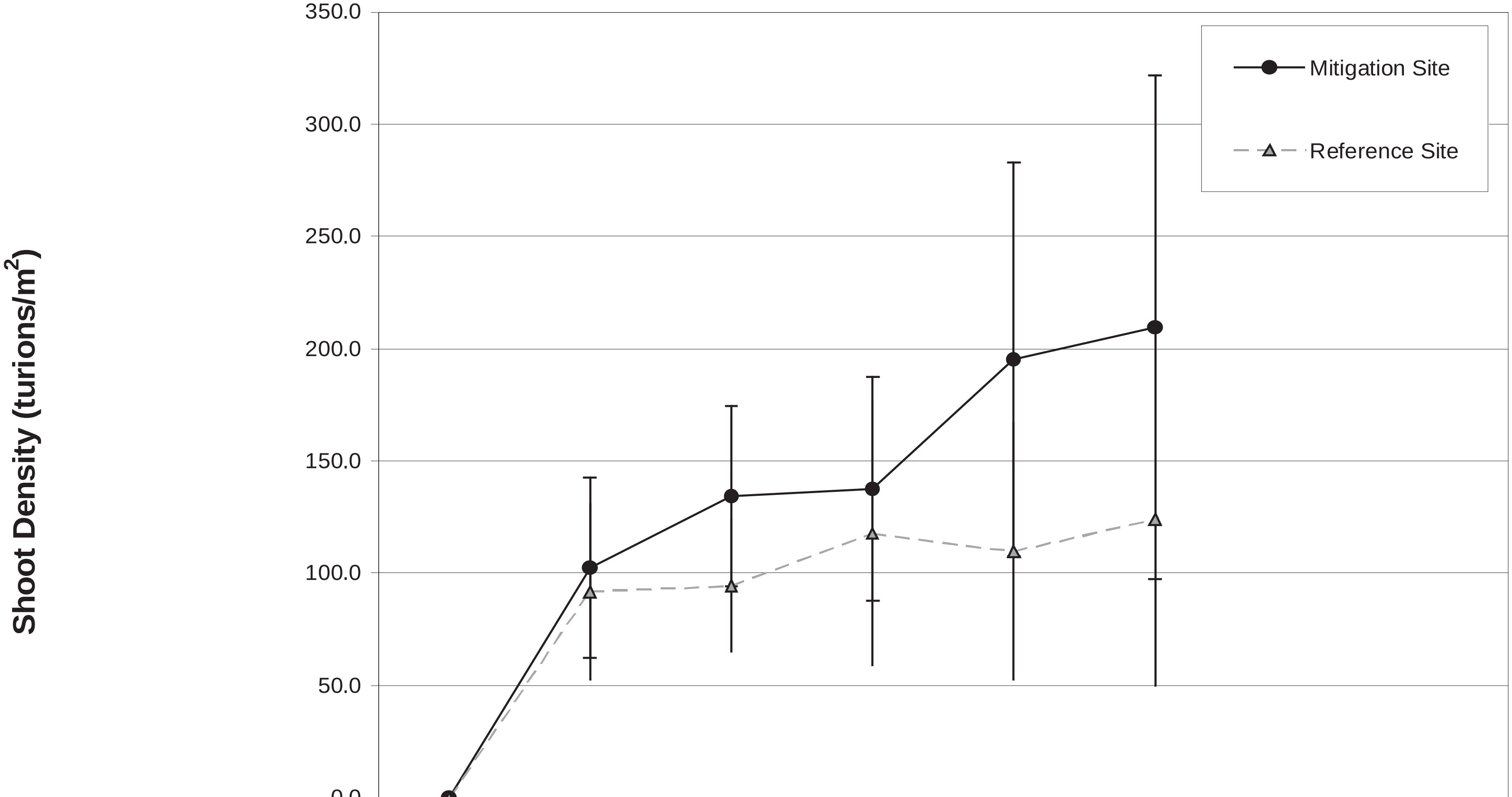
Eelgrass Coverage at Mitigation and Reference Sites Relative to Restoration Requirements

Morro Bay Fiscal Year 2010 Maintenance Dredging Project

Morro Bay, CA

Figure 6

Merkel & Associates, Inc.



	7/9/2010 Transplant	10/15/2010 3-month	4/17/2011 6-month	7/23/2011 12-month	7/1/2012 24-month	7/1/2013 36-month	48-month	60-month
Mitigation Site	0.0	102.5	134.4	137.6	195.2	209.6		
Reference Site	0.0	91.7	94.4	117.8	109.6	124		
% Mitigation/Reference	0%	112%	142%	117%	178%	169%		

Mitigation Site Eelgrass Shoot Density Relative to Reference Site Shoot Density

Morro Bay Fiscal Year 2010 Maintenance Dredging Project

Morro Bay, CA

Figure 7

Merkel & Associates, Inc.

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Merkel & Associates. 2013c. Morro Bay Estuary Eelgrass Recovery Program, 2013 Volunteer Orientation Presentation, Morro Bay, CA, August 18, 2013.

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Appendix A. Monitoring and Compliance Reporting Summary

Southern California Eelgrass Mitigation Policy

Monitoring and Compliance Reporting Summary
(to be submitted with each monitoring report)

PERMITTEE CONTACT INFORMATION:

Project Name (same as permit reference): Morro Bay Fiscal Year 2010 Maintenance Dredging Project

1.0 Permittee Information

Name	US ACOE	Address	915 Wilshire Blvd
Contact Name	Ms. Gail M. Campos	City, State, Zip	Los Angeles, CA 90017
Phone	213-452-3874	Fax	213-452-4204
Email	Gail.M.Campos@usace.army.mil		

Mitigation Consultant

Name	Merkel & Associates, Inc.	Address	5434 Ruffin Rd.
Contact Name	Keith Merkel	City, State, Zip	San Diego, CA 92123
Phone	858-560-5464	Fax	858-560-7779
Email	kmerkel@merkelinc.com		

PERMIT DATA:

Permit	Issuance Date	Expiration Date	Agency Contact

EELGRASS IMPACT AND MITIGATION REQUIREMENTS SUMMARY:

Permitted Eelgrass Impact Estimate (m^2):	4,047 m^2		
Actual Eelgrass Impact (m^2):	4,047 m^2	On (post-construction date):	February 2010
Eelgrass Mitigation Requirement (m^2):*	4,856 m^2 7,042 m^2	Mitigation Plan Reference:	Merkel & Associates, 2010 Merkel & Associates, 2012
Impact Site Location:	Morro Bay, CA		
Impact Site Center Coordinates (projection & datum):	35º 22.3’ N; 120º 51.6’W		
Mitigation Site Location:	Morro Bay, CA		
Mitigation Site Center Coordinates (projection & datum):	35º 22.0’ N; 120º 51.4’W		

PROJECT ACTIVITY DATA:

Activity	Start Date	End Date	Reference Information
Eelgrass Impact	November 2009	February 2010	Merkel & Associates June 2010
Installation of Eelgrass Mitigation	July 6, 2010	July 9, 2010	Merkel & Associates July 2010
Initiation of Mitigation Monitoring	October 2010	July 2015	Merkel & Associates December 2010

MITIGATION STATUS DATA:

	Mitigation Milestone	Scheduled Survey	Survey Date	Area (m^2)	Density (turions/m^2)	Reference Information
Month	**0**	July 2010	July 9, 2010	9,712		Merkel & Associates July 2010
	3	October 2010	October 15, 2010	7,161	102.5±40.3	Merkel & Associates. December 2010
	6	April 2011	April 17, 2011	5,340	134.4±40.3	Merkel & Associates July 2010
	12	July 2011	July 23, 2011	5,179	137.6±49.9	Merkel & Associates August 2011
	24	July 2012	July 1, 2012	3,687	195.2±87.7	Merkel & Associates July 2012
	36	July 2013	July 1, 2013	6,354	209.6±112.2	Merkel & Associates September 2013
	48	July 2014	TBD	NA	NA	NA
	60	July 2015	TBD	NA	NA	NA

FINAL ASSESSMENT:

2.0 Was mitigation met?	Yes (to date)*
Were mitigation and monitoring performed timely?	Yes (to date)
Was delay penalty required or were supplemental mitigation programs necessary?	None (to date)

*The initial mitigation was determined by agreement based on an anticipated impact of 4,047 m^2 (1.0 acre) with a mitigation requirement of 4,856 m^2 (1.2 acres). Subsequent determination of impacts beyond the initially estimated footprint resulted in an increase in the mitigation requirement to 7,042 m^2 (1.74 acres) in 2012 by commitment of the Corps. Poor performance of natural reference sites due to baywide eelgrass declines has been an important factor to success of the mitigation site.

Appendix H

Pre-Dredge *Caulerpa taxifolia* Survey Report (2013)

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May 26, 2013
M&A #05-024-31

Ms. Gail Campos
U.S. Army Corps of Engineers
Los Angeles District
CESPL-PD-RL
915 Wilshire Boulevard
Los Angeles, CA 90017

Pre-Dredge *Caulerp*a *taxifolia* Survey Report
In Support of the Morro Bay 2013-2014 Maintenance Dredging Project
W912PL-13-F-0005, Item A

Dear Ms. Campos:

Enclosed is the report for the *Caulerpa* survey conducted at Morro Bay in support of the 2013-2014 Morro Bay Maintenance Dredging Project (Figure 1). The survey was performed per the *Caulerpa* Control Protocol (Version 4 - February 25, 2008) on May 17-19, 2013. The project area was surveyed with sidescan sonar, Remotely Operated Vehicle (ROV) video and towed camera array surveys. In addition, low tide visual inspections were conducted within the intertidal and shallow subtidal areas within and adjacent to the proposed dredge locations. The entire federal channel area and all water areas within the vicinity of the federal channel were surveyed with sidescan sonar (Figure 1). Within the limits of the federal channel, surveys conducted by visual observation, ROV, and towed cameras covered 20 percent of the bottom. Areas for ROV inspection were selected based on their representation as anomalous conditions to the otherwise well defined sand bottom. These areas ultimately proved to be pockets of drift algae in eddy areas, sand dollar beds, and trapped drift algae and dead eelgrass leaves that were partially anchored by over-running sand waves.

I am pleased to report that *Caulerpa* was not found within the survey area. This survey will complete your pre-construction survey obligations for *Caulerpa* at Morro Bay, and is valid for construction activities in the project area initiated within the next 90 days.

I hope your construction activities proceed in a safe and timely manner. If you have any questions regarding the enclosed documents or this letter, feel free to contact me at (858) 560-5465.

Sincerely,

Keith W. Merkel
Principal Consultant

Caulerpa Survey Reporting Form

This form is required to be submitted for any surveys conducted for the invasive exotic alga *Caulerpa taxifolia* that are required to be conducted under federal or state permits and authorizations issued by the U.S. Army Corps of Engineers or Regional Water Quality Control Boards (Regions 8 & 9). The form has been designed to assist in controlling the costs of reporting while ensuring that the required information necessary to identify and control any potential impacts of the authorized actions on the spread of *Caulerpa*. Surveys required to be conducted for this species are subject to modification through publication of revisions to the *Caulerpa* survey policy. It is incumbent upon the authorized permittee to ensure that survey work is following the latest protocols. For further information on these protocols, please contact: Bryant Chesney, National Marine Fisheries Service (NOAA Fisheries), (562) 980-4037, or William Paznokas, California Department of Fish & Game, (858) 467-4218).

Report Date:	May 26, 2013
Name of bay, estuary, lagoon, or harbor:	Morro Bay, California
Specific Location Name: (address or common reference)	2013 Cycle of Morro Bay Harbor Six-Year Maintenance Dredging Project. Work is located at the mouth of Morro Bay, including areas outside of the sand trap jetties and adjacent to Morro Rock.
Site Coordinates: (UTM, Lat./Long., datum, accuracy level, and an electronic survey area map or hard copy of the map **must** be included)	35°21'49.49"N 120°52'00.28"W Boundaries of the surveyed area are illustrated on the attached Figure 1. Sidescan surveys extend beyond the federal channel limits. Surveys with ROV, towed camera arrays, and visual investigations were conducted within the federal channel limits as provided by the Corps.
Survey Contact: (name, phone, e-mail)	Keith W. Merkel, Merkel & Associates, 858-560-5465, kmerkel@merkelinc.com
Personnel Conducting Survey (if other than above): (name, phone, e-mail)	Keith Merkel (*Caulerpa* certified surveyor) Jordan Volker (*Caulerpa* certified surveyor) Kathy Rogers (*Caulerpa* certified surveyor)
Permit Reference: (ACOE Permit No., RWQCB Order or Cert. No.)	Contract No. W912PL-09-C-0033 EFH Consultation on Morro Bay Harbor Six Year Maintenance Dredging Program (June 24, 2008)
Is this the first or second survey for this project?	First
Was *Caulerpa* Detected?: (if *Caulerpa* is found, please immediately contact NOAA Fisheries or CDFG personnel identified above)	___________________**Yes, Caulerpa was found at this site and** ____________________**has been contacted on** __________ **date.** ________X__________**No, Caulerpa was not found at this site.**

Description of Permitted Work: (describe briefly the work to be conducted at the site under the permits identified above)	The work is the completion of regular channel maintenance dredging of the approach and entrance to Estero Bay, Morro Bay, California. The areas to be dredged are shoal areas within the entrance channel, transition area, main channel, and the western half of the Navy channel. Work is anticipated to be completed by hopper dredge.	
Description of Site: (describe the physical and biological conditions within the survey area at the time of the survey and provide insight into variability, if known. Please provide units for all numerical information).	*Depth range:*	0 to greater than -35 feet MLLW
	Substrate type:	Sand Bottom – stable and active sand substrate, cobble reef.
	Temperature:	14.4 C
	Salinity:	~34 ppt
	Dominant flora:	Eelgrass is common along the fringes of the survey area within the Navy Channel and Morro Channel. Kelp beds dominated by Macrocystis canopy are found along the eastern portion of the Main Channel and the northern portion of the Navy Channel.
	Dominant fauna:	Scattered beds of sand dollars (*Dendraster excentricus*)
	Exotic species encountered (including any other Caulerpa species):	*Sargassum muticum* was observed on some rock inside the jetties but not within the survey area. The bryozoan *Watersipora subtorquata* was observed on pilings and mooring blocks along the Morro Channel.
	Other site description notes:	Sand bottom exhibits high energy wave rippling with trapped drift algae. Many areas exhibit no vegetative matter only large sand wave forms. Drift macroalgae was observed in a few locations, considerably greater drift green alga was observed within the channel areas than has been observed over the past two years. Sand dollar beds were a common feature in low energy regions of the survey area.
Description of Survey Effort: (please describe the surveys conducted including type of survey (SCUBA, remote video, etc.) and survey methods employed, date of work, and survey density (estimated percentage of the bottom actually viewed). Describe any limitations encountered during the survey efforts.	*Survey date and time period:*	May 17-19, 2013
	Horizontal visibility in water:	Variable from 4 to 12 feet horizontal visibility depending upon tidal conditions and location in the survey area
	Survey type and methods:	Sidescan sonar, remotely operated vehicle video, towed video array survey along transects through dredge footprint, visual inspection of intertidal and shallow subtidal areas.
	Survey personnel:	Keith Merkel (*Caulerpa* certified surveyor) Jordan Volker (*Caulerpa* certified surveyor) Kathy Rogers (*Caulerpa* certified surveyor)
	Survey density:	Surveys covered 20% of the area via ROV video, towed video, and low tide visual inspection, with 100% of survey area being covered by sidescan sonar. Video surveys included transects and focused inspections of targets identified in sidescan survey as anomalous conditions.
	Survey limitations:	None
Other Information:	Please see attached map (Figure 1).	

Caulerpa Survey Reporting Form (version 1.2, 10/31/04)

Caulerpa Survey - May 2013

Morro Bay Harbor Maintenance Dredging 2013

Figure 1

Merkel & Associates, Inc.