4.1 BIOLOGICAL RESOURCES

4.1.1 Environmental Setting

This section of the Environmental Impact Report (EIR) identifies potential impacts to biological resources, principally fish and aquatic invertebrates, and describes mitigation measures to reduce significant Project impacts associated with the proposed San Francisco Bay and Delta Sand Mining Project (Project). The proposed Project would extend existing sand mining operations by Hanson Marine Operations (Hanson) and Jerico Products, Inc./Morris Tug & Barge (Jerico) (the applicants) for another 10 years, and requires leases from the California State Lands Commission (CSLC) and approvals from other agencies (see Section 1.3, Permits, Approvals, and Regulatory Requirements, in Section 1.0, Introduction).

The approach used in this analysis relies upon recent available scientific studies of marine communities in the San Francisco Bay-Delta, including: regional biological and ecological habitat reports (National Oceanic and Atmospheric Administration [NOAA] 2007); long-term regional studies such as the ongoing Regional Monitoring Program for Water Quality in San Francisco Estuary (RMP); the California Department of Fish and Game's (CDFG) San Francisco Bay Study (CDFG 2000-2007); the 2009 Interagency Ecological Program (IEP) for the San Francisco Estuary (Estuary); and other California Environmental Quality Act (CEQA) documents (Chambers Group, Inc. 2007; Jones and Stokes 2003). Information on terrestrial biological resources such as the California Natural Diversity Database (CNDDB) (CDFG 2009a) and other published literature were also reviewed. The discussion below summarizes the information presented in these documents, which may be consulted for additional detail. In addition, Applied Marine Sciences (AMS) performed two studies in support of the EIR analysis: a characterization of sediment and invertebrates within and outside the CSLC lease areas (AMS 2009a [Appendix F]); and an assessment of fish and invertebrate entrainment[1] effects from commercial aggregate sand mining (AMS 2009b [Appendix E]).

Biological Communities

The San Francisco Bay-Delta is the second largest estuary in the United States and supports numerous aquatic habitats and biological communities. It encompasses 479 square miles, including shallow mudflats. San Francisco Bay is divided into four

[1] The term "entrainment" as used in this assessment refers to the direct uptake of aquatic organisms by the suction created at the hydraulic drag head and in the water used to create the hydraulic lift.

main basins: South Bay, Central Bay, San Pablo or North Bay, and Suisun Bay. The discussion and assessment in this EIR of aquatic habitats and associated biota for the San Francisco Bay-Delta focus primarily on the following regions:

- Central Bay, which is located between the Oakland Bay Bridge and the Richmond-San Rafael Bridge and connects to the Pacific Ocean through the Golden Gate;
- North Bay/San Pablo Bay, which stretches between the Richmond-San Rafael Bridge and the Carquinez Bridge; and
- Suisun Bay, a large shallow embayment that lies east of the Carquinez Strait which transforms into the diked wetlands of the western Delta.

Project Site

As discussed in Section 2.0, Project Description, commercial sand mining occurs in the western portion of Central Bay, at Middle Ground Shoal in Suisun Bay, and along the main navigation channel in the western Delta. San Francisco Bay Conservation and Development Commission (BCDC) permit conditions allow sand mining in water depths greater than 30 feet in the Central Bay, with 90 feet as the physical limit of mining equipment. Mining leases in the Central Bay are roughly bounded by Angel Island to the east, the Tiburon Peninsula and Richardson Bay to the north, the Golden Gate to the west, and the San Francisco Embarcadero to the south (see Figure 2-1a). In the Suisun Bay and Delta area, one State lease (consisting of two segments) (see Figure 2-1b) and one privately owned parcel (Middle Ground Shoal; see Figure 2-2) are located east of Carquinez Strait; mining in these areas occurs primarily along the upper edge of the shipping channel, along a band of the channel where decreasing water velocity allows coarser sand fractions to settle out.

The marine habitats where sand mining occurs consist of open water pelagic (midwater) habitat and soft substrate benthic (bottom) habitat. No mining occurs in the nearshore subtidal (soft or hard substrate) or intertidal habitats, within submerged aquatic vegetation beds or emergent saltwater marsh or wetlands. The following sections describe the marine habitats and associated biota within the Bay-Delta that could be affected by sand mining operations.

Central Bay. Spanning the entrance to the Pacific Ocean, Central Bay contains the deepest areas of the Estuary and the most natural and human-made hard bottom substrate (NOAA 2007). Beneath the Golden Gate, the seafloor reaches depths of 361 feet with strong tidal currents running through the Golden Gate and throughout

Central Bay (NOAA 2007). These strong tidal flows maintain deeper water depths, despite the large volume of sediment that has historically moved through the Bay from the Delta and local streams. In the western part of Central Bay, where sand mining occurs, the substrate is mostly coarse mobile sand intermixed with pebble, cobble and gravel (NOAA 2007; AMS 2009a [Appendix F]). Pockets of mud are also interspersed with the coarser sediment material. Typically, Central Bay waters are colder and saltier than other regions of the Bay-Delta.

Suisun Bay and Western Delta. Suisun Bay is a large shallow embayment that lies east of the Carquinez Strait and consists of two shallow bays (Honker and Grizzly), the deeper Suisun Bay, and a deep water channel connecting them. Its proximity between the western Delta and North (San Pablo) Bay results in strong tidal flow of ocean water mixed with freshwater flows from the Sacramento, San Joaquin, and Napa Rivers. As a consequence, this estuarine water tends to be mesohaline (moderately saline, ranging from 5 to 18 parts per thousand [ppt]) (NOAA 2007).

The western Delta, generally described as the area near the confluence of the Sacramento and San Joaquin Rivers, is subject to substantial tidal effects, although salt intrusion is rare (Herbold and Moyle 1989). Sediments tend to be finer sands, silts and clays in the shallows and shoals and graded along the main navigation channels where sand mining occurs (NOAA 2007; AMS 2009a [Appendix F]). Water temperatures in the western Delta fluctuate more than in other regions of the Bay-Delta because of its proximity to seasonally colder Sacramento and San Joaquin freshwater flow and its greater distance from and influence by marine waters through the Golden Gate (NOAA 2007).

Open Water Pelagic Environments

The open water pelagic environment is the predominant habitat of the Bay-Delta and includes the area between the water surface and the seafloor. The physical conditions of the open water environment are constantly changing with tidal flow and season. Each of the main basins is heavily influenced by ocean water brought into the Bay by the daily tidal cycle and by freshwater flow into the Bay by the many rivers and tributaries that flow through the Bay-Delta. The pelagic environment is predominantly inhabited by planktonic[2] organisms floating and swimming in the water, fish, marine birds, and marine mammals. These communities are described below.

[2] Plankton are generally small, passively or weakly moving organisms, including algae, larval invertebrates and protozoans that float or drift in great numbers in salt water, especially at or near the surface.

Plankton Community. Due to its proximity to the ocean, the open water environment of Central Bay is most like the open water environment along the coast. With a lack of significant freshwater inflow, the phytoplankton (microscopic plant) and zooplankton (microscopic animal) communities are almost entirely marine in composition and seasonality. Phytoplankton species throughout the Bay-Delta are typically tolerant of broad salinity and temperature ranges because of the normal annual fluctuations between marine and freshwater influences (NOAA 2007). The species composition and distribution of phytoplankton communities in Central Bay and Suisun Bay are beyond the scope of this EIR section, and are discussed in detail in the NOAA (2007) *Report on the Subtidal Habitats and Associated Biological Taxa in San Francisco Bay*.

The zooplankton community consists of small invertebrate organisms that spend their entire life cycle in the water column and predominantly feed on phytoplankton species and small suspended organic particles. These include microzooplankton, copepods, cladocerans, and the larvae of benthic and pelagic invertebrate animals. Other components of the zooplankton community include larval forms of shrimp, krill, barnacles, worms, and other invertebrates. Zooplankton species typically change seasonally with a few species being present throughout the year. Likewise, the abundance and distribution of zooplankton species vary substantially within the Estuary in response to seasonal cycles and environmental factors such as salinity gradients. In the high-salinity portions of Central Bay, the primary zooplankton are calanoid copepods (*Acartia clausi*, *A. tonsa*, and *Paracalanus parvus*). In the low-salinity regions of Suisun Bay and the western Delta the primary zooplankton are also calanoid copepods (*Eurytemora affinis* and *A. clausi*) and the opossum shrimp (*Neomysis mercedis*). The cladocerans (*Daphnia pulex* and *D. parvula*), and calanoid copepods (*Diaptomus* spp. and *Limnocalanus macrurus*) are the primary zooplankton species in the freshwater portions of the Delta (Hanson Environmental 2004; NOAA 2007). Zooplankton taxa found throughout the Bay include *A. clausi*, *A. californiensis*, *Oithona davisae*, harpacticoid copepods, tintinnids, and the larvae of gastropods, bivalves, barnacles, and polychaetes (Ambler et al. 1985).

Meroplankton are marine organisms that are planktonic for a part of their life cycle, usually the larval stage. They predominantly occur in North Bay and originate from adult fish species including Pacific herring (*Clupea pallasi*), longfin smelt (*Spirinchus thaleichthys*), and plainfin midshipmen (*Porichthys notatus*) (NOAA 2007).

Pelagic Fish Community. Forty-six fish species have been documented to use Central Bay pelagic waters; three of these 46 species account for more than 98 percent of the total abundance of fish regularly encountered by CDFG during their monthly IEP fish monitoring program between 2000 and 2007 (Table 4.1-1) (CDFG 2000-2007).

Table 4.1-1. Pelagic Fish Community Composition for Central Bay Based on 2000 to 2007 Midwater Trawl Data (Fish/Hectare-Meter)[1,2]

Species	Common Name	2000 to 2007 Mean	Percent Composition
Engraulis mordax	Northern anchovy	575	90.8%
Clupea pallasi	Pacific herring	35	5.5%
Sardinops sagax	Pacific sardine	11	1.8%
Atherinopsis californiensis	Jacksmelt	3	0.5%
Cymatogaster aggregata	Shiner surfperch	3	0.4%
Atherinops affinis	Topsmelt	1	0.2%
Peprilus simillimus	Pacific pompano	1	0.2%
Hyperprosopon argenteum	Walleye surfperch	1	0.2%

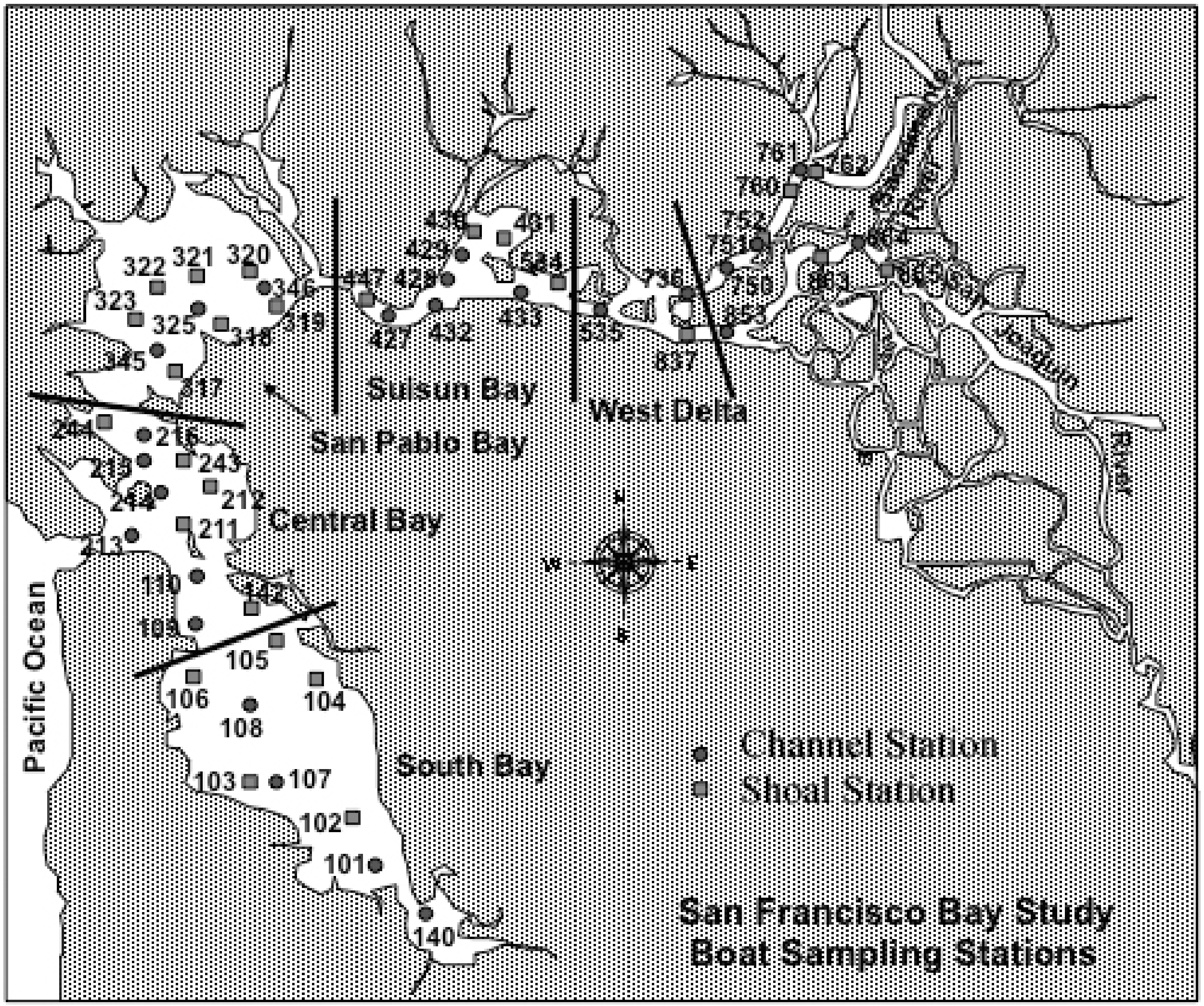
[1] Species also present with less than 0.2 percent of total abundance include: American shad, barred surfperch (*Amphistichus argenteus*), bat ray (*Myliobatis californica*), bay goby (*Lepidogobius lepidus*), bay pipefish (*Syngnathus leptorhynchus*), big skate (*Raja binoculata*), black perch (*Embiotoca jacksoni*), brown smoothhound (*Mustelus henlei*), California grunion (*Leuresthes tenuis*), California halibut, cheekspot goby (*Ilypnus gilberti*), Chinook salmon (*Oncorhynchus tshawytscha*), diamond turbot (*Hypsopsetta guttulata*), English sole (*Parophrys vetulus*), kelp greenling (*Hexagrammos decagrammus*), leopard shark (*Triakis semifasciata*), lingcod (*Ophiodon elongatus*), longfin smelt, Pacific electric ray (*Torpedo californica*), Pacific sanddab (*Citharichthys sordidus*), Pacific staghorn sculpin (*Leptocottus armatus*), Pacific tomcod (*Microgadus proximus*), pile perch (*Rhacochilus vacca*), plainfin midshipman, queenfish (*Seriphus politus*), steelhead trout, redtail surfperch (*Amphistichus rhodoterus*), river lamprey (*Lampetra ayresii*), speckled sanddab (*Citharichthys stigmaeus*), starry flounder, striped bass, surf smelt (*Hypomesus pretiosus*), threadfin shad, threespine stickleback, white croaker, white seaperch (*Phanerodon furcatus*), whitebait smelt (*Allosmerus elongatus*), and yellowfin goby.

[2] Hectare-Meter refers to a hectare-sized area 1 meter deep.

Source: CDFG 2000-2007

Figure 4.1-1 illustrates the station locations for the Bay-Delta Fish Monitoring Program conducted by CDFG as part of the IEP for the Bay-Delta.

Three species that dominate the pelagic fish community in Central Bay are northern anchovy (*Engraulis mordax*), which accounts for up to 91 percent of those fish inhabiting the water column, Pacific herring, and Pacific sardine (*Sardinops sagax*). Other common fish include jacksmelt (*Atherinopsis californiensis*), shiner surfperch (*Cymatogaster aggregata*), topsmelt (*Atherinops affinis*), Pacific pompano (*Peprilus simillimus*), walleye surfperch (*Hyperprosopon argenteum*), California grunion (*Leuresthes tenuis*), and white croaker (*Genyonemus lineatus*). The remaining 36 species individually account for less than 0.1 percent of the fish species present (CDFG 2000-2007).



Source: Hieb, in AMS 2009b [Appendix E]

Figure 4.1-1
Location of CDFG Trawling Stations

Other important species or species that are observed in Central Bay pelagic waters include longfin smelt and California halibut (*Paralichthys californicus*) (CDFG 2000-2007). The presence of more outer coast species in Central Bay compared to other regions of the Bay-Delta is a result of the Central Bay's proximity to the Golden Gate channel and Pacific Ocean.

In Suisun Bay, the pelagic fish community is dominated by northern anchovy, longfin smelt, striped bass (*Morone saxatilis*), American shad (*Alosa sapidissima*), Chinook salmon (*Oncorhynchus tshawytscha*), Pacific herring, threadfin shad (*Dorosoma petenense*), delta smelt (*Hypomesus transpacificus*), yellowfin goby (*Acanthogobius flavimanus*), splittail (*Pogonichthys macrolepidotus*), and plainfin midshipman

(Table 4.1-2). These 11 taxa account for 98 percent of all taxa present in Suisun Bay between 2000 and 2007 (CDFG 2000-2007). Other common fish taxa include starry flounder (*Platichthys stellatus*), Pacific staghorn sculpin (*Leptocottus armatus*), white croaker, threespine stickleback (*Gasterosteus aculeatus*), Shokihaze goby (*Tridentiger barbatus*), topsmelt, white sturgeon (*Acipenser transmontanus*), shimofuri goby (*Tridentiger bifasciatus*), and common carp (*Cyprinus carpio*). Another 12 species, including steelhead trout (*Oncorhynchus mykiss*), a species listed as threatened under the Federal Endangered Species Act (ESA), comprise less than 0.1 percent of fish present in Suisun Bay (Table 4.1-2).

Table 4.1-2. Pelagic Fish Community Composition For Suisun Bay Based on 2000 to 2007 Midwater Trawl Data (Fish/Hectare-Meter)[1]

Species	Common Name	2000 to 2007 Mean	Percent Composition
Engraulis mordax	Northern anchovy	6.6	33.0%
Spirinchus thaleichthys	Longfin smelt	4.1	20.4%
Morone saxatilis	Striped bass	3.3	16.2%
Alosa sapidissima	American shad	2.3	11.5%
Oncorhynchus tshawytscha	Chinook salmon	0.9	4.7%
Clupea pallasi	Pacific herring	0.7	3.5%
Dorosoma petenense	Threadfin shad	0.4	2.2%
Hypomesus transpacificus	Delta smelt	0.4	1.9%
Acanthogobius flavimanus	Yellowfin goby	0.4	1.8%
Pogonichthys macrolepidotus	Splittail	0.3	1.4%
Porichthys notatus	Plainfin midshipman	0.2	0.8%

[1] Species present with less than 0.4 percent of total abundance include: starry flounder, Pacific staghorn sculpin, white croaker, threespine stickleback, Shokihaze goby, topsmelt, white sturgeon, common carp, shimofuri goby, steelhead trout, jacksmelt, bay goby (*Lepidogobius lepidus*), bluegill (*Lepomis macrochirus*), English sole (*Parophrys vetulus*), hardhead (*Arius felis*), Mississippi silverside (*Menidia audens*), Pacific lamprey (*Lampetra tridentata*), Pacific pompano, river lamprey (*Lampetra ayresii*), shiner surfperch, and speckled sanddab (*Citharichthys stigmaeus*).

Source: CDFG 2000-2007

The presence of sculpin, gobies, and carp in midwater sampling events by CDFG in Suisun Bay is the result of the shallow water depths throughout much of this area. The pelagic fish community in the western Delta is similar in composition and dominant species to Suisun Bay, with one exception: the northern anchovy is a minor species (AMS 2009a [Appendix F]). In recent years, the fish populations in the western Delta, Suisun Bay, and to a lesser degree San Pablo Bay, have changed significantly. Four of the dominant pelagic species, delta smelt, longfin smelt, striped bass, and threadfin shad have undergone significant decline since 2000 (American Fisheries Society [AFS] 2007). The delta smelt is listed under both the Federal and State ESAs. The longfin smelt is listed under the California ESA but is not listed under the Federal ESA. This decline has, in part, been attributed to the invasive Asian clam (*Corbula amurensis*) and severely altered water flow from the Sacramento and San Joaquin Rivers (AFS 2007).

Northern anchovy are also protected under the Coastal Pelagic Fishes Management Plan. Finally, the Project area is located within the established migration corridor for steelhead trout adults and smolts. Both the main shipping channel and adjacent shallows are used by migrating steelhead trout for movement and foraging. Although CDFG data (CDFG 2000-2007) did not identify steelhead trout in the Project area in any significant numbers, individuals can be expected during migration periods.

Under the Pacific Coast Salmon Fishery Management Plan, the entire San Francisco Bay-Delta Estuary has been designated as Essential Fish Habitat (EFH) for Spring-, fall/late fall- and winter-run Chinook salmon (Pacific salmon) (Pacific Marine Fisheries Council [PMFC] 2003). Winter- and spring-run Chinook salmon are listed under the Federal and State ESAs as endangered and threatened, respectively. These areas serve as a migratory corridor, holding area, and rearing habitat for both adult and juvenile salmon. Likewise, the Pacific Pelagic Fishery Management Plan identifies the Bay-Delta as EFH for fish managed under their program, which includes Pacific herring, northern anchovy, and Pacific sardine (PMFC 1998).

Marine Bird Community. The San Francisco Bay-Delta is an important wintering and stop-over site for the Pacific Flyway. More than 300,000 wintering waterfowl use the region and associated ponds (NOAA 2007). Bird guilds that use the open waters of the Bay-Delta include the diving benthivores, which feed in deeper water on benthic invertebrates; dabblers, which feed in the upper water column of shallow subtidal areas; piscivores, which feed on fish; and opportunistic predators (NOAA 2007). The majority of birds using the Bay-Delta are bay and sea ducks.

The dominant marine birds regularly inhabiting or using the areas of the Bay-Delta where sand mining occurs include cormorants (*Phalacrocorax* spp.), pigeon guillemot (*Cepphus columba*), herring gull (*Larus argentatus*), mew gull (*L. canus*), and California brown pelican (*Pelecanus occidentalis californicus*). California brown pelican was recently delisted but remains a Fully Protected species under the California Fish and Game Code (Fish & G. Code, § 3511, subd. (b)(2)). Among the diving benthivores guild, canvasback (*Aythya valisineria*), greater scaup (*A. marila*), lesser scaup (*A. affinis*), and surf scoter

(*Melanitta perspicillata*) are the most common, although canvasback abundance has declined in recent years (NOAA 2007). Osprey (*Pandion haliaetus*) are also frequently observed throughout the Bay-Delta (NOAA 2007).

Marine Mammal Community. Seven species of marine mammals occur within the Bay-Delta (NOAA 2007). The four species that commonly use the open waters of the Bay-Delta for migrating, foraging, and resting are ~~The~~ harbor seal (*Phoca vitulina*), California sea lion (*Zalophus californianus*), harbor porpoise (*Phocoena phocoena*), ~~and~~ gray whale (*Eschrichtius robustus*).[3] ~~are the most common that use the open waters of the Bay-Delta for migrating, foraging, and resting (NOAA 2007).~~ While these species typically concentrate their activities in Central Bay and adjacent portions of South Bay and North Bay, some harbor seals, harbor porpoise, and California sea lions travel throughout the Bay-Delta and up into the Sacramento River in search of salmon and other forage. There are no major haul-outs or rookeries in the North Bay for marine mammals. All these species are protected under the Federal Marine Mammal Protection Act of 1972 (MMPA; 16 United States Code [U.S.C.] § 1361 et seq.).

Harbor seals are the only year-round residents of the Bay-Delta, with colonies located at Castro Rocks in San Pablo Bay, Yerba Buena Island in Central Bay, and Mowry Slough in South Bay (NOAA 2007). The harbor seal population is estimated to be between 500 and 700 individuals (NOAA 2007). Harbor seals forage throughout the Bay-Delta feeding on schooling fish such as smelt, anchovies, herring, rockfish, sculpin, perch, and midshipmen, along with squid and mysid shrimp. California sea lions use the Bay-Delta for refugia and forage but do not pup or breed within the Estuary (NOAA 2007). Sea lions are most prevalent in the Bay-Delta when migrating between their primary breeding areas in the Farallon and California Channel Islands and when both Pacific herring and salmon are present in the Bay-Delta in large numbers during spawning (NOAA 2007).

The harbor porpoise is a near-shore species that is commonly observed near the Golden Gate channel and other areas of Central Bay. Individuals observed in San Francisco Bay are believed to be of a distinct genetic stock, the San Francisco-Russian River Stock that range between Point Arena and Monterey Bay (NOAA 2007). Some eastern Pacific gray whales and humpback whales have been documented entering the Bay during their annual migrations between Alaska and Mexico, often injured or lost, or pausing to feed in soft sediments or seek shelter with their young (NOAA 2007). Eelgrass (*Zostera marina*)

[3] The other three species that occur within the Bay are Steller sea lion (*Eumetopias jubatus*), humpback whale (Megaptera novaeangliae), and California sea otter (*Enhydra lutris*).

is an important resource to all marine mammals that occur in the Bay as eelgrass beds tend to concentrate food items and are an ideal place for harbor seals, sea lions and gray whales to feed on schooling fishes during winter months when herring are in their highest abundance in the Bay (NOAA 2007).

Benthic and Demersal Environment[4]

Soft Sediment Habitat. The primary bottom habitat in the sand mining lease areas is soft bottom substrate with a combination of mud/silt/clay (particles 0.001 to 0.062 millimeter [mm] in diameter), sand (particles 0.062 to 2.0 mm in diameter), and pebble/cobble (particles 2 to 256 mm in diameter), with varying amounts of intermixed shell fragments. Exposure to wave and current action, temperature, salinity, and light penetration determines the composition and distribution of organisms within these soft sediments. Most surveys and other information sources indicate unconsolidated sediments are present throughout the Bay-Delta and are the most common substrate type in the Bay. The locations where sand mining occurs in Central Bay and the Delta consist primarily of coarser sand components with minimal silt and clay fractions. Small rocks, cobbles, gravel, and shell debris are also present (AMS 2009a [Appendix F]).

The soft gravel, sand and silt sediments of the Bay-Delta are subdivided into several habitat categories, including channel edge, slough channel, main channel, and shallow subtidal (NOAA 2007). Each of these soft-substrate habitat categories has different ecological conditions that result in different benthic infaunal communities. Central Bay contains primarily main channel and shallow subtidal shoal areas whereas Suisun Bay and the western Delta contain all four categories (NOAA 2007). Sand mining occurs in main channel or deep channel habitat in the Central Bay and main channel habitat in the Delta mining leases. In the Delta mining sites, mining occurs along the upper edge of the channel and not along the channel bottom where the finer sediments accumulate.

Benthic Infauna and Epifauna. The benthic invertebrate community can be generally classified into infauna that live within the bottom substrate and epifauna that live on the substrate. At any given site, these communities appear as a patchwork of different species groups that are recovering from local disturbances such as sand or current movement. Different invertebrate groups respond differently to environmental conditions and disturbance, thus, the makeup of the invertebrate community reflects the quality and character of the environment where the groups reside.

[4] The benthic zone is the ecological region that includes the sediment surface and subsurface. The demersal zone is the lowest portion of the water column that is near to and influenced by the seabed.

In its assessment of benthic infauna in Central Bay mining leases, AMS reported a low diversity, low abundance community composed of 107 taxa which appeared to be heavily influenced by sediment disturbance and instability (AMS 2009a [Appendix F]). This sediment instability is the result of the high currents that characterize the portion of Central Bay near the Golden Gate channel. AMS observed a region-wide community where the benthic infauna community is dominated by nematodes, polychaetes, oligochaetes and nemerteans, all of which are worms, and amphipods (AMS 2009a [Appendix F]). Total animal density was estimated at about 2,000 individuals per square meter (m^2), which is similar to recent findings in the Alcatraz Shoal region of Central Bay (MEC and Cheney 1990). Other dominant taxa reported by AMS included several native and introduced bivalves (clams) and the holothurian sea cucumber (*Leptosynapta* spp.) (AMS 2009a [Appendix F]).

Central Bay samples identified that dominant taxa were further observed to separate or cluster into five sub-groups. One subgroup was characterized by high species diversity with equally abundant amphipod, bivalve, and polychaete species (AMS 2009a [Appendix F]); this community was associated with the coarsest sands and gravels. A second subgroup, with slightly higher species diversity, was dominated by the bivalve *Nutricola*, spp., followed by polychaetes, amphipods, bivalves, and nematodes. The three remaining subgroups showed extremely low species diversity; of these three subgroups, two were overwhelmingly dominated by nematodes with a lesser abundance of polychaetes.

In Suisun Bay and the western Delta, the invertebrate benthic community in the Delta channels is dominated in both abundance and biomass by two invasive clams, *Corbula amurensis* and *Corbicula fluminea* (NOAA 2007). Other key species include polychaetes and the small marine crustacean, *Nippoleucon hinumensis* (NOAA 2007). In its assessment of the Delta mining leases, AMS observed the same overwhelming dominance of the infauna by *C. amurensis* in Middle Ground Shoal and in the western Delta mining leases (AMS 2009a [Appendix F]). The less saline tolerant Asian clam, *C. fluminea*, assumed dominance in the eastern and more freshwater areas of the mining leases.

Megabenthos. The dominant mobile crustaceans in Central Bay include blackspotted shrimp (*Crangon nigromaculata*), bay shrimp (*Crangon franciscorum*), Dungeness crab (*Cancer magister*), and the slender rock crab (*Cancer gracilis*), which may burrow into or live on the benthos. Other species of shrimp are present in Central Bay but are significantly reduced in individual abundance compared to the California bay and blackspotted shrimps (NOAA 2007). All of these mobile invertebrates provide an important food source for carnivorous fish, marine mammals, and birds in the San Francisco Bay food web. They occur in large numbers throughout Central Bay, San Pablo Bay, and South Bay. Dungeness crab use most of San Francisco Bay, as they do all estuaries along the north Pacific coast, as an area for juvenile growth and development prior to returning to the ocean as sexually mature adults (Tasto 1979; Pauley et al. 1989). They are present in Suisun Bay in small numbers compared to other parts of the Bay-Delta, and infrequently occur in the western Delta (AMS 2009b [Appendix E]).

The abundance of blackspotted shrimp typically peaks from May through August, and again from December to February (Hieb 1999). The bay shrimp is the most common *Crangon* species in San Francisco Bay (NOAA 2007). A strong positive relationship has been described between bay shrimp and freshwater outflow in spring (NOAA 2007; CDFG 1987); bay shrimp are most common in the Central Bay, most likely using San Francisco Bay as an extension of their coastal habitat (Hieb 1999).

Large mobile invertebrates common in Suisun Bay include Dungeness crab, blackspotted shrimp, a gastropod snail (*Ilyanassa obsoleta*), the American spider crab (*Pyromaia tuberculata)* and the nudibranch (*Sakuraeolis enosimensis*) (NOAA 2007).

Submerged Aquatic Vegetation. Subtidal plants and submerged aquatic vegetation occur throughout the Bay-Delta on both soft and hard substrate. Several species of green algae and eelgrass (*Zostera marina*) occur on shallow unconsolidated subtidal habitat in Central Bay (NOAA 2007). The green algae *Ulva* is commonly observed on exposed mudflats; *Gracillaria* prefers quiet embayments like Richardson Bay and on the leeside of islands, such as Angel and Alcatraz Islands (Silva 1979). Eelgrass, as a shallow subtidal and intertidal flowering plant, inhabits bays, estuaries, and the leeside of islands, such as Treasure, Angel, Yerba Buena, and Alcatraz Islands (Merkel & Associates 2004). The largest eelgrass bed in Central Bay and the second largest in San Francisco Bay is located in Richardson Bay; additional large beds can be found along the Tiburon Peninsula; in Kiel Cove; on either side of Pt. Richmond and along the Richmond breakwater; throughout the Emeryville flats and along the Emeryville Marina breakwater; and adjacent to the Bay Bridge Toll Plaza (Merkel & Associates 2004). Bed locations and size are determined by water depth and turbidity. Eelgrass can only become established in areas of the Bay-Delta where water depth and turbidity allow light to penetrate to the seafloor (Merkel & Associates 2004). As a result, no eelgrass beds are located where sand mining occurs because of the deeper water depths.

Although eelgrass is the dominant submerged plant throughout most of San Francisco Bay, it has limited presence east of the Carquinez Strait (Merkel & Associates 2004). The dominant submerged aquatic vegetation beds in Suisun Bay include widgeon grass (*Ruppia maritima*) and Sago pondweed (*Potamogeton pectinatus*), which occur surrounding Simmons, Ryer, and Roe Islands and in Little Honker Bay. Sago pondweed and widgeon grass are identified as important food sources for waterfowl in North America, although their importance and role in the Estuary is unknown (NOAA 2007).

Demersal Fish. Many different fish species spend all or part of their life cycle in association with the demersal zone, including flatfish, gobies, poachers, eelpouts, and sculpins, which all live in close association with the benthos during their sub-adult and adult lives. Others, such as Chinook salmon, steelhead trout, and longfin smelt use the benthos for foraging. In total, 71 demersal fish species were collected during CDFG surveys between 2000 and 2007 (CDFG 2000-2007); of these 21 species, speckled sanddab (*Citharichthys stigmaeus*), bay goby (*Lepidogobius lepidus*), plainfin midshipmen, Pacific staghorn sculpin, shiner surfperch, white croaker, longfin smelt, Pacific tomcod (*Microgadus proximus*), and cheekspot goby (*Ilypnus gilberti*) accounted for 96 percent of the species present in the survey period (Table 4.1-3).

Table 4.1-3. Demersel Fish Community Composition for Central Bay Based on 2000 to 2007 Otter Trawl Data (Fish/Hectare-Meter)[1]

Species	Common Name	2000 to 2007 Mean	Percent Composition
Citharichthys stigmaeus	Speckled sanddab	519	28.4%
Lepidogobius lepidus	Bay goby	424	23.2%
Porichthys notatus	Plainfin midshipman	301	16.5%
Parophrys vetulus	English sole	265	14.5%
Leptocottus armatus	Pacific staghorn sculpin	102	5.6%
Cymatogaster aggregata	Shiner surfperch	82	4.5%
Genyonemus lineatus	White croaker	23	1.3%
Spirinchus thaleichthys	Longfin smelt	22	1.2%
Microgadus proximus	Pacific tomcod	13	0.7%
Ilypnus gilberti	Cheekspot goby	11	0.6%
Artedius notospilotus	Bonyhead sculpin	9	0.5%

[1] Species with less than 0.5 percent of total abundance include bay pipefish, Pacific herring, Pacific sanddab, showy snailfish (*Liparis pulchellus*), California tonguefish (*Symphurus atricaudus*), saddleback gunnel (*Pholis ornate*), California halibut, curlfin sole (*Pleuronichthys decurrens*), yellowfin goby and brown smoothhound.

Source: CDFG 2000-2007

Other species of importance or concern present in Central Bay demersal environments include Pacific herring and numerous anadromous species that spend their adult lives in the open ocean, but use the San Francisco Bay Estuary on their way upriver to spawn and as a rearing area for juveniles on their way down from their natal river to the open ocean. Native anadromous species include Chinook salmon, steelhead trout, and both green sturgeon (*Acipenser medirostris*) and white sturgeon. Introduced anadromous species include striped bass and American shad (NOAA 2007).

Brown rockfish (*Sebastes auriculatus*) and surfperches (family *Embiotocidae*) are the most common fishes associated with natural hard substrates (NOAA 2007). Shiner surfperch move from South and North Bays to Central Bay as they mature (DeLeon 1999). During winter months, Pacific herring enter euhaline (marine waters for which the salinity ranges from 30 to 35 ppt) areas of San Francisco Bay to spawn during periods of low salinity (NOAA 2007). Schools of adult herring enter the Bay during fall and winter, depositing adhesive eggs onto submerged aquatic vegetation and hard bottom substrate (O'Farrell and Larson 2005).

California halibut became common in San Francisco Bay in the 1980s and 1990s when abundances increased, apparently as a result of a succession of warm water and El Niño years (Baxter et al. 1999). Adult California halibut enter the Bay to forage and spawn, and juveniles use intertidal sand and mud flats for refuge and feeding (Pearson and Owen 2001). California halibut is found from South Bay to the Carquinez Strait, but highest juvenile catches are in South Bay (Greiner et al. 2005). The plainfin midshipman is a demersal, marine fish that burrows into soft sediments during the day and moves into the water column to feed at night (Fitch and Lavenberg 1971).

The demersal fish population in Suisun Bay is not as diverse as that in Central Bay. It consists of over 39 species, but eight taxa accounted for 94 percent of total fish abundance between 2000 and 2007 (Table 4.1-4) (CDFG 2000-2007).

Dominant species include striped bass, yellowfin goby, Shokihaze goby, Pacific staghorn sculpin, longfin smelt, starry flounder, plainfin midshipman, and English sole (*Parophrys vetulus*) (CDFG 2000-2007). Another 19 species account for 5 percent of the individuals present throughout each year and include shimofuri goby, threespine stickleback, American shad, river lamprey (*Lampetra ayresii*), Pacific lamprey (*Lampetra tridentata*), splittail, bay goby, delta smelt, speckled sanddab, threadfin shad, Pacific herring, prickly sculpin (*Cottus asper*), white sturgeon, white catfish (*Ictalurus catus*), California halibut, sand sole (*Psettichthys melanostictus*), white croaker, Chinook salmon and shiner surfperch; green sturgeon are also present, but are observed in low numbers (CDFG 2000-2007).

Table 4.1-4. Demersel Fish Community Composition for Suisun Bay Based on 2000 To 2007 Otter Trawl Data (Fish/Hectare-Meter)[1]

Species	Common Name	2000 to 2007 Mean	Percent Composition
Morone saxatilis	Striped bass	34.7	26.85%
Acanthogobius flavimanus	Yellowfin goby	24.4	18.93%
Tridentiger barbatus	Shokihaze goby	22.2	17.20%
Leptocottus armatus	Pacific staghorn sculpin	14.5	11.21%
Spirinchus thaleichthys	Longfin smelt	9.4	7.31%
Platichthys stellatus	Starry flounder	9.2	7.14%
Porichthys notatus	Plainfin midshipman	4.8	3.70%
Parophrys vetulus	English sole	1.8	1.41%
Tridentiger bifasciatus	Shimofuri goby	1.1	0.86%
Gasterosteus aculeatus	Threespine stickleback	0.8	0.64%
Alosa sapidissima	American shad	0.8	0.62%
Lampetra ayresii	River lamprey	0.7	0.54%
Lampetra tridentata	Pacific lamprey	0.7	0.52%
Pogonichthys macrolepidotus	Splittail	0.7	0.52%
Lepidogobius lepidus	Bay goby	0.5	0.35%
Hypomesus transpacificus	Delta smelt	0.4	0.32%
Citharichthys stigmaeus	Speckled sanddab	0.4	0.32%

[1] Species with less than 0.5 percent of total abundance include: threadfin shad, Pacific herring, prickly sculpin (*Cottus asper*), white sturgeon, white catfish (*Ictalurus catus*), California halibut, sand sole (*Psettichthys melanostictus*), white croaker, Chinook salmon, shiner surfperch, cheekspot goby, diamond turbot, tule perch (*Hysterocarpus traskii*), channel catfish (*Ictalurus punctatus*), common carp, arrow goby (*Clevelandia ios*), brown smoothhound, goldfish (*Carassius auratus*), green sturgeon, bonyhead sculpin (*Artedius notospilotus*), rainwater killifish (*Lucania parva*), and Pacific sanddab.

Source: CDFG 2000-2007

The demersal fish community inhabiting the western Delta is similar to that inhabiting Suisun Bay and shows the influence of freshwater Delta flow. Twelve taxa represent 95.3 percent of the fish present: striped bass, Shokihaze goby, yellowfin goby, white catfish, channel catfish, longfin smelt, starry flounder, American shad, shimofuri goby, tule perch, Pacific lamprey, and Pacific staghorn sculpin (CDFG 2000-2007). Other fish species in the western Delta that account for 4 percent of the individuals present include splittail, delta smelt, river lamprey, white sturgeon, bigscale logperch (*Percina macrolepida*), prickly sculpin, Chinook salmon, threadfin shad, threespine stickleback, plainfin midshipman, green sturgeon, and Pacific herring. In both Suisun Bay and the western Delta, an exotic oriental shrimp (*Palaemon macrodactylus*) and bay shrimp are the dominant mobile invertebrates (NOAA 2007).

Special Status Species

With regard to special-status species, the Project area provides habitat for several special status fish and marine mammals. The distribution of fish species in the Project area is based on available literature and CDFG trawl studies conducted between 2000 and 2007. Several terrestrial wildlife species, all birds, also forage in the vicinity of Project activities. These species are described below.[5]

Fish

Green sturgeon (*Acipenser medirostris*). The southern Distinct Population Segment (DPS) of the green sturgeon is listed as a threatened species under the Federal ESA, with the only known spawning habitat available in the upper Sacramento River. The green sturgeon is the most widely distributed member of the sturgeon family and the most marine-oriented of the sturgeon species. Green sturgeons range in the nearshore waters from Mexico to the Bering Sea and are common occupants of bays and estuaries along the western coast of the United States (Moyle et al. 1995). Adults in the San Joaquin Delta are reported to feed on benthic invertebrates including shrimp, amphipods, and occasionally small fish while juveniles have been reported to feed on opossum shrimp and amphipods (Moyle et al. 1995). Adult green sturgeons migrate into freshwater beginning in late February with spawning occurring March through July; and peak activity is in April and June. After spawning, juveniles remain in fresh and estuarine waters for one to four years and then begin to migrate out to the sea (Moyle et al. 1995). Although green sturgeon are caught and observed in the lower San Joaquin River, spawning is not known to occur within the river.

The CDFG's IEP Data (CDFG 2000-2007) indicate that green sturgeons are uncommon inhabitants in the portion of Central Bay, Suisun Bay, and the western Delta where the Project is located. They occur within the shallows and use the navigation channel to migrate between the ocean and the Sacramento River. In March 2006, the National

[5] The baseline population data for Coho salmon (*Oncorhynchus kisutch*), based on CDFG survey data (CDFG 2000-2007) and agency consultations to date (e.g., NMFS 2006), show only historical accounts of species presence in the streams of Marin and Sonoma Counties that are tributary to San Pablo Bay. Presently, Coho salmon spawning is only associated with coastal streams outside the Golden Gate and does not occur in streams tributary to the Central Bay or Suisun Bay Project areas. If present in these areas, their population numbers are too small to be reflected in monthly CDFG trawling surveys. Due to their infrequent presence and habitat use in the Project area, Coho salmon are not analyzed further in this EIR.

Marine Fisheries Service (NMFS)[6] issued a Conference Opinion to address the effects of sand mining activities in the Central Bay and Delta on green sturgeon (NMFS 2006), as discussed in the Impacts section, below.

Delta smelt (*Hypomesus transpacificus*). Delta smelt is listed as a threatened species under the Federal ESA and an endangered species under the California ESA. The delta smelt is a small, slender-bodied fish that is able to tolerate a wide salinity range and is native to the Sacramento-San Joaquin Estuary. This species, which has a one-year life span, inhabits Delta waters between Cache Slough and the Sacramento Deep Water Ship Channel (upstream of Rio Vista) to San Pablo Bay. Juveniles and adults inhabit the brackish lower-salinity waters of the Sacramento-San Joaquin Delta, ~~lives primarily~~ along the freshwater edge of the saltwater-freshwater interface (approximately 2 ppt salinity). ~~of the Sacramento-San Joaquin Delta.~~

It is critical to note that the survival or abundance of multiple biological populations in the San Francisco Estuary, including delta smelt populations, ~~is positively~~ exhibits a positive correlation ~~related to~~ with salinity levels, which are directly affected by the amount of freshwater flow reaching the western Delta. The critical salinity level of Delta waters is frequently identified and referred to as ~~a relationship which is described in terms of "related to freshwater flow, a relationship which is described in terms of~~ "X2", where "X" is the distance from the Golden Gate Bridge and "2" is where the salinity at the bottom of the water column is 2 practical salinity units (psu=ppt) (Hollibaugh 1996). Flows associated with this low-salinity zone deliver nutrients to shallow water habitats in Suisun Bay and correlate to fish abundance (USFWS 2005).

Delta smelt live in schools and primarily feed on planktonic crustaceans, small insect larvae, and mysid shrimp (Moyle 2002). Prior to spawning, delta smelt migrate upstream from the brackish-water habitat to river channels and tidally influenced backwater sloughs to spawn. Migration and spawning occur between December and June (Moyle 2002). The species has been collected in large quantities in Suisun Bay and the western Delta~~Central Bay~~. The delta smelt has no commercial or recreational value, but is considered a key indicator species of the environmental health of the Delta. In 2006 and 2007, the delta smelt population in the Delta dropped to record low levels prompting additional measures by Federal and State agencies to protect it. The CDFG's IEP Data (CDFG 2000-2007) indicate that delta smelt are present in low numbers in Suisun Bay and the western Delta

[6] Subsequently renamed NOAA Fisheries, the agency continues to be referred to, and refers to itself, as NMFS or NOAA Fisheries; it is referred to herein as NMFS.

(Table 4.1-2). This species was detected during CDFG surveys in ~~Central~~ Suisun Bay (CDFG 2000-2007).

In 2006, the US Fish and Wildlife Service (USFWS) issued a formal Letter of Concurrence which identified that sand mining activities in the Sacramento-San Joaquin Estuary are not likely to adversely affect delta smelt (USFWS 2006). This concurrence was based on the implementation of specific permit conditions, which are identified in the Impacts discussion, below.

Longfin smelt (*Spirinchus thaleichthys*). Longfin smelt, listed in April 2010 as a threatened species under the California ESA, is a small schooling fish that inhabits the freshwater section of the lower Delta and has been observed from south San Francisco Bay to the Delta. The bulk of the San Francisco Bay population occupies the region between the Carquinez Strait and the Delta (CDFG 2009b, Miller and Lea 1972). They have been collected in large numbers in Montezuma Slough, Suisun Bay, and near the Pittsburgh and Contra Costa power plants. In the fall and winter, adults from San Francisco and San Pablo Bays migrate to fresher water in the Delta to spawn. The spawning habits of longfin smelt are similar to the delta smelt and both species are known to school together. Larval stages are known to inhabit Suisun Bay and move south within the Bay-Delta as they grow larger in April and May (CDFG 2009b, Ganssle 1966). The larvae are pelagic and found in the upper layers of the water column. Longfin smelt are rarely found in waters warmer than 22 degrees Celsius (° C), and adults are predominantly found in the middle and lower portions of the water column. The CDFG's IEP Data (CDFG 2000-2007) indicate that longfin smelt is one of the dominant species comprising the mid-water and bottom fish populations in Suisun Bay and the western Delta near the Project area (Table 4.1-2), and is present, though to a lesser extent, in the Central Bay (Table 4.1-1).

Sacramento splittail (*Pogonichthys macrolepidotus*). The Sacramento splittail is a California species of special concern that is native to the San Francisco Estuary and the Central Valley in California. This small minnow was once prevalent in lakes and rivers throughout the Central Valley and in the Delta, but water diversions and habitat alteration, among other causes, have contributed to its demise. CDFG trawling records indicate that splittail occur in all portions of the Project area including Suisun ~~Central~~ Bay (Table 4.1-2) and the western Delta (Table 4.1-4) (CDFG 2000-2007). Remnant populations of splittail in the Delta require adequate freshwater outflow and periodic floodplain inundation. This species was formerly listed as a Federal threatened species and was delisted in 2003~~ despite a strong consensus by scientists that it should retain its protected status~~.

Pacific herring (*Clupea pallassi*). Pacific herring are protected under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) and are both a popular sport fish and a commercially important species. The Pacific herring is a small schooling marine fish that enters estuaries and bays to spawn. This species is known to spawn along the Oakland and San Francisco waterfronts and attaches its egg masses to eelgrass, algae (including *Gracilaria* sp. and *Laminaria* sp.), and hard substrates such as pilings and breakwater rubble. Spawning usually takes place between October and March with a peak between December and February. After hatching, juvenile herring typically congregate in the Bay during the summer and move into deeper waters in the fall. In areas of San Francisco Bay where eelgrass and other aquatic vegetation is not abundant, herring are known to broadcast eggs on rocks, rocky jetties, pilings, sandy beaches, and other submerged objects (Barnhart 1988). An individual can spawn only once during the season, and the spent female returns to the ocean immediately after spawning. The CDFG data (2000-2007) indicate that Pacific herring are present in Central Bay, Suisun Bay, and the western Delta and comprise a major component of the mid-water (pelagic) fish community.

Sacramento River winter-run, Central Valley spring-run, and Central Valley fall/late fall-run Chinook salmon (*Oncorhynchus tshawytscha*). The population of Chinook salmon, also known as king salmon, in the San Francisco Bay-Delta is comprised of three distinct evolutionarily significant units (ESUs): winter-run, spring-run, and fall/late fall-run. These ESUs are distinguished by the seasonal differences in adult upstream migration, spawning, and juvenile downstream migration. Chinook salmon are anadromous fish, spending three to five years at sea before returning to freshwater to spawn. These fish pass through San Francisco Bay waters to reach their upstream spawning grounds. In addition, juvenile Chinook salmon migrate through the Bay en route to the Pacific Ocean.

Sacramento River winter-run Chinook salmon, listed as endangered under the State and Federal ESAs, migrate through San Francisco Bay from December through July with a peak in March (Moyle 2002). Spawning is confined to the mainstream Sacramento River and occurs from mid-April through August (Moyle 2002). Juveniles emerge between July and October, and are resident in their natal stream five to 10 months followed by an indeterminate residency period in estuarine habitats (Moyle 2002).

Central Valley spring-run Chinook salmon, listed as threatened under the State and Federal ESAs, migrate to the Sacramento River from March to September with a peak spawning period between late August and October (Moyle 2002). Juvenile Chinook salmon emerge between November and March, and are resident in streams for a period of three to 15 months before migrating to downstream habitats (Moyle 2002).

The Central Valley fall/late fall-run Chinook salmon is a Federal candidate for listing, and a California species of special concern. These salmon enter the Sacramento and San Joaquin Rivers from June through December and spawn from October through December, with a peak in November.

Adult and juvenile (smolts) winter-run, spring-run, and fall-run Chinook salmon are present in the Central Bay, Suisun Bay, and the western Delta Project areas during migrations to and from upstream freshwater spawning habitat. Although principally found in the main channels, they can use adjacent shallows for foraging. The CDFG data (CDFG 2000-2007) indicate that Chinook salmon represented less than 0.2 percent of the Central Bay fish community from 2000 to 2007 and nearly 5 percent of the Suisun Bay fish community (Tables 4.1-1 and 4.1-2).

In 2006, NMFS issued a Biological and Conference Opinion (BO) to address the effects of sand mining activities in the Central Bay and Delta on Chinook salmon (NMFS 2006), as discussed in the Impacts section, below.

Central Valley and Central California Coast steelhead trout (*Oncorhynchus mykiss*). Steelhead trout populations in the Central California Coast ESU and Central Valley DPS are listed as threatened under the Federal ESA. Steelhead trout possess the ability to spawn repeatedly, maintaining the ability to return to the Pacific Ocean after spawning in freshwater. Juvenile steelhead trout may spend up to four years residing in freshwater prior to migrating to the ocean as smolts. Steelhead trout smolts enter San Francisco Bay during outmigration between November and May. Most Sacramento River steelhead trout migrate out towards the ocean in spring and early summer, transiting through the Project area. The CDFG's IEP Data (CDFG 2000-2007) suggest that steelhead trout can be expected in the Central Bay, Suisun Bay and the western Delta Project areas in very small numbers (Tables 4.1-1 and 4.1-2).

In 2006, NMFS issued a BO to address the effects of sand mining activities in the Central Bay and Delta on steelhead trout (NMFS 2006), as discussed in the Impacts section, below.

Birds

Osprey (*Pandion haliaetus*). Osprey are a California species of special concern; additionally, the take, sale, or purchase of osprey is prohibited pursuant to Fish and Game Code section 3505. They feed on fish and typically nest within 1 mile of water (Airola and Shubert 1981). They summer throughout California, and winter in Central and South America, but some stay in the San Francisco Bay Area year-round. Osprey establish nests from mid-March to early April. In October, most migrate south to Central and South America. Foraging habitat is potentially available in Suisun Bay and the western Delta, though nesting habitat is absent.

California brown pelican (*Pelecanus occidentalis californicus*). The California brown pelican is a subspecies of pelican that is found on the Pacific coast from California to Mexico. Formerly listed as endangered under both the State and Federal ESAs, the California brown pelican was de-listed in 2009; however, it remains a Fully Protected species under Fish and Game Code section 3511. It is found in coastal salt water, beaches, bays, marshes, and the open ocean. Breeding takes place between March and August along the southern California coast, from the Channel Islands to Baja California (Zeiner et al*.* 1990). They migrate north from June to November. Brown pelicans feed on fish in both shallow and deep waters, using structures such as breakwaters, pilings, and salt-pond dikes as roosts. They are common in Central Bay and San Pablo Bay, and may forage in the Central Bay Project area. This species does not nest in the Bay Area.

Double-crested cormorant (*Phalacrocorax auritus*). Double-crested cormorants are a State species of special concern. They rest and roost on offshore rocks, islands, steep cliffs, dead branches of trees, wharfs, jetties, transmission lines, bridges, or marine terminals. Double-crested cormorants are colonial breeders and have established large colonies on both the Bay and Richmond-San Rafael Bridges. They are year-long residents of California, are common in Central Bay and San Pablo Bay, and may forage in the Central Bay Project area, though nesting habitat is absent.

California least tern (*Sternula antillarum*). The California least tern is a State and federally listed endangered species and a Fully Protected species in California. The migratory least tern is known to breed in San Francisco Bay between April and August. They nest on the ground in abandoned salt ponds and along estuarine shores. Least terns have been known to nest on dredge-spoil islands as well as areas next to airport runways and industrial ports. Nesting sites do not occur near any of the mining lease sites.

Mammals

California gray whale (*Eschrichtius robustus*). The California gray whale is protected by the MMPA. Identified as Eastern North Pacific stock found along the west coast of North America, the California gray whale was delisted from the Endangered Species Act in 1994 (alternately, stock found along the coast of Eastern Asia are still depleted and endangered). During annual migrations, this baleen whale is a frequently observed marine mammal along the west coast, where it can be observed in shallow coastal waters. They are bottom feeders and suck sediment and benthic amphipods from the ocean floor. California gray whales occasionally enter San Francisco Bay, but are not expected in Suisun Bay or the western Delta Project areas.

Humpback Whale (*Megaptera novaeangliae*). The humpback whale is protected by the MMPA, and is listed as endangered throughout its range under the ESA. Humpbacks are also baleen whales, and they filter feed on krill, plankton, and small fish. They will sometimes make "bubble nets" to corral their prey, a behavior that is unique to this whale. Humpback whales live in all major oceans, and the California/Oregon/Washington stock winters in coastal Mexico/Central America and migrates to the California coast and southern British Columbia in summer and fall. During migration, they stay near the ocean surface and prefer shallow waters during feeding and calving. They are best known for their large pectoral fins, aerial displays of breaching, and surface-slapping performed with their pectoral fins, tails, and heads. Humpback whales occasionally enter San Francisco Bay, and wayward whales have infrequently wandered into the Sacramento River Delta, but they are not expected in Suisun Bay or the western Delta Project areas.

Pacific harbor seal (*Phoca vitulina*). The Pacific harbor seal is protected by the MMPA. It is a common, resident marine mammal along the west coast. They prefer to stay close to shore in subtidal and intertidal habitats such as bays, estuaries, and sometimes venture into rivers. Groupings of various sizes can haul out on rocks, mudflats, and sandy/cobble coves (Zeiner et al. 1990). In general, the same sites are used over many years. Pacific harbor seals in the Bay feed on yellowfin goby, northern anchovy, Pacific herring, Pacific staghorn sculpin, plainfin midshipman, and white croaker (Harvey and Torok 1994). Pacific harbor seals may forage and occur year-round throughout the Central Bay, Suisun Bay, and the western Delta Project areas.

Harbor Porpoise (*Phocoena phocoena*). The harbor porpoise is protected by the MMPA. Harbor porpoises are distributed discontinuously throughout the world's northern oceans, and occur along the Pacific coast from southern California to Alaska. There are 10 stocks of harbor porpoises in U.S. waters, including the San Francisco-Russian River stock which encompasses the Bay and extends from Point Arena in the north to Monterey in the south, and is estimated at approximately 9,200 individuals (NMFS 2009). They are non-social animals usually observed in groups of two to five, and when surfacing for air, they arch their backs and roll from beak to fluke. Their primary threat is entrainment in fishing gillnets and trawls. They are commonly found in bays, estuaries, and harbors, and may be encountered in the Central Bay, Suisun Bay and the western Delta Project areas.

California sea lion (*Zalophus californianus*). Like other marine mammals, the California sea lion is protected by the MMPA. A common, abundant marine mammal, they are found along the west coast. They breed in Southern California and the Channel Islands after which they migrate up the Pacific coast to the Bay. They haul out on offshore rocks, and may forage in the vicinity of Project activities in Central Bay. Sea lion haul out areas are limited in Suisun Bay and the western Delta, though sea lions may forage in these areas as well.

Sensitive Natural Communities

Sensitive communities include those that are especially diverse, regionally uncommon, considered sensitive natural communities by CDFG, or are otherwise covered by State, Federal, or local regulations. CDFG tracks the status of sensitive natural communities throughout California. No sensitive natural communities occur in the Project area.

Designated Critical Habitat

The USFWS and NMFS designate critical habitat with the purpose of contributing to the conservation of threatened and endangered species and the ecosystems upon which they depend. The designation of an area as critical habitat provides additional protection to habitat only when there is a Federal nexus with regard to a proposed action, for example, when a Federal agency is implementing or issuing a permit for a project. Critical habitat protection is only relevant when other statutory or regulatory protections, policies, or other factors relevant to agency decision-making would not prevent the destruction or adverse modification of habitat. Designation of critical habitat triggers the prohibition of destruction or adverse modification of that habitat. It does not require specific actions to restore or improve habitat.

The lease areas occur within designated critical habitat for Chinook salmon in the California Central Valley and Central California Coast ESUs. On October 9, 2009, NMFS designated all of San Francisco Bay-Delta as critical habitat for the green sturgeon. Central Bay is also EFH for Chinook salmon, steelhead trout, and green sturgeon. EFH is defined as all fish habitat types that contain the waters and substrates necessary for spawning, breeding, or growth, as defined in the Magnuson-Stevens Act.

Fish and Invertebrate Entrainment Background

Hydraulic suction head dredging, as used for sand mining in the Bay-Delta, creates an environmental condition where benthic infauna and epifauna, adult and juvenile fish, mobile macroinvertebrates, and planktonic larvae are captured (entrained) along with the sand and water (Hanson Environmental 2004; LFR Levine Fricke [LFR] 2004). Scientific concerns about the potential ecological effect of fish and invertebrate taxa entrainment by suction dredges have resulted in numerous studies being conducted since the late 1970s that are summarized by Hanson Environmental and AMS (Hanson Environmental 2004; AMS 2009b [Appendix E]). The majority of these investigations were concerned with hydraulic suction dredge entrainment of Dungeness crab and salmon by maintenance dredging operations, though other more recent studies were conducted in San Francisco Bay, specifically targeting sand mining operations.

These studies collectively reveal that benthic infauna is particularly vulnerable to entrainment, with mobile megabenthic and demersal organisms slightly less so (Nightingale and Simenstad 2001). In addition, the physical environmental conditions present at the dredging location, local population dynamics (species presence, density and seasonal movements), and the natural behavior patterns of individual species affect what taxa are entrained as well as the number of individuals per species that are susceptible to entrainment. Because most of these studies were conducted to assess the potential environmental effect of maintenance dredging for regulatory and resource managers, study results are typically presented as the number of entrained individuals, for a specific taxa, per volume of material dredged. Data reported in this manner cannot, unfortunately, be readily applied to other locations because of critical differences between the sites in terms of the physical conditions and biological community parameters mentioned above.

Woodbury demonstrated that small fish (both adults and juveniles) are capable of being entrained during routine harbor maintenance operations in San Francisco Bay and in numbers greater than previously believed (Woodbury 2008). Hanson Environmental demonstrated: (1) that even when the drag head is approximately three feet off the seafloor, as it is during barge ballasting operations, and when operating at normal or near normal operational pump speeds, small adult and juvenile fish are entrained; (2) that when fish are potentially concentrated in a shallow channel, some sand mining equipment can create sufficient suction to capture larger and faster swimming species, including Chinook salmon smolts; and (3) that entrainment of fish during the night may be greater than during daylight hours (Hanson Environmental 2006).

Because of concerns by State and Federal agencies about the potential magnitude of entrainment by sand mining in the Bay-Delta, a literature-based entrainment study was conducted to estimate entrainment of demersal fish, planktonic larvae, megabenthic invertebrates, commercially important fish and invertebrate species, and special status fish species inhabiting Bay-Delta waters (AMS 2009b [Appendix E]). Entrainment estimates were based upon the level of mining effort in each of the mining lease areas in the Bay-Delta based on information presented for a representative year, and fish densities as estimated from CDFG trawling studies (Hanson Environmental 2004; CDFG 2000-2007).

AMS calculated entrainment estimates which indicate that entrainment of fish larvae, juveniles and adults, and invertebrate taxa are occurring during sand mining in Central Bay, Suisun Bay and the western Delta (AMS 2009b [Appendix E]). In the Central Bay mining leases, for the nine dominant fish species identified from CDFG 2000-20007 data, the number of juveniles and adults estimated to be entrained ranged from 54 to 37,901 individuals per year. Bay gobies were estimated to be the most entrained species (37,901) followed by speckled sanddabs (36,739), plainfin midshipmen (27,393), English sole (22,346), Pacific staghorn sculpin (10,098), and shiner surfperch (5,802) (AMS 2009b [Appendix E]). These entrainment estimates represented between less than 0.1 percent and 0.6 percent of the estimated Central Bay regional abundance index for each species. All of the northern anchovy and most of the Pacific herring are predicted to be entrained as planktonic larvae. Bay gobies were also entrained in significant numbers as planktonic larvae.

AMS noted that in the Potrero Power Plant 316(b) entrainment study (AMS 2009b [Appendix E]; TENERA 2005), the Pacific sand lance accounted for 11 percent of all larvae collected, yet were reported by CDFG in very small numbers. They attributed this inconsistency to the sand lance’s natural predator avoidance behavior which ultimately results in low estimates of entrainment based on trawl data but very high actual entrainment by suction dredges (McGraw & Armstrong 1990). McGraw & Armstrong estimated that Pacific sand lance individuals were being entrained at a rate of 594 individuals per 1,000 cubic yards of dredged material in Grays Harbor, Washington. AMS estimated that if the sand lance’s density in Central San Francisco Bay were similar to Grays Harbor, Pacific sand lance could be directly entrained as adults and juveniles in numbers as high as 700,000 individuals per year, which would make them also the most entrained fish species in San Francisco Central Bay by an order of magnitude over all other estimated taxa (AMS 2009b [Appendix E]).

At the Middle Ground Shoal mining lease in Suisun Bay, AMS estimated entrainment for the 14 dominant species reported to be present based on CDFG 2000-2007 data (AMS 2009b [Appendix E]). Individual species entrainment estimates ranged between one (1) and 2,680 individuals occurring per year from sand mining operations. Calculated entrainment estimates indicate that Pacific herring (2,680), striped bass (456), Shokihaze goby (268), yellowfin goby (223), Pacific staghorn sculpin (207), starry flounder (103), longfin smelt (73), and plainfin midshipmen (43) were the most entrained fish species (AMS 2009b [Appendix E]).

As observed with the Central Bay entrainment estimates, Pacific herring were primarily entrained by sand mining operations as planktonic larvae and may represent a higher estimate than may actually be occurring in Middle Ground Shoal due to the lack of suitable spawning habitat in that region of the Bay-Delta. These levels of entrainment for all species, except Pacific herring, were estimated to represent between less than 0.1 percent and 0.5 percent of the total abundance index for each species within Suisun Bay. AMS estimated that longfin smelt, delta smelt, and Chinook salmon may be entrained by Middle Ground Shoal mining operations at an annual rate of 73, seven, and one fish, respectively (AMS 2009b [Appendix E]). They suggested that the low estimate for Chinook salmon was, in part, the result of this species being under-represented in CDFG otter trawl data used to calculate entrainment estimates. Chinook salmon's natural ability to avoid the slow moving trawl, their behavioral tendency to inhabit demersal waters only during nighttime hours and pelagic waters during daylight hours, and the collection of CDFG trawls predominantly during daylight hours, all contribute to the low reported densities for Chinook salmon (AMS 2009b [Appendix E]).

In the western Delta, AMS estimated entrainment numbers for the 11 dominant species identified from CDFG monthly trawl data to best represent the demersal fish community inhabiting the sand mining leases in the area (AMS 2009b [Appendix E]). Individual species entrainment estimates ranged between zero and 176 individuals per year. Calculated entrainment estimates indicate that Shokihaze goby (176), yellowfin goby (56), white catfish (45), longfin smelt (21), striped bass (12), channel catfish (7), starry flounder (4), and delta smelt (4) were the most entrained fish species. These levels of entrainment were estimated to represent between 0.0 percent and 0.2 percent of the total abundance index for each species within the western Delta. Chinook salmon was estimated to be entrained at a rate of one (1) fish per year as a result of sand mining activities in the western Delta. As discussed previously for the Suisun Bay mining operations, this estimate may be low due to potential underestimates of Chinook salmon presence in CDFG data from which the entrainment estimates were made.

AMS also calculated entrainment estimates for important megabenthic invertebrates including caridean shrimp and Dungeness crab. Both Dungeness crab and several species of caridean shrimp are important forage for Bay-Delta fish as well as supporting major commercial fisheries in the region (AMS 2009b [Appendix E]).

Of the three Bay-Delta mining regions, Central Bay, Suisun Bay (Middle Ground Shoal), and the western Delta, juvenile Dungeness crab are only found in significant numbers in Central Bay. AMS estimated that in Suisun Bay, between 61 and 79 juvenile crabs were entrained annually in years for which juvenile crab were relatively abundant; for years in which they were not, as has been the case for the last several years, they estimated the annual entrainment of juvenile crabs to be less than one (AMS 2009b [Appendix E]). At Middle Ground Shoal, AMS estimated that for those years in which juvenile crab were abundant, approximately one adult would be removed from the population (AMS 2009b [Appendix E]).

For the Central Bay mining lease sites, the entrainment of Dungeness crab juveniles was predicted to be much greater. AMS estimates suggested that approximately 851 adults would be removed annually from future populations of mature crabs as a result of sand mining activities, representing between 0.2 percent and 1 percent of future adult populations for any single year based upon the eight-year study period (2000-2007) (AMS 2009b [Appendix E]). The potential effect of sand mining entrainment in the Bay-Delta on commercial landings of Dungeness crab were estimated to range between less than 0.01 percent and 0.08 percent per year (AMS 2009b [Appendix E]).

Of the 17 species of caridean shrimp observed by CDFG in Bay-Delta waters, nine species dominate the local food web and mobile megabenthic community. Of these, only bay shrimp are commercially harvested (for use as bait for sturgeon and striped bass sport fishing). All of the major shrimp species in the Bay-Delta represent important prey for many fish that inhabit the Estuary, such as green and white sturgeon, striped bass, leopard shark (*Triakis semifasciata*), Pacific staghorn sculpin, starry flounder, English sole, pile and rubberlip perch (*Rhacochilus vacca* and *R. toxotes*), Pacific tomcod, and brown rockfish (Baxter et al. 1999). As such, these shrimp represent a key component of the food web.

In the Central Bay mining leases, AMS estimated that blacktail shrimp were the most frequently entrained species from sand mining activities, whereas bay shrimp were estimated to be more heavily entrained in both Middle Ground Shoal and the western Delta (AMS 2009b [Appendix E]). Bay-wide, approximately 1.2 million shrimp were estimated to be entrained by sand mining activities in the Central Bay, Middle Ground Shoal, and the western Delta, representing an estimated 0.5 percent of the estimated shrimp abundance indices for those regions. Of these 1.2 million shrimp, one million were blacktail shrimp entrained at the Central Bay mining leases.

Since bay shrimp are harvested commercially, AMS compared entrainment numbers with commercial fish landing data and estimated that sand mining activities entrained, on average, between 3 percent and 6 percent of the annual commercial landings (AMS 2009b [Appendix E]). Since the bay shrimp commercial fishery was market driven by local demand for frozen and live shrimp for sport fishing, the annual landings did not represent either the potential fishery landings or the ability of the local bay shrimp population to support a larger fishery (AMS 2009b [Appendix E]).

Invasive and Non-Native Species

New species of estuarine and marine animals are inadvertently or intentionally introduced into California waters annually. Often referred to as introduced, non-indigenous, alien, non-native, or exotic species, most pose little or no threat to native ecosystems or biological communities. However, a few have the potential to severely disrupt local ecosystems, fisheries, and human infrastructure (Ray 2005). California has the largest number of known introduced estuarine and marine animals in North America, with the Bay-Delta reporting over 200 taxa (Ray 2005). Introduced species now dominate all benthic communities within the Bay-Delta. Known invasive species appear to be dominated by polychaete worms, mollusks, and crustaceans, but this may be more reflective of the ease of identification and detection than their actual representativeness. Of the known invasive species in California waters, 54 species of mollusks, 47 species of polychaetes, and 36 species of amphipods have been reported (Ray 2005). Invaded habitats tend to have low natural diversity, relatively simple food webs, and a history of recent natural or anthropogenic disturbance (Ray 2005). Estuaries and sheltered coastal areas appear to be among the most invaded habitats because they are typically naturally disturbed, low-diversity systems, and are historic centers of anthropogenic disturbance from shipping, industrial development, and urbanization (Ray 2005).

Invasive organisms are introduced by a variety of methods, the most prevalent being shipping, of which the largest single source is the discharge of ballast water. Other methods of introduction include: fouling organisms that have attached themselves to ship hulls, navigation buoys, anchors and anchor chains; recovered flotsam; releases of “live” rock and plants from the aquarium trade; and accidental release of animals from packing materials by restaurants serving live seafood and by the live bait industry (Ray 2005). Finally, many invasive species were deliberately introduced into California waters such as striped bass, channel and white catfish, and giant pacific oysters.

A few of the most damaging introduced species in the Bay-Delta include the Chinese mitten crab (*Eriocheir sinesis*), the European green crab (*Carcinus maenas*), the Asian clam (*Corbula amurensis*), and the isopod *Sphaeroma quoyanun*. The Chinese mitten crab is found throughout the Bay-Delta and is displacing native intertidal crabs. The Asian clam has completely changed the subtidal benthic infaunal community in the western Delta and because of its voracious feeding on bacterioplankton, phytoplankton, and copepod larvae, it has significantly reduced the phytoplankton community in the North Bay and western Delta, resulting in reduced zooplankton and fish abundances and distributions (Ray 2005). It is one of the factors attributed to the decline of delta and longfin smelt populations in the Bay-Delta (AFS 2007).

The Asian kelp (*Undaria pinnatifida*), which is native to Japan and Asian waters, arrived in coastal Southern California in 2000 and quickly spread northward. Two small kelp populations were identified in San Francisco Bay in May 2009. As this species can quickly foul natural and human-made structures, management efforts are underway by the CSLC and NOAA, in cooperation with the Smithsonian Environmental Research Center, to remove the kelp. The Asian kelp could drastically alter native ecosystems in San Francisco Bay as it competes for light and space with native populations of marine algae, plants and animals.

4.1.2 Regulatory Setting

This subsection briefly describes Federal, State, and local regulations, permits, and policies pertaining to biological resources and wetlands as they apply to the proposed Project.

Federal

Clean Water Act

The U.S. Army Corps of Engineers (ACOE) and the U.S. Environmental Protection Agency (U.S. EPA) regulate the discharge of dredged or fill material into waters of the United States, including wetlands, under Section 404 of the Clean Water Act (CWA). Projects that would result in the placement of dredged or fill material into waters of the United States require a Section 404 permit from the ACOE.

Federal Endangered Species Act

The USFWS, which has jurisdiction over listed (i.e., threatened and endangered) plants, wildlife, and resident fish, and NMFS, which has jurisdiction over anadromous fish and marine fish and mammals, oversee the Federal ESA (16 U.S.C. § 1531 et seq.) and other Federal provisions related to the protection of fish and wildlife resources. The Federal ESA prohibits the "take" of any fish or wildlife species listed as threatened or endangered and the destruction or adverse modification of habitat that could hinder species recovery. Section 7 of the ESA requires all Federal agencies to consult with the USFWS and/or NMFS, as appropriate, if they determine a project "may affect" a species listed under the Federal ESA to ensure that Federal agency actions do not jeopardize the continued existence of a listed species or destroy or adversely modify critical habitat for listed species. If it is determined that a project will adversely affect a listed species, but not result in jeopardy, the USFWS or NMFS may issue a BO. If take is expected, the BO will also contain an incidental take statement and "reasonable and prudent measures" that must be implemented by the project proponent to minimize the level of take of the species. If the USFWS or NMFS determines the project will jeopardize the continued existence of the species, the BO will instead contain one or more "reasonable and prudent alternatives" to the project that, if implemented, would avoid jeopardizing the species.

Federal Migratory Bird Treaty Act

The Federal Migratory Bird Treaty Act (16 U.S.C. § 703, Supplement I, 1989) prohibits killing, possessing, or trading in migratory birds, except in accordance with regulations prescribed by the Secretary of the Interior. This act encompasses whole birds, parts of birds, bird nests, and eggs.

Marine Mammal Protection Act

The Marine Mammal Protection Act (MMPA) of 1972 (16 U.S.C. § 1361 et seq.) prohibits the taking (including harassment, disturbance, capture, and death) of any marine mammals except as set forth in the MMPA. An incidental harassment authorization under Section 101(a)(5)(D) of the MMPA can be issued for activities other than commercial fishing that may impact only small numbers of marine mammals. This covers activities that do not occur longer than one year and only have a negligible impact on the species.

Magnuson-Stevens Fishery Management and Conservation Act

The Magnuson-Stevens Act as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-297), established requirements for EFH descriptions in Federal Fisheries

Management Plans (FMPs) and requires Federal agencies to consult with NMFS on activities that may adversely affect EFH. The Magnuson-Stevens Act requires all Fishery Management Councils to amend their FMPs to describe and identify EFH for each managed fishery. The Pacific Fisheries Management Council currently manages four major fisheries, of which the salmon, pelagic fish, and groundfish fisheries are pertinent to the proposed Project.

The Magnuson-Stevens Act also requires consultation for all Federal agency actions that may adversely affect EFH (i.e., direct versus indirect effects); it does not distinguish between actions in EFH and actions outside EFH. Any reasonable attempt to encourage the conservation of EFH must take into account actions that occur outside of EFH, such as upstream and upslope activities that may have an adverse effect on EFH. Therefore, EFH consultation with NMFS is required by Federal agencies undertaking, permitting, or funding activities that may adversely affect EFH, regardless of the activity’s location. Under Section 305(b)(4) of the Magnuson-Stevens Act, NMFS is required to provide EFH conservation and enhancement recommendations to Federal and State agencies for actions that adversely affect EFH. However, State agencies and private parties are not required to consult with NMFS unless State or private actions require a Federal permit or receive Federal funding. Although the concept of EFH is similar to that of critical habitat under the Federal ESA, measures recommended to protect EFH by NMFS are advisory, not directory.

State

California Endangered Species Act

The California ESA (Fish & G. Code, § 2050 et seq.) was enacted in 1984; subsequent amendments took effect in 1998. The California ESA is intended to conserve, protect, restore, and enhance species designated as endangered or threatened, and their habitat, and further directs all State agencies, boards, and commissions to seek to conserve endangered and threatened species, and to use their authority in furtherance of that policy. The California ESA, pursuant to section 2080, prohibits the take[7] of endangered, threatened, and candidate species except as authorized by other provisions of the Fish and Game Code. This includes sections 2080.1 and 2081, which provide mechanisms by which the CDFG may authorize take, including take that is incidental to, and not the purpose of, an activity or project. However, the CDFG may only authorize the incidental

[7] "Take" is defined specifically in the Fish and Game Code to mean "hunt, pursue, catch, capture, or kill," or an attempt to do any such act.

take of species listed under the California ESA using one of the above-listed statutory sections if it finds that the impacts of the authorized taking will be minimized and fully mitigated, that funding to carry out all required measures is assured, and that the authorized taking will not jeopardize the continued existence of the species. Because of the presence of listed species in the proposed Project area and the likelihood of entrainment of these species, the CDFG stated, in its comments on the 2010 Draft EIR (Memo from Charles Armor, Regional Manager, CDFG-Bay Delta Region, to Chris Huitt, CSLC, September 27, 2010):

> "The draft EIR states that the Project operations will likely "take" listed species including Delta smelt, longfin smelt, winter-run Chinook salmon and Central Valley spring-run Chinook salmon. As such, the Applicants will need an Incidental Take Permit (ITP) from the Department for all State-listed species to address impacts of the "taking" pursuant to Fish and Game Code sections 2080.1 or 2081(b), and California Code of Regulations, Title 14 Section 783 et seq."

Other Relevant California Fish and Game Code Sections

Lake or Streambed Alteration. Sections 1600-1616 of the Fish and Game Code relate to activities affecting the natural flow of a stream, river, or lake. Fish and Game Code section 1602 states that it is unlawful for any person to "substantially divert or obstruct the natural flow of, or substantially change or use any material from the bed, channel, or bank of, any river, stream, or lake" without first notifying CDFG of that activity. Thereafter, if CDFG determines and informs the entity that the activity will not substantially adversely affect any existing fish or wildlife resources, the entity may commence the activity. If, however, CDFG determines that the activity may substantially adversely affect an existing fish or wildlife resource, the entity may be required to obtain from CDFG a Lake or Streambed Alteration Agreement, which will include reasonable measures necessary to protect the affected resource(s), before the entity may conduct the activity or activities described in the notification. CDFG interprets "streambed" to encompass all portions of the bed, banks, and channel of any stream, including intermittent and ephemeral streams, extending laterally to the upland edge of riparian vegetation. It should be noted that the ACOE Section 404 jurisdiction is a subset of CDFG's Fish and Game Code section 1600 jurisdiction. Because certain areas proposed for dredging are within areas subject to CDFG's streambed alteration jurisdiction, it is anticipated that the applicants will be required to notify CDFG as required by Fish and Game Code section 1602, and negotiate an agreement if it is determined to be necessary by CDFG staff.

Nests and eggs. Under Fish and Game Code section 3503, it is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird, except as provided by other sections of the Fish and Game Code (e.g., California ESA provisions) or any regulation made pursuant thereto. Section 3503.3 of the California Fish and Game Code extends this prohibition and its limitations to the take, possession, or destruction of any birds in the orders Falconiformes (hawks) or Strigiformes (owls), or of their nests and eggs.

Fully Protected Species. Fish and Game Code sections 3511 (birds), 4700 (mammals), 5050 (reptiles and amphibians), and 5515 (fish) list the species that are designated as Fully Protected Species. Species given this designation, but for two narrow exceptions, may not be taken or possessed at any time. If a Fully Protected Species is also listed under the California ESA, CDFG cannot issue authorization to incidentally take that species, and a project proponent would be required to avoid take.

San Francisco Bay Plan/McAteer-Petris Act

The McAteer-Petris Act of 1965 established the Bay Conservation and Development Commission (BCDC) and authorized the agency to prepare an enforceable plan to analyze, plan, regulate, and otherwise guide the future protection and use of San Francisco Bay and its shoreline. BCDC implements the San Francisco Bay Plan and regulates filling and dredging in the Bay, its sloughs and marshes, and certain creeks and their tributaries. BCDC jurisdiction includes the waters of the Bay as well as a shoreline band that extends inland 100 feet from the high tide line. Any fill, excavation of material, or substantial change in use within BCDC jurisdiction requires a permit from BCDC.

BCDC completed and adopted the San Francisco Bay Plan in 1968 and submitted it to the California Legislature and Governor in January 1969. It has been amended since then, most recently in October 2011 (BCDC 2011). The resource protection policies of the Bay Plan that are relevant to the current Project include those that identify fish, wildlife and aquatic organisms in the Bay, water quality, habitats including tidal marshes, tidal flats and subtidal areas, and dredging. The Bay Plan also presents 11 mitigation policies that cover the full lifespan of a project, from the initial project design to monitoring and management of mitigation areas. These general policies include avoiding and minimizing impacts on Bay natural resources through project design; the siting of compensatory mitigation areas; the amount and type of required compensatory mitigation; the need for management and monitoring of mitigation areas; coordination with local, State, and Federal agencies that have jurisdiction over protected resources; the use of alternatives; and guidance on the use of mitigation banks and fee-based mitigation. Specific San Francisco Bay Plan policies relative to these resources and activities are presented in Table 4.1-5. A portion of the project area in Suisun Marsh is outside the jurisdiction of the Bay Plan (please refer to

Table 4.1-5. San Francisco Bay Plan Polices

Bay Plan Policies	Description
Fish, Other Aquatic Organisms and Wildlife	1. To assure the benefits of fish, other aquatic organisms and wildlife for future generations, to the greatest extent feasible, the Bay's tidal marshes, tidal flats, and subtidal habitat should be conserved, restored and increased. 2. Specific habitats that are needed to conserve, increase or prevent the extinction of any native species, species threatened or endangered, species that the California Department of Fish and Game has determined are candidates for listing as endangered or threatened under the California ESA, or any species that provides substantial public benefits, should be protected, whether in the Bay or behind dikes. 4. The Commission should: (a) Consult with the California Department of Fish and Game and the U.S. Fish and Wildlife Service or the National Marine Fisheries Service whenever a proposed project may adversely affect an endangered or threatened plant, fish, other aquatic organism or wildlife species; (b) Not authorize projects that would result in the "taking" of any plant, fish, other aquatic organism or wildlife species listed as endangered or threatened pursuant to the State or Federal ESAs, or the Federal Marine Mammal Protection Act, or species that are candidates for listing under the California ESA, unless the project applicant has obtained the appropriate "take" authorization from the U.S. Fish and Wildlife Service, National Marine Fisheries Service or the California Department of Fish and Game; and (c) Give appropriate consideration to the recommendations of the California Department of Fish and Game, the National Marine Fisheries Service or the United States Fish and Wildlife Service in order to avoid possible adverse effects of a proposed project on fish, other aquatic organisms and wildlife habitat.
Tidal Marshes and Tidal Flats	1. Tidal marshes and tidal flats should be conserved to the fullest possible extent. Filling, diking, and dredging projects that would substantially harm tidal marshes or tidal flats should be allowed only for purposes that provide substantial public benefits and only if there is no feasible alternative. 2. Any proposed fill, diking, or dredging project should be thoroughly evaluated to determine the effect of the project on tidal marshes and tidal flats, and designed to minimize, and if feasible, avoid any harmful effects.
Subtidal Areas	1. Any proposed filling or dredging project in a subtidal area should be thoroughly evaluated to determine the local and Bay-wide effects of the project on: (a) the possible introduction or spread of invasive species; (b) tidal hydrology and sediment movement; (c) fish, other aquatic organisms and wildlife; (d) aquatic plants; and (e) the Bay's bathymetry. Projects in subtidal areas should be designed to minimize and, if feasible, avoid any harmful effects. 2. Subtidal areas that are scarce in the Bay or have an abundance and diversity of fish, other aquatic organisms and wildlife (e.g., eelgrass beds, sandy deep water or underwater pinnacles) should be conserved. Filling, changes in use, and dredging projects in these areas should therefore be allowed only if: (a) there is no feasible alternative; and (b) the project provides substantial public benefits.

Table 4.1-5. San Francisco Bay Plan Polices

Bay Plan Policies	Description
	5. The Commission should continue to support and encourage expansion of scientific information on the Bay's subtidal areas, including: (a) inventory and description of the Bay's subtidal areas; (b) the relationship between the Bay's physical regime and biological populations; (c) sediment dynamics, including sand transport, and wind and wave effects on sediment movement; (d) areas of the Bay used for spawning, birthing, nesting, resting, feeding, migration, among others, by fish, other aquatic organisms and wildlife; and (e) where and how restoration should occur.
Dredging	1. Dredging and dredged material disposal should be conducted in an environmentally and economically sound manner. Dredgers should reduce disposal in the Bay and certain waterways over time to achieve the [Long Term Management Strategy (LTMS)] goal of limiting in-Bay disposal volumes to a maximum of one million cubic yards per year. The LTMS agencies should implement a system of disposal allotments to individual dredgers to achieve this goal only if voluntary efforts are not effective in reaching the LTMS goal. In making its decision regarding disposal allocations, the Commission should confer with the LTMS agencies and consider the need for the dredging and the dredging projects, environmental impacts, regional economic impacts, efforts by the dredging community to implement and fund alternatives to in-Bay disposal, and other relevant factors. Small dredgers should be exempted from allotments, but all dredgers should comply with policies 2 through 12. 2. Dredging should be authorized when the Commission can find: (a) the applicant has demonstrated that the dredging is needed to serve a water-oriented use or other important public purpose, such as navigational safety; (b) the materials to be dredged meet the water quality requirements of the San Francisco Bay Regional Water Quality Control Board; (c) important fisheries and Bay natural resources would be protected through seasonal restrictions established by the California Department of Fish and Game, the U.S. Fish and Wildlife Service and/or the National Marine Fisheries Service, or through other appropriate measures; (d) the siting and design of the project will result in the minimum dredging volume necessary for the project; and (e) the materials would be disposed of in accordance with Policy 3. 7. All proposed channels, berths, turning basins, and other dredging projects should be carefully designed so as not to undermine the stability of any adjacent dikes, fills or fish and wildlife habitats. 12. The Commission should continue to participate in the LTMS, the Dredged Material Management Office, and other initiatives conducting research on Bay sediment movement, the effects of dredging and disposal on Bay natural resources, alternatives to Bay aquatic disposal, and funding additional costs of transporting dredged materials to non-tidal and ocean disposal sites.

Source: BCDC 2011

Figure 4.7-1 in Section 4.7, Land Use); that easternmost portion of parcel PRC 7781 (East) is regulated under the Suisun Marsh plan and statute described below, but not under the Bay Plan.

Suisun Marsh Protection Plan (SMPP) and Suisun Marsh Preservation Act

The SMPP seeks to preserve and enhance the diversity of habitats in the Suisun Marsh and surrounding upland areas to maintain wildlife habitat, preserve the integrity of marsh waterways, managed wetlands, tidal and seasonal marshes, and lowland grasslands in Suisun Marsh; and also maintain existing uses of upland grasslands and cultivated areas surrounding the critical habitats of the Suisun Marsh in order to protect the Marsh and preserve valuable marsh-related wildlife habitats. Although no marsh or wetland habitats occur within the Delta sand mining leases, the channels where sand mining occurs in Suisun Channel and Middle Ground Shoal are identified as critical waterways for the preservation and enhancement of the Suisun Marsh and therefore fall within the jurisdiction of the SMPP. The Suisun Marsh Preservation Act was enacted in 1977 to incorporate the findings and policies contained in the SMPP into State law. It was enacted to preserve the integrity and assure continued wildlife use of the Suisun Marsh, including the preservation of its waterfowl-carrying capacity and retention of the diversity of its flora and fauna.

Other State Policies and Regulations Regarding Waters of the U.S. and Wetlands

State regulation of activities in waters and wetlands resides primarily with the CDFG and the State Water Resources Control Board (SWRCB). BCDC has similar authority for wetlands within San Francisco Bay, and the California Coastal Commission has review authority for wetland permits within its planning jurisdiction. The CDFG provides comment on ACOE, NMFS, and USFWS permit actions under the Fish and Wildlife Coordination Act. The SWRCB, acting through the nine Regional Water Quality Control Boards (RWQCBs), must certify that an ACOE permit action meets State water quality objectives (Clean Water Act § 401).

Water Quality Control Plan for the San Francisco Region (Basin Plan)

Pursuant to the Porter-Cologne Water Quality Control Act (Wat. Code, § 13000 et seq.). each of California’s nine RWQCBs must prepare and periodically update basin plans that set forth water quality standards for surface and groundwater, as well as actions to control nonpoint and point sources of pollution to achieve and maintain these standards. Basin plans offer an opportunity to achieve wetlands protection based on water quality standards. Water quality for the Project is under the jurisdiction of the San Francisco RWQCB (SFRWQCB).

The SFRWQCB is responsible for developing and implementing the *San Francisco Bay Basin Water Quality Control Plan* (Basin Plan), last revised in 1995, which documents approaches to implementing State and Federal policies in the context of actual water quality conditions. The SFRWQCB's other activities include permitting waste discharges, and implementing monitoring programs of pollutant effects. For more information about the State and Regional Board regulations and permits that affect the proposed Project, see Section 4.3, Hydrology and Water Quality.

Solano County - Local Suisun Marsh Protection Policies

The County's local protection program is the *Solano County Policies and Regulations Governing the Suisun Marsh* (Solano County 1982). The Marsh and Wetland Habitats Land Use Proposals Policies seek to preserve and enhance wherever possible the diversity of wildlife and aquatic habitats in Suisun Marsh and surrounding upland areas to maintain unique wildlife resources.

4.1.3 Significance Criteria

The thresholds for determining the significance of impacts for this analysis are listed below. These thresholds also encompass the factors taken into account under CEQA to assess an impact in terms of its context and intensity. A biological resource impact is considered significant if:

- There is a potential for the Project to "take" any part of the population of a special status species (such as State or federally endangered species) through direct effects or indirect harm through the disturbance or loss of its habitat.
- A net loss occurs in the functional habitat value of a sensitive biological habitat, or any area of special biological significance.
- There is a potential for the movement or migration of fish to be impeded.
- A substantial loss occurs in the population or habitat of any native fish or vegetation or if there is an overall loss of biological diversity, with substantial defined as any change that could be detected over natural variability.

4.1.4 Impact Analysis and Mitigation

As described in the Setting section above, sand mining activities would not take place in the nearshore subtidal (soft or hard substrate) or intertidal habitats, within submerged aquatic vegetation beds or emergent saltwater marsh or wetlands, but rather in largely unvegetated sandy deposits. Therefore, there would be no impact to the population or habitat of any native vegetation.

The proposed Project may impact areas where the presence of special-status species is presumed, based on: occurrence of suitable habitat; known distribution; or CNDDB occurrence. Mitigation for impacts to special-status species would be implemented to reduce the potential for "take" of listed or otherwise special-status species, and to lessen or avoid other Project-related impacts to these species, such as increased vulnerability to predation or avoidance of use of habitat near Project activities due to disturbance, noise, or siltation. In some cases, work timing and avoidance of sensitive periods would avoid significant impacts to fish and wildlife. Special-status fish and wildlife species that have the potential to occur in the vicinity of the Project include:

- Delta smelt
- Longfin smelt
- Green sturgeon
- Chinook salmon
- Steelhead trout
- Pacific herring
- California brown pelican
- California gray whale
- California sea lion
- Harbor seal
- Harbor porpoise
- Humpback whale

Table 4.1-6, located at the end of Section 4.1.4, Impact Analysis and Mitigation, provides a summary of biological resource impacts and mitigation measures (MMs).

Existing Permit Conditions

In 2006 NMFS issued a BO to address the effects of sand mining activities in the Central Bay and Delta on green sturgeon, Chinook salmon, and steelhead trout. The USFWS issued a formal Letter of Concurrence addressing the effects of sand mining activities on the delta smelt. The measures listed below are required as conditions of the NMFS BO and the USFWS Letter of Concurrence (NMFS 2006; USFWS 2006). The CSLC, as the lead agency under CEQA, is responsible for ensuring that potentially significant impacts are reduced to the extent feasible. CSLC determined that these measures should be incorporated into the Project. Therefore, while these measures have been imposed by NMFS and USFWS, and are part of the existing permit context as long as the BO is in effect, if the CSLC approves the proposed Project, the measures would be considered part of the "approved Project" and as such would be required to be implemented by the Applicants regardless of the status of the BOs. The measures contained in the BO are as follows:

- When priming the pump or clearing the pipe, the end of the pipe shall be held at a height in the water column no greater than 3 feet off the bottom (NMFS 2006).
- Limited volume per year: existing State and Federal permits regulate the annual volume of sand that can be harvested from each lease area. These limits serve to reduce the potential risk of adverse effects of sand mining on subtidal habitat and aquatic resources (USFWS 2006).
- Water depth limitation to avoid sensitive habitat: in Central Bay, sand mining occurs in relatively deep water (from 30 to 90 feet). Within the region of Middle Ground Shoal and Suisun Bay, sand mining typically occurs in waters 15 to 45 feet deep. Due to equipment constraints, such as the barge and tug draft and the suction drag head minimum operation depth (due to pipe length and angle during operation), sand mining cannot occur in shallow water areas. For instance, Applicants cannot practically mine in areas with less than 20 feet of water or in areas with depths greater than approximately 80 feet of water. In addition to equipment constraints, all recently issued ACOE and BCDC mining permits prohibit sand mining within 200 feet of any shoreline. The permits also prohibit sand mining within 250 feet of any water having a depth of 9 feet or less (mean lower low water [MLLW]), or 30 feet (MLLW), depending on the location in the estuary (USFWS 2006).
- Limited mining areas: sand mining is restricted to specific CSLC-designated lease areas. Mining is not permitted outside of the lease areas. The lease areas and specific locations within the lease areas where sand deposits occur and mining activity is most frequent, are characterized by relatively high river and tidal current velocities, are areas of sediment (sand) accumulations, have a low percentage of fine sediments, and are dynamic areas with frequent natural disturbance as evidenced by the presence of sand wave formations. These limitations reduce and avoid the risk of mining in sensitive subtidal habitat located outside the designated lease areas (USFWS 2006).
- Monitoring actual mining locations: current sand mining permits require detailed tracking and accounting of the specific locations of each mining event. Results of the tracking are submitted to BCDC and CSLC quarterly in accordance with permit conditions. Tracking mining locations serves to ensure that mining occurs only within designated lease areas and that mining avoids sensitive subtidal habitat located outside of a lease area (USFWS 2006).

Impact Discussion

Impact BIO-1: Potential displacement of special status species

Commercial sand mining in the San Francisco Bay-Delta may result in the direct and indirect physical displacement of special status fish species, including delta smelt, longfin smelt, green sturgeon, Chinook salmon, steelhead trout, and Pacific herring, Fishery Management Plan-managed pelagic fish and groundfish, marine bird species such as California brown pelican, and protected marine mammals, including California gray whale, humpback whale, California sea lion, harbor seal, and harbor porpoise (Less than Significant, Class III).

The proposed Project may have minor direct impacts to the free movement or foraging of special status fish, birds, and marine mammals during active sand extraction activities in Central Bay, Suisun Bay, and the western Delta. All of these animals are known to use the waters where sand mining occurs. The potential effects are expected to be minimal since sand mining in these locations occurs for only a few hours during each sand mining event, physically occupies a small area of the region they are mining in, and during mining, the mining equipment remains predominantly stationary. Most of these species, especially the marine mammals and birds, can be considered relatively acclimated to interactions with humans and vessels and are capable of easily avoiding sand mining barges. Based on these findings, the temporary displacement of fish from active mining areas is considered less than significant.

Impact BIO-2: Potential impacts to fish and wildlife species from increased noise

Sand mining activities result in increased noise at the location of the suction drag head on the seafloor that can result in increased disturbance to marine biota, especially fish, including special status fish species (Less than Significant, Class III).

Sand mining operations in the San Francisco Bay-Delta produce additional noise from vessel engines, propeller turbulence, the centrifugal pump used to lift the mined sand to the hopper barge, and at the hydraulic drag head itself (Hanson Environmental 2004). Although many of these noises (e.g., engine noise and propeller turbulence) are comparable to other common noise sources throughout the Bay-Delta and might be considered part of the normal background-noise level, others that are unique to dredging and sand mining result in additional noises at potentially different sound frequencies that could have an effect on Bay-Delta marine biota. These biota include marine mammals and special status fish such as delta smelt, longfin smelt, green sturgeon, Chinook salmon, steelhead trout, Pacific herring, and Fishery Management Plan-managed pelagic fish and groundfish.

Sustained underwater noise elicits behavioral responses by fish and marine mammals, such as erratic avoidance, altered foraging, and suspended or aborted reproductive behaviors, as well as physiological effects, such as damaged hearing, ruptured internal organs, and death. Key factors in determining the potential for impacts from noise and severity of the potential impact are generally the intensity, frequency, and duration of the noise (Hanson Environmental 2004). Although few data have been gathered concerning underwater noise generated by hydraulic suction dredging in general and sand mining in the Bay-Delta in particular, sufficient information exists to determine the kind of noise generated by sand mining in the Bay-Delta and to assess its potential effect on resident marine biota. Hanson Environmental provides a review of pertinent scientific studies concerning hydraulic dredging and other applicable anthropogenic noise sources (Hanson Environmental 2004). Underwater ambient noise levels in areas relatively free from anthropogenic activities are typically in the 88 to 108 decibel (dB) range, with an average level of 98 to 100 dB; measured frequencies range from 155 to 407.5 hertz (Hz) in the Sacramento-San Joaquin Delta (Hanson Environmental 2004).

Various studies have shown that sand mining using a hydraulic suction head produces noise levels above ambient background levels. Such sound is produced during operations from the tug engines, propeller rotation, centrifugal pumps, dredge head, and wave action against the hull of the tug and barge. Noise generation persists at the mining location (i.e., stationary pothole, trolling line or moving pothole) during the average 3- to 4.5-hour mining event. Hydraulic suction dredge operations can generate noise as high as 130 to 140 dB at the dredge head. Most underwater sound from suction dredges are at low frequencies, around 400 Hz, but vary between 20 and 1,000 Hz (Richardson et al. 1995). At this amplitude, suction dredge sounds can decrease to 120 dB (22 dB above ambient measured noise levels) at a distance of 0.75 mile and continue dropping to levels between 112 dB and 117 dB at a distance of 1.25 to 8.1 miles (Hanson Environmental 2004). These studies also report that the lower awareness threshold, or sound level at which fish and marine mammals are reported to detect sound, is around 120 dB. At 140 to 160 dB modified behavior such as avoidance or startle responses occur, and at sound levels above 160 dB, physiological impacts occur (Hanson Environmental 2004). Furthermore, sounds in the 180 to 220 dB level are likely to cause damage to sensory receptors of the ears in fish. Concerning sound effects on fish eggs and invertebrates, Bennett et al. indicated that 105 to 167 dB sounds in the 100 to 5,600 Hz range resulted in little to no effect on the development of fish eggs and zooplankton (Bennett et al. 1994). Finally, Hanson Environmental determined that sounds in the range and frequency generated by sand mining do not result in acute mortality of most of the common fish species present in the Bay-Delta, including Chinook salmon, steelhead trout, American shad, delta smelt, inland silversides, sturgeon, catfish, Pacific herring, golden shiner, and select species of macroinvertebrates (Hanson Environmental 2004).

In summary, noise generated by sand mining is marginally above ambient levels and only within the range detectable by fish (and most likely marine mammals) over a very small area of the Bay-Delta located immediately around the sand mining operation. Noise levels generated by sand mining at the hydraulic suction dredge's location are within the sound range that can elicit behavioral responses, such as altered swimming direction and speed, by fish and marine mammals, but are expected to occur only immediately adjacent to the drag head and below intensity levels that are likely to cause physical damage to sensory receptors or other physiological effects (Hanson Environmental 2004). Because such impacts are largely localized, result in no permanent loss of habitat, result in no net loss in the functional value of habitat, do not impede or prevent fish migration, and do not result in any substantial loss in population, habitat, or biological diversity, the temporary increase in noise above ambient levels due to sand mining activities is considered less than significant.

Impact BIO-3: Potential sand mining impacts on benthic habitat, infauna, epifauna, and foraging habitat

San Francisco Bay-Delta sand mining results in the temporary disturbance, alteration and loss of soft substrate benthic habitat and associated benthic infauna and epifauna, which could affect foraging habitat for special status fish, marine bird species, such as California brown pelican, and protected marine mammals including California gray whale, humpback whale, California sea lion, harbor seal, and harbor porpoise and affect Bay-Delta food web dynamics (Less than Significant, Class III).

Hydraulic suction dredging of Bay-Delta sediments during sand mining disturbs, alters, and results in the loss of soft sediment habitat and associated benthic infauna and epifauna. Removal of soft sediment and associated biota causes a short-term, localized reduction in available forage for macroinvertebrates and benthic feeding fish. If sediment composition changes in an area after sand mining, then the replacement infaunal and epifaunal communities differ from the communities present before mining.

Hanson Environmental summarized several scientific studies that evaluate the effects of dredging on benthic communities, recovery, and potential effects on higher trophic levels

(Hanson Environmental 2004). In its assessment of the benthic infaunal communities in the Bay-Delta mining leases in Central Bay, Suisun Bay, and the western Delta, AMS investigated whether sand mining activities had any detectable effect on community composition and abundance (AMS 2009a [Appendix F]). AMS reported that the benthic infauna community in Central Bay was very low in species diversity and individual species abundances compared to other areas of the Bay-Delta and that sandy sediments with little silt and clay fractions, and low organic composition, characterized the sediment composition in the areas of the mining leases where mining occurs (AMS 2009a [Appendix F]). These findings were consistent with the known high-energy environment in all of the mining leases, wherein most fine sediment fractions remain in suspension in the water column. AMS also reported that they could detect no effect of sand mining in the Central Bay leases, and surmised that this is attributable to the natural instability of the sediments in this area caused by the high-energy regime that is present in west Central Bay (AMS 2009a [Appendix F]).

AMS' findings in the Delta mining leases were similar but less conclusive. The benthic infaunal communities in the western Delta and Suisun Bay have become so altered and dominated both in abundance and biomass by the invasive Asian clam (*Corbicula amurensis*) that no significant effects of sand mining on the infaunal community could be detected (AMS 2009a [Appendix F]). AMS reported similar low sediment fines and organic composition in the areas of the mining leases where sand mining occurs.

Recovery of benthic infaunal and epifaunal communities following dredging is controlled by many physical and ecological factors, including: the areal extent of dredging; the operational method of dredging; the temporal occurrence of the dredging relative to natural recruitment; the species composition of adjacent undisturbed sediments; the sediment composition after dredging; and other factors (Nairn et al. 2001; Newell et al. 1998). The recovery of benthic infauna following dredging to a community composition of similar diversity and abundance is reported to take between one and 10 years (Newell et al*.* 1998; Hammer et al*.* 1993). AMS estimated that recovery of the infaunal communities in both the Central Bay and Delta mining leases appeared to occur within a few years to compositions similar to un-mined areas and were at similar water depths and sediment composition (AMS 2009a [Appendix F]). Because the dominant species in the Delta is the Asian clam*,* which in many cases is larger than the sizing screens used on the mining leases, it is probable that many of these individuals are returned to the Delta floor unharmed during mining operations.

Because of the high-energy conditions present in the mining leases, discharged silts, clays, and organic sediments in the barge overflow plume are expected to remain in suspension and settle out away from the active mining leases along with other fines held in suspension. As a consequence, the potential for these fines to alter or change the sediment composition in areas with similar coarser sediment composition is unlikely.

In summary, sand mining results in short-term changes in habitat composition and associated marine infauna and epifauna in areas of the Bay-Delta mining leases where sand extraction has just occurred; however, these changes do not appear to last more than a few years and do not appear to result in any detectable changes in infaunal composition or forage suitability. Thus, the alteration of soft substrate benthic habitat under the proposed Project is not expected to substantially affect the availability or distribution of foraging habitat for fish, or marine birds and mammals. As a result, this potential impact is considered less than significant.

Impact BIO-4: Discharge of suspended sediments may potentially release contaminants into waters that affect plankton and wildlife species

The discharge of suspended sediments in the overflow plume during sand mining will increase suspended sediment concentrations (SSC) and potentially release organic and inorganic contaminants into Bay-Delta waters affecting plankton and fish populations including delta smelt, longfin smelt, green sturgeon, Chinook salmon, steelhead trout, Pacific herring, and Fishery Management Plan-managed pelagic fish and groundfish (Less than Significant, Class III).

During hydraulic suction dredge mining, fine sediment fractions consisting of clays, silts, and organic material that are intermixed with the extracted sand are discharged in the barge overflow plume causing increases in the SSC of Bay-Delta waters, which typically disperse after three to four hours following completion of a mining event (Hanson Environmental 2004). Sustained levels of SSC can cause environmental degradation, including reduced phytoplankton productivity, and can result in deleterious effects to fish, including physiological stresses from clogged gills, eroded gill and epithelial tissues, impaired foraging activity and feeding success, delayed hatching, altered swimming behavior and movement including migration patterns of juvenile and adult fish, and possible death (Clarke and Wilber 2000; Anchor Environmental 2003). At a minimum, increased SSC results in behavioral avoidance and exclusion behaviors from otherwise suitable habitat and reduced feeding rates and growth (Clarke and Wilbur 2000; Hanson Environmental 2004). The response of fish to suspended sediments varies among species, life stage, and the specifics of the suspended sediments.

In addition to increases in SSC from the overflow plume, the release of sediment fines could also result in increased organic and inorganic contaminant loading of Bay-Delta waters, posing increased risk of toxicity exposure to Bay-Delta biota, including plankton, fish, and invertebrates. As discussed in Section 4.3, Hydrology and Water Quality, multiple areas within the Bay-Delta, including Central Bay, Suisun Bay, and the Sacramento San Joaquin Delta are listed as an impaired water body under Clean Water Act Section 303(d) for several organic and inorganic pollutants. These pollutants include mercury, PCBs, dioxins, furan compounds, dieldrin, selenium, DDT, and chlordane.

Because of concerns over the potential effects of hydraulic dredging and the effects of disposing of dredged sediments into marine and estuarine environments, substantial scientific literature exists on this topic, much of which is reviewed in Clarke and Wilbur and Anchor Environmental (Clarke and Wilbur 2000; Anchor Environmental 2003). Hanson Environmental also reviews many of these studies and how they apply to sand mining in the San Francisco Bay-Delta (Hanson Environmental 2004). Recent work by Colby and Hoss provides insight into behavioral effects of increased subsurface countercurrents from dredging on fish, including Pacific herring and other species that inhabit the Bay-Delta aquatic habitats (Colby and Hoss 2004). Finally, several past and more recent studies in the Bay-Delta (e.g., MEC and Cheney 1990; SFEI 2008; MEC 1993) address concerns about increased SSC and the toxic effects of increased contaminant loading from dredging plumes and dredged sediment disposal.

These studies collectively indicate that hydraulic suction dredge sand mining in the San Francisco Bay-Delta results in an elevation of SSC within the plume located immediately down current of the dredging barge. Hanson Environmental estimated that the turbidity plume from sand mining in the Bay-Delta could last up to 9.5 hours (Hanson Environmental 2004). Data from MEC and Cheney, MEC, and Anchor Environmental suggest that the time duration in the Bay-Delta at which sand mining generated total suspended solid (TSS) levels might exceed 100 mg/L[8] may never occur; if it did, it should last from a few minutes to one hour after dredging concludes (MEC and Cheney 2990; MEC 1993; Anchor Environmental 2003). Thereafter, discharged sediment either settles out on the seafloor or reaches background turbidity levels and remains in suspension due to high-energy conditions present in the sand mining leases. The areal extent of the plume in which TSS concentrations could be greater than 100 mg/L is estimated to be extremely small and located immediately down current of

[8] SSC concentrations greater than 100 mg/L are the estimated acute sublethal threshold for physiological effects to juvenile and adult fish, fish larvae, fish eggs and invertebrates.

the discharge source. Ambient background turbidity levels are routinely achieved at a distance of less than 400 yards.

In summary, commercial sand mining in the Bay-Delta causes short-term increases in SSC and may elevate organic and inorganic contaminants associated with silts, clays, and organic matter discharged in the overflow plume. However, materials in the sand particle size that are targeted by sand miners tend to be low in fine sediment (e.g., less than 10 percent) and as a consequence have low levels of contaminants. Although some increased contaminant loading occurs from resuspended fine sediment fractions, the contaminants appear to remain bonded to the sediment and not available. As a result, no toxicity to aquatic organisms has been demonstrated from the discharge plume from commercial sand mining operations in the Bay-Delta. This finding is consistent with an assessment of the effects of short-term water quality impacts due to maintenance dredging and disposal on sensitive species in San Francisco Bay conducted by the San Francisco Estuary Institute (SFEI 2008). Based on these findings, impacts to Bay-Delta marine biota from discharge plumes would be less than significant.

Impact BIO-5: Disturbance of sediments at the seafloor could result in increased turbidity, SSC, and release of contaminants that potentially impact plankton and wildlife species

Disturbance of sediments at the seafloor during sand mining could result in increased turbidity and suspended sediment concentrations at the seafloor and the potential release of organic and inorganic contaminants to Bay-Delta waters affecting plankton and fish populations including special status fish species such as delta smelt, longfin smelt, green sturgeon, Chinook salmon, steelhead trout, Pacific herring, and Fishery Management Plan-managed pelagic fish and groundfish (Less than Significant, Class III).

This potential impact is similar to the potential impact discussed in BIO-4 above, concerning the overflow plume from sand mining barges during sand mining operations. The data on increased TSS concentrations at which physiological effects occur for aquatic taxa and the potential toxic effect of increased contaminant loading still apply; however, little to no scientific data exist to evaluate what TSS concentrations are present immediately adjacent to and down current of the hydraulic suction drag head.

Since the material being disturbed at the seafloor is identical to that being placed into the sand mining barge, the potential for any toxic impact on marine taxa is the same as for the overflow plume. No toxic impact is therefore anticipated. The potential exposure of organisms living in or on the seafloor, including demersal fish, benthic infauna and epifauna, and mobile invertebrates such as crabs and shrimp is also expected to be minimal. The material mined is typically sand-sized, and quickly resettles when resuspended (Hanson Environmental 2004). The finer grained sediment fractions (i.e., material with a particle size 95 percent less than 200 micrometers (µm), or 1/5 of a mm) can be expected to float away with the current and either remain in suspension or settle out over a broad area of the seafloor, down current of the point of disturbance, as part of the natural deposition of suspended sediments. As a result, the time period that demersal fish and other benthic taxa will be exposed to increased SSC is less than the exposure times that result in physiological effects to marine taxa discussed in BIO-4 above. The high-energy regime present in the areas of the sand mining leases in the Bay-Delta that cause the natural grading of seafloor sediments will quickly dissipate any seafloor sediment plume caused by the suction drag head. Impacts to Bay-Delta marine biota from increased turbidity and sediment resuspension at the seafloor from the suction drag head would therefore be less than significant.

Impact BIO-6: Sand mining could result in smothering or burial of, or mechanical damage to, infauna and epifauna, and reduced fish foraging

Resettlement of discharged sediments from the barge overflow plume and disturbed sediments at the seafloor during sand mining could potentially result in the smothering, burial, or loss of soft substrate benthic infauna and epifauna, and hard substrate epifauna, and could indirectly reduce fish foraging (Potentially Significant, Class II).

The resuspension of bottom sediments and the natural settlement of discharged fine fraction sediments in the discharge plume during sand mining could bury benthic infauna and epifauna down current of the sand mining operation. Studies conducted for the U.S. Department of the Interior, Minerals Management Service (now named the Bureau of Ocean Energy and Management) for offshore sand mining for beach replenishment along the U.S. East and Gulf coasts and aggregate mining in the North Sea indicate that the eventual settlement of resuspended and released sediment during hydraulic dredging occurs over a fairly large area, depending on the oceanographic dynamics present (Nairn et al. 2001; Newell et al. 1998). Typically, the more energy in the water column, the larger the area over which the resuspended sediments settle out and the thinner the layer of deposition. Soft substrate infauna and epifauna live in an environment of constant deposition, and as a result are acclimated to occasional burial. As discussed above, the areas within the Bay-Delta where sand mining occurs are characterized by high energy and tidal flow. As a result, any resuspended or discharged sediments from the overflow plume, especially the finer silt, clay, and organic sediments, can be assumed to be kept in suspension and deposited back on the seafloor over a broad region of the Bay-Delta, or open ocean in the case of Central Bay.

Within and adjacent to the Central Bay mining leases are the Bay-Delta's largest areas of natural sub-tidal hard substrate, such as Arch Rock, Harding Rock, Shag Rock, and Blossom Rock (Chin et al. 2004; NOAA 2007). The Suisun Bay and western Delta mining leases have no known natural or artificial hard benthic substrate in or adjacent to them (NOAA 2007). The high natural currents present in the Central Bay mining leases are expected to keep any resuspended material in suspension and redeposited over a fairly broad area of the seafloor or out into the ocean. The increased SSC caused by sand mining is not, therefore, anticipated to result in more deposition at these hard bottom areas in Central Bay than occurs normally. Impacts to Bay-Delta hard bottom marine biota from increased turbidity and sediment resuspension at the seafloor from the suction drag head and settling of the overflow plume would therefore be less than significant. Hanson Environmental indicated that sand miners avoid these hard bottom areas, as the sand deposits are of poor quality for mining and the rocky substrate can damage mining equipment. However if mining were to occur in these areas it could cause mechanical damage to the benthic community inhabiting the hard substrate areas, which could result in a significant impact to these biotic communities (Hanson Environmental 2004).

MM for Impact BIO-6: Sand mining could result in smothering or burial of, or mechanical damage to, infauna and epifauna, and reduced fish foraging

MM BIO-6. Establish a 100-foot buffer around hard bottom areas within and adjacent to Central Bay mining leases. Sand mining dredging operations must maintain a sufficient buffer zone around all hard bottom areas, especially Harding, Shag, and Arch rocks, such that dredging equipment does not come into physical contact with these sensitive hard bottom areas. This buffer zone will, at a minimum, be 100 feet from the outward edge of any hard bottom feature. In the event dredging equipment comes into physical contact with any hard bottom area during the term of the leases, it shall be immediately reported to the CSLC, who shall establish a new minimum buffer zone distance.

Rationale for Mitigation

MM BIO-6 would prevent mechanical damage to hard substrate areas, thereby avoiding damage to the associated benthic community.

Impact BIO-7: Sand mining will cause entrainment and mortality of common and managed aquatic species

The Project will cause the entrainment and mortality of common and managed juvenile and adult fish, invertebrates, and plankton, including Dungeness crab, Pacific herring, and Fishery Management Plan-managed pelagic fish and groundfish during sand mining (Less than Significant, Class III).

AMS examined the estimated annual entrainment for Dungeness crab and splittail, as well as common fish and managed pelagic fish and groundfish that occur in the Project area (AMS 2009b [Appendix E]).

Of the three Bay mining regions (Central Bay, Middle Ground Shoal, and western Delta), juvenile Dungeness crab are only found in significant numbers in Central Bay and are not regularly observed in the western Delta. In an assessment of invertebrate entrainment, AMS found that within Suisun Bay, mining operations at Middle Ground Shoal were estimated to entrain between 61 and 79 juvenile crabs in years crabs are relatively abundant (AMS 2009b [Appendix E]). For years in which the juvenile Dungeness crab population in the Estuary is low, as it has been for the last several years, the estimated annual entrainment of juvenile crabs is less than one (AMS 2009b [Appendix E]).

Within the Central Bay mining leases, entrainment of Dungeness crab juveniles is predicted to be higher than that at Middle Ground Shoal, with an average of approximately 850 adults estimated to be removed annually from future populations of adult crabs. Based on the estimated total number of Dungeness crab juveniles inhabiting the Central Bay region of San Francisco Estuary and their estimated survival to adulthood, the juvenile crabs entrained by sand mining activities in Central Bay represented approximately 0.2 percent to 1 percent of future adult populations over the eight-year study period (AMS 2009b [Appendix E]).

These losses are estimated to represent approximately 0.01 percent to 0.08 percent of commercially landed Dungeness crab at San Francisco ports, depending on the year. Juvenile crab entrained at Middle Ground Shoal by sand mining operations was estimated to result in the loss of less than 0.0001 percent of the landed adult catch between 2000 and 2007. Thus, on average, San Francisco Estuary sand mining activities were estimated to cause the loss of less than 0.1 percent of the annual harvested Dungeness crab harvests through entrainment. Based on the small number of Dungeness crabs that would be entrained by sand mining operations, which represents a tiny fraction of the overall San Francisco Bay crab population, Project impacts to Dungeness crab are considered less than significant.

AMS found that the potential environmental impacts of entrainment of non-special status taxa, managed pelagic fish, and groundfish appears to be minimal, and is therefore less than significant (AMS 2009b [Appendix E]).

While this impact is considered less than significant without mitigation, the required NMFS and USFWS operational conditions will reduce entrainment and mortality of common and non-listed invertebrate and fish species such as Dungeness crab, white sturgeon, splittail, managed pelagic fish and groundfish during sand mining.

Impact BIO-8: Regular operation of sand mining activities will cause entrainment and mortality of delta and longfin smelt

The Project would result in a significant impact to delta smelt and longfin smelt as a result of entrainment and mortality during sand mining operations impacting ~~adult life stages of the~~ delta smelt and longfin smelt thereby exceeding the established significance level criteria thresholds (Significant, Class I).

AMS conducted a study to assess the potential for sand mining to entrain and kill delta smelt and longfin smelt (AMS 2009b [Appendix E]). The study predicted that, in the Middle Ground Shoal and western Delta mining leases, sand mining would entrain an estimated 0.3 percent of the regional abundance index for delta smelt within the Bay-Delta region. The model developed in the study estimated that sand mining would entrain zero, three, and six individuals per year in the Central Bay, Middle Ground Shoal, and western Delta lease areas, respectively. For longfin, smelt the study predicted that, in each of the three mining lease areas (Central Bay, Middle Ground Shoal, and western Delta), sand mining would entrain less than 0.3 percent of the regional abundance index for that species. The model developed in the study estimated that sand mining would entrain an average of 750, 72, and 20 individual longfin smelt annually in the Central Bay, Middle Ground Shoal, and western Delta lease areas, respectively (AMS 2009b [Appendix E]). Estimated entrainment for longfin smelt was higher than for other species, because longfin smelt swim throughout the water column periodically.

The effects of sand mining on delta smelt populations were the subject of the 2006 USFWS Letter of Concurrence (USFWS 2006). This letter concluded that sand mining activities were not likely to have an adverse effect on the threatened delta smelt or affect critical habitat that occurs in the Project area, as long as specific permit conditions are implemented. These conditions are identified at the beginning of this section. They include measures to avoid and minimize take of delta smelt by keeping mining activities away from sensitive near-shore and shallow-water habitat, limiting mining volumes, defining mining areas, and imposing limitations on priming the dredge pump.

While the USFWS concluded in its 2006 Letter of Concurrence that sand mining activities were unlikely to adversely affect delta smelt, based upon the analysis of the information presented in this EIR and consultation with CDFG staff, the CSLC concluded that there is sufficient evidence to conclude that incidental take of both delta smelt and longfin smelt will occur as a result of Project activities. Most notably, CDFG and its partners are involved in several programs to monitor the abundance and population trends of Delta and longfin smelt, including the "Smelt Larva Survey" (Adib-Samii 2010a, Baxter 2009) and "20mm Survey" (Adib-Samii 2010b), which include sampling stations in the vicinity of proposed Project activities. These survey programs along with other Delta monitoring efforts can provide information on larval and post-larval/juvenile smelt distribution and relative abundance in near real-time, and indicate that delta and longfin smelt are present in varying numbers where mining would occur, and therefore, would be subject to entrainment and mortality. Incidental take of delta smelt and longfin smelt is considered potentially significant given the listing of these species under the California ESA and the critically low population numbers now being observed.

Because the Project is expected to result in the incidental take of delta and longfin smelt, the CSLC expects that the Applicants will be required to obtain an Incidental Take Permit (ITP) pursuant to section 2081 of the California Fish and Game Code to carry out the Project in compliance with the California ESA. The CDFG would only issue an ITP if it meets certain criteria for issuance, including finding that the impacts of the taking are minimized and fully mitigated through required permit measures; that the Applicants have ensured funding adequate to carry out the required measures; and that implementation of the Project would not jeopardize the continued existence of the species. Nonetheless, for purposes of this analysis, impacts related to the entrainment mortality of delta and longfin smelt are considered significant. The CSLC has identified MM BIO-8 as a feasible measure that would reduce this impact; however, the impact will remain significant.

MMs for Impact BIO-8: Regular operation of sand mining activities will cause entrainment and mortality of delta and longfin smelt

MM BIO-8a. Applicants shall implement operational measures to minimize the potential for entrainment and mortality of delta and longfin smelt.

- **Timing of dredging relative to X2.** To protect delta and longfin smelt and potentially eggs and young larvae from mortality related to entrainment, sand mining activities shall be restricted upstream of the X2 location (i.e., the location of 2 parts per thousand (ppt) salinity) from December 1 through June 30 each year. This location changes during the water year in response to river flows and its location is tracked on the following website: http://cdec.water.ca.gov/cgi-progs/queryDaily?X2. The degree and duration of mining restrictions, and the specific locations where mining should be restricted during this sensitive seasonal period will be based on factors including the specific location of X2 relative to mining activities, species presence and relative abundance in the Project area based on sampling data from the nearest survey stations, and the overall status of the species (population trend). Specific seasonal restrictions will be set through consultation with the California Department of Fish and Game (CDFG) and would likely be a requirement of any Incidental Take Permit that may be issued for the Project.

- **Current restrictions on sand mining operations,** as specified in the National Marine Fisheries Service Biological Opinion (NMFS 2006) and the U.S. Fish and Wildlife Service Letter of Concurrence (USFWS 2006), serve to avoid and minimize take of delta smelt. Currently there are no Federal restrictions on longfin smelt. Due to similar life stages, however, State delta smelt restrictions and conditions will be applied to both smelt species. These conditions include restrictions on pump priming, limiting the total mining volume, prohibiting mining in areas of shallow water depth and in proximity to shorelines, restricting mining to the designated lease areas which are away from sensitive habitat, and monitoring and reporting the location of each mining event.

- <u>**Additional requirements and restrictions to minimize and avoid take** will be set through consultation with the CDFG and would likely be a requirement of any Incidental Take Permit that may be issued for the Project. To further minimize take, the Applicants shall keep the end of the pipe and drag head as close to the bottom as possible, and no more than three feet from the bottom, whenever feasible when priming the pump or clearing the pipe. Additional requirements and restrictions may be set through consultation with CDFG.</u>

MM BIO-8b. Applicants shall provide off-site mitigation to compensate for the impacts of the taking that may be unavoidable.

- **Compensatory mitigation measures** shall include restoration of delta and longfin smelt spawning and rearing habitat, and/or purchase of California Department of Fish and Game (CDFG)-approved mitigation credits, unless otherwise specified in an Incidental Take Permit, in an amount based on factors including the distribution and relative abundance of the species in areas subject to mining activities and the implementation of the above-specified minimization measures, such that the amount of compensatory mitigation required is roughly proportional to the impacts of the taking on the species. Determination of the restoration area or credits required will be accomplished through consultation with CDFG and is expected to be specified in the Incidental Take Permit. Currently, mitigation credits for delta and longfin smelt are available through the Liberty Island Mitigation Bank.

Rationale for Mitigation

Sand mining operations using moving pot-hole and stationary pot-hole methods (5,000-15,000 gallons per minute slurry rate) are proposed for regions generally described as: 1) the western Delta from Broad Slough at the San Joaquin River downstream to Chipps Island, 2) Suisun Bay southeast of Ryer Island or the Middle Ground Shoal, and 3) south and west of Angel Island and westward to a line directly south of Point Cavallo (south end of Richardson Bay). The Project would be permitted to move 2,040,000 cubic yards of material per year. The moving pot-hole method drag-head is 4 feet high by 3 feet wide and is typically buried 12-18 inches deep, leaving substantial open area to entrain bottom oriented fishes. The stationary pot-hole method limits the amount of time the drag head is in unimpeded contact with the water column, but minimization still allows priming and clearing the head within 3 feet of the bottom. Priming and clearing would occur at least once per day and at every change in dredge location. Priming and clearing within 3 feet of the bottom could entrain delta and longfin smelt. Moreover, delta smelt eggs are adhesive and will attach to substrates in freshwater. CDFG has made a recent observation of a delta smelt egg attached to sand particles, and longfin smelt eggs in studies of Lake Washington stocks were predominantly attached to sand particles (CDFG 2009). Dredging in freshwater upstream of X2 location during winter and spring (December 1 through June 30) could take delta and longfin smelt eggs, and delta smelt larvae which are also bottom oriented for a short period soon after hatching.

Residual Impacts

While implementation of MMs BIO-8a and BIO-8b would reduce the magnitude of potential entrainment effects on delta and longfin smelt, it would likely not reduce the impact to a less-than-significant level. Although there are no current broadly applied programs for offsetting sand mining impacts to delta and longfin smelt, implementation of MMs BIO-8a and BIO-8b would require actions intended to both reduce and offset impacts related to incidental take of delta and longfin smelt. There are no other feasible mitigation measures available at this time, although it is anticipated that CDFG staff will establish recommended conditions that will be included in the ITP that is expected to be issued for the Project. However, even with extensive consultation with CDFG during development of the draft EIR, because specific measures are developed by the CDFG on a case-by-case basis through their permitting process and are therefore not available for inclusion in the draft EIR, approval of the Project would be subject to a Statement of Overriding Considerations under CEQA by the CSLC.

While the CSLC as the lead agency for the Project must do all that is feasible to address significant impacts even where a subsequent permit from another agency is necessary, the required measures may specify performance standards which would ensure the mitigation of the significant effect and which may be accomplished in more than one specified way, when such specificity is infeasible or impractical at the time of preparation of the EIR. The specific conditions for mitigating the impacts of the incidental take of delta and longfin smelt would be formulated based on the CDFG's review of the Applicant's ITP application and the final EIR, should one be certified.

Because a determination of the exact timing of mining restrictions necessary to reduce the entrainment of delta and longfin smelt (which may vary from year to year), and of the quantity of compensation necessary to mitigate the impacts of the taking lies with the specialized scientific expertise of the CDFG, who would be conducting its evaluation after completion of the EIR, the above measures are provided as performance standards that the CSLC expects will be met through specific conditions set forth in the ITP.

Impact BIO-9: Green sturgeon, Chinook salmon, and steelhead trout will be impacted during sand mining

The Project will cause the entrainment and mortality of green sturgeon, Chinook salmon and steelhead trout during sand mining (Potentially Significant, Class II).

A recent AMS study estimated that Chinook salmon are entrained at a rate of one fish per year in the Middle Ground Shoal and western Delta mining leases as a result of sand mining activities, with no entrainment in Central Bay (AMS 2009b [Appendix E]). AMS notes, however, that this estimate may be low due to potential underestimates of Chinook salmon presence in CDFG data from which the AMS entrainment estimates were made. NMFS in its BO for commercial sand mining in the San Francisco Bay-Delta, used a different modeling approach to estimate entrainment of special status species, including Chinook salmon and green sturgeon, than was used by AMS. NMFS estimated that between 143 and 273 Federal ESA-listed salmonid smolts could be entrained annually by all commercial sand mining in the western Delta and Suisun Bay mining leases, with 13 being Central Valley steelhead trout, 43 to 87 Sacramento River winter-run Chinook salmon, and 87 to 173 Central Valley spring-run Chinook salmon (NMFS 2006). NMFS estimated that one Central California Coast steelhead trout smolt would be entrained every 100 years. NMFS assumes that only one juvenile green sturgeon is entrained annually by the Project proponent’s sand mining activities (NMFS 2006). Based upon the analysis of the information presented in this EIR and consultation with CDFG staff, the CSLC concluded that sufficient evidence exists to conclude that incidental take of Chinook salmon, steelhead trout, and green sturgeon will occur as a result of Project activities. The entrainment of Chinook salmon, steelhead trout, and green sturgeon is considered significant given their listing status under the California and/or Federal ESAs.

The implementation of operational conditions required by NMFS and the USFWS would reduce Project impacts to green sturgeon and steelhead trout to less than significant; however, additional measures are needed to reduce Project impacts to Chinook salmon. In its 2006 BO, NMFS recommended the adoption of several conservation measures to further reduce impacts to salmon smolts during sand mining activities (NMFS 2006). Two measures are incorporated as mitigation requirements in this EIR to reduce Project impacts on migrating salmon smolts. Because the Project is expected to result in the incidental take of Chinook salmon, the CSLC expects that the Applicants will be required to obtain an ITP pursuant to section 2081 of the California Fish and Game Code to carry out the Project in compliance with the California ESA. The CDFG would only issue an ITP if it meets certain criteria for issuance, including finding that the impacts of the taking are minimized and fully mitigated though required permit measures, that the Applicants have ensured funding adequate to carry out the required measures, and that implementation of the Project would not jeopardize the continued existence of the species. The implementation of MMs BIO-9a and BIO-9b would reduce the potential to entrain migrating salmon smolts in the Delta mining leases during critical migration time periods. Because of the limited time outmigrating Chinook salmon smolts occur in mining areas, the relatively small fraction of smolts that would be entrained when compared to the total number of smolts, and the very small number of steelhead trout and green sturgeon that would be affected, these measures, along with operational conditions required by NMFS and the USFWS, would minimize Project effects on salmonids, such that impacts due to entrainment of these species would be reduced to less than significant. While these measures will reduce the impacts to a less-than-significant level under CEQA, additional measures may be imposed by CDFG in any ITP that may be issued for Chinook salmon to ensure impacts are fully mitigated under the California ESA. These measures could include off-site compensation or contributing to the restoration of Chinook salmon habitat, or any other combination of requirements deemed necessary by CDFG.

MMs for Impact BIO-9: Green sturgeon, Chinook salmon, and steelhead trout will be impacted during sand mining

MM BIO-9a. Sand mining halted during peak Chinook salmon migration. Sand mining in the western Delta and Suisun Bay leases shall be halted during the approximate two-week peak Chinook salmon smolt outmigration period through the Delta as monitored by USFWS at Chipps Island. Mining operations in the Delta and Suisun Bay lease areas will be coordinated with the fish monitoring program during the months of March to May to determine the appropriate non-work closure period.[9]

MM BIO-9b. Sand mining limited to daylight hours from January 1 to May 31. Sand mining in western Delta and Suisun Bay leases shall be limited to daylight hours

[9] USFWS permitting requirements for the Central Valley Project and State Water Project require continued funding of annual juvenile salmon surveys with emphasis on winter-run Chinook salmon. One objective of this program is to monitor the relative abundance and timing of juvenile Chinook salmon rearing and migration through the Lower Sacramento River and Delta. Based out of the USFWS Stockton Fish and Wildlife Office, surveys include trawling at Chipps Island to estimate the number of unmarked fish emigrating from the Delta.

during the period January 1 to May 31 to minimize entrainment of migrating salmon smolts through the Delta, which tend to be more surface-oriented during the daytime.

Rationale for Mitigation

MMs BIO-9a and BIO-9b would reduce potentially significant impacts to less-than-significant levels by limiting mining to specific time periods so that fish species would be least affected.

Impact BIO-10: Potential effects on fish movement and migration

Physical modification of bottom habitat through the removal of sediment has the potential to affect fish movement or migration (Less than Significant, Class III).

This potential impact considers the behavior of moving or migrating fish relative to their physical environment and whether the incremental modification of bottom topography as a result of sand removal has the potential to impede fish movement. Most studies of fish movement have focused on adult stream fishes, particularly salmonids. Studies of sand mining effects on such species are specific to stream habitats where physical barriers such as culverts, drop structures, and dams pose an impediment to fish movement.

Based on CDFG trawling studies (CDFG 2000-2007), the most common fish species in Central Bay demersal habitat where the majority of sand mining will occur are speckled sanddab, bay goby, plainfin midshipmen, Pacific staghorn sculpin, shiner surfperch, white croaker, longfin smelt, Pacific tomcod and cheekspot goby (Table 4.1-3). Together these species constitute more than 97 percent of the fish community and represent those species that could be most affected by bottom changes. In Suisun Bay and the western Delta, 12 species dominate the bottom community, including striped bass, Shokihaze goby, yellowfin goby, white catfish, channel catfish, longfin smelt, starry flounder, American shad, shimofuri goby, tule perch, Pacific lamprey, and Pacific staghorn sculpin. The majority of these are common, non-migratory species for which mining traces would not create a movement barrier.

Anadromous species that migrate through the Central Bay, Suisun Bay, and western Delta Project areas, including Chinook salmon and steelhead trout, principally use the middle to upper portions of the water column in the Project areas (Tables 4.1-2 and 4.1-4) and principally rely on sensory cues such as chemical signals rather than bottom topography during migratory movements. Sand mining does not occur in areas with less than 20 feet of water, within 200 feet of any shoreline, or within 250 feet of any water having a depth of 9 to 30 feet MLLW, depending on the location in the estuary. CDFG studies indicate that such areas provide the principal movement corridors for migratory fish. Thus, the most frequently used movement corridors would not be affected by the Project.

Because migratory fish tend to use mid-water and shallow water areas for movement, and these areas would not be affected by proposed activities, and also because the effects are expected to be minor and temporary, impacts to fish movement or migration corridors would be less than significant.

Table 4.1-6. Summary of Biological Resources Impacts and Mitigation Measures

Impact	Mitigation Measures
BIO-1: Potential displacement of special status species.	Less than Significant impact; no mitigation necessary.
BIO-2: Potential impacts to fish and wildlife species from increased noise.	Less than Significant impact; no mitigation necessary.
BIO-3: Potential sand mining impacts on benthic habitat, infauna, epifauna, and foraging habitat.	Less than Significant impact; no mitigation necessary.
BIO-4: Discharge of suspended sediments may potentially release contaminants into waters that affect plankton and wildlife species.	Less than Significant impact; no mitigation necessary.
BIO-5: Disturbance of sediments at the seafloor could result in increased turbidity, suspended sediment concentrations, and release of contaminants that potentially impact plankton and wildlife species.	Less than Significant impact; no mitigation necessary.
BIO-6: Sand mining could result in smothering or burial of, or mechanical damage to, infauna and epifauna, and reduced fish foraging.	**BIO-6.** Establish a 100-foot buffer around hard bottom areas within and adjacent to Central Bay mining leases.
BIO-7: Sand mining will cause entrainment and mortality of common and managed aquatic species.	Less than Significant impact; no mitigation necessary.
BIO-8: Regular operation of sand mining activities will cause entrainment and mortality of delta and longfin smelt.	**BIO-8a.** Applicants shall implement operational measures to minimize the potential for entrainment and mortality of delta and longfin smelt. **BIO-8b.** Applicants shall provide off-site mitigation to compensate for the impacts of the taking that may be unavoidable.
BIO-9: Green sturgeon, Chinook salmon, and steelhead trout will be impacted during sand mining.	**BIO-9a.** Sand mining halted during peak Chinook salmon migration. **BIO-9b.** Sand mining limited to daylight hours from January 1 to May 31.
BIO-10: Potential effects on fish movement and migration.	Less than Significant impact; no mitigation necessary.

4.1.5 Impacts of Alternatives

No Project Alternative

The No Project Alternative would result in the cessation of mining of sand from the Bay-Delta estuary for the next 10 years. Therefore, the biological impacts described above that would occur under the proposed Project would not occur under the No Project Alternative.

Long-Term Management Strategy Management Plan Conformance Alternative

This alternative would require proposed sand mining operations to comply with the temporal and spatial restrictions on dredging contained in the *Long-Term Management Strategy for the Placement of Dredged Material in the San Francisco Bay Region Management Plan 2001* (LTMS Management Plan). The LTMS Management Plan Conformance Alternative would restrict sand mining in the Central Bay lease sites to a five- to six-month period, and in the Suisun Bay and western Delta sites for a three-month period each year. This alternative would allow for the same volume of sand extraction as in the Project as proposed, but mining would likely be more intensive during the LTMS work windows, followed by no mining for the remainder of the year.

Because mining would occur in the same locations, this alternative would have the potential to cause mechanical damage to the benthic communities inhabiting hard substrate areas, and Impact BIO-6 and the identified MM would apply. Because the LTMS was specifically intended to protect special status species, and the protective measures required by the 2006 NMFS conference opinion would remain in effect, this alternative would avoid most of the Project’s significant impacts associated with Impact BIO-8, on delta and longfin smelt, and Impact BIO-9, on green sturgeon, Chinook salmon and steelhead trout. However, since adoption of the LTMS, the longfin smelt has been listed under the State ESA and the southern distinct population segment of the green sturgeon has been listed under the Federal ESA. Protection of these species is not considered in the LTMS. Therefore, Impacts BIO-8 and BIO-9 and the identified mitigation measures would apply under this alternative. As under the Project, the impact on delta and longfin smelt would remain significant even though LTMS temporal restrictions combined with the temporal restriction contained in MM BIO-8a may incrementally reduce the impact. MMs BIO-8a and BIO-8b would be necessary as they provide enhanced and refined protection for both delta and longfin smelt not contained in the LTMS. Although green sturgeon is not included in the LTMS (because it was listed after the LTMS was adopted), the measures included in the 2006 NMFS conference opinion would reduce impacts on this species to less than significant.

Clamshell Dredge Mining Alternative

The Clamshell Dredge Mining Alternative would employ a method other than suction dredge mining for recovering sand from the floor of the Bay-Delta estuary. The volume of sand and lease sites mined would remain the same as for the proposed Project. Because mining would occur in the same locations, it would have the potential to cause mechanical damage to the benthic communities inhabiting hard substrate areas, and MM BIO-6 would apply. Because the clamshell method does not involve suction, the potential for entrainment of fish is greatly reduced. Furthermore, fish are likely to be able to avoid the clamshell bucket, and not to become entrapped within it. However, as discussed in Section 4.3, Hydrology and Water Quality, clamshell bucket mining would involve raising the clamshell up through the entire water column, and would likely create a more extensive plume of elevated turbidity and suspended sediment than would the proposed Project. The clamshell method would also require more time per volume of sand extracted than would suction dredge mining. However, Sustar et al. found that the turbidity and suspended sediment characteristics of plumes resulting from clamshell and suction head dredging were similar (i.e., the range of measured SSC values within the plumes were similar) (Sustar et al 1976). As such, the potential for the Clamshell Dredge Alternative to adversely affect biological resources would be less than under the proposed Project, and would likely be less than significant.

Reduced Project Alternative

The Reduced Project Alternative would reduce the allowable mining volumes in all lease areas to a level equivalent to current baseline volumes (i.e., the average mined per year at each Project parcel from 2002 to 2007), as described in Section 3.0, Alternatives and Cumulative Projects. All other aspects of the Project would remain the same, including mining methods, equipment, and locations. Because mining would occur in the same locations, this alternative would have the potential to cause mechanical damage to the benthic communities inhabiting hard substrate areas, although the reduced volume of operations would reduce the impact. Nevertheless, the impact would be significant and Impact BIO-6 would apply. The Reduced Project Alternative would reduce the number of individuals of listed species that mining operations would be likely to entrain or otherwise kill, thus reducing the level of incidental take. Therefore, this alternative would reduce the severity of Impacts BIO-8 and BIO-9. However, the likelihood exists that some take would still occur; therefore, these impacts would remain significant. As under the Project, MMs BIO-8a and BIO-8b would reduce the severity of Impact BIO-8, but this impact would remain significant; MMs BIO-9a and BIO-9b would mitigate impact BIO-9 to less than significant.

4.1.6 Cumulative Projects Impact Analysis

As discussed throughout this section, the proposed sand mining operations would result in temporary, mostly less-than-significant impacts on biological resources within Central Bay, Suisun Bay, and the western Delta. The majority of Project impacts on biological resources would be limited to within the mining lease areas. Mining activities occur on relatively disturbance-prone bottom habitat, which is expected to recover to pre-mining conditions within a period of several months to years. Other projects in San Francisco Bay would also contribute to the incremental loss of biological resources, specifically through the entrainment of juvenile and adult fish, and invertebrates. As identified in Section 3.0, Alternatives and Cumulative Projects, these projects include the Potrero Generating Plant on the south San Francisco waterfront, (which ceased operation in January 2011); Marin Municipal Water District Desalination facility; Bay Area Regional Desalination Project; dredging and dredge materials disposal per the LTMS; dredging to potentially deepen and/or widen parts of the John F. Baldwin Ship Channel in San Francisco Bay, the Stockton Deep Water Ship Channel, and the Sacramento River Deep Water Ship Channel; and various waterfront and restoration projects around the Bay. Environmental analysis is either underway or completed for most of these projects, and several are under construction or have recently been completed.

Three impacts of the proposed Project are considered to be significant prior to mitigation – mechanical damage to the benthic communities inhabiting hard substrate areas (BIO-6), the potential entrainment of delta and longfin smelt (Impact BIO-8); and the loss of green sturgeon and migrating Chinook salmon smolts (Impact BIO-9). Continuation of existing permit conditions in conjunction with implementation of MMs BIO-6, BIO-8a, BIO-8b, BIO-9a, and BIO-9b, would reduce Impacts BIO-6 and BIO-9 to less-than-significant. The severity of BIO-8, however, would remain significant.

The cumulative projects described above, as well as larger-scale impacts to these species, including water diversions, habitat modification, and pollution, result in a cumulative impact that has resulted in the listing of these species under the State and Federal ESAs. With the specified mitigation measures, the Project would not be expected to make a considerable contribution to cumulative impacts to benthic communities, Chinook salmon, or green sturgeon; neither would the other, less-than-significant biological impacts of the Project combine with other projects to cause a significant impact, either because their contribution to such an impact would not be cumulatively considerable, or because the cumulative impact itself would not be significant.

The Project's significant unavoidable impact on longfin smelt and delta smelt, however, is cumulative in nature: the Project itself would not be the primary cause of the decline of these species, but it would contribute to that decline. Therefore, Impact BIO-8 is considered significant and unavoidable for the Project, both individually and cumulatively.

This Page Intentionally Left Blank