# 4.2 BIOLOGICAL RESOURCES

Section 4.2 presents the existing environment and impacts analysis of biological resource issues associated with the granting of a new lease to the Amorco Marine Oil Terminal (Amorco Terminal) to continue to operate in the southeastern Carquinez Strait. The existing biological resources in the San Francisco Bay Estuary and in the Amorco Marine Oil Terminal Lease Consideration Project (Project) study area (lower Suisun Bay and upper Carquinez Strait) are described, as well as in the immediate vicinity of the Amorco Terminal. Also included is a summary of laws and regulations that may affect biological resources. This is followed by an analysis of the potential Project impacts. Routine operations at the Amorco Terminal, or an accidental release of oil, present the potential to impact nearby biological resources. An oil spill could have wide-ranging effects on biological resources in the San Francisco Bay Estuary.

## 4.2.1 ENVIRONMENTAL SETTING

### 4.2.1.1 San Francisco Bay Estuary

#### *Geographic and Hydrologic Characteristics of the San Francisco Bay Estuary*

The San Francisco Bay Estuary is typically divided into five segments: The Sacramento-San Joaquin River Delta (Delta), Suisun Bay, San Pablo Bay, Central Bay, and South Bay (see Figure 4.2-1).

The Delta is the easternmost, or most upstream, segment. The Delta is a 1,150-square-mile triangle-shaped region roughly bounded on the north by the city of Sacramento, on the south by the city of Tracy, and on the west by Chipps Island. The Sacramento and San Joaquin Rivers and their tributaries flowing into the Delta drain about half of the surface area of California and establish the extent of brackish water habitat in Suisun Bay.

Suisun Bay is a shallow estuarine bay bounded by Chipps Island on the east and the Benicia-Martinez Bridge on the west. Suisun Marsh, the largest brackish water marsh in the United States and the largest wetland in California, forms its northern boundary. Suisun Bay has the lowest salinity levels in the San Francisco Bay system, with values ranging from oligohaline (0.5 to 5.0 parts per thousand [ppt]) to mesohaline (5.0 to 18.0 ppt) depending on seasonal variations in tides, evaporation, and freshwater inflows from the Delta. The southern shore of Suisun Bay is home to the Concord Naval Weapons Station and the cities of Pittsburg, West Pittsburg, Avon, and Martinez. Suisun Bay is connected to San Pablo Bay via the Carquinez Strait, a narrow, 12-mile-long band of water that extends from between the Benicia-Martinez Bridge to Mare Island.

San Pablo Bay is the second largest bay in the estuary; it extends from the Carquinez Strait to the San Pablo Strait near the Richmond-San Rafael Bridge, where it forms the upstream boundary of the Central Bay. San Pablo Bay is moderately saline, or polyhaline, with salinity levels ranging from 18.0 – 30.0 ppt. Much of the north shore of San Pablo Bay is protected as part of the San Pablo Bay National Wildlife Refuge.

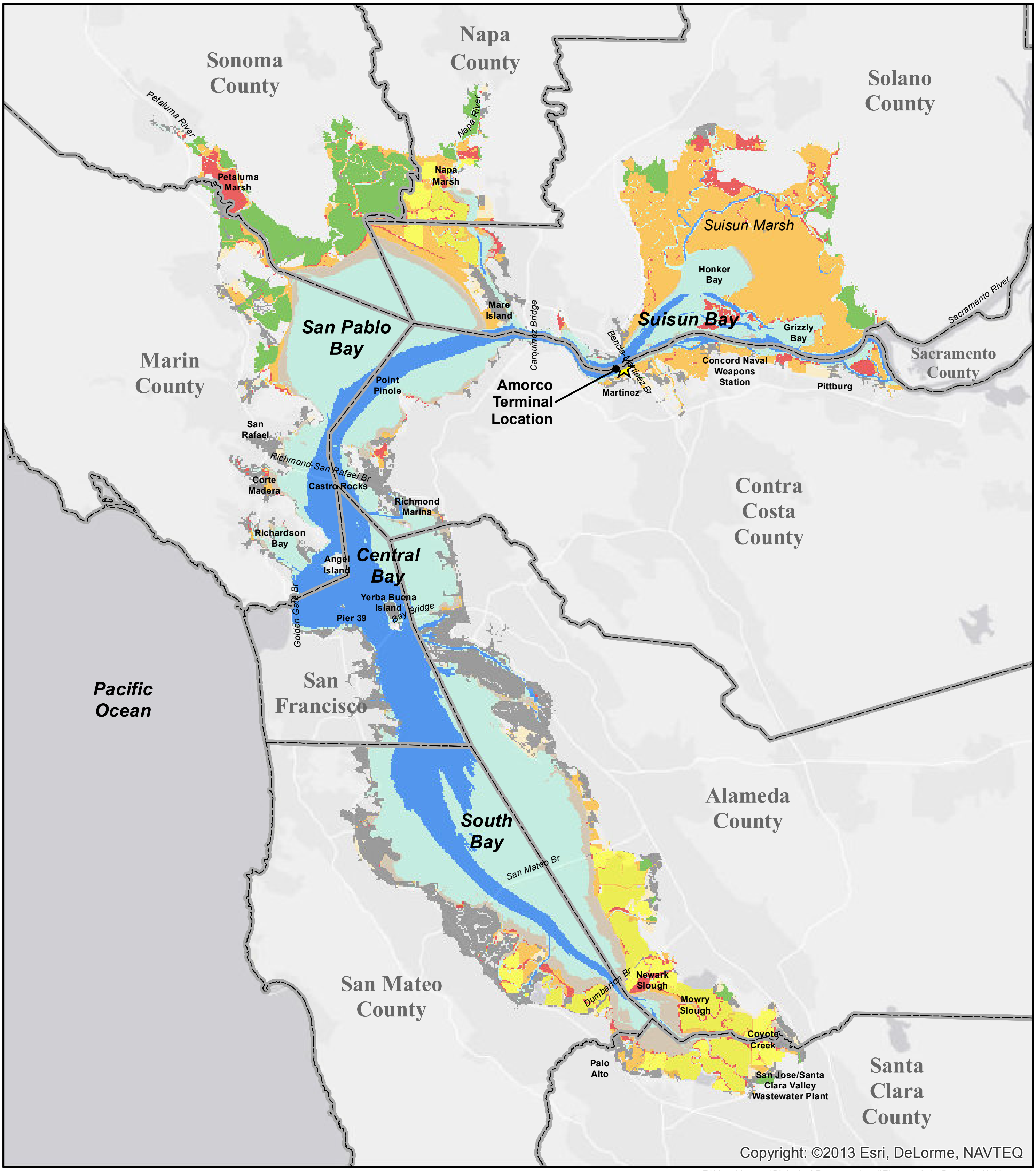
The Central Bay is defined as an area bounded by three bridges: The Richmond-San Rafael Bridge, Golden Gate Bridge, and San Francisco-Oakland Bay Bridge. Central Bay is the coldest, deepest, and most saline of the bays; it is considered euhaline, with salinity levels between 30.0 – 35.0 ppt. Because of its proximity to the Pacific Ocean, its water quality parameters are more stable than its neighboring bays. Ecological conditions in the Central Bay are also more stable than in neighboring bays (SFEP 2011).

The waters south of the San Francisco-Oakland Bay Bridge form the largest embayment, known as the South Bay. The waters here are shallow and polyhaline. Freshwater flows to the South Bay are limited to seasonal flows from Guadalupe River and other streams. Throughout the year, the largest flows into South Bay are treated waters from the San Jose/Santa Clara County Water Pollution Control Plant (Okamoto and Wong 2011). Water circulation and fresh inflows are so limited that this bay is considered a lagoon-like, estuarine backwater.

The estuary's tidal cycle is mixed semidiurnal, resulting in two cycles each day. The average height of the higher tide is called extreme high tide, or local mean higher high water (MHHW), while the average of the high tides is called high tide, or local mean high water (MHW). Extreme low tide or mean lower low water (MLLW) and low tide or mean low water (MLW) refer to the average height of the lowest tide and the average of all low tides, respectively. Mean tide level (MTL) lies midway between MHW and MLW. Tidal highs and lows in the bay vary with time of day, the position of the moon, season, and distance from the Pacific Ocean. The relative height covered by these tidal datums have important implications for shoreline habitat.

### *Habitats of the San Francisco Bay Estuary*

The habitats in the estuary are dynamic and can be influenced by seasonal flooding, extreme tides, drought, and human activity. Characteristics of the biotic communities at each habitat are found in Table 4.2-1. Figure 4.2-2 depicts habitat distribution in the estuary.




F:\Maps\Amorco\Biological Resources\mxd\Figure 4-2-1 - Baylands Habitat.mxd

**Figure 4.2-1 Bayland Habitat**
California State Lands Commission
*Amorco Marine Oil Terminal*
*Lease Consideration Project*

TRC

8/21/2013

**Habitat Type**

| | |
|---|---|
| Shallow Bay | Diked Marsh |
| Deep Bay | Agricultural Bayland |
| Tidal Flat | Salt Pond |
| Old Tidal Marsh | Filled Baylands |
| Tidal Marsh | |

DATA: SFEI

N

1:500,000

1 inch = 8 miles

0 19,000 38,000 ft

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1 **Table 4.2-1: Biotic Communities of the San Francisco Bay Estuary[1]**

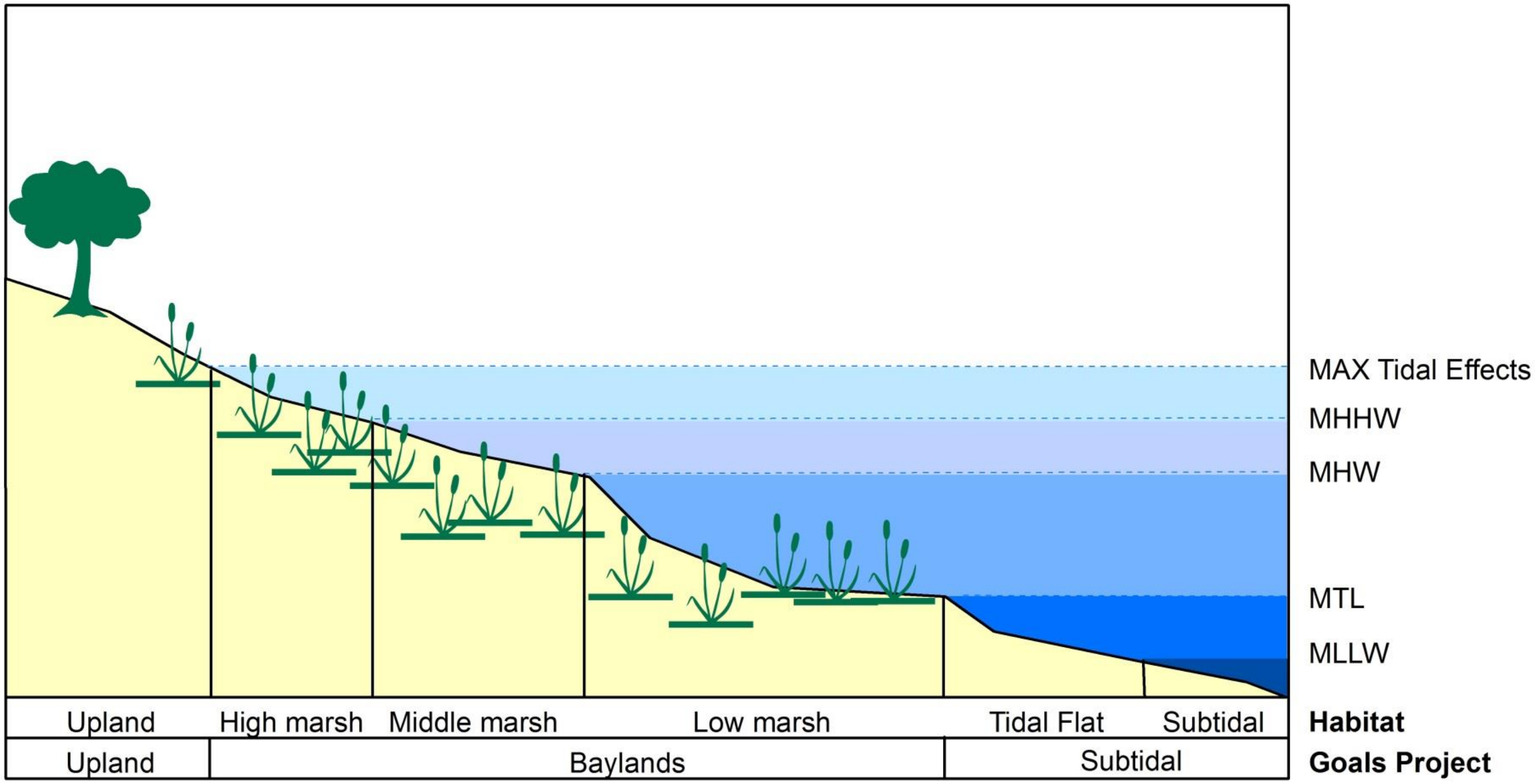
| Community | Locations & Examples | Characteristic Plants | Characteristic Animals |
|---|---|---|---|
| Diadromous | Open waters of the San Francisco Bay Estuary, Sacramento and San Joaquin Rivers, Napa River | N/A | Chinook salmon (*Oncorhynchus tshawytscha*), steelhead (*Oncorhynchus mykiss*), delta smelt (*Hypomesus transpacificus*), longfin smelt (*Spirinchus thaleichthys*), striped bass (*Morone saxatilis*) |
| Limnetic | 0 – 0.5 ppt[2] salinity. Sacramento River, San Joaquin River | Sago pondweed (*Potomogeton pectinatus*) | Asian clam (*Corbicula fluminea*) |
| Oligohaline | 0.5 – 5.0 ppt salinity. Suisun Bay | Widgeon grass (*Ruppia maritime*) | California bay shrimp (*Crangon franciscorum*) |
| Mesohaline | 5.0 – 18.0 ppt salinity. Suisun Bay, Carquinez Strait | Widgeon grass (*Ruppia maritime*) | Overbite clam (*Corbula amurensis*), Oriental shrimp (*Palaemon macrodactylus,* starry flounder (*Platichthys stellatus*) |
| Polyhaline | 18.0 – 30.0 ppt salinity. Carquinez Strait, San Pablo Bay, South Bay | *Ulva, Gracilaria pacifica, Fucus, Sargassum muticum,* eelgrass (*Zostera marina*) | Blacktail bay shrimp (*Crangon nigricauda*), Dungeness crab (*Metacarcinus magister*), Pacific herring (*Clupea pallasii*), Pacific staghorn sculpin (*Leptocottus armatus*), English sole (*Parophyrys vetulus*) |
| Euhaline | 30.0 – 35.0 ppt salinity. Central Bay | *Ulva, Gracilaria pacifica, Fucus, Sargassum muticum,* eelgrass (*Zostera marina*) | Blackspotted bay shrimp (*Crangon nigromaculata*), leopard shark (*Triakis semifasciatai*), bat ray (*Myliobatis californica*), Pacific sardine (*Sardinops sagax*), northern anchovy (*Engraulis mordax*), California halibut (*Paralichthys californicus*) |

| Community | Locations & Examples | Characteristic Plants | Characteristic Animals |
|---|---|---|---|
| Tidal flat | Along bay shore in San Mateo, Santa Clara, Alameda, Marin, Napa, Contra Costa, Solano counties | *Ulva spp., Gracilaria pacifica, Fucus spp., Sargassum muticum,* eelgrass (*Zostera marina*) | California bay shrimp (*Crangon franciscorum*), least sandpiper (*Calidris minutilla*), western sandpiper (*Calidris mauri*), willet (*Tringa semipalmata*) |
| Tidal marsh | Along bay shore in San Mateo, Santa Clara, Alameda, Marin, Napa, Contra Costa, Solano counties (e.g., Martinez marshes, Peyton Slough) | Pickleweed (*Salicornia virginica*), sea blite (*Suaeda californica*), marsh rosemary (*Limonium commune*), marsh grindelia (*Grindelia hirsutula*), California cord grass (*Spartina foliosa*) | Clapper rail (*Rallus longirostris*), marsh hawk (*Circus cyaneus*), short-eared owl, (*Asio flammeus*), salt-marsh harvest mouse (*Reithrodontomys raviventris*), vagrant shrew (*Sorex vagrans*), salt marsh fly (*Ephydra riparia*), salt marsh mosquitoes (*Aedes sqamiger, A. dorsalis*). |
| Coastal scrub | Dry rocky or gravelly slopes below 3,000 feet (e.g., steep slopes at the Amorco Terminal) | California sage brush (*Artemesia californica*), black sage (*Salvia mellifera*), coyote brush (*Baccharis pilularis*), bush monkey-flower (*Mimulus aurantiacus*). | Rufous-crowned sparrow (*Aimophila rucifeps*), rock wren (*Salpinctes obsoletus*), wrentit (*Chamaea fasciata*), brush rabbit (*Sylvilagus bachmani*), western fence lizard (*Sceloporus occidentalis*). |
| Urban shoreline | Manmade shorelines in all San Francisco Bay Area counties, San Francisco shoreline, Oakland shoreline | Himalayan blackberry (*Rubus armeniacus*), pampas grass (*Cortaderia spp.*), Bermuda grass (*Cynodon dactylon*) | House sparrow (*Passer domesticus*), rock dove (*Columba livia*), western scrub jay (*Aphelocoma californica*), domestic cat (*Felis catus*), domestic dog (*Canis lupus familiaris*), raccoon (*Procyon lotor*) |

Note: [1] Many aquatic plant and animal species may be found in more than one biotic community and inclusion as a characteristic species does not mean a species can only be found in a single habitat.

[2] Parts by weight of salt per thousand parts of water (ppt)

Sources: Smith 1959, NOAA 2007




Source: Josselyn 1983

**Figure 4.2-2: Marsh Zonation**
California State Lands Commission
*Amorco Marine Oil Terminal Lease Consideration Project*

Subtidal

Open-water habitats are divided into two categories: Shallow bay and deep bay. Shallow bays are subtidal areas less than 18 feet deep below extreme low tide; deep bay habitats are deeper. The bay contains approximately 164,000 acres of shallow bay habitat and 81,000 acres of deep bay habitat (Monroe et al. 1999). Deep bay areas are found in the Central Bay and South Bay, and along the main deep-water channel in the San Pablo and Suisun Bays. All bays contain extensive areas of shallow bay habitat.

The open waters of the bay are primarily underlain by soft-bottom bay sediments, although there are small and important areas where the substrate is either vegetated or supports shellfish beds. Areas of eelgrass habitat are found along the urban coastlines west of Richmond and Oakland. The southern shoreline of San Pablo Bay contains the most extensive areas of eelgrass beds in the San Francisco Bay Estuary. Native oyster beds are found in the same general areas as eelgrass habitats. Crushed shell substrate is found in the South Bay (SFEP 2011).

Soft-bottom substrate consists of sedimentary particles such as clay, silt, and sand that can be readily mobilized by tidal currents. This widespread substrate covers 90 percent of the San Francisco Bay Estuary (SFEP 2011). The primary sources of sediment into the San Francisco Estuary are the watersheds of the Sacramento and San Joaquin Rivers. River currents carry sediment into the estuary and deposit it onto the channel bottom, while tidal currents resuspend the fine sediment into the water column. The cyclical deposition and resuspension of fine sediments leads to sorting by grain size, where larger grain sediments are found in the channels and mud/silt/clay accretes into consolidated mudflats near shore. Soft-bottom substrates are characterized by a lack of large, stable surfaces for plant and animal attachment (National Oceanic and Atmospheric Administration [NOAA] 2007). Because of the lack of hard surfaces for rooting, few plants are associated with soft-bottom habitats. However, though mobile, the fine-grained sediment is both stable and compact enough to support a diverse benthic assemblage.

The biotic assemblages in the subtidal habitats of the San Francisco Bay Estuary vary with salinity. Species tolerant of high levels of salinity but less adaptable to variable changes in salinity are found in Central and South Bays. San Pablo Bay and Suisun Bay support brackish water and freshwater species that are more tolerant of the shifting salinity levels.

Suisun Bay is also the site of the entrapment zone, an area where suspended materials concentrate as a result of mixing by the outgoing freshwater flow from the Delta above the heavier saltwater flow from San Francisco Bay. The entrapment zone contains concentrations of suspended materials such as nutrients, plankton, and fine sediments that are often many times higher than in areas upstream or downstream of the entrapment zone (Levine-Fricke 2004). This trophically rich habitat is thought to be important for the rearing of many fish species. Its precise location between the lower Delta and Suisun Bay varies according to the strength and phase of the tides, and the level of freshwater inflow from the Sacramento and San Joaquin Rivers. High freshwater flows from the Delta push the entrapment zone west toward Carquinez Strait; low flows put it closer to the mouth of the Delta.

Tidal Flats

Tidal flat habitat is the strip of intertidal habitat located between MLLW and MTL. It is exposed twice a day during low tide. During high tide, inundated tidal flats provide foraging habitat for fish such as longfin smelt , starry flounder (*Platichthys stellatus*), and several species of sculpin. During low tide, shorebirds feed on clams, shrimp, and worms found in the exposed tidal flats. Extreme high and low tides occur between May and June and in November and December, the latter period coinciding with the time that high numbers of waterbirds migrate through the San Francisco Bay Area (Bay Area).

The most extensive areas of tidal flat are found in the South Bay and along the north shore of San Pablo Bay. About half of the bay's tidal flats are found in the South Bay, making it the region's most important area for shorebirds (Monroe et al. 1999). Tidal flats in the Central Bay are limited by shoreline development. Suisun Bay has a more narrow tidal range than the other bays and has correspondingly less tidal flat.

Tidal Marsh

Tidal marshes are defined as the vegetated habitat between MLW and extreme high water (Josselyn 1983). Though not all tidal marshes are saline, they are sometimes also called salt marshes or saline wetlands. These marshes intergrade on their bay side with tidal flats and on their inland side with freshwater marshes. Tidal marshes are highly productive biological systems. Though only a small number of vascular plant species are capable of living in these areas, they support unique and diverse communities of plants and animals. Vegetation in tidal marshes are nurseries for commercially important species and endangered species; the tidal marshes are feeding and nesting areas for birds. In recognition of the importance of the San Francisco Bay Estuary, the United States named it as its 35$^{th}$ Wetland of International Importance (Ramsar Convention on Wetlands 2013).

Birds that feed or roost in tidal marshes include herons, egrets, ducks, coots, rails, swallows, wrens, and hawks. The majority of birds that use the tidal marshes of San Francisco Bay are migratory. Shorebirds that breed in the marshes include American avocet (*Recurvirostra Americana*), black-necked stilt (*Himantopus mexicanus*), and snowy plover (*Charadrius alexandrines*). Mammals found in these areas include mice, shrews, bats, and raccoons. Lizards and snakes are commonly found here, as are frogs and toads. Tidal marshes provide nursery habitat for fish, offering protection, food, and reduced osmoregulatory stress (Josselyn 1983).

Tidal marshes can be qualitatively divided into low, middle, and high marsh based on tidal inundation (see Figure 4.2-2). Low marsh consists of the area between MTL and MHW (Monroe et al. 1999). In salt marshes, these areas are characterized by saline-tolerant plants, usually grasses, which are adapted to regular inundation. In brackish and freshwater tidal marshes, cattails (*Typha* sp.), California bulrush (*Scirpus* sp.), and alkali bulrush (*Bolboschoenus maritimus*) dominate the low marsh. Waterfowl and rails make extensive use of low marshes. Middle marsh consists of the area between MHW and MHHW. Plant species typically found in the middle marsh include bulrushes (*Scirpus* sp.), spike rush (*Eleocharis* sp.), silverweed (*Potentilla anserine*), and salt grass (*Atriplex* sp.). High marsh consists of the area between MHHW and the highest margin of the marsh. Plants found in the high marsh include pickleweed (*Salicornia* sp.), saltgrass, gumplant (*Grindelia* sp.), and alkali heath (*Frankenia salina*).

Extensive areas of tidal marsh are found in all bays except the Central Bay. Suisun Marsh, found north of Suisun Bay, is the State's largest brackish-water marsh. Most of northern San Pablo Bay is marshland, and the extent of marshland in the South Bay is rising with ongoing restoration of the area's salt ponds.

<u>Urban Shoreline</u>

Much of the historical shoreline of Central Bay has been replaced with artificial fill or structures armored with revetments, seawalls, or rip-rap. Urban land uses tend to encroach on the shoreline in urbanized areas. These areas of shoreline may be fringed with narrow bands of recently formed tidal marshes dominated by common, widespread marsh species, including a high proportion of non-native species. The shorelines of the Central Bay and the northeast and northwest shorelines of the South Bay are heavily urbanized; the south shorelines of San Pablo Bay and Suisun Bay are less intensely urbanized.

<u>Coastal Scrub</u>

California's coastal scrub communities are dominated by low-growing shrubs such as coyote brush (*Baccharis pilularis*), California blackberry (*Rubus ursinus*), and poison oak (*Toxicodendron diversilobum*). Coastal scrub provides habitat for a variety of small-mammal species such as Botta's pocket gopher (*Thomomys bottae*), California mouse (*Peromyscus californicus*), and western harvest mouse *(Reithrodontomys megalotis).* Larger mammals such as bobcat (*Lynx rufus*), coyote (*Canis latrans*), and mule deer (*Odocoileus hemionus*) may occur in or near frequent larger areas of coastal scrub communities. Bird species that frequent coastal scrub habitat include California towhee (*Melozone crissalis*), spotted towhee (*Pipilo maculatus*), white-crowned sparrow (*Zonotrichia leucophrys*), wrentit (*Chamaea fasciata*), California thrasher (*Toxostoma redivivum*), and western scrub jay (*Aphelocoma californica*). Lizards such as western fence lizard (*Sceloporus occidentalis*) and northern alligator lizard (*Elgaria coerulea*) may also occur within coastal scrub and adjacent grassland habitats.

### *Biological Characteristics of the San Francisco Estuary*

Plankton

Phytoplankton (e.g., diatoms, cyanobacteria, dinoflagellates) are photosynthesizing microorganisms that inhabit water. Phytoplankton provide a source of organic carbon and energy at the base of the food chain (Cloern 1979). Compared to other estuaries, phytoplankton primary productivity in the San Francisco Bay Estuary is relatively low. The population density of phytoplankton in the bay cycles throughout the year, with levels higher during spring in San Pablo, Central, and South Bays, and during the summer in Suisun Bay (Cloern 1979). In the northern bays, phytoplankton growth can be separated into three seasons: A spring bloom period during which water-born nitrates are available to phytoplankton; a low-productivity period in the summer when turbidity limits light penetration into the water; and a second, smaller fall bloom based on ammonium uptake (Wilkerson et al. 2006). High levels of phytoplankton (algal blooms) can cause environmental stress, affecting concentrations of dissolved oxygen and carbon dioxide, dissolved organic and inorganic substances, and pH.

Zooplankton are a diverse group that can range in size from microscopic (microplankton) to those that can be seen by the naked eye (macroplankton). This heterogeneous group includes mysid shrimp, clams, jellyfish, copepods, and crustaceans. They feed upon phytoplankton, bacteria, organic detritus, and each other.

Nonnative jellyfish are found throughout the estuary, including three hydrozoan species thought to be native to the Black Sea and one scyphozoan species thought to be introduced from Tokyo Bay. The hydrozoan species are present among the plankton from May through November, with peak abundances coinciding with warmer summer and fall temperatures. It has been suggested that jellyfish are passively spread through all low-salinity areas of San Francisco Bay via attachment to boat bottoms (NOAA 2007).

Icthyoplankton consists of fish eggs and larvae found in near-surface waters, where they float passively on water currents. Ichtyoplankton feed on microplankton and are in turn fed on by larger animals.

Invertebrates

California bay shrimp (*Crangon franciscorum*) is the most common shrimp in San Francisco Bay most years and supports a small commercial fishery. The blackspotted shrimp (*Crangon nigromaculata*) is the second most common shrimp in the San Francisco Bay overall and the most common shrimp in some years.

The San Francisco Bay Estuary is a nursery area for shrimp and crabs, and fish. The highest densities of bay shrimp are found in Suisun Bay, where juveniles rear in shallow, low saline waters (NOAA 2007). Dungeness crab (*Metacarcinus magister*) reproduce in the ocean, and the small juvenile stages settle to the bottom of the ocean where they are carried into the bay on tidal currents and spend the first year or two of their lives rearing in San Pablo and South Bays (NOAA 2007).

Different species of shrimp tend to inhabit different regions of the bay, though species do overlap in distribution. Shrimp species that live in the more saline environment of the bay have grown in abundance over the past 15 years and expanded in range into the upstream regions of the bay, particularly in dry years when saline levels increase upstream. Low-salinity species such as the bay shrimp show no increase in abundance over the past 15 years. Regionally, shrimp abundance increased in all parts of the bay except in Suisun Bay (SFEP 2011).

The abundance of shrimp and crab in the South Bay during the last 15 years is largely in response to increased nutrient availability in coastal waters. Because shrimp and crab prey on large benthic invertebrates, particularly clams, the increased numbers have led to a decline in the abundance of clams in the South Bay (Cloern 2011).

<u>Fish</u>

The health of the San Francisco Bay Estuary's fish communities varies geographically. The Central Bay fish population has been stable for 30 years, but the populations in the other bays have seen declines in health over the same period. This decline has been most dramatic for Suisun Bay, but is also apparent in San Pablo Bay and, increasingly, in the South Bay. Fish abundance, diversity, and percentage of native species have declined in all bays except the Central Bay (SFEP 2011).

Beginning in 2002, abundance indices of four pelagic fishes in the upper San Francisco Estuary declined rapidly to record low levels from which they have not recovered. Since 2004, a consortium of federal and State agencies formed the Pelagic Organisms Decline Management Team to focus attention on the causes of the decline for delta smelt, longfin smelt, threadfin shad (*Dorosoma petenense*), and juvenile striped bass (*Morone saxatilis*). The emerging conclusion from nearly a decade of research is that the decline has its roots in multiple, interacting causes, including low original population abundance, a decrease in suitable habitat, mortality from predation and entrainment into water diversions, and a fundamental shift in the food web in the upper Delta from a phytoplankton-based food web to a detritus-based food web (IEP 2010).

<u>Birds</u>

San Francisco Bay Estuary is a major stopover for birds migrating along the Pacific Flyway, and many birds also nest along the San Francisco Bay. Nearly half of Pacific Coast waterfowl and shorebirds depend upon the San Francisco Bay and its mudflats for foraging during migration, with peak abundance occurring November through mid-March (SFEP 2011). In recognition of its critical conservation importance for shorebirds, San Francisco Bay Estuary is listed as an important shorebird migratory stopover in the Western Hemisphere Shorebird Reserve Network (USFWS 2002). Migratory stopovers are wetlands and associated habitats that have high densities of food available at critical times during waterfowl and shorebird migration. These migrations are energy intensive and may include long-distance, non-stop flights of over 1,000 miles between stopover areas. Migrating flocks are large and migrations may occur in a very tight window, resulting in a large proportion of a species' entire population visiting a single site over a few weeks and requiring a vast quantity of available forage.

Waterbirds are typically classified based on habitat and foraging preference. Waterfowl are those species that depend primarily on open-water habitat for foraging and roosting, but breed in wetland and/or adjacent upland habitats. Ducks, geese, and grebes are all waterfowl. Waterfowl are further divided into dabblers and divers. Dabbling ducks, which feed at or below the surface of shallow water, have increased in Suisun and San Pablo Bays, while populations have held steady in the Central and South Bays (Pitkin and Wood 2011). Diving ducks, which feed in deeper waters, have decreased in San Pablo Bay but increased in Suisun Bay as populations of their primary prey, large invertebrates such as clams, have changed. Overall, populations of dabbling ducks have increased and winter populations of diving ducks have decreased. Seabirds such as gulls, terns, and cormorants forage and nest in many of the habitats found around the San Francisco Bay. Many species make use of human-created habitats such as piers, bridges, and the structures found at Alcatraz Island (Pitkin and Wood 2011).

Shorebirds primarily use beach, tidal flats, salt ponds, and shallow open-water habitats for foraging and roosting, and nest on beaches or adjacent upland areas. Sandpipers, plovers, and dowitchers are all examples of shorebirds. The overall status of shorebirds in tidal flats is stable. Population declines in the South Bay have been offset by population increases in San Pablo Bay. The western sandpiper (*Calidris mauri*), one of the most common species, has declined across the San Francisco Estuary, but populations of two other common species, least sandpiper (*Calidris minutilla*) and willet (*Tringa semipalmata*), have increased greatly (Pitkin and Wood 2011).

Marsh birds include species that depend on emergent marshes for foraging, nesting, and roosting. California black rail (*Laterallus jamaicensis coturniculus*) and song sparrows are examples of marsh birds. Tidal marsh bird abundance has increased in San Pablo Bay and Suisun Bay, mainly driven by increases in common yellowthroat (*Geothlypis trichas*) and California black rail populations, but has decreased in the Central and South Bays (SFEP 2011). Reproductive success of tidal marsh birds has increased in Suisun Bay but is decreasing in San Pablo Bay. In particular, San Pablo song sparrow and Suisun song sparrow populations are below the level required to sustain their populations, and are expected to exhibit long-term declines. The decrease in tidal marsh bird abundance is attributed to predators and nest flooding (Pitkin and Wood 2011).

Wading birds use emergent marsh, marsh edge, and shallow open-water habitats to forage and roost in upland areas. Locally, examples include the great blue heron, cattle egret, and great egret. Heron and many egret populations are increasing in San Pablo Bay, but there has been a decline in the nesting success for great egrets (SFEP 2011).

Mammals

San Francisco Bay Estuary's mammals are found on the shore and in the water. The most common terrestrial species found in coastal marshes include generalists such as Norway rat (*Rattus norvegicus*), house mouse (*Mus musculus*), California vole (*Microtus californicus*), and raccoon (*Procyon lotor*), which are adaptable to a wide range of habitats. Terrestrial mammals that are obligate users of marsh habitat, such as saltmarsh harvest mouse (*Reithrodontomys raviventris*), have seen drastic population declines as a result of habitat loss, and many are now listed as Threatened or Endangered by the federal and State governments.

Populations of beaver (*Castor canadensis*), river otter (*Lontra canadensis*), and sea otter (*Enhydra lutris*) were extirpated from the San Francisco Estuary by over harvesting in the 19th century. Both river otter and beaver have recently recolonized the San Francisco Estuary; river otter have been reported throughout the San Francisco Bay, including Coyote Creek in the South Bay, the Richmond Marina in the Central Bay, Martinez Marina on Carquinez Strait, and from wetlands in Suisun Bay (ROEP 2013). Beaver are now found in the marshes in north San Pablo Bay and on the lower Alhambra Creek in downtown Martinez.

The most common aquatic mammals in the San Francisco Estuary are California sea lion (*Zalophus californianus*) and harbor seal (*Phoca vitullina*) (NOAA 2007). The California sea lions are mainly males that migrate to the San Francisco Estuary to forage and establish a dominance hierarchy; female California sea lions stay south of Santa Barbara. California sea lion haul outs are found throughout the San Francisco Bay, most prominently on San Francisco's Pier 39. Harbor seals are resident breeders. Harbor seals will haul out throughout the San Francisco Bay; major haul out and pupping sites are located in the Central and South Bays at the Castro Rocks near the Richmond-San Rafael Bridge, Yerba Buena Island by the San Francisco-Oakland Bay Bridge, Corte Madera, and Mowry Slough in the South Bay.

***Nonindigenous Aquatic Species***

San Francisco Bay Estuary has been described as one of the most invaded ecosystems in North America (Cohen and Carlton 1995). Nonindigenous aquatic species dominate many parts of the San Francisco Bay, to the extent that in some locations only introduced species can be found. In 2010, the California Department of Fish and Wildlife (CDFW) collected 497 species from San Francisco Bay Estuary, of which 98 species were classified as introduced, including three newly detected species to San Francisco Bay Estuary that had likely been spread from other locations in California (OSPR 2011). The results indicate high numbers of introduced species are found in the South Bay, San Pablo Bay, and Central Bay. Suisun Bay had the lowest number of introduced species.

Nonindigenous aquatic species have been introduced to the San Francisco Bay via a number of vectors, including the deliberate introduction of species for recreational or commercial purposes. The shipping industry has been identified as one of the major vectors of nonindigenous aquatic species, and vessel biofouling and ballast water are considered the largest contributors of nonindigenous species to the San Francisco Bay (California State Lands Commission [CSLC] 2013e). Eighteen percent of established nonindigenous aquatic species are tied to vessel biofouling as the primary likely vector and 9 percent for ballast water; however, when considering established species with multiple possible vectors, 60 percent could have been introduced via vessel biofouling as one of several possible vectors, and 53 percent could have been introduced via ballast water as one of several possible vectors (OSPR 2011).

Invasive species may compete directly with native species for food or space, or prey upon native species. They can also change the food chain or physical environment to the detriment of native species. Approximately 42 percent of the species on the federal Threatened or Endangered species list are at risk primarily because of predation, parasitism, and competition from nonindigenous invasive species (OSPR 2011). One such currently pernicious invasive species is the overbite clam (*Corbula amurensis*), first found in the San Francisco Bay Estuary in 1986. Thought to have been introduced into the San Francisco Bay Estuary by ballast water discharge from a vessel, this planktivore is now so abundant that the current population is capable of filtering the estuary's water column several times a day. In some portions of the Suisun Bay floor, the clam accounts for the vast majority of biomass, and it has been implicated in the pelagic organism decline by severely reducing the availability of phytoplankton in Suisun Bay (SFEP 2004, Greene 2011).

#### *Rare, Threatened, and Endangered Species*

Owing to the diversity of habitat between embayments, the distribution and abundance of rare and sensitive species that depend on the estuarine habitat for some or all of their life cycle vary throughout the region. Each habitat supports a distinct community of sensitive species. To aid in the assessment of impacts, each category of sensitive species is summarized by embayment. Appendix D includes Tables D-1 through D-5, which provide further detailed information about each species that was considered under this assessment and their potential to be present near the Project site and impacted by the Project.

<u>Sensitive Plants</u>

Tidal habitats in the San Francisco Estuary support 12 plant species that are identified by federal and/or State agencies as endangered, threatened, or rare, or are listed by the

California Native Plant Society as status 1B or higher. The distribution of sensitive plant species varies geographically within the estuary. In general, the less urbanized the bay, the more likely it is to retain a proportion of its historical marshland and to support rare or sensitive plants (see Appendix D, Table D-1).

The Central Bay has not retained any historical tidal marsh remnants, which limits the potential for rare plants with few exceptions. Naturally occurring populations of Point Reye's bird's-beak (*Cordylanthus maritimus* ssp. *palustris*) are found along the shores of Richardson Bay, and a population was reintroduced to the Crissy Field wetlands in the Presidio. This species inhabits the high marsh or upper middle marsh zone. It is a hemiparasitic plant, meaning that although it possesses chlorophyll and is capable of limited photosynthesis, it must attach its root system to a host plant to extract water and nutrients and to reproduce. Point Reye's bird's-beak is dependent upon plants that are active in summer such as pickleweed (*Salicornia* sp.), saltgrass (*Distichlis* sp.), and fleshy jaumea (*Jaumea carnosa*), all of which are abundant in Richardson Bay. One other sensitive species is found in the Central Bay: California sea blite (*Suaeda californica*). This species is restricted to the intertidal zone of salt marshes, and was extirpated from the San Francisco Bay region in the 1960s. Since 2000, it has been successfully reintroduced at four sites in the Central Bay: Heron's Head Park at Pier 98, Pier 94, Eastshore State Park north of Oakland, and Roberts Landing near San Leandro in South Bay.

The South Bay retains fragments of historical tidal marshes at upper Newark Slough, Dumbarton Marsh, and along the Palo Alto shoreline. However, no sensitive tidal marsh or estuarine beach plants are known to remain in the South Bay. As mentioned above, one population of California sea blite was re-introduced at Roberts Landing.

San Pablo Bay has retained more of its historic tidal marshes than any other bay, and as a result supports naturally occurring populations of six rare species. Historical tidal marshes are found along the north edge of San Pablo Bay, including China Camp in San Rafael, Heerdt Marsh by Corte Madera, most of Petaluma Marsh, Whittell Marsh by Point Pinole, and areas of Napa marsh, including Fagan's Slough. The richest diversity of sensitive plants is found in the marshes at the mouths of the Petaluma and Napa Rivers.

San Joaquin spearscale (*Atriplex joaquinana*) is a tall annual herb known mainly from alkali grasslands and is only rarely known from tidal marsh edges where it may opportunistically colonize the high-tide shorelines. Recent populations are reported from along the lower Napa River. Saline marsh clover (*Trifolium hydrophilum*) is known to occur in marshes as well as alkaline grasslands. One population is known from the Viansa wetlands in northwest San Pablo Bay. The upper marsh zone of San Pablo Bay's brackish and freshwater marshes supports populations of endemic species known only to San Francisco Bay Estuary: Suisun marsh aster (*Symphyotrichum lentum*), delta tule pea (*Lathyrus jepsonii* var. *jepsonii*), and Mason's lilaeopsis (*Lilaeopsis masonii*). Suisun marsh aster was once widely distributed in San Pablo Bay, but is reported now only from the vicinity of Fagan Slough. The delta tule pea is a climbing species; individuals are present in marshes along the Napa River. Mason's lilaeopsis (*Lilaeopsis masonii*) is also known from the Napa River corridor; it is a shade-sensitive, early successional colonizer of newly deposited or exposed sediments. Two species of bird's-beak are found in the upper marsh zone in San Pablo Bay: Point Reye's bird's beak and the federally endangered soft-bird's beak (*Cordylanthus mollis* ssp*. mollis*). One population of Point Reye's bird's-beak is known from the Petaluma River. Extant populations of soft bird's-beak are found in the marshes along the mouth of the Napa River.

Most of the sensitive plants found in San Pablo Bay are also found in Suisun Bay, where they are more widely distributed and abundant, particularly in the extensive brackish waters of Suisun Marsh. In addition to the plants described above, Suisun Bay contains populations of the federally endangered Suisun thistle (*Cirsium hydrophilum* var. *hydrophilum*) in the northern reaches of Suisun Marsh in the vicinity of Rush Ranch. Bolander's water-hemlock (*Cicuta maculata* var. *bolanderi*) was once common in Suisun Marsh.

<u>Sensitive Fishes</u>

The San Francisco Estuary provides habitat to seven species of sensitive fish. Most of the sensitive fish species in the estuary either rely on brackish water habitat for their adult habitat and/or travel upstream to spawn in freshwaters and have thus been affected by degradation or removal of spawning habitats, entrainment by the State water projects, drought, pollution, predation, disruption of the food web and direct competition for space with and predation by non-indigenous aquatic species. The discussion below summarizes the distribution of sensitive species in the estuary; Table D-2 in Appendix D provides more detailed information for each species. Sensitive fish species are found mainly in the north bays. All sensitive fish species of the San Francisco Estuary have the potential to be impacted by a crude oil spill. Suisun Bay is home to two native species of "true" estuarine fish, i.e. fish that spend all their lives in estuaries: delta smelt and Sacramento splittail (*Pogonichthys macrolepidotus*). Both species are endemic to the Delta, and both travel into fresh water to spawn. Delta smelt are found in greatest abundance in shallow, turbid waters at the freshwater edge of the entrapment zone where they feed on plankton; Sacramento splittail are found mainly along the benthos of small, shallow, turbid sloughs lined with emergent vegetation, where they feed on macroinvertebrates and detritus. The delta smelt population is listed as threatened at the federal level and endangered by the State. As of 2010, populations of the splittail were considered stable by the United States Fish and Wildlife Service (USFWS), which found its listing was not warranted, but the species remains a CDFW species of special concern, and it is a targeted species of the Delta Stewardship Council (USFWS 2010).

Four anadromous species are found in the San Francisco Bay: longfin smelt, chinook salmon (*Oncorhynchus tshawytscha*), steelhead trout (*Oncorhynchus mykiss*), and the Southern Distinct Population of green sturgeon (*Acipenser medirostris*). Longfin smelt are primarily estuarine, though they are found in small numbers in the coastal waters beyond the Golden Gate Bridge. In summer, adults congregate in the cooler waters and deep-water habitats of the Central Bay, where they feed on zooplankton such as the opossum shrimp, *Acanthomysis* sp., and *Neomysis mercedis* when available and on copepods otherwise (Hobbs 2006). They migrate upstream in fall to spawn in the limnetic and oligohaline waters of the Delta. Populations have declined steadily over the past two decades (Rosenfeld and Baxter 2007).

Chinook salmon are born in fresh water and migrate into the Pacific Ocean to mature, reaching maturity between 2 and 5 years of age. They migrate into freshwater streams to spawn, after which they die. Their eggs incubate for several months. Upon hatching, fry undergo physiological changes in preparation for migration and enter the smolt stage. Most chinook smolt migrate to the ocean within a few months of hatching, though some may remain in fresh water for a year. Peak out-migrations are between April and June.

The Sacramento-San Joaquin River basin runs of chinook salmon are differentiated into four runs by their time-of-spawning migrations: Fall-run, late fall-run, winter-run, and spring-run. Fall-run chinook migrate upstream from July to November, late fall-run migrate October to February, winter-run migrate December to April, and spring-run migrate April to July. The Delta is a nursery area for all runs of chinook salmon. Winter-run chinook, the young of which out-migrate during the driest times of the year, are listed as critically endangered at both the federal level and by the State. Spring-run salmon are listed as threatened at both federal and state levels.

A close ally to salmon, the steelhead is an anadromous kind of rainbow trout. They migrate into the estuarine river basins from October to April and spawn from December to May. Populations that spawn eastward to the Napa River are listed as threatened at the federal level. This includes runs in San Pablo Bay's Napa River, Petaluma River, and Sonoma Creek, and the South Bay's Guadalupe River.

Green sturgeon may be found throughout the Central, San Pablo, and Suisun Bays. Adults are primarily marine, but enter the estuary to feed or migrate to spawning grounds. Juveniles rear in the northern bays for 1 to 4 years before joining the more marine adults. Sturgeon are benthic feeders, feeding mainly on shrimp and crabs.

<u>Sensitive Birds</u>

San Francisco Bay Estuary's sensitive birds are generally obligate inhabitants of tidal marshes, and have experienced population declines as a result of the removal and degradation of marsh habitat. Thus, the Central Bay, which possesses few tidal marshes, has few populations of sensitive birds (see Appendix D, Table D-3).

Many sensitive species such as California clapper rail (*Rallus longirostris obsoletus*) and California black rail are widely distributed throughout the bays. Others are subspecies known from single embayments: The Suisun song sparrow (*Melospiza melodia maxillaris*) is found in Suisun Bay, the San Pablo song sparrow (*Melospiza melodia samuelis*) in San Pablo Bay, and the Alameda song sparrow (*Melospiza melodia pusillula*) in the South Bay. California least tern (*Sterna antillarum browni*) is known to nest in the South Bay and along the southern shore of Suisun Bay. Western snowy plover (*Charadrius nivosus* ssp. *nivosus*) also nests in the South Bay, as well as in the San Pablo Bay marshes.

Colonial nesters found in the estuary include double-crested cormorant (*Phalacrocorax auritus*), great blue heron (*Ardea herodias*), great egret (*Ardea alba*), black-crowned night-heron (*Nycticorax nycticorax*), and snowy egret (*Egretta thula*). Double-crested cormorant colony nest sites are found under the bridges that divide the bays and on large electric transmission structures in the South Bay. Heron rookeries, which may consist of several heron and egret species, are found throughout the Bay Area.

<u>Sensitive Mammals</u>

Tidal marshes in the San Francisco Estuary support four sensitive mammalian species, while seven mammalian species use the aquatic habitats of the estuary. Additionally, three species of bats forage over tidal marsh and estuarine waters (see Appendix D, Table D-4).

Many of the sensitive mammals of the tidal marsh habitats are small rodents: Suisun ornate shrew (*Sorex ornatus sinuosus*), saltmarsh wandering shrew (*Sorex vagrans halicoetes*), the federally endangered saltmarsh harvest mouse, and the San Pablo vole (*Microtus californicus sanpabloensis*) all weigh less than an ounce at adult size. Where present, they are prey species for higher order predators. Both shrews are insectivorous, while the mouse and vole are vegetarian. The endemic saltmarsh harvest mouse is generally restricted to tidal marsh habitats. It is found throughout the estuary, albeit in low numbers due to habitat destruction and degradation. The saltmarsh wandering shrew is found in the South Bay, while the Suisun ornate shrew is found in Suisun Bay. The San Pablo vole is known only from a small region in the vicinity of Wildcat Creek, on the southeast shore of San Pablo Bay.

Seven marine mammal species are known to migrate, forage, and rest in the San Francisco Bay. Gray whale (*Eschrichtius robustus*) and humpback whale (*Megaptera novaeangliae*) occasionally enter the Central Bay to feed during seasonal migrations. The harbor porpoise (*Phocoena phocoena*) is another visitor to the Central Bay. Harbor seal and California sea lion both venture as far upstream as Suisun Bay, but in general marine mammals prefer the deep, cold waters of the Central Bay.

The big free-tailed bat (*Nyctinomops macrotis*) has been collected in Martinez. Hoary bat (*Lasiurus cinereus*) has been observed in Suisun Marsh, but is more widely distributed in the South Bay. The pallid bat (*Antrozous pallidus*) has been collected in the Central, South, and San Pablo Bays. The distribution of these species and their use of estuarine habitats has not been well described.

<u>Sensitive Amphibians and Reptiles</u>

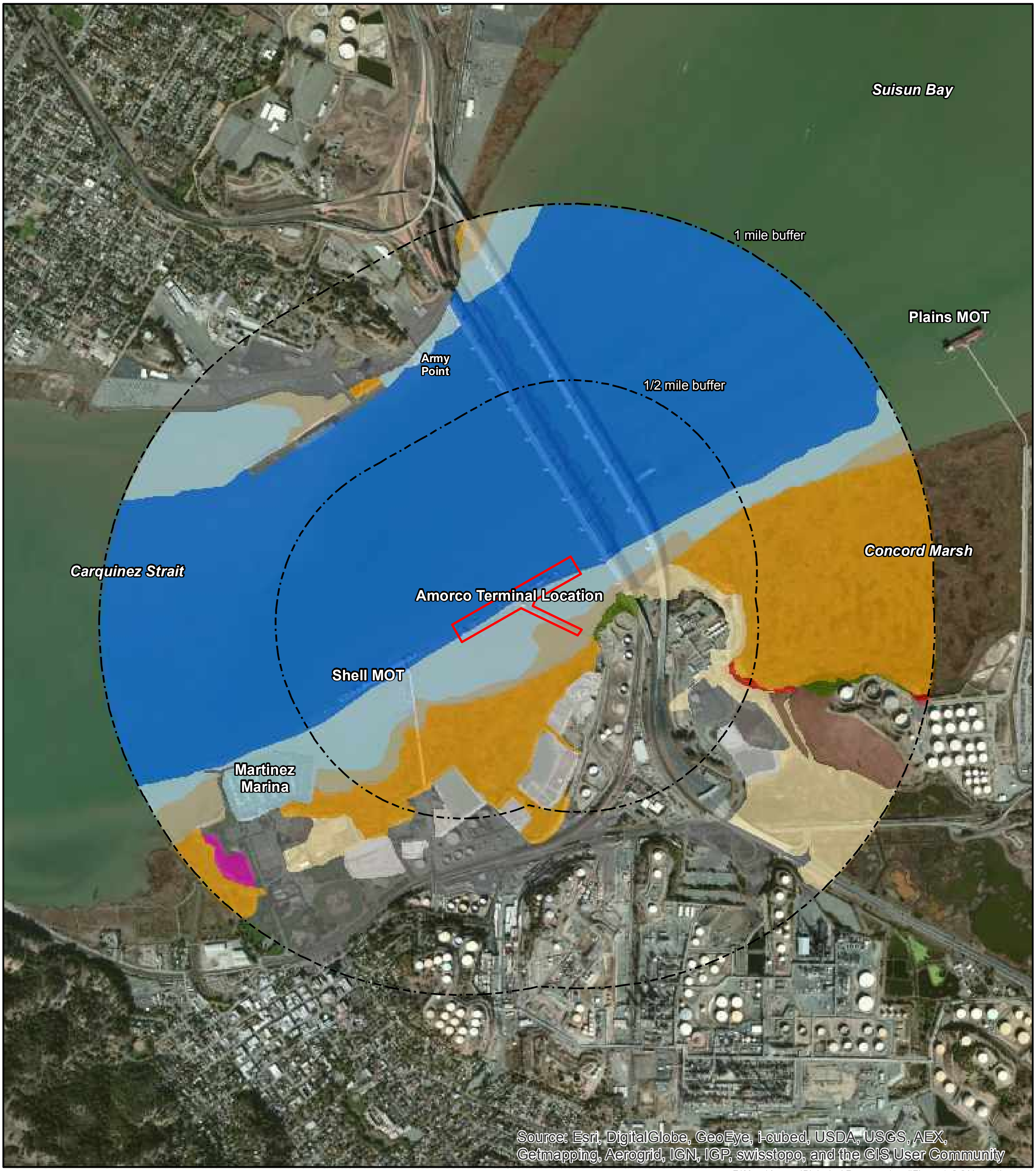
The San Francisco Bay Estuary supports only a handful of sensitive amphibians and reptiles (see Appendix D, Table D-5). Both California red-legged frog (*Rana draytonii*) and western pond turtle (*Actinemys marmorata*) are distributed in low numbers throughout the San Francisco Bay (CDFW 2013c). These species prefer freshwater ponds and streams, but are tolerant of limited saltwater intrusion and are documented from brackish marshes in San Pablo and Suisun Bays. California red-legged frogs appear to be eliminated from the western lowland portions of Contra Costa and Alameda counties (west of Highway 80 and 880, particularly in urban areas). California tiger salamanders, which are found in grasslands and vernal pools, are known only from the Don Edwards National Wildlife Refuge in the South Bay (CDFW 2013c).

### 4.2.1.2 Project Study Area

The Project study area includes lower Suisun Bay and upper Carquinez Strait, including vegetation at the Amorco Terminal lease area and along the shoreline within a 0.5-mile radius of the Amorco Terminal, as well as known habitats of rare, threatened, or endangered plant or animal species within a 1-mile radius of the Amorco Terminal (see Figure 4.2-3). Table D-6 in Appendix D includes a matrix depicting habitat use by wildlife found in the Project study area.

#### *Characteristics of the Project Study Area*

The Project is located on the eastern end of the Carquinez Strait in northern Contra Costa County on 16.6 acres of public land leased from the CSLC (proposed to be 14.9 acres as part of a new lease), approximately 300 feet west of the Benicia-Martinez Bridge. The lease extends approximately 1,300 feet into the Strait.




F:\Maps\Amorco\Biological Resources\mxd\Figure 4_2-2 Vegetation.mxd

**Figure 4.2-3 Vegetation and Habitat**
California State Lands Commission
*Amorco Marine Oil Terminal*
*Lease Consideration Project*

TRC

9/3/2013

Terminal Boundary
Buffer

**Habitat**

- Deep Bay
- Shallow Bay
- Lagoon
- Tidal Flat
- Tidal Marsh
- Old Tidal Marsh
- Diked Marsh
- Ruderal
- Coastal Scrub
- Storage or Treatment Basin
- Filled Baylands

N

1:24,000

1 inch = 2,000 feet

0 900 1,800 ft

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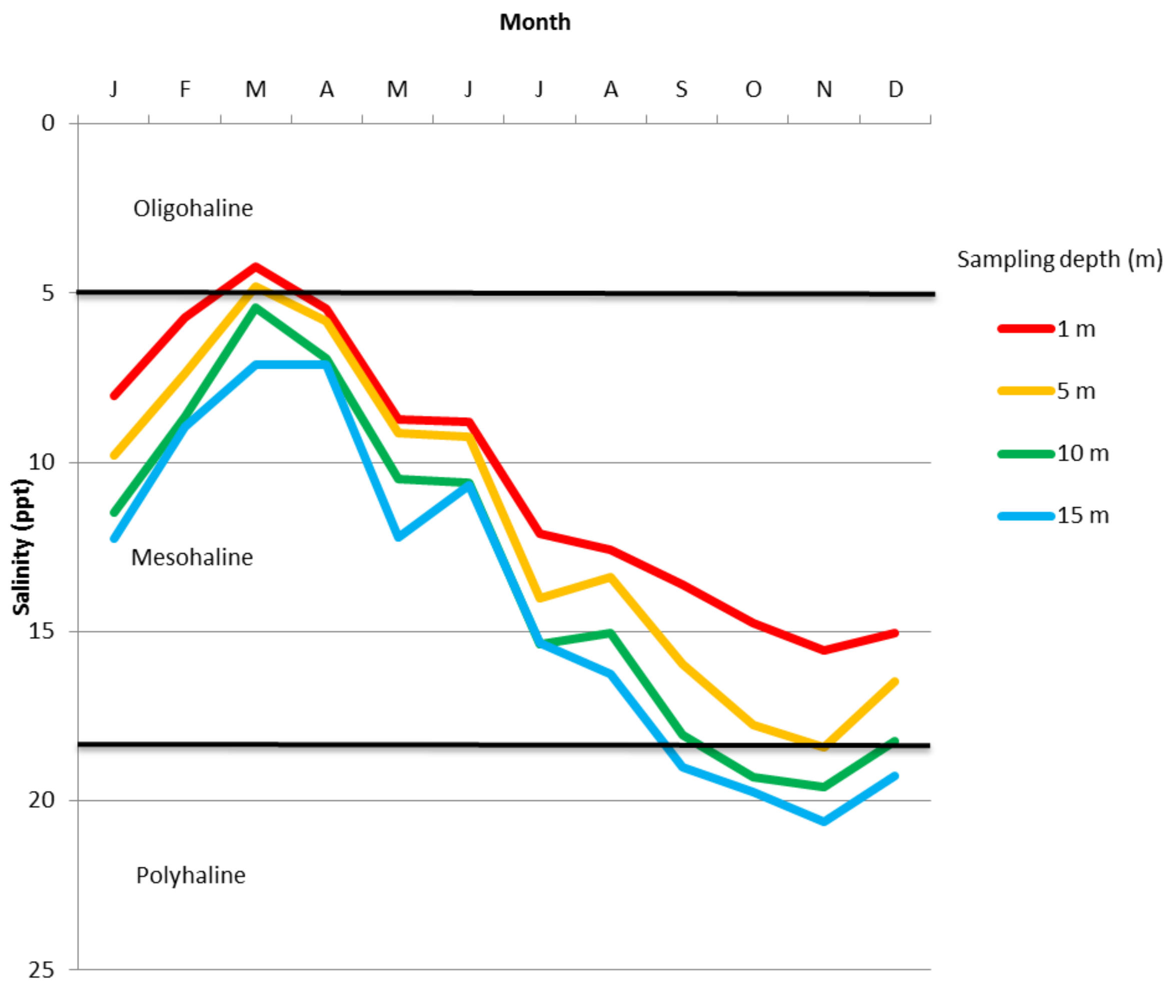
Water depths in the lease area range from 15 meters at the lease edge to 3 meters along the dock. The benthic substrate consists of soft bay sediments over bedrock, also known as mudstone.

Land use in the vicinity of the Amorco Terminal is a mosaic of industrial and open space. Coastal brackish marsh is present along the shoreline between Bulls Head Point to the east and the Martinez Marina to the west of the Amorco Terminal. Upland areas associated with the marshlands are given over to industrial use with the exception of a small patch of coastal scrub/ruderal vegetation found on the hillside leading up to the Amorco Tank Farm. Directly west of the Amorco Terminal, Hanson Sand Mining has a floating pipeline used to transfer sand slurry from vessels to the shore. The Shell Martinez Marine Terminal is approximately 500 feet west of the Amorco Terminal. The channel north of the Amorco Terminal is about 4,000 feet wide and is bordered by the Port of Benicia and Valero's Benicia Refinery.

Carquinez Strait is a narrow gap in the Coast Range that connects the San Pablo Bay to Suisun Bay and the Sacramento-San Joaquin River Delta. Typical river deltas widen from their source into a fan-shaped, sediment-heavy region. The narrow channel in the Carquinez Strait, however, restricts the outflow of flood waters and sediment from the Central Valley to the ocean, causing waters to pool and sediment to slow and settle in Suisun Bay, and resulting in a rare geological feature known as an inverted river delta. Upstream of the strait, the channel depth transitions rapidly from the deep channel of Carquinez Strait into the shallows of Suisun Bay. This area of bathymetric change is known as the Garnet Sill.

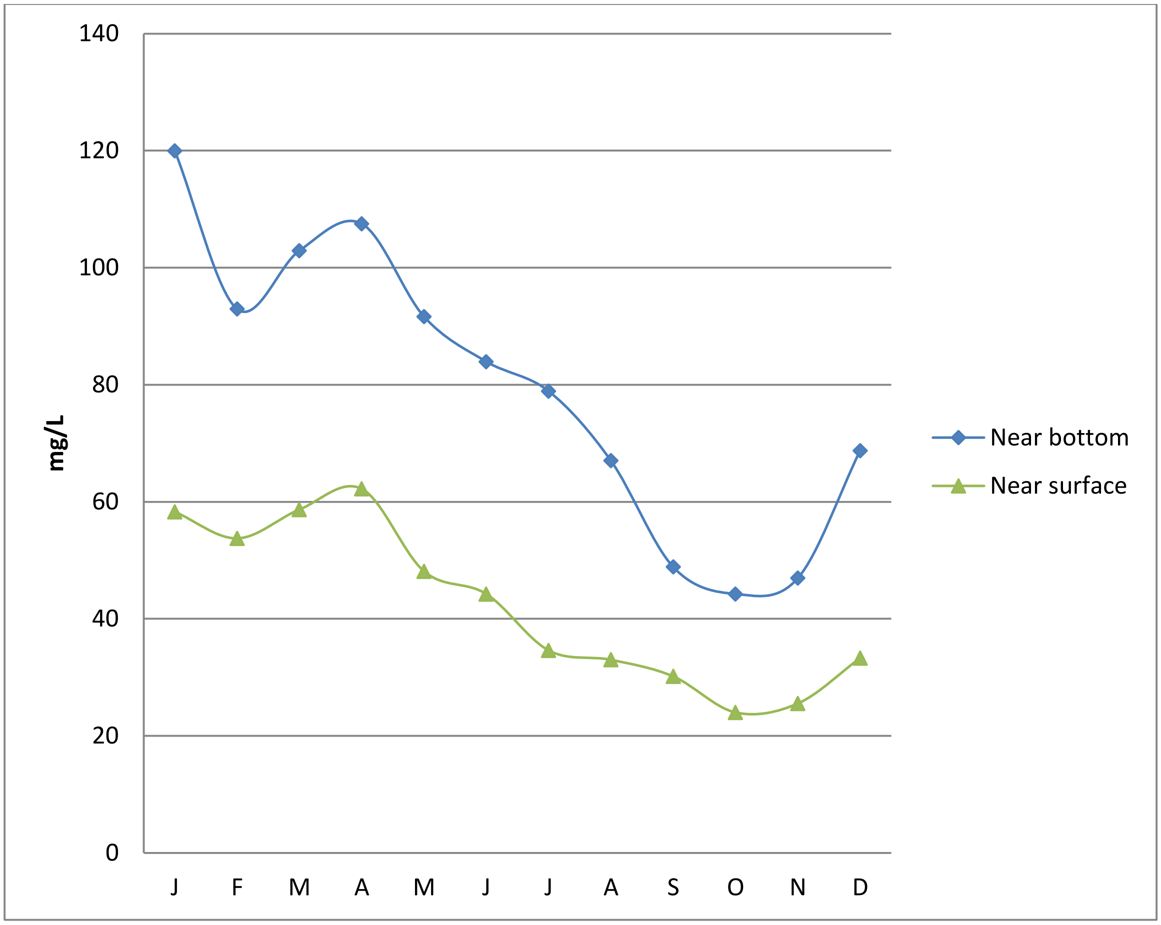
The Garnet Sill is the upstream endpoint of a gravitational circulation cell that forms in response to strong tidal currents that carry salt water upstream along the bottom of the channel while fresh water flows seaward along the top of the channel. Salinity in the water column in Carquinez Stratit is stratified by depth, with fresh water along the surface and saline waters along the bottom (see Figure 4.2-4). Salinity stratification is greatest during neap tides. Following winter storms, the surface waters reach their lowest levels of salinity, and for a brief time, the upper five meters of the channel become oligohaline. Once the winter floods have stopped, the channel waters quickly become mesohaline and then slowly polyhaline.

The area where upstream and downstream currents meet and cancel each other out is known as the null zone; in Carquinez Strait, this zone typically forms near the strait's upper end, downstream of the Garnet Sill. During spring tide, the strait is the site of the San Francisco Bay estuarine turbidity maxima; during neap tide, the estuarine turbidity maximum is found upstream at Middle Ground (Schoellhamer 2002). Suspended sediment concentration (SSC) is greater near the bottom of the channel than higher in the water column. SSCs are seasonally dependent and are at their highest in the winter and spring, and decrease through summer to fall lows (see Figure 4.2-5).




Source: USGS 2001

**Figure 4.2-4: Salinity Stratification in Carquinez Strait**
California State Lands Commission
*Amorco Marine Oil Terminal Lease Consideration Project*




Source: USGS 2007

**Figure 4.2-5: Average Suspended Sediment Concentration at Benicia Bridge, 2003-2007**
California State Lands Commission
*Amorco Marine Oil Terminal Lease Consideration Project*

Note: Benicia Station is located approximately 0.6 mile north of the Amorco Marine Oil Terminal. Data from this site are considered representative of suspended-solids concentration in the strait.

### Terminal Structures

The Amorco Terminal consists of a 1,130-foot-long wharf arm connected to the shore by 1,500 feet of approach trestle. The Amorco Terminal is constructed of wood, concrete, and metal. The wharf has four small buildings on-site, including two buildings for personnel, a pump house, and a tool shed. Lights are placed regularly along the wharf arm and approach trestle, and there is one large light bank under the main loading arm.

The Amorco Terminal provides shade and refuge areas for fish, and resting spots and foraging opportunities for fish, birds, and marine mammals. The Amorco Terminal also provides nesting habitat for some bird species, including a pair of osprey (*Pandion haliaetus*) that have successfully fledged offspring from a nest atop the main loading arm since 2009 (Jim Herron pers. comm.). Support pilings provide attachment areas for sessile invertebrates and a place for fish to spawn.

### Subtidal

The water column consists of the area between the benthos and the water surface. The water column contains both channels, which are areas with strong currents and a deep rounded bottom, and shoals, or shallow weak-current areas. Channels provide a connection between marine and freshwater ecosystems, while shoals function as collection areas for sediment and detritus. In San Francisco Bay Estuary, areas of the water column less than 18 feet deep are considered shallow bay; areas deeper than 18 feet are considered deep bay. Approximately 238 acres of shallow bay and 1,097 acres of deep bay are found within 1 mile of the Amorco Terminal. The lease area includes 5.00 acres of shallow bay and 8.93 acres of deep bay. These habitats provide foraging areas for invertebrates, fish, diving birds, and marine mammals, and nursery and spawning habitat for invertebrates and fish.

Compared to other parts of the San Francisco Bay, the Carquinez Strait is not particularly rich in phytoplankton (USGS 2013a). Phytoplankton productivity is generally calculated from measurements of chlorophyll α. Chlorophyll α concentrations below about 10 micrograms per liter are known to cause food-limited declines in zooplankton reproduction. Measurements of water quality in the Carquinez Strait from 2003 to 2013 show that chlorophyll α levels in the strait rarely exceed this threshold in either spring or fall (USGS 2013).

The benthic substrate at the Project site consists of soft bay sediments over bedrock, also known as mudstone. Because of the lack of hard surfaces for rooting, few plants are associated with soft-bottom habitats. However, though mobile, the fine-grained sediment is both stable and compact enough to support a diverse benthic assemblage. The biotic assemblage associated with this habitat is known as the benthos. The benthos consists of bacteria and animals that live in (infauna), on (epifauna), or near (demersal) the bottom of the water channel.

Salinity levels along the substrate are generally polyhaline in summer and fall and mesohaline in the winter and spring, leading to fluxation on the benthic habitat and community composition.

The most common benthic species observed at the Amorco Terminal is *Corbula amerensis* (see Table 4.2-2).

**Table 4.2-2: Common Benthic Invertebrates in Carquinez Strait**

| Species | Status | Group | Salinity | Habitat | Relative Frequency |
|---|---|---|---|---|---|
| *Ampelisca abdita* | I | amphipod | polyhaline | channel, shallow subtidal | common, persistent |
| *Ascidia zara* | I | tunicate | polyhaline | hard bottom substrate | common, persistent |
| *Corbula amurensis* | I | bivalve | oligohaline, mesohaline, polyhaline | channel, channel edge, shallow subtidal | common, persistent |
| *Gemma gemma* | I | bivalve | polyhaline | shallow subtidal | common, persistent |
| *Grandidierella japonica* | I | amphipod | mesohaline | channel edge | persistent in low numbers |
| *Heteromastus spp.* | U | polychaete | mesohaline, polyhaline | channel, shallow subtidal | persistent in low numbers |
| *Macoma petalum* | I | bivalve | polyhaline | shallow subtidal | low numbers, persistent |
| *Monocorophium acherusicum* | I | amphipod | polyhaline | shallow subtidal | sporadic |
| *Arcuatula senhousia* | I | bivalve | polyhaline | channel, shallow subtidal | low numbers, persistent |
| *Mya arenaria* | I | bivalve | polyhaline | channel, shallow subtidal | common, persistent |
| *Alitta succinea* | I | polychaete | polyhaline | channel | low numbers, persistent |
| *Nippoleucon hinumensis* | I | cumacean | mesohaline, polyhaline | channel, channel edge, shallow subtidal | persistent in low numbers in the channel, and peaks in spring/summer at channel edge |
| *Polydora cornuta* | C | polychaete | polyhaline | channel | low numbers, persistent |
| *Streblospio benedicti* | I | polychaete | polyhaline | channel | low numbers, persistent |

Sources: NOAA 2007, Rowan et al. 2011
Status: I = Nonindigenous; U = Unresolved; C = Cryptogenic

### *Tidal Flat*

A narrow band of tidal flat habitat is located between the shallow waters of the San Francisco Bay and shoreline marsh areas. The Amorco Terminal lease includes approximately 0.96 acre of this habitat; approximately 77 acres are found within 1 mile of the Amorco Terminal. The tidal flats at the Amorco Terminal are comprised of mudflats, which are formed of fine-grained silts and clays, and typically support a diverse community of diatoms, worms, shellfish, and algal flora. These creatures are prey for a wide variety of birds and fish. Wading birds known to use the tidal flats for forage during low tide include western sandpiper, least sandpiper, willet, and dunlin (*Calidris alpina* ) (eBird 2012). Harbor seals are also known to frequent tidal flats. Other species such as white pelican (*Pelecanus erythrorhynchos*) rest on the tidal flats between fishing expeditions. During high tide, the flats provide foraging areas for fish, including longfin smelt.

***Tidal Marsh***

Approximately 432 acres of tidal marsh are found within 1 mile of the Amorco Terminal, mainly along the southern shore of the Carquinez Strait where they are surrounded by heavy industry. The marshes are composed primarily of low/middle tidal brackish marsh, muted tidal brackish marsh, and diked brackish marsh. Small, discrete areas of high tidal marsh occur along the north shore of Carquinez Strait and at the southern edge of the Concord Marshes.

Tidal brackish marsh is found along the southern edge of the Carquinez Strait east of the Benicia-Martinez Bridge and west of the Martinez Marina. East of the bridge, the predominantly low/middle marsh plain extends up to 3,000 feet from the edge of the tidal flat; west of Martinez Marina, the marsh plain is approximately 1,000 feet wide and abuts an area of muted tidal brackish marsh. A narrow band of high marsh is found at its southern edge. Muted tidal brackish marsh is found west of the Carquinez Bridge, where the marsh plain varies in width between 300 and 1,500 feet. Both marsh plains are fairly level. Their tidal channels are a combination of straight channels superimposed on the marsh for drainage or mosquito control and linear dendritic in areas closest to shore. The dominant species present are common reed (*Phragmites australis*), cattails, California tule (*Schoenoplectus californicus*), broad-leaf pepperweed (*Lepidium latifolium*), pickleweed (*Salicornia pacifica*), Baltic rush (*Juncus balticus*) and gumplant.

The muted tidal marsh adjacent to the Amorco Terminal provides habitat for a variety of rare, threatened, and endangered species. California clapper rail was detected during a 2008 survey of the marsh but appeared to be foraging rather than breeding; California black rail forage and breed in the marsh (WRA 2011). Based on habitat quality and survey results from adjacent marshes, saltmarsh harvest mouse are presumed to inhabit this marsh. Several rare plants have potential to be found in the marshes, including soft bird's-beak, delta tule pea, Mason's lilaeopsis (*Lilaeopsis masonii*), and Suisun thistle.

Diked brackish marsh is found adjacent to both the tidal brackish marsh and the muted tidal marsh. Diked marshes may provide important habitat for a variety of wildlife, especially waterfowl, shorebirds, and small mammals. They may provide high-tide refugia for small mammals and roosting habitat for shorebirds.

### *Lagoon*

A 6-acre lagoon is located at the Martinez Marina approximately 0.75 mile from the Amorco Terminal. Lagoons support the same species of aquatic invertebrates and fish found in shallow bays and tidal channels, and provide feeding and resting areas for water birds. They may also provide protected areas that facilitate early colonization by nonindigenous aquatic species (Monroe et al. 1999).

### *Special-status Habitats*

Critical Habitat

The Project is located within critical habitat for delta smelt (59 Federal Register 242), the southern Distinct Population Segment (DPS) of green sturgeon (74 Federal Register 195), winter-run chinook salmon, Central Valley steelhead, and Central California coastal steelhead (70 Federal Register 170).

Primary constituent elements (PCEs) for the delta smelt that are located within the vicinity of the Project include the physical habitat, water, river flow, and salinity concentrations required to maintain delta smelt habitat for (1) larval and juvenile transport, (2) rearing habitat, and (3) adult migration. Because of the fluid nature of the Delta's hydrology, the quality of the PCEs for the delta smelt fluctuate within the designated area. The final ruling on the critical habitat identifies marina construction as activities that, depending on the season of construction and scale of the Project, might result in destruction or adverse modification of critical habitat that could jeopardize the continuing existence of the delta smelt and that would require consultation with the USFWS.

PCEs for the southern DPS of the green sturgeon in the estuary include food resources for all life stages, water flows, water quality, migratory corridors, channel depths, and sediment quality. Dredging, in-water construction, National Pollutant Discharge Elimination System activities, commercial shipping, and habitat restoration are identified in the final critical habitat rule as activities that may affect one or more PCEs through alteration of the physical parameters of the estuary.

The Amorco Terminal is located in critical habitat for steelhead. Critical habitat for steelhead includes the Sacramento River from Keswick Dam in Shasta County to Chipps Island, and all waters downstream of Chipps Island and north of the San Francisco-Oakland Bay Bridge.

California Department of Fish and Wildlife Natural Communities

The California Natural Diversity Database shows two natural communities within and adjacent to the lease area: Coastal Brackish Marsh and Northern Coastal Salt Marsh (CDFW 2013c). Coastal Brackish Marsh is found along the shoreline at the Amorco Terminal. The Coastal Brackish Marsh is dominated by perennial, emergent, herbaceous monocots that create a dense cover up to 2 meters tall. The Amorco Terminal is located approximately 0.3 mile east of Northern Coastal Salt Marsh. Due to the saline and semi-aquatic environment, plant species diversity in these types of marshes is typically low. Plant species are stratified by salinity levels. Both marsh types support a diverse biotic assemblage and provide nursery grounds for numerous organisms, including fish, mammals, and birds (CERES 1996).

## 4.2.2 REGULATORY SETTING

Federal and State laws that may be relevant to the Project are identified in Table 4-1. Regional and local laws, regulations, and policies are discussed below.

***National Estuary Program, Comprehensive Conservation and Management Plan***

The San Francisco Estuary Project is a federal-state-local partnership established in 1987 under the CWA Section 320: National Estuary Program. The 1993 plan was mandated under a reauthorization of the CWA in 1987, and revised in 2007. This plan is administered by the San Francisco Estuary Project Implementation Committee.

***Contra Costa County***

The Amorco Terminal abuts marshes along the shoreline between the Martinez waterfront and the Concord Naval Weapons Station, an area that has been identified in the *Contra Costa County General Plan* (2005) as a Significant Ecological Resource Area. The general plan contains goals and policies to recognize and protect sensitive and significant ecological resources.

## 4.2.3 IMPACT ANALYSIS

### 4.2.3.1 Significance Criteria

For the purposes of this analysis, an impact was considered to be significant and to require mitigation if it would result in any of the following:

- Substantially affect threatened or endangered species, or protected species (including candidate, sensitive, or special-status species)
- Alter or diminish critical habitat or a special biological habitat, including saltwater, freshwater, or brackish marsh; major marine mammal haul out or breeding area; eelgrass; major seabird rookery; or any Area of Special Biological Significance
- Violate any environmental law or regulation designed to protect wildlife, plants, or habitat areas
- Isolate wildlife populations and/or disrupt wildlife migratory or movement corridors, or use native wildlife nursery sites

- Conflict with any local policies or ordinances protecting biological resources or provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or State habitat conservation plan
- Re-suspend bottom material, causing turbidity during vessel maneuvering such that suspended sediment concentrations are substantially increased above background levels
- Create underwater sound pressure levels (SPLs) during operation that exceed National Oceanic and Atmospheric Administration Fisheries Service (NMFS) guidelines for protection of marine mammals
- Cause the introduction or substantial spread of nonindigenous species, either aquatic or terrestrial.
- Cause the loss of wetlands or other waters of the United States under the Clean Water Act, 40 Code of Federal Regulations (CFR) 230, Section 404
- Cause a substantial loss of population or habitat of any native fish, wildlife, or vegetation, or an overall loss of biological diversity (*Note: Substantial is defined as any change that could be detected over natural variability*)

### 4.2.3.2 Assessment Methodology

For the purposes of this Environmental Impact Report, potential impacts to biological resources are evaluated based on available literature, previous biological assessments for the Terminal wharf and adjacent wetlands, and publicly available documents that provided information on species status, distribution, habitat, and sensitivity to impacts. A biological site reconnaissance was conducted on June 11, 2013 by TRC Biologist Molly Sandomire. Impacts that are considered substantial are those that would substantially diminish or cause the loss of an important biological resource, or that would conflict with local, State, or federal resource conservation plans, goals, or regulations.

### 4.2.3.3 Impacts Analysis and Mitigation Measures

The following subsections describe the Project's potential impacts on biological resources. Where impacts are determined to be significant, feasible mitigation measures (MMs) are described that would reduce or avoid the impact.

**Proposed Project**

**Impact Biological Resources (BIO)-1: Increase deposition or erosion of sensitive habitats along the vessel path, including marshlands within and adjacent to the lease area, resulting from the resuspension of sediments by calling vessels. (Less than significant.)**

Sediment plumes associated with ship traffic vary considerably depending on vessel type and movement (Clarke et al. 2007). The largest, most prominent plumes are caused by deep-draft vessels turning into the entrance of secondary berth access. Clarke et al. observed that these vessel maneuvers increased total suspended solids (TSS) concentrations above 90 milligrams per liter (mg/l), an effect that persisted at least 50 minutes in open water and tidal-washed channels, and indefinitely in secondary channels that lacked current flow to disperse the plumes. A less pronounced but still prominent effect was observed along the bottom of navigation channels, where TSS concentrations increased 40 mg/l from residual plumes along the lower 2 meters of the water column for over 1 hour following the passage of a deep-draft vessel. However, they found little evidence that tug boats and draft barges caused sediment plumes along the channel bottom. In a separate study, Connor et al. (2005) observed that a sediment plume caused by the vessel propeller, movement of tug boats, and water displacement during vessel berthing at Richmond Long Wharf was approximately 350 meters across tidal flow and persisted over 75 minutes.

Vessel calls at the Amorco Terminal are typically fewer than two calls a week, with no more than 90 anticipated per year. Sediment plumes would be generated by calling vessels as they transit along the navigation channels and maneuver into and out of the wharf. Once vessels are moored to the dock, all underwater propulsion is shut off. Sediment lifting from the navigation channel substrate would contribute to the paucity of infaunal abundance typically found in these channels. While sediment levels could potentially be increased at the wharf for approximately 6 hours a week throughout the year, the tidal currents at the wharf are considerable and sediment plumes are expected to be quickly dispersed. In addition, the Amorco Terminal is located in the range of the estuary’s maximum turbidity zone; thus the local biotic community is acclimated to increased turbidity levels and unlikely to be affected by the temporary, intermittent increases caused by vessel maneuvering.

**Mitigation Measure:** No mitigation required.

**Impact BIO-2: Cause substantial impact to special-status wildlife species, including impact to behavior and the composition of biotic communities, in the vicinity of the Amorco Terminal as a result of the use of bright lights during nighttime Amorco Terminal operations. (Less than significant.)**

Vessels may visit the Terminal any time of day or night. Lights at the Amorco Terminal are regularly spaced along the wharf arms and dock. Additional lights are located onboard visiting vessels. These lights are reflected in the water beneath the wharf and adjacent to the ship, and cast a long light shadow on the surface of the water. Use of bright lights during nighttime operations can affect the behavior of animals and the composition of the biotic community in the vicinity of the Amorco Terminal. Artificial light may attract pelagic fishes, including juvenile salmonids, larval crabs, and their predators (Hagan et al. 2008, Porter et al. 2008), but repel phytoplankton and shrimp (Moore et al. 2000, Moore et al. 2006). Artificial lights may also put nocturnal migrating birds at risk of collision. Birds are attracted to lights, and young birds are more vulnerable to collision with structures than more experienced migrators. Many species of birds are nocturnal migrants, including shorebirds, waterbirds, and passerines.

The Carquinez Strait is subject to industrial use and is well lit at night. Neighboring light sources include the Shell Martinez Marine Terminal, Benicia Harbor, and Benicia-Martinez Bridge. Because the Amorco Terminal is located within an area that has been historically lit at night, it is likely that the aquatic community and migrating birds have acclimated to the presence of light in this area. No change in Amorco Terminal lighting is proposed as part of this Project; therefore, there would not be any new or increased impacts from night lighting at the Amorco Terminal.

**Mitigation Measure:** No mitigation required.

**Impact BIO-3: Cause substantial direct and/or indirect impacts on aquatic biota through the changing of physical and chemical environmental factors as a result of maintenance dredging. (Less than significant.)**

The Amorco Terminal is periodically dredged to maintain a depth of 48 feet below MLLW. Dredging most recently occurred in 2005 and removed 500 cubic yards of material.

Turbidity and SSC can be much greater than ambient conditions in the immediate vicinity of dredging activities. Increased turbidity increases light attenuation, which can reduce phytoplankton productivity, reduce the feeding of some fish species, and change feeding and migration patterns, while increased SSCs can bury the benthic community, reduce the water-filtration rates of filter feeders adjacent to the dredge area, or increase fish gill injury (NMFS 2004). Estimates of the amount of material that is resuspended during dredging ranges from 0 to 5 percent (Suedel et al. 2008). Dredging at the Amorco Terminal would potentially resuspend 25 cubic yards of sediment over the course of dredging activity. The majority of sediment resuspended during dredging activities resettles within 50 meters of the dredge site within 1 hour (Anchor Environmental 2003), though plume effects can be observed as far downstream as 400 meters (Clarke et al. 2007). Densities of suspended sediment over ambient levels decrease with distance from the dredge site and are more pronounced at the bottom of the water column than near the surface (Clarke et al. 2007). However, sediment plumes are unlikely to have lasting effects given the high background turbidity; in one study in San Pablo Bay, dredging plumes were found to have only a localized effect (Schoellhamer 2002). Resuspended sediments near the surface of the water column are expected to dissipate downstream, where they would not increase sediment significantly above ambient levels. Therefore, impacts from increased turbidity and increased SSC concentrations on pelagic species would be less than significant.

Dredging would remove the existing infauna community and alter the substrate composition and topography at the Amorco Terminal. Following the completion of dredging, the benthic community is expected to undergo typical ecological succession patterns. As previously described, the benthic community at any estuarine location is dependent on salinity levels. Following salinity change events, it takes several months for the initial group of benthic organisms to settle and grow. However, dredging at the site is intermittent and minor. Therefore, this impact would be less than significant.

Indirect effects that are anticipated by dredging are the potential spread of nonindigenous species as a result of disturbing the benthic habitat. Dredging would create newly disturbed benthic habitat, making it attractive for settlement by opportunistic nonindigenous species. However, maintenance dredging disturbs areas that are continually disturbed due to maintenance dredging and vessel traffic. Maintenance dredging at the Amorco Terminal is intermittent and minor. As such, it is expected that further introduction of nonindigenous aquatic species to the San Francisco Bay Estuary resulting from maintenance dredging at the Amorco Terminal may impact but is not likely to significantly impact aquatic biota.

Scheduled maintenance dredging is known sufficiently in advance and Tesoro Refining and Marketing Company, LLC (Tesoro) continues to comply with applicable permits to ensure appropriate assessments are conducted prior to conducting maintenance-related dredging. Dredged spoils are tested and managed according to permits issued by jurisdictional agencies, including the CSLC, U.S. Army Corps of Engineers (USACE), San Francisco Bay Conservation and Development Commission, and San Francisco Bay Regional Water Quality Control Board. Because disturbance from dredging operations is intermittent and impacts are temporary, impacts from routine maintenance dredging are anticipated to be less than significant.

**Mitigation Measure:** No mitigation required.

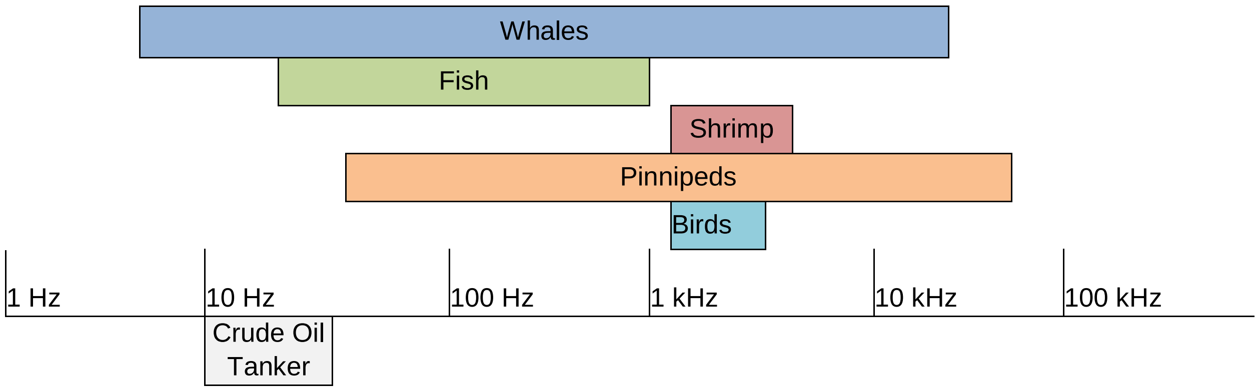
**Impact BIO-4: Cause injury or behavioral interruptions to aquatic species as a result of noise from vessels. (Less than significant.)**

Ships are the dominant source of low-frequency noise in many highly trafficked coastal zones (OSPAR 2009). Although the effect of increased noise on the underwater environment is still under investigation, there is emerging concern that vessel noise may cause substantial, adverse impacts to the underwater environment and sensitive aquatic species. Much of the noise associated with a vessel is caused by propeller wash. As the propellers spin underwater, small air bubbles form in nicks and gauges along the propeller edge. The bursting of these bubbles is called cavitation. Other sources of noise include mechanical motors and other onboard machinery. Crude oil tankers, which are among the largest marine vessels, move slowly, tend to emit continuous, omnidirectional sounds of around 40 hertz while in motion, and produce source levels at 1 meter between 179 to 182 decibel root mean square ($dB_{RMS}$) at 1 micro Pascal (µPa; McKenna 2012). Noise produced by vessels transiting the San Francisco Bay tends to be mitigated by the soft-bottom substrate and sediment-rich waters, which help to attenuate sound. Vessel calls are typically fewer than two calls a week. Once inside the San Francisco Bay, it takes each vessel approximately 3 hours to travel to the Amorco Terminal. Once moored, the sound produced by the vessel drops significantly.

Direct impacts from increased sound exposure include masking, behavioral disturbance, and physical damage.

*Masking* noise can be considered biologically significant if it coincides with the frequency range of the communication or echolocation signals of aquatic organisms (OSPAR 2009). Certain aquatic species that rely on sound to communicate such as whales, shrimp, crab, and certain species of fish may no longer be able to hear each other when ambient noise increases with a vessel's passing. Over the long term, species may adapt the frequency they use to communicate. Figure 4.2-6 shows the typical frequency bands of sounds produced by marine organisms compared with the low-frequency sound associated with crude oil tankers.

Vessels visiting the Amorco Terminal have the potential to cause masking of communications for whales and fish, shrimp, pinnipeds, or birds. However, the typical frequency bands of sound produced by crude oil tankers are lower than the typical frequency bands of sounds produced by shrimp, pinnipeds, and birds and are, therefore, not likely to interfere with their communications. Whales and some species of fish do communicate in the frequency bands at which crude oil tankers emit sound, and thus the noise from vessels visiting the Amorco Terminal may mask communication. However, due to the low number of weekly vessel calls and the limited transit time in the San Francisco Bay (approximately 12 hours per week), impacts to whales and fish from masking caused by shipping noise are not expected to be significant.




Sources: OSPAR 2009, McKenna 2012, Popper and Dooling 2007, Wenz 1962

**Figure 4.2-6: Typical Frequency Bands of Sounds Produced by Marine Organisms Compared with the Low Frequency Sounds Associated with Crude Oil Tankers**
California State Lands Commission
*Amorco Marine Oil Terminal Lease Consideration Project*

*Behavioral disturbances* are changes in activity in response to sound. These effects are difficult to measure and can vary both within a population and with any individual at any time. Rafting or roosting birds tend not to be disturbed by the approach of ships when they are on-site, but it is not known how underwater sound affects diving birds as they forage underwater. The noise from approaching ships causes fish to take evasive actions, moving as far as 400 meters away in a three dimensional space to maintain a buffer between themselves and the source of sound (Mitson 1995). While fish tend to scatter in response to sound, benthic larvae show diverse reactions to anthropogenic sound, with some species attracted to the noise and others repelled or indifferent (Stocks 2012). Marine mammals may stop feeding, resting, or engaging in social behavior, and show increased alertness and avoidance behaviors (Richardson et al. 1995).

The NMFS (2004, 2012) has established thresholds for disturbance to behavior for fish and pinnipeds. SPLs above 150 $dB_{RMS}$ at 1 µPa can alter fish behavior, causing a startle response of avoidance of an area. For pinnipeds, the underwater disturbance level from continuous low-level sound is 120 $dB_{RMS}$ at 1 µPa. Although vessels traveling to and from the Amorco Terminal are expected to cause behavior disturbance to fish and marine mammals, the behavioral disturbance to fish and marine mammals caused by shipping noise is not expected to be significant due to the low number of weekly vessel calls and the limited transit time (about 12 hours per week).

*Physical damage* may be caused by increased sound levels. Individuals that are exposed to sound could experience temporary (temporary threshold shift [TTS]) or permanent (permanent threshold shift [PTS]) loss of ability to hear at a particular frequency. Both TTS and PTS are triggered by the level and duration of exposure.

Sound can damage non-auditory tissue such as swim-bladders and lateral lines in fish. It may also cause increased levels of stress hormones to circulate in the blood of exposed individuals (OSPAR 2009). The NMFS has established thresholds for harm to fish and pinnipeds; the threshold for physical harm to fish from continuous sound occurs at 183 or 187 $dB_{RMS}$ at 1 µPa depending on size, and at 190 $dB_{RMS}$ at 1 µPa for pinnipeds. Because the source level noise produced by crude oil tankers does not exceed these thresholds, physical injury from shipping noise is not expected to occur.

Little is known about the indirect effects associated with increased underwater noise, though it has been speculated that underwater noise can act as a stressor in marine mammals with consequences to individual health and population viability (OSPAR 2009). Noise that causes adverse effects to prey species could indirectly impact higher-order predators by reducing prey abundance or availability. Because direct impacts to prey species from vessels calling at the Amorco Terminal are expected to be less than significant, no indirect impacts to higher-order predators are expected to occur.

**Mitigation Measure:** No mitigation required

**Impact BIO-5: Cause impacts to the San Francisco Bay Estuary and associated aquatic biota as a result of minor fuel, lubricant, and/or boat-related spills. (Less than significant.)**

With continuing operation, the Amorco Terminal would remain a potential point location for minor fuel, lubricant, and other boat-related spills. Any material that is not captured by various BMPs and enters the water would be dispersed around the Amorco Terminal, degrading the quality of the water column and benthic habitat in the vicinity of the Amorco Terminal. Though minor spills are not an occurrence of normal Project operations, and BMPs are in place to prevent them, they are reasonably foreseeable as an occasional result of the Project.

Examples of past minor spills from the Amorco Terminal include the release of small amounts of diesel fuel from pipelines or transfer lines into the strait, discharge of lubricating oil from docking vessels into the strait, and the accidental release of hydraulic fluid from a boom during an oil spill drill (USCG 2013). In the State of California, any release or threatened release of a hazardous material must be reported to the local emergency response agency and to the California Emergency Management Agency. There is no minimum reporting quantity. All reported releases from the Amorco Terminal were minor, ranging from seven drops of hydraulic fluid to one gallon of diesel. Minor spills are quickly cleaned up using vac trucks and absorbent pads to recover the material.

No significant adverse impacts are expected to aquatic life from minor spills associated with the ongoing operation of the Amorco Terminal. Tesoro operators have a demonstrated history of quick containment response and reporting for small spills. Any minor amounts of contaminants that are released into the water would be quickly dispersed by the swift currents in the strait such that concentrations of pollutants would not achieve the levels at which harm to aquatic species is observed.

Tesoro's operators use Consequences of Deviation Tables to monitor, compensate, and correct for operating parameters that deviate due to equipment failure, routine maintenance, feed variations, and other factors. The tables detail mechanical set-point criteria, consequences of deviation from the set point, and operator response for instrument Critical Operating Limits/Process Operating Limits (COL/POL). A COL/POL database for current unit operating limits is maintained on the Golden Eagle Intranet. Adherence to these operating ranges and consequences of deviation reduces the potential for minor spills from transfer of crude oil. Although impacts from minor spills are adverse, they are not expected to have a significant effect on biota at the Amorco Terminal.

**Mitigation Measure:** No mitigation required.

**Impact BIO-6: Cause impacts to the San Francisco Bay Estuary and associated aquatic biota as a result of major fuel, lubricant, and/or boat-related spills. (Significant and unavoidable.)**

Impacts from spills would depend on the material and quantity spilled. Light oils such as fuel oil are acutely toxic and cause the greatest impacts to species that live in the upper water column such as juvenile fish. Medium oils such as most crude oils do not mix well with water and can cause severe, long-term contamination to intertidal areas and cause oiling of waterfowl and marine mammals. Heavy oils such as heavy crude and some fuel oils weather slowly and may cause severe long-term contamination of intertidal areas and sediments. These oils have severe impacts on waterfowl and marine mammals, and their cleanup is usually difficult and long term.

Depending on the weight of the oil, spills may harden and wash up along the shoreline. Crude oils contain a large proportion of highly persistent tar-like compounds. Volatile components of crude oil stock disappear over a few days, but the heavier fractions form an emulsion with sea water (called "mousse") which allows greater dispersal of oil. Some fraction of crude oil would aggregate into tarballs or mats. The more exposed to the elements oil is, the more rapidly it weathers. The heaviest oils may sink in the water, contaminating the water column and being forced by tidal waves into the substrate. Buried oils are not weathered.

Short-term, direct impacts to marine biota from an accidental oil spill include physical oiling, which may cause injury or death; toxic exposure to volatile gas; disturbance from clean-up activities; and loss of habitat. Indirect impacts include disruption of predator-prey relationships; introduced toxins in the food web, which may cause low-level health impacts to prey species that bioaccumulate in predator species; possible toxic effects on embryos; and interruption or degradation of reproduction potential. Population recovery from spills is dependent on generation time. Species that reproduce early and often are quick to rebound after spills, while those with longer generation spans may see long-term impacts to abundance.

**Birds**

Birds can be killed or injured from contact with oil spills. The degree to which a species is susceptible to oil spills depends on its habitat use and behavioral characteristics. Diving birds are particularly susceptible to injury from oil spills because they forage in open waters, and oil slicks may make the water look calmer and more inviting. Seabirds, which dive when disturbed, are also susceptible to injury. Birds that contact oil may get oil on their feathers and lose the ability to stay warm, waterproof, and buoyant. Birds use their beaks to clean their feathers, and thus may ingest oil while trying to remove oil.

The species impacted and the extent of the impact from an oil spill would depend on when the spill occurred. The Amorco Terminal is located within the Pacific flyway, a major migratory corridor for waterbirds. Migrating flocks are large and migrations may occur in a very tight window, resulting in a large proportion of a species' entire population visiting a single site over a few weeks. Following the most recent large petroleum spill in San Francisco Bay, the November 2007 Cosco Busan spill, which spilled 58,000 gallons of fuel into the San Francisco Bay, two thousand bird carcasses representing 57 bird species were recovered during clean up. Fatalities were highest among diving birds: surf scoter (*Melanitta perspicillata*), western grebe (*Aechmophorus occidentalis*), common murre (*Uria aalge*), Clarke's grebe (*Aechmophorus clarkia*), Brant's cormorant (*Phalacrocorax penicillatus*), greater scaup (*Aythya marila*), and eared grebe (*Podiceps nigricollis*).

Birds may also be impacted by the loss or degradation of breeding sites. Colony nest sites for double-crested cormorants are found on the Benicia-Martinez Bridge, and for great blue heron on Mare Island.

**Fish and Invertebrates**

Fish can be killed or injured from contact with oil spills. The susceptibility of fish to a spill depends on its growth stage, feeding behavior, and the type of oil. Juvenile fish and fish species that use shallow or near-surface waters such as longfin smelt and delta smelt are susceptible to acute toxicity from lighter oils, while fish that swim lower in the water column such as steelhead and salmon are less likely to come in direct contact with oil. Fish may come into direct contact with oil, thus contaminating their gills; they may absorb toxic components of oil through their skin; and they may suffer adverse effects from eating contaminated food.

The number and type of species impacted by an oil spill depends on the season in which the spill occurs. The Carquinez Strait is a migratory corridor for a number of threatened and endangered fish species, including green sturgeon, longfin smelt, steelhead, and chinook salmon. Delta smelt and Sacramento splittail are seasonally abundant in Suisun Bay.

**Mammals**

The susceptibility of mammals to an oil spill is highly variable. Mammals that need clean fur to stay warm such as river otters, beavers, sea otters, vagrant shrew, and salt-marsh harvest mouse are injured by contact with oil. Harbor seal and sea lion have blubber for insulation and do not groom or depend on fur to stay warm; this makes them less susceptible to crude oil spill than mammals with dense fur, which lose the ability to stay warm when their fur becomes matted with heavy oil. All mammals that come in contact with oil spills are susceptible to the acute effects of light oils, which may cause injury to eyes, nerve damage, behavioral abnormalities, and, if ingested, digestive tract bleeding and liver and kidney damage (Harwell and Gentile 2006).

California sea lions are found in the estuary from August to mid-May. In June and July, most of the sea lions have left for breeding grounds further south. Harbor seals are resident breeders, and their haul out and pupping sites may be degraded by oil spills. Saltmarsh harvest mouse individuals may be directly impacted by oil if the spill reaches tidal marsh. All mammals may be disturbed by containment and clean-up activities.

**Habitat**

Low-energy marshy sites with high organic content are susceptible to widespread toxic effects from intertidal sediment hydrocarbon exposure. Damage is caused both by the spill and by the clean-up activities that follow. Oils and cleanup may remove massive amounts of marsh vegetation, requiring years to recover. Oils that are buried in the sediments and escape removal during cleanup can cause long-term low-level degradation of the marsh environment, with detectable effect on benthic invertebrates.

**Oil Spill Modeling**

As presented in Section 4.1, Operational Safety/Risk of Accidents, the average most probable and maximum most probable spills for crude oil shipped through the Amorco Terminal were modeled. Results of these models indicate that while spills at or near the Amorco Terminal have the potential to travel through Carquinez Strait into San Pablo Bay and into Suisun Bay and its associated marshes, the highest probability of contact with oil occurs within the direct vicinity of the Amorco Terminal. The trajectory of the spill and the extent of its distribution vary seasonally. A spill in winter during the flooding season would be carried by heavy Delta outflows into San Pablo Bay, oiling shorelines along the

Carquinez Strait. During the dry summer months, spills are carried upstream along tidal currents and dispersed by wind into Suisun Bay and marshes.

Table 4.2-3 shows impacts to birds, wetlands, and fish and invertebrates from a modeled spill at a Martinez wharf (ASA 2009). In general, bird impacts are higher for heavy fuel oil and crude oil than diesel because the area is confined and oil remains on the water and in the marshes longer than the more volatile diesel.

Appendix E shows sensitive species located within the modeled spill envelope; sensitive species that are more than 50 percent likely to be impacted by an oil spill are listed in Table 4.2-4. It can be seen from the table that a spill in winter would contact a greater number of species due to the migration of birds and fish through the San Francisco Bay at that time.

**Table 4.2-3: Biological Impacts of 100,000-gallon Spill from a Martinez Wharf**

| | Heavy Fuel oil | Crude oil | Diesel |
|---|---|---|---|
| ***Birds (individuals killed)*** | | | |
| Waterfowl | 94 | 71 | 67 |
| Seabirds | 89 | 67 | 63 |
| Wading birds | 575 | 317 | 299 |
| Shorebirds | 2,693 | 1,485 | 1,398 |
| **Total birds** | **3,451** | **1,940** | **1,826** |
| ***Fish, invertebrates, vegetation*** | | | |
| Fish and invertebrates (kg) | 18.9 | 128.6 | 203.8 |
| Wetland invertebrates ($m^2$) | 565,833 | 453,095 | 604,264 |
| Mudflat invertebrates ($m^2$) | 1,203,508 | 930,955 | 989,983 |
| Wetland vegetation ($m^2$) | 565,546 | 163,705 | 256,612 |

Source: ASA 2009

**Table 4.2-4: Sensitive Species With Greater than 50 Percent Chance of Contacting Oil From a Spill at the Amorco Terminal**

| | Numbers | Reproductive Cycle[1] | | | | Probability of oiling greater than 50 percent | |
|---|---|---|---|---|---|---|---|
| **Birds** | | **Nesting** | **Laying** | **Hatching** | **Fledging** | **Summer** | **Winter** |
| Western gull *Larus occidentalis* | High | Apr-Aug | Apr-Jun | May-Jul | Jul-Aug | X | X |
| Peregrine falcon *Falco peregrinus* | Present | - | - | - | - | X | X |
| Saltmarsh common yellowthroat *Geothlypis trichas sinuosa* | Present | Mar-May | - | - | - | X | X |
| California black rail *Laterallus jamaicensis coturniculus* | Present | Mar-May | - | - | - | X | X |
| California clapper rail *Rallus longirostris obsoletus* | Present | Mar-Jul | - | - | - | X | X |
| Suisun song sparrow *Melospiza melodia maxillaris* | Present | Mar - Jun | - | - | - | X | X |
| San Pablo song sparrow *Melospiza melodia samuelis* | Present | Mar - Jun | - | - | - | X | X |
| Canvasback *Aythya valisineria* | Med | - | - | - | - | X | X |
| Ruddy duck *Oxyura jamaicensis* | Low | - | - | - | - | X | X |
| Western grebe *Aechmophorus occidentalis* | High | - | - | - | - | - | X |
| Shorebirds | Low | - | - | - | - | - | X |
| Wading birds | High | - | - | - | - | - | X |
| Diving ducks | High | - | - | - | - | X | X |
| Dabbling ducks | High | - | - | - | - | - | X |
| **Fish and Invertebrates** | | **Spawn** | **Eggs** | **Larvae** | **Juvenile** | | |
| Chinook salmon (fall) *Oncorhynchus tshawytscha (fall)* | High | - | - | - | Jan-Dec | X | X |
| Chinook salmon (late fall) *Oncorhynchus tshawytscha (late fall)* | High | - | - | - | Jan-Dec | X | X |

| | Numbers | Reproductive Cycle[1] | | | | Probability of oiling greater than 50 percent | |
|---|---|---|---|---|---|---|---|
| Chinook salmon (spring and winter)<br>*Oncorhynchus tshawytscha* | High | - | - | - | Jan-Dec | X | X |
| Longfin smelt<br>*Spirinchus thaleichthys* | High | - | Jan-Mar | Jan-Apr | Apr-Apr | - | X |
| Green sturgeon<br>*Acipenser medirostris* | Med | - | - | - | Jan-Dec | X | X |
| Striped bass<br>*Morone saxatilis* | High | - | Apr-May | Apr-Jun | Jan-Dec | X | X |
| White sturgeon<br>*Acipenser transmontanus* | High | - | - | - | Jan-Dec | X | X |
| Delta smelt<br>*Hypomesus transpacificus* | Low | - | - | Apr-Jun | Apr-Aug | X | X |
| White croaker<br>*Genyonemus lineatus* | High | - | - | Sep-Mar | Jan-Dec | X | X |
| American shad<br>*Alosa sapidissima* | High | - | - | - | Aug-Dec | X | X |
| Dungeness crab<br>*Metacarcinus magister* | High | - | - | - | Apr-Feb | X | X |
| California bay shrimp<br>*Crangon franciscorum* | High | Jan-Mar | Jan-Sep | Mar-Sep | Mar-Oct | X | X |
| **Mammals** | | | | | | | |
| Salt-marsh harvest mouse<br>*Reithrodontomys raviventris* | Present | - | - | - | - | X | X |
| Saltmarsh wandering shrew<br>*Sorex vagrans halicoetes* | Low | - | - | - | - | X | X |
| **Plants** | | **Blooming Period** | | | | | |
| Delta tule pea<br>*Lathyrus jepsonii jepsonii* | Low | May-September | | | | X | X |
| Soft bird's-beak<br>*Cordylanthus mollis mollis* | Present | April-November | | | | X | X |
| Mason's lilaeopsis<br>*Lilaeopsis masonii* | Low | April-November | | | | X | X |

Sources: NOAA 1998, WRA 2011

[1]A dash (-) indicates that the time frame, for either a given reproductive cycle or the probability of oiling greater than 50 percent, is not applicable.

In addition to the Biological Resources mitigation measures presented below, implementation of Mitigation Measures OS-1, OS-4a, and OS-4b (refer to Section 4.1, Operational Safety/Risk of Accidents) would reduce impacts to biological resources.

**Mitigation Measures:**

**MM BIO-6a: Bird rescue personnel and rehabilitators.** Tesoro shall ensure that procedures are in place to bring bird rescue personnel and rehabilitators to the site following a spill event that is not immediately contained at the Amorco Terminal. This requires having contractual arrangements in place as part of the Golden Eagle Refinery Oil Spill Contingency Plan so that bird rescue personnel and equipment can be on-site within hours of the onset of an accidental release.

**MM BIO-6b: Cleanup of oil from biological area.** When a spill occurs, Tesoro shall develop procedures for cleanup of any sensitive biological areas contacted by oil in consultation with biologists from the California Department of Fish and Wildlife, National Marine Fisheries Service, and U.S. Fish and Wildlife Service.

**MM BIO-6c: Natural Resource Damage Assessment (NRDA) Team.** Tesoro shall coordinate to the maximum extent feasible with the NRDA Team to determine the extent of damage and loss of resources, cleanup, restoration, and compensation. Tesoro shall keep the CSLC staff informed of its participation in such efforts by providing copies of memos, meeting agendas, emails, or other appropriate documentation. Tesoro shall be responsible for cleanup, restoration, and compensation of damages to resources if Tesoro is determined to be the responsible party for a spill.

**Impact BIO-7: Introduce invasive nonindigenous species to the San Francisco Bay Estuary. (Significant and unavoidable.)**

The San Francisco Bay and Sacramento-San Joaquin River Delta region is a highly invaded ecosystem, among the most invaded aquatic ecosystems in North America; Since 1970, the rate of invasion has been one new species every 24 weeks (Cohen 1995). In some parts of the estuary, introduced species account for the majority of species diversity, dominate the estuary’s food webs, and may result in profound structural changes to habitat (Cohen 1995).

The rate of species introductions, and thus the risk of invasion by species with detrimental impacts, has increased significantly during recent decades. In North America, and particularly in California and the rest of the west coast, the rate of reported introductions in marine and estuarine waters has increased exponentially over the last 200 years (Ruiz 2000a, 2011). Prior to the implementation of ballast water management regulations in California, a new species was believed to become established every 14 weeks on average in the San Francisco Estuary (Cohen and Carlton 1998). One of the primary factors leading to this increase has been the vast expansion of global trade during the past 50 years, which in turn has led to significantly more ballast water, fouled hulls, and associated organisms moving around the world. The increased speed of vessels involved in global trade has allowed many more potentially invasive organisms entrained in ballast tanks to survive under shorter transit times (Ruiz and Carlton 2003) and arrive in recipient ports in better condition. Organisms that arrive "healthy" in recipient regions are more likely to thrive and reproduce in their new habitats.

Once established, NIS can have severe ecological, economic, and human health impacts in the receiving environment. The overbite clam (*Corbula amurensis*) is believed to be a major contributor to the decline of several pelagic fish species in the Sacramento-San Joaquin River Delta, including the threatened delta smelt, by reducing the planktonic food base of the ecosystem (Feyrer 2003, Sommer 2007, MacNally 2010). In California, control of zebra and quagga mussels, which can clog municipal water systems and electric generating plans, has already cost over $14 million; these costs represent only a fraction of the cumulative expenses related to NIS control over time, because control is an unending process. The Japanese sea slug *Haminoea japonica* is a host for parasites that cause cercarial dermatitis, or "swimmer's itch," in humans. Since 2005, cases of swimmer's itch at Robert Crown Memorial Beach in Alameda have occurred on an annual basis and are associated with high densities of *Haminoea japonica* (Brant 2010).

The California Aquatic Invasive Species Management Plan identifies commercial shipping as the most important vector for the introduction of aquatic invasive species (OSPR 2008). Commercial ships can introduce nonindigenous aquatic species through ballast water discharge or vessel biofouling. These vectors are addressed separately below.

### *Ballast Water Discharge*

As discussed in Section 2.0, Project Description, ballast is a material placed low in a vessel to improve its stability. The amount of ballast a ship carries affects how high or low a ship's hull sits in the water; the vertical distance between the waterline and the bottom of the hull is known as a ship's draft. The draft determines the minimum depth of water a ship can safely navigate. Ships commonly use water as ballast because it is freely available and can be easily managed. Ballast water can be released to reduce draft, allowing the boat to sit higher in the water, or it can be taken on to increase draft and further submerge propellers or allow a ship to travel under a bridge or other structure. Ballast tanks are typically filled with water after discharging cargo to improve vessel stability, maneuverability, and propulsion. Tankers carry the highest volume of ballast water of any vessel type in the merchant class: 31,643 MT metric tons (MT) on average. By comparison, container vessels carry less than half this amount.

In commercial ships, ballast water is able to support a host of marine species during transit times in ballast. Ballast water is, therefore, capable of transporting live aquatic species around the world. It is estimated that every day more than 10,000 marine species are transported across oceans in ballast water (Buck 2007).

Vessels calling at the Amorco Terminal are required to comply with all federal and State ballast water laws, regulations, and permits. Ballast water discharges in the United States are under the jurisdiction of the U.S. Coast Guard (USCG) and the U.S. Environmental Protection Agency (USEPA), and at the State level by the CSLC. A detailed discussion of applicable laws, regulations, and permits can be found in Chapter 2.3.3 Ballast Water.

Under the National Aquatic Nuisance Prevention and Control Act, revised as the National Invasive Species Act of 1996, the USCG established regulations and guidelines to prevent the introduction of aquatic invasive species from ballast water discharge. As of 2004, all vessels are required to manage their ballast water in accordance with the USCG-administered Ballast Water Management Program (33 CFR 151 Subparts C and D), which includes provisions for ballast water exchange, good housekeeping, and reporting. The USCG published regulations on March 23, 2012 in the Federal Register that establish federal performance standards for living organisms in ships' ballast water discharged in U.S. waters (Table 4.2-5); however, the rule provides exemptions for Trans-Alaska Pipeline System (TAPS) trade tankers, which are the primary vessels expected to visit the Amorco Terminal. For other tankers calling at the Amorco Terminal, all new vessels must meet the standards as of December 31, 2013 and all existing tankers must meet them by the first scheduled dry docking after January 1, 2016 unless, despite all best efforts, the tanker will not be able to comply with the standards, in which case the vessel owner may request an extension.

**Table 4.2-5 Ballast Water Treatment Performance Standards**

| Organism Size Class | Federal Standard | State Standards |
|---|---|---|
| > 50 µm | < 10 viable organisms per cubic meter | No detectable living organisms |
| 10 – 50 µm | < 10 viable organisms per ml | < 0.01 living organisms per ml |
| < 10 µm | | < 103 bacteria/100 ml < 104 viruses/100 ml |
| *Escheria coli* | < 250 cfu/100 ml | < 126 cfu/100 ml |
| Intestinal enterococci | < 100 cfu/100 ml | < 33 cfu/100 ml |
| Toxicogenic *Vibrio cholera* (O1 & O139) | < 1 cfu/100 ml or < 1 cfu/gram wet weight zooplankton samples | < 1 cfu/100 ml or < 1 cfu/gram wet weight zoological samples |

Sources: CSLC 2013e

The USEPA regulates ballast water discharge under the Vessel General Permit for Discharges Incidental the Normal Operation of Vessels (VGP). The 2013 VGP, which is a 5-year permit, contains ballast water discharge performance standards consistent with the USCG standards and ballast water management requirements for vessels traveling along the Pacific Coast. Vessels arriving to California ports from outside the EEZ and intending to discharge ballast in California waters are required by the State of California to exchange ballast water in ballast tanks prior to travelling within 200 nautical miles (nm) of land. Vessels transiting between Captain of the Port Zones along the Pacific Coast of the U.S. are required to conduct ballast water exchange at least 50 nm from shore in waters at least 200 nm deep.

At the state level, the CSLC is the lead implementing agency for the State's Marine Invasive Species Program. As directed by the 1999 Ballast Water Management for Control of Nonindigenous Species Act, as revised and reauthorized by the Marine Invasive Species Act of 2003 (Pub. Resources Code §§ 71200 to 71271), the CSLC formulated recommendations to prevent or minimize the introduction of nonindigenous species discharges for vessels 300 gross registered tons or greater, capable of carrying ballast water, operating in State waters. California Code of Regulations Article 4.6 addresses ballast water management for vessels arriving at California ports from another port or place within the Pacific Coast Region; California Public Resources Code section 71204.3 addresses requirements for vessels whose voyage originated outside of the Pacific Coast Region (PCR), a shipping zone that encompasses coastal waters within 200 nautical miles (nm) of the Pacific Coast of North America from Cooks Inlet in Alaska down through three-quarters of the Baja Peninsula.

Beginning in 2016, all tankers will be required to implement ballast water treatment standards (Table 4.2-5). Until then, ballast water must be managed in compliance with state regulations. California regulations (Cal. Code Regs., tit. 2, § 2280 et seq.) requires that the master, operator, or person in charge of a vessel arriving to a California port or place from another port or place within the PCR with ballast water sourced from within the PCR, manage ballast water in at least one of the following ways:

- Exchange the vessel's PCR-sourced ballast water in near-coastal waters (more than 50 nm from land and at least 200 m deep) before entering the waters of the State.
- Retain all ballast water on board the vessel.
- Use an alternative, environmentally sound, Commission or USCG-approved method of treatment.
- Discharge the ballast water to an approved reception facility (Currently there are no such facilities in California).

Public Resources Code section 71204.3 requires that the master, operator, or person in charge of a vessel arriving to a California port or place from a port or place outside of the Pacific Coast Region, or with ballast water sourced from outside the PCR, shall manage ballast water as above or discharge ballast water at the same location where it was taken on, provided that the ballast water has not been mixed with water taken on in an area other than mid-ocean waters.

All vessels that depart a California port or place are required to submit to the CSLC a Ballast Water Reporting Form that includes information about port of origin, how the ballast water was managed, and how much ballast water was discharged. The CSLC staff has collected mandatory Ballast Water Reporting Forms since 2004. Compliance with the requirement to submit forms is high. Between July 2010 and June 2012, 97 percent of forms for vessels arriving at California ports were submitted as required.

Commercial vessels carrying a combined total of more than 122 MT of ballast water made about 10,000 visits a year to California ports between 2010 and 2012. Tankers account for 21 percent of vessel traffic to all California ports, with 20 percent of these tankers (about 400 vessels each year) destined for Carquinez Strait ports. Most vessels arriving in Carquinez Strait ports originate in the coastal waters of the PCR.

The primary vessel-reported practice for ballast water management is retention of all ballast on board, which is considered the most protective management strategy (CSLC 2013e). However, a quarter of all arriving tankers discharge ballast water in California, with an average discharge of about 10,000 metric tons (MT). Between 2010 and the first half of 2012, Carquinez Strait received the majority of ballast water discharged into San Francisco Bay Estuary (Table 4.2-6). About 80 percent of the ballast water discharged to Carquinez Strait was of coastal origin.

**Table 4.2-6: Total Discharge Volume (metric tons) by Port, Six-Month Period (2010b-2012a; a = January to June, b = July to December)**

| Port | 2010b | 2011a | 2011b | 2012a |
|---|---:|---:|---:|---:|
| Sacramento | 35,873 | 106,451 | 81,408 | 82,767 |
| Stockton | 117,454 | 418,209 | 485,650 | 587,760 |
| Carquinez | 1,272,551 | 1,197,113 | 1,397,434 | 1,468,294 |
| Richmond | 805,038 | 983,687 | 960,611 | 1,100,030 |
| San Francisco | 12,034 | 24,155 | 41,328 | 81,322 |
| Oakland | 239,365 | 334,305 | 349,514 | 345,211 |
| Redwood | 141,718 | 90,198 | 99,198 | 48,293 |
| Total Discharge Volume | 2,624,033 | 3,154,118 | 3,415,143 | 3,713,677 |

Sources: CSLC 2013e

Total managed ballast discharges have increased between 2006 and 2012. The majority of ballast water discharged from all vessel types into California waters is in compliance with ballast exchange regulations. Vessels primarily conduct two types of ballast water exchange: flow-through (FT) and empty-refill (ER). In FT exchange, ocean water is pumped continuously through a ballast tank to flush out coastal water from the ballast source port. Empty-refill exchange is conducted by draining a ballast tank of coastal source water as much as possible, and refilling it with open-ocean water. Between 2010 and 2012, 56 percent of managed and discharged ballast water, by volume, was exchanged using ER compared to 44 percent using FT. While ballast water exchange, when properly practiced, can remove 95 to 100 percent of the original source water (Hay and Tanis 1998) and reduce the number of coastal species in ballast tanks, differences in the effectiveness of the two management options (FT and ER) exist. Flow-through exchange has been shown to be significantly less effective than ER in reducing the amount of coastal species in exchanged ballast tanks (Cordell 2009).

The volume of noncompliant ballast water discharged as a percentage of total discharges has decreased from 24 percent in 2006 to 10 percent in 2012. Between 2010 and 2012, approximately 2.5 million MT of noncompliant ballast water was discharged to California waters. The majority of noncompliant discharges (88%) between 2010 and 2012 consisted of water that was exchanged offshore, but in a location not acceptable under California law. Approximately nine percent of discharged water was not exchanged at all. Unexchanged ballast water discharge is considered a high-risk for invasive species. In the period between 2010 and 2012, tankers accounted for about half of all noncompliant discharges and one-fifth of high-risk ballast water discharge (CSLC 2013e).

Factors that influence invasion risk, in addition to the volume of ballast water released and the type of exchange, include the age of the ballast water discharged (species often survive better when held for a short period of time), the degree of repeated inoculation (frequency with which ballast is discharged in a given area), and similarity between donor and recipient regions (biological, chemical, and physical characteristics at each port) (Carlton 1996, Ruiz and Carlton 2003). Recent studies have demonstrated that there is a strong pattern of intraregional spread of nonindigenous aquatic species along the North American Pacific coast (Ruiz et al. 2011). Because of the volume of ballast water discharged by tankers to Carquinez Strait, the origin of the ballast water, and ongoing noncompliance with ballast water management regulations, the risk of introduction of further nonindigenous aquatic organisms to the San Francisco Bay Estuary as a result of the Project is significant and unavoidable.

#### *Vessel Biofouling*

Many marine organisms that have a sessile or sedentary life stage in which they are attached or associated with hard substrata can readily colonize ships' hulls or niche areas, such as sea chests, bow thrusters, propeller shafts, and inlet gratings, that are inadequately protected by anti-fouling systems. The most common biofouling organisms are barnacles, mussels, seaweed, anemones, and sea squirts (OSPR 2008). Mobile organisms, such as shrimps, worms, and snails can reside in the crevices created by colonies of barnacles and mussels. Biofouling organisms are then transported by vessels into new environments where they may be transferred from the ship into the new environment by spawning, detachment, or mechanical removal.

Thus vessel biofouling has been identified as one of the most important mechanism for marine nonindigenous aquatic species introductions in several regions, including Australia, North America, Hawaii, the North Sea, and California (Ruiz 2000b, 2011, Eldredge and Carlton 2002, Gollasch 2002). The CSLC, which regulates vessel biofouling under the Marine Invasive Species Act of 2003, states that all vessels pose some level of risk from biofouling (CSLC 2013e). Since 2008, the CSLC has required vessels operating in State waters to submit an annual Hull Husbandry Reporting Form. These data have since been used in conjunction with results from CSLC-funded biological research to develop management requirements that will reduce the risk of nonindigenous aquatic species introductions through vessel biofouling. The CSLC is in the process of developing regulations to amend California Code of Regulations Article 4.8 (Title 2, Division 3, Chapter 1) that would establish management requirements for vessel biofouling, including the use of a biofouling management plan specific to the vessel, biofouling logbook, and use of antifouling systems or practices to deter or prevent species attachment.

Tesoro has no control over, ownership of, or authority to direct vessels that would dock at its marine terminal; therefore, specific details of how vessels manage biofouling or ballast water cannot be provided as part of the Project. The vessels would be governed by the applicable CSLC requirements for biofouling management, which would reduce the potential impact of aquatic species invasion from biofouling. Under Mitigation Measure BIO-7a, Tesoro would ensure that vessels seeking to call at the Amorco Terminal are advised of California's Marine Invasive Species Act and are submitting forms as required by the CSLC. However, the impact of introducing new non-native and invasive species via ballast water and vessel biofouling in the San Francisco Bay and Sacramento-San Joaquin River Delta could potentially be so devastating that even a reduced risk has the potential to cause a significant and unavoidable adverse impact to special-status species and habitats.

**Mitigation Measures:**

**MM BIO-7a: Marine Invasive Species Act Reporting Forms**. Following the adoption of the Mitigation Monitoring Program for the Project, Tesoro shall advise both agents and representatives of shipping companies having control over vessels that have informed Tesoro of plans to call at the Amorco Terminal about the California Marine Invasive Species Act and associated implementing regulations. Tesoro shall satisfy itself that all vessels submit required reporting forms, as applicable for each vessel, to the California State Lands Commission Marine Facilities Division, including, but not limited to, the Ballast Water Reporting Form, Hull Husbandry Reporting Form, Ballast Water Treatment Technology Reporting Form, and/or Ballast Water Treatment Supplemental Reporting Form.

**MM BIO-7b: Invasive species action funding.** Tesoro shall participate and assist in funding ongoing and future actions related to nonindigenous aquatic species as identified in the October 2005 Delta Smelt Action Plan (State of California 2005). The funding support shall be provided to the Pelagic Organism Decline Account or other account identified by the California Department of Water Resources (DWR) and California Department of Fish and Wildlife (CDFW), the lead Action Plan agencies. The level of funding shall be determined through a cooperative effort between the California State Lands Commission, DWR, CDFW, and Tesoro, and shall be based on criteria that establish Tesoro's commensurate share of the plan's nonindigenous aquatic species actions costs.

**Alternative 1: No Project**

**Impact BIO-8: Cause impacts to the San Francisco Bay Estuary and associated biota resulting from the decommissioning and abandoning in place of existing structures. (Significant and unavoidable.)**

As described in Section 3.3, under the No Project Alternative, the Amorco Terminal lease would not be renewed, and the Amorco Terminal would be decommissioned and either abandoned in place or partially or completely removed. Decommissioning the Amorco Terminal would have the potentially insignificant beneficial impact of locally reducing the amount of sediment resuspension caused by vessels docking at the Amorco Terminal and removing a potential point source for minor spills.

Crude oil vessel traffic would most likely be transitioned to the nearby Avon MOT, so there would be little reduction in crude oil tanker traffic transiting the estuary. Thus, there would be no overall reduction in shipping noise, and the risk of hazards from an oil spill and from the introduction of nonindigenous aquatic species introduced via ballast water and vessel biofouling would be shifted upstream rather than reduced, and the potential impact to the San Francisco Bay Estuary and associated biota would be continue to be significant and unavoidable.

**Impact BIO-9: Cause impacts to the San Francisco Bay Estuary and associated biota resulting from the partial or complete removal of Amorco Terminal structures. (Potentially significant.)**

Construction activities associated with partial or complete removal of the Amorco Terminal would cause temporary disturbances to habitat and wildlife that inhabit the Carquinez Strait. Removal of Amorco Terminal structures would result in physical harm or injury fish and wildlife and increased levels of noise that could cause harm to fish and wildlife. Depending on construction timing, noise levels could also impede fish migration. Work that disturbs deeply buried sediments in the channel bottom could release contaminated sediments from the channel floor with potential adverse effects to wildlife. Removal of the structures would also remove an osprey nest site and a potential sea lion haul out. Beneficially, removal of the Amorco Terminal structures would result in a small but probably insignificant lessening of night lights along the Carquinez Strait. Mitigation would be required to ensure that removal of the Amorco Terminal structures was conducted to reduce adverse impacts to habitat and species. Appropriate mitigation measures would include scheduling work to be conducted outside of crucial fish migratory periods and the use of sound dampening measures for pile removal. Ultimately, any Amorco Terminal removal projects would be subject to regulation under existing State and federal regulations, at which point environmental review would be conducted and mitigation measures developed to ensure that the project was in compliance with relevant regulations.

**Impact BIO-10: Cause impacts to the San Francisco Bay Region and associated biota by decommissioning and removing the Amorco Terminal and shifting crude oil imports to overland transport. (Significant and unavoidable.)**

Under this alternative, the Amorco Terminal would not be in use, and crude oil would be transported overland through a combination of rail, tanker, and/or pipeline to the Golden Eagle Refinery. Decommissioning and removing the Amorco Terminal would result in the same level of impacts as the No Project Alternative. In addition, the overall number of vessels transiting the estuary would be reduced, though not significantly, with beneficial reduction of shipping noise, sediment resuspension, and reduction in the potential for a major oil spill or the introduction of nonindigenous aquatic species via ballast water or vessel biofouling.

However, overland transportation of crude oil could result in potentially adverse environmental impacts, including potential loss of habitat, impacts to riparian areas and wetlands, and additional impacts to upland species. These impacts would be addressed in a separate environmental review of the Project; however, while potentially subject to National Environmental Policy Act review by the USACE and USFWS, development of additional rail track would not be subject to CEQA review.

**Alternative 2: Restricted Lease Taking Amorco Out of Service for Oil Transport**

**Impact BIO-11: Cause impacts to the San Francisco Bay Region and associated biota by shifting crude oil imports to overland transport. (Significant and unavoidable.)**

Refer to Impact BIO-10.

**Cumulative Impact Analysis**

The geographic context for analysis of cumulative impacts to biological resources includes the San Francisco-San Pablo Bay region, Carquinez Strait, and the outer coast of California. Impacts to biological resources from the Project that are less than significant may become significant when combined with impacts from related projects in the region. This analysis identifies cumulative impacts and evaluates whether the incremental contribution of the Project to a cumulative impact would be considerable.

**Impact CUM-BIO-1: Cause cumulative adverse impacts to special-status species, biotic communities, and habitat through vessel resuspension of sediment, use of bright night time lights, routine dredging, shipping noise, and potential minor oil spills as a result of Amorco Terminal operations. (Less than significant.)**

*Sediment Resuspension*. Large vessels traveling inside San Francisco Bay are slowly guided along the navigation channels by tug boat. Because they move at speeds around 10 knots or less, these vessels do not typically create waves strong enough to cause erosion along the shoreline. Although large vessels do resuspend sediments in the water column, the waters of the San Francisco Bay Estuary tend to be turbid; therefore, the incremental impact is expected not to be cumulatively considerable.

*Light*. The Project does not add additional lights to the San Francisco Bay Area. Ambient night conditions in the Bay Area are already very bright, and animals and the composition of the biotic community in urban settings may be habituated to bright nighttime conditions. The impact from the Project is, therefore, not expected to be cumulatively considerable.

*Dredging*. Dredging could potentially contribute to cumulative impacts to special-status species and habitat conversion. Every year, an average of 3 to 6 million cubic yards of sediments are dredged to maintain safe navigation in and around San Francisco Bay. Maintenance dredging can disturb special-status species and degrade habitat by temporarily increasing turbidity, resuspending sediments, and increasing noise in the dredging area. This impact would contribute cumulatively to the disturbance of sensitive species in the estuary. Tesoro would conduct dredging under the provisions of the 2001 LTMS Management Plan, which identifies work windows during which disturbance of special-status species is expected to be less than significant (USACE 2001). Therefore, intermittent maintenance dredging would not contribute to a cumulatively significant impact to special-status species. Dredging would cause temporary conversion of benthic habitat through removal of benthic species. However, the amount of material removed during each maintenance event is relatively minor. The most recent dredging event occurred in 2005 and removed 500 cubic yards of material. Therefore, the contribution of the Project to this impact would not be cumulatively considerable.

*Shipping Noise*. Ships are the dominant source of low-frequency noise in many highly-trafficked coastal zones. Although the vessel calls to the Amorco Terminal represent a small fraction of the total number of vessel trips within the San Francisco Bay, the temporary disturbance to aquatic habitat from increased noise has the potential to cause cumulatively considerable impacts to aquatic species and habitat. However, the impacts to aquatic species from the global increase in underwater sound are not well understood, and there is a great deal of uncertainty regarding the risks to marine mammals and marine ecosystems from underwater sound (MMC 2007). Scientific understanding of the impacts of underwater sound from increased shipping is still in its infancy. The cumulative impact from sound is too speculative for evaluation, and therefore this discussion is excluded, per State CEQA Guidelines 15145.

**Mitigation Measure:** No mitigation required.

**Impact CUM-BIO-2: Cause cumulative impacts to San Francisco Bay Estuary and associated biota from oil spills from all marine oil terminals combined, or from all tankering combined. (Significant and unavoidable.)**

A major oil spill at the Amorco Terminal or from vessels visiting the Amorco Terminal would potentially affect a wide range of marine and terrestrial biological resources. As discussed in Section 4.1, Operation Safety/Risk of Accidents, operations associated with the Amorco Terminal contribute incrementally to the cumulative risk of an oil spill. Vessel traffic associated with the Amorco Terminal is approximately 4.7 percent of the total probability of a spill from tanker and tank barge traffic in the San Francisco Bay. Among the facilities with potential to contribute to the accidental release of petroleum products are the Chevron Richmond Refinery Long Wharf Terminal, Tesoro Avon Marine Terminal, and the Plains All American Martinez Marine Terminal. As discussed in Impact BIO-6, major spills of fuel, crude oil, or other materials can be expected to have serious adverse effects on species and habitat. Migration of special-status species could be halted and spawning grounds degraded, and critical habitat for listed species would be adversely affected and degraded. Two major spills into the San Francisco Bay Estuary from different sources within the same season would cause even greater adverse impacts to the biota and habitats. Mitigation Measures BIO-6a through BIO-6c collectively aid in the prevention and cleanup of accidental releases of oil spills; however, a major spill could have a residual impact following spill response and cleanup. Therefore, the impact would be cumulatively considerable and significant cumulative impacts would occur from implementation of the Project.

**Mitigation Measure:** No additional mitigation measures available.

**Impact CUM-BIO-3: Cause cumulative impacts by increasing the risk of introduction of nonindigenous aquatic species from vessel traffic to San Francisco Bay. (Significant and unavoidable).**

The California Ballast Water Management for Control of Nonindigenous Species Act of 1999, as revised and reauthorized by the Marine Invasive Species Act of 2003 (Pub. Resources Code §§ 71200 to 71271) specify required ballast water and vessel biofouling management practices. These laws and associated regulations were developed to prevent future introductions of nonindigenous species to California waters. Prior to the introduction of these management practices, however, a considerable number of nonindigenous species have been introduced in to the San Francisco Bay Estuary, resulting in a realignment of the biotic communities in the bay. All commercial vessel traffic to the San Francisco Bay has the potential to introduce nonindigenous aquatic species. Although vessels that call at the Terminal are required to comply with federal and State provisions, compliance with the current regulations is not enough to ensure full mitigation of this impact. Thus significant cumulative impacts would occur even with implementation of mitigation measures BIO-7a and BIO-7b.

**Mitigation Measure:** No additional mitigation measures available.

**Impact CUM-BIO-4: Cause cumulative impacts to the biota of the San Francisco Bay Estuary resulting from degradation of water quality from vessels visiting the Amorco Terminal that are coated with antifouling paints. (Less than significant.)**

Ships that travel through marine environments are subject to a natural process known as biofouling. Biofouling causes drag, which reduces ship speed and increases fuel expenditure. To inhibit fouling, most vessels visiting the San Francisco Bay use biocidal antifouling coatings that may release copper from the vessel's surface into the surrounding water. Levels of the biocide are higher next to the hull and decrease rapidly with distance from the vessel. By design, small organisms are directly affected by the biocides contained in antifouling coatings. Larger organisms are less susceptible to injury from the small amount of direct exposure to biocides, but may be affected through the bioaccumulation of biocides in their trophic environment.

The greatest contributor of copper to the San Francisco Bay Estuary is from Central Valley rivers, local watershed sources, and erosion of buried sediment (see Table 4.2-7; Looker 2007). Ninety percent of biocide-based coatings on oil tankers entering California's water are copper-based and approximately 8 percent use biocide-free coatings (CSLC 2009). Between 2000 and 2004, antifouling marine coatings loaded approximately 25 kilograms of copper into the San Francisco Bay each day, about 2 percent of the daily load (Looker 2007). The Amorco Terminal receives approximately 90 vessel visits a year, which is a small fraction of the total vessel traffic to the estuary. Although the continuing operation of the Amorco Terminal would contribute to this impact cumulatively, its incremental contribution is not cumulatively significant.

**Table 4.2-7: Estimated Inputs of Total Copper to San Francisco Bay, 2000-2004**

| Source | Load (kg/day) |
|---|---|
| Sacramento and San Joaquin Rivers | 740 |
| Urban and non-urban Runoff | 180 |
| Wastewater (north of Dumbarton Bridge) | 23 |
| Industrial Wastewater | 0.5 |
| Anti-fouling Marine Coatings | 25 |
| Atmospheric Deposition (wet) | 1.4 |
| Atmospheric Deposition (dry) | 2.1 |
| Erosion of Buried Sediment | 342 |
| **Total** | **1314** |

Source: Looker 2007

**Mitigation Measure:** No mitigation required.

### 4.2.4 SUMMARY OF FINDINGS

Table 4.2-8 includes a summary of anticipated impacts to biological resources and associated mitigation measures.

**Table 4.2-8: Summary of Biological Resources Impacts and Mitigation Measures**

| Impact | Mitigation Measure(s) |
|---|---|
| ***Proposed Project*** | |
| BIO-1: Increase deposition or erosion of sensitive habitats along the vessel path, including marshlands within and adjacent to the lease area, resulting from the resuspension of sediments by calling vessels | No mitigation required. |
| BIO-2: Cause substantial impact to special-status wildlife species, including impact to behavior and the composition of biotic communities, in the vicinity of the Amorco Terminal as a result of the use of bright lights during nighttime Amorco Terminal operations | No mitigation required. |
| BIO-3: Cause substantial direct and/or indirect impacts on aquatic biota through the changing of physical and chemical | No mitigation required. |

| Impact | Mitigation Measure(s) |
|---|---|
| environmental factors as a result of maintenance dredging | |
| BIO-4: Cause injury or behavioral interruptions to aquatic species as a result of noise from vessels | No mitigation required. |
| BIO-5: Cause impacts to the San Francisco Bay Estuary and associated aquatic biota as a result of minor fuel, lubricant, and/or boat-related spills | No mitigation required. |
| BIO-6: Cause impacts to the San Francisco Bay Estuary and associated aquatic biota as a result of major fuel, lubricant, and/or boat-related spills | BIO-6a: Bird rescue personnel and rehabilitators.<br>BIO-6b: Cleanup of oil from biological area.<br>BIO-6c: Natural Resource Damage Assessment Team. |
| BIO-7: Introduce invasive nonindigenous species to the San Francisco Bay Estuary | BIO-7a: Marine Invasive Species Act Reporting Forms.<br>BIO-7b: Invasive species action funding. |
| ***Alternative 1: No Project*** | |
| BIO-8: Cause impacts to the San Francisco Bay Estuary and associated biota resulting from the decommissioning and abandoning in place of existing structures | Should this alternative be selected, mitigation measures would be determined during a separate environmental review under CEQA. |
| BIO-9: Cause impacts to the San Francisco Bay Estuary and associated biota resulting from the partial of complete removal of Amorco Terminal structures | Should this alternative be selected, mitigation measures would be determined during a separate environmental review under CEQA. |
| BIO-10: Cause impacts to the San Francisco Bay Region and associated biota by decommissioning and removing the Amorco Terminal and shifting crude oil imports to overland transport | Should this alternative be selected, mitigation measures would be determined during a separate environmental review under CEQA. |
| ***Alternative 2: Restricted Lease Taking Amorco Out of Service for Oil Transport*** | |
| BIO-11: Cause impacts to the San Francisco Bay Region and associated biota by shifting crude oil imports to overland transport | Should this alternative be selected, mitigation measures would be determined during a separate environmental review under CEQA. |
| ***Cumulative Impacts*** | |
| CUM-BIO-1: Cause cumulative adverse impacts to special status species, biotic communities, and habitat through vessel resuspension of sediment, use of bright night time lights, routine dredging, shipping noise, and potential minor oil spills as a result of Amorco Terminal operations | No mitigation required. |

| Impact | Mitigation Measure(s) |
|---|---|
| CUM-BIO-2: Cause cumulative impacts to San Francisco Bay Estuary and associated biota from oil spills from all marine oil terminals combined, or from all tankering combined | No additional mitigation measures available. (refer to MMs BIO-6a through BIO-6c.) |
| CUM-BIO-3: Cause cumulative impacts by increasing the risk of introduction of nonindigenous aquatic species from vessel traffic to San Francisco Bay Estuary | No additional mitigation measures available. (refer to MMs BIO-7a and BIO-7b.) |
| CUM-BIO-4: Cause cumulative impacts to the biota of the San Francisco Bay Estuary resulting from degradation of water quality from vessels visiting the Amorco Terminal that are coated with antifouling paints | No mitigation required. |