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 for the continued operation of the Tesoro Avon Marine Oil Terminal (Avon Terminal) in the lower Suisun Bay, and Marine Oil Terminal Engineering Maintenance Standards (MOTEMS) compliance-related renovation. This section describes the existing biological resources in the San Francisco Bay Estuary (SFBE) and in the Avon Marine Oil Terminal Lease Consideration Project (Project) study area (lower Suisun Bay, upper Carquinez Strait, and Avon Terminal vicinity) and summarizes laws and regulations associated with biological resources. This is followed by an analysis of the potential Project impacts associated with routine continued operations and MOTEMS renovation at the Avon Terminal. An accidental release of oil presents the potential to impact nearby biological resources and could have wide-ranging effects on biological resources in the SFBE.

4.2.1 ENVIRONMENTAL SETTING

4.2.1.1 San Francisco Bay Estuary

Geographic and Hydrologic Characteristics of the San Francisco Bay Estuary

The SFBE is typically divided into five segments: Sacramento-San Joaquin River Delta (Delta), Suisun Bay, San Pablo Bay, Central Bay, and South Bay (see Figure 4.2-1). In recognition of the importance of the SFBE, the United States named it as its 35th Wetland of International Importance (Ramsar Convention on Wetlands 2013).

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 SFBE, 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 Military Ocean Terminal Concord (MOTCO; formerly known as the Concord Naval Weapons Station), the cities of Pittsburg, West Pittsburg, and Martinez, and the unincorporated community of Avon. Suisun Bay is connected to San Pablo Bay via the Carquinez Strait, a narrow, 12-mile-long band of water that extends from the Benicia-Martinez Bridge to Mare Island.

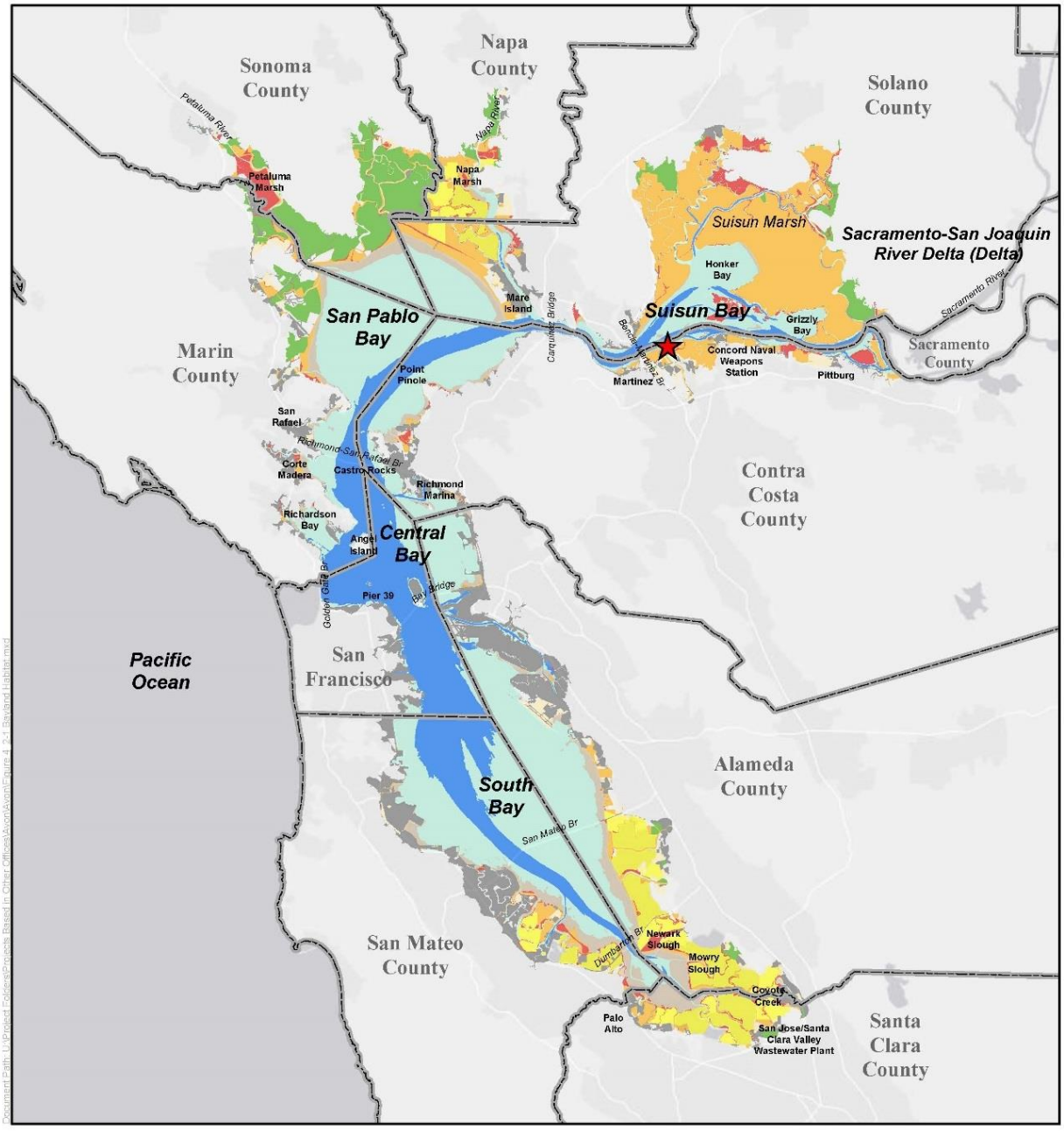


Figure 4.2-1
Bayland Habitat
California State Lands Commission
Avon Marine Oil Terminal Lease Consideration Project

TRC Results you can rely on

8/13/2014

Approximate Terminal Location
Shallow Bay
Deep Bay
Tidal Flat
Old Tidal Marsh
Tidal Marsh
Diked Marsh
Agricultural Bayland
Salt Pond
Filled Baylands

N

0 4.5 9 Miles

Service Layer Credits: Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community, SFEI

San Pablo Bay is the second largest bay in the SFBE; 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 to 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 bound 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 and 35.0 ppt. Due to 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 (San Francisco Estuary Partnership [SFEP] 2011).

The waters south of the San Francisco-Oakland Bay Bridge form the largest embayment, known as the South Bay. The waters in the South Bay 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 SFBE'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 has important implications for shoreline habitat.

Habitats of the San Francisco Bay Estuary

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

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

Community	Locations and 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 to 0.5 ppt[2] salinity. Sacramento River, San Joaquin River	Sago pondweed (*Potomogeton pectinatus*)	Asian clam (*Corbicula fluminea*)
Oligohaline	0.5 to 5.0 ppt salinity. Suisun Bay	Widgeon grass (*Ruppia maritime*)	California bay shrimp (*Crangon franciscorum*)
Mesohaline	5.0 to 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 to 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 to 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*)
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	Pickleweed (*Salicornia virginica*), sea blite (*Suaeda californica*), marsh rosemary (*Limonium commune*), marsh grindelia (*Grindelia hirsutula*),	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*),

Community	Locations and Examples	Characteristic Plants	Characteristic Animals
	marshes, Peyton Slough)	California cord grass (*Spartina foliosa*)	salt marsh mosquitoes (*Aedes sqamiger, A. dorsalis*).
Coastal scrub	Dry rocky or gravelly slopes below 3,000 feet	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*)

Sources: Smith 1959, National Oceanic and Atmospheric Administration 2007

[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] ppt = Parts by weight of salt per thousand parts of water

Subtidal

Open-water habitats are divided into shallow bay (subtidal areas less than 18 feet deep below extreme low tide) and deep bay (more than 18 feet deep). 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 of the bays in the SFBE contain extensive areas of shallow bay habitat.

The open waters of the SFBE are primarily underlain by soft-bottom bay sediments, although small areas exist where the substrate is either vegetated or supports shellfish beds. Eelgrass is present, and has potential to expand its range in the North, Central, and South Bays, but is absent from Suisun Bay (Boyer and Wyllie-Echeverria 2010). 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 SFBE. 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 SFBE (SFEP 2011). The primary sources of sediment into the SFBE 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). Due to a 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 SFBE vary with salinity. Species tolerant of high levels of salinity, but less adaptable to variable changes in salinity, are found in the Central and South Bays. San Pablo Bay and Suisun Bay support brackish water and freshwater species that are more tolerant of 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, which 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 (*Spirinchus thaleichthys*), 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 in 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 SFBE'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.

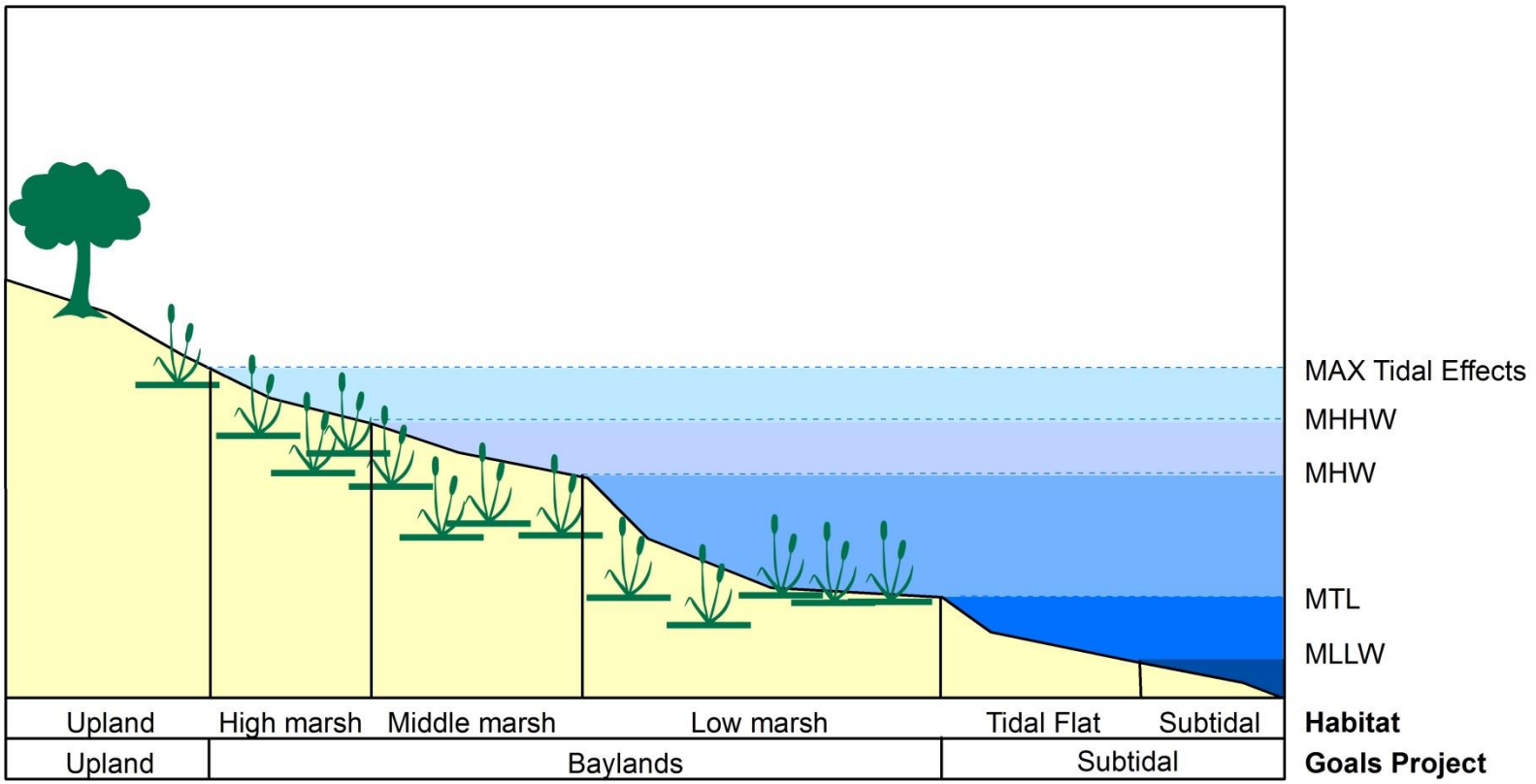
Tidal Marsh

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 provides nurseries for commercially important species and endangered species; the tidal marshes are feeding and nesting areas for birds.

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 the SFBE are migratory. Shorebirds that breed in the marshes include American avocet (*Recurvirostra Americana*), black-necked stilt (*Himantopus mexicanus*), and Western snowy plover (*Charadrius nivosus* ssp. *nivosus*). Mammals found in these areas include mice, shrews, bats, and raccoons. Lizards, snakes, frogs, and toads are commonly found here. 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 (*Schoenoplectus* 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.



Source: Josselyn 1983

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

Urban Shoreline

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 urbanized.

Coastal Scrub

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 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 Bay 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 SFBE is relatively low. The population density of phytoplankton in the bay cycles throughout the year, with levels higher during spring in the 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 can range in size from microscopic (microplankton) to those that can be seen by the naked eye (macroplankton). This heterogeneous group includes mysid shrimp, clam larvae, cnidarians, copepods, and other crustaceans. They feed upon phytoplankton, bacteria, organic detritus, and each other.

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

Invertebrates

The SFBE is a nursery area for shrimp, crabs, and fish. California bay shrimp (*Crangon franciscorum*) is the most common shrimp in the SFBE most years, and supports a small commercial fishery. The blacktail bay shrimp (*Crangon nigricauda*) is the second most common shrimp in the SFBE overall, with increased abundance during higher salinity years that result from low river inflows, but not to levels that replace California bay shrimp (CDFG 2001). 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; the small juvenile stages are carried into the bay on tidal currents and spend the first year or two of their lives rearing in the San Pablo and South Bays (NOAA 2007).

Different species of shrimp tend to inhabit different regions of the SFBE, though species do overlap in distribution. Shrimp species that live in the more saline environment of the SFBE 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 bay shrimp, show no increase in abundance over the past 15 years. Regionally, shrimp abundance increased in all parts of the SFBE 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).

Fish

The health of the SFBE 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 SFBE 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 (Interagency Ecological Program 2010).

Birds

The SFBE 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 SFBE 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, SFBE is listed as an important shorebird migratory stopover in the Western Hemisphere Shorebird Reserve Network (U.S. Fish and Wildlife Service [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 the 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 SFBE. 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 beaches, 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 SFBE, but populations of 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 (*Melospiza melodia samuelis*) and Suisun song sparrow (*Melospiza melodia maxillaris*) 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

Mammals in the SFBE 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 SFBE by overharvesting in the 19th century. Both river otter and beaver have recently recolonized the SFBE; 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 wetlands in Suisun Bay (River Otter Ecology Project 2014). 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 SFBE are California sea lion (*Zalophus californianus*) and harbor seal (*Phoca vitullina*) (NOAA 2007). The California sea lions are mainly males that migrate to the SFBE 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

The SFBE has been described as one of the most invaded ecosystems in North America (Cohen and Carlton 1995). Nonindigenous aquatic species (NAS) dominate many parts of the SFBE, to the extent that in some locations it can be difficult to find any native species (Cohen and Carlton 1995). In 2010, a field survey funded by the California Department of Fish and Wildlife (CDFW) reported 497 species from SFBE, of which 98 species were classified as introduced, including three newly detected species to SFBE that had likely been spread from other locations in California (CDFW Office of Spill Prevention and Response [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 SFBE 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 NAS, and vessel biofouling and ballast water are considered the largest contributors of NAS to the SFBE (California State Lands Commission [CSLC] 2013c). Eighteen percent of established nonindigenous aquatic species are tied to vessel biofouling as the primary likely vector and 9 percent to 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). Non-native 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. Jellyfish may be passively spread through all low-salinity areas of SFBE via attachment to boat bottoms (NOAA 2007).

Nonindigenous aquatic 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 NAS (OSPR 2011). One such currently pernicious NAS is the overbite clam (*Corbula amurensis*), first found in the SFBE in 1986. Thought to have been introduced into the SFBE by ballast water discharge from a vessel, this filter feeder is now so abundant that the current population is capable of filtering the water column over the SFBE shallows almost 13 times per day (SFEP 2004). 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).

Rare, Threatened, and Endangered Species

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 due to the diversity of habitat between embayments. Each habitat supports a distinct community of sensitive species. To aid in impact assessment, each category of sensitive species is summarized by embayment (see Appendix C, Tables C-1 through C-5, for information about each species, and their potential to be present near the Project site and impacted by the Project). Figure 4.2-3 depicts the special-status species that have been recorded by the California Natural Diversity Database within a 10-mile radius of the Project.

Sensitive Plants

Tidal habitats in the SFBE 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 (California Native Plant Society 2014). The distribution of sensitive plant species varies geographically within the SFBE. 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 C, Table C-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 Reyes 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.

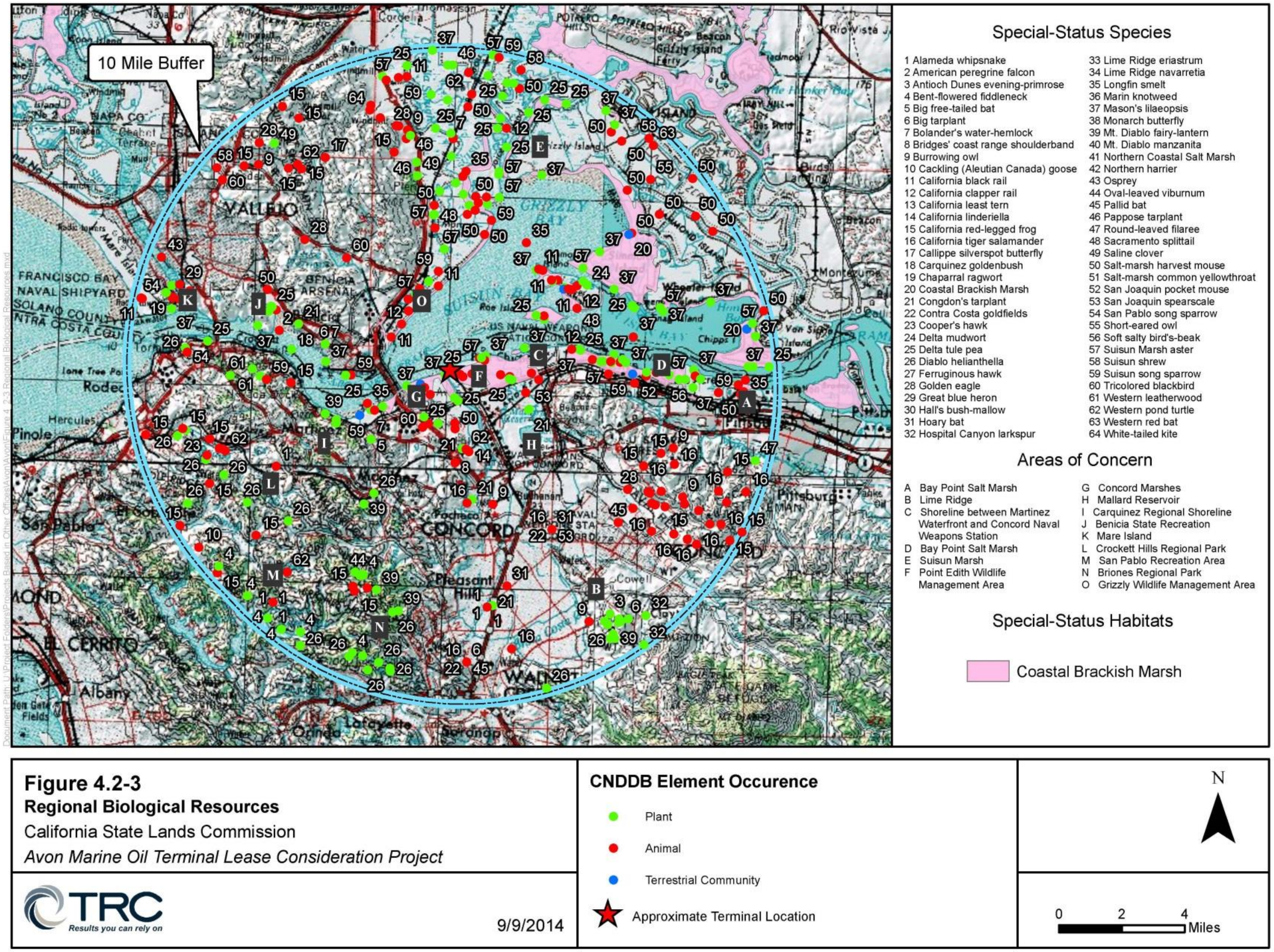


Figure 4.2-3
Regional Biological Resources
California State Lands Commission
Avon Marine Oil Terminal Lease Consideration Project

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9/9/2014

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One other sensitive species found in the Central Bay, California sea blite (*Suaeda californica*), is restricted to the intertidal zone of salt marshes, and was extirpated from the SFBE 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 the 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 previously, one population of California sea blite was re-introduced at Roberts Landing.

San Pablo Bay, which has retained more of its historic tidal marshes than any other bay, supports naturally occurring populations of six rare plant 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, George 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 high-tide shorelines. Recent populations are reported from along the lower Napa River. Saline marsh clover (*Trifolium hydrophilum*) occurs in marshes and alkaline grasslands and is present in 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 SFBE: 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 now reported only near Fagan Slough. The delta tule pea, a climbing species, is present in marshes along the Napa River. Mason's lilaeopsis 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: one population of Point Reyes bird's-beak is known from the Petaluma River; and extant populations of the federally endangered soft bird's-beak (*Cordylanthus mollis* ssp*. mollis*) are found in the marshes along the mouth of the Napa River.

Most sensitive plants found in San Pablo Bay are also found in Suisun Bay, where they are more widely distributed and abundant, particularly in the brackish waters of Suisun Marsh. In addition to the plants described previously, 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.

Sensitive Fishes

The SFBE provides habitat to seven species of sensitive fish. Most sensitive fish species in the SFBE 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, drought, pollution, predation, disruption of the food web, and direct competition for space with and predation by nonindigenous aquatic species. The following discussion summarizes the distribution of sensitive species in the estuary; Table C-2 in Appendix C provides more detailed information for each species. Sensitive fish species are found mainly in the north bays. 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 they 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 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.

Four anadromous species are found in the SFBE: 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 (Rosenfield 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 the federal and State levels.

An ally to salmon, the steelhead, is an anadromous type of rainbow trout. They migrate into the estuarine river basins from October to April and spawn from December to May. Central California Coast steelhead populations in the SFBE are aggregated into two geographically based diversity strata, both of which are listed as threatened at the federal level. The Coastal SFBE strata includes populations that spawn in Corte Madera Creek, Guadalupe River, Miller Creek, Novato Creek, and San Francisquito Creek. The Interior SFBE strata includes populations that spawn in Alameda Creek, Coyote Creek, Napa River, Petaluma River, San Leandro Creek, and San Lorenzo Creek (National Marine Fisheries Service [NMFS] 2011a). Central Valley steelhead, which are also listed as threatened at the federal level, migrate through the SFBE en route to spawning sites in tributaries to the Sacramento and San Joaquin Rivers (NMFS 2011b).

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.

Sensitive Birds

Sensitive birds in the SFBE are generally obligate inhabitants of tidal marshes, and have experienced population declines as a result of the removal and degradation of marsh habitat (see Appendix C, Table C-3 for species list). Thus, the Central Bay, which possesses few tidal marshes, has few populations of sensitive birds. Many sensitive species, such as California clapper rail (*Rallus longirostris obsoletus*) and California black rail, are widely distributed throughout the SFBE. Others are subspecies known from single embayments: the Suisun song sparrow is found in Suisun Bay, the San Pablo song sparrow 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 also nests in the South Bay, as well as in the San Pablo Bay marshes. Colonial nesters found in the SFBE 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.

Sensitive Mammals

Tidal marshes in the SFBE 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 C, Table C-4). 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 San Pablo vole (*Microtus californicus sanpabloensis*), all weighing 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 SFBE, 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 SFBE. 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 distribution of bat species and their use of estuarine habitats has not been well described. 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.

Sensitive Amphibians and Reptiles

The SFBE supports a few sensitive amphibians and reptiles (see Appendix C, Table C-5). California red-legged frog (*Rana draytonii*) and western pond turtle (*Actinemys marmorata*), which prefer freshwater ponds and streams but are tolerant of limited saltwater intrusion, are distributed in low numbers throughout the SFBE (CDFW 2013c) and are documented from brackish marshes in the San Pablo and Suisun Bays. California red-legged frogs appear to be eliminated from the western lowland portions of Contra Costa and Alameda Counties, particularly in urban areas. California tiger salamanders (*Ambystoma californiense*), 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, and along the shoreline within a 0.5-mile radius of, the Avon Terminal. Known habitats of rare, threatened, or endangered plant or animal species are present within a 1-mile radius of the Avon Terminal (see Figure 4.2-4). Table C-6 in Appendix C 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 south shore of Suisun Bay, approximately 1.75 miles east of the Benicia-Martinez Bridge. The existing lease extends approximately 1,200 feet into the bay. Water depths in the lease area range from 13 meters at the lease edge to 3 meters along the dock. Maintenance dredging at the Avon Terminal maintains the overall sediment elevation at approximately 44 feet below MLLW. The benthic substrate consists of soft bay sediments over bedrock, also known as mudstone. The Avon Terminal is located in a slightly depositional environment, where water moving into the Carquinez Strait slows as it passes through Berth 1, allowing sediment in the water to settle out. Local scour occurs east of the Avon Terminal.

Land uses near the Avon Terminal include industrial and open space. North of the Avon Terminal, Carquinez Strait and Suisun Bay provide wildlife habitat, commercial and recreational water use, and industrial transport access. The channel north of the Avon Terminal is about 9,000 feet wide; the north shore is home to the Suisun Bay Reserve Fleet and Grizzly Island Wildlife Area. The shoreline east and west of the Avon Terminal is composed of coastal brackish marsh, and areas of tidal flats lie to the south and west. Point Edith Wildlife Area lies east of the Avon Terminal and approachway. West of the Avon Terminal are the Point Edith Wetlands (also known as Concord Marsh) and the Plains All American Marine Oil Terminal.

Carquinez Strait is a narrow gap in the Coast Range that connects San Pablo Bay to Suisun Bay and the Sacramento-San Joaquin River Delta. The Strait's narrow channel 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, resulting in a geological feature known as an inverted river delta. Upstream, channel depths transition rapidly from the deep channel of Carquinez Strait into the shallows of Suisun Bay. This area of bathymetric change, known as 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 Suisun Bay is stratified by depth, with fresh water along the surface and saline water along the bottom (see Figure 4.2-5). Salinity stratification is greatest during neap tides. Following winter storms, surface waters reach their lowest levels of salinity, and for a brief time, the channel becomes oligohaline. Once winter floods have stopped, channel waters return to mesohaline.

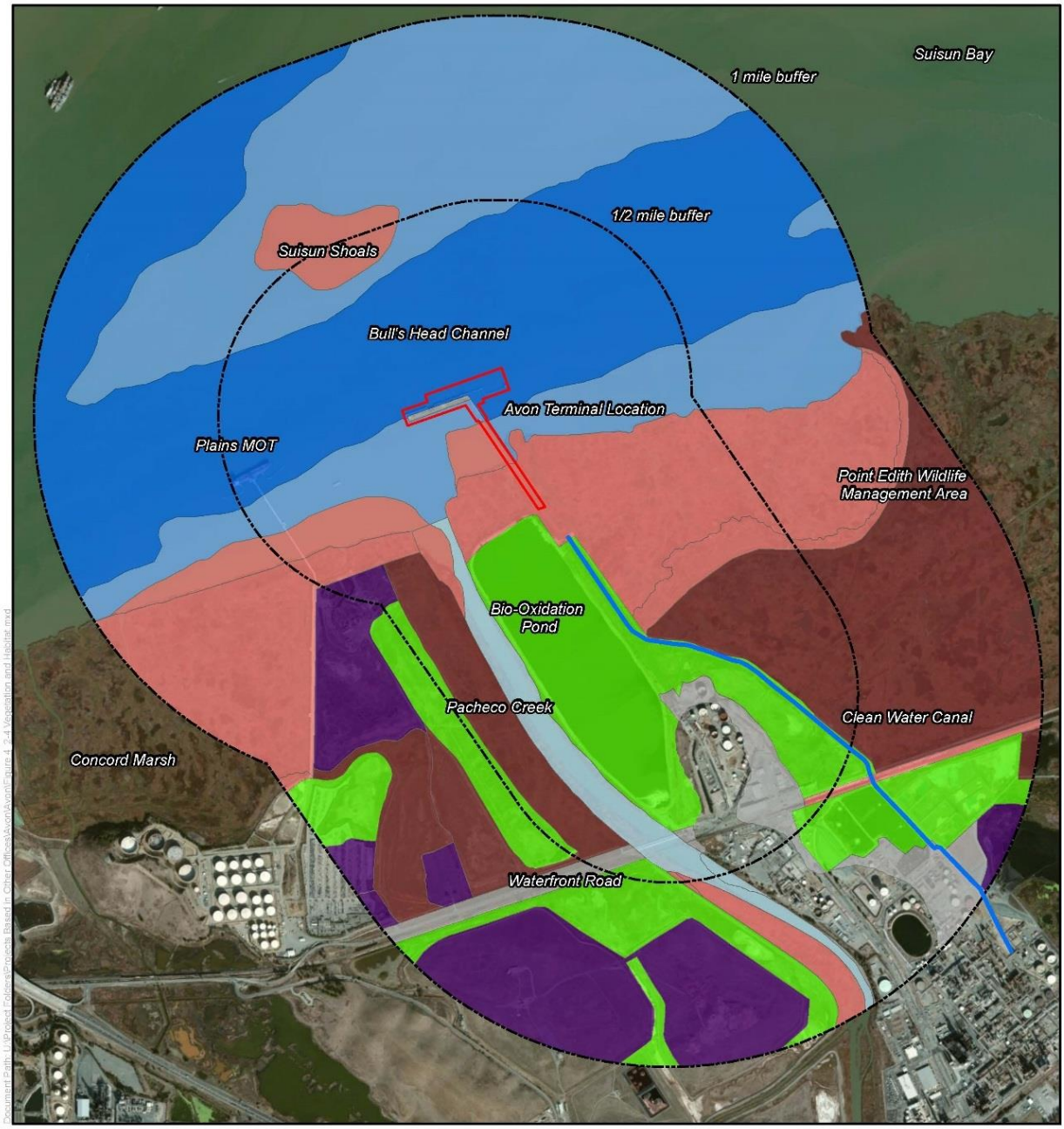

Figure 4.2-4
Vegetation and Habitat
California State Lands Commission
Avon Marine Oil Terminal Lease Consideration Project

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8/27/2014

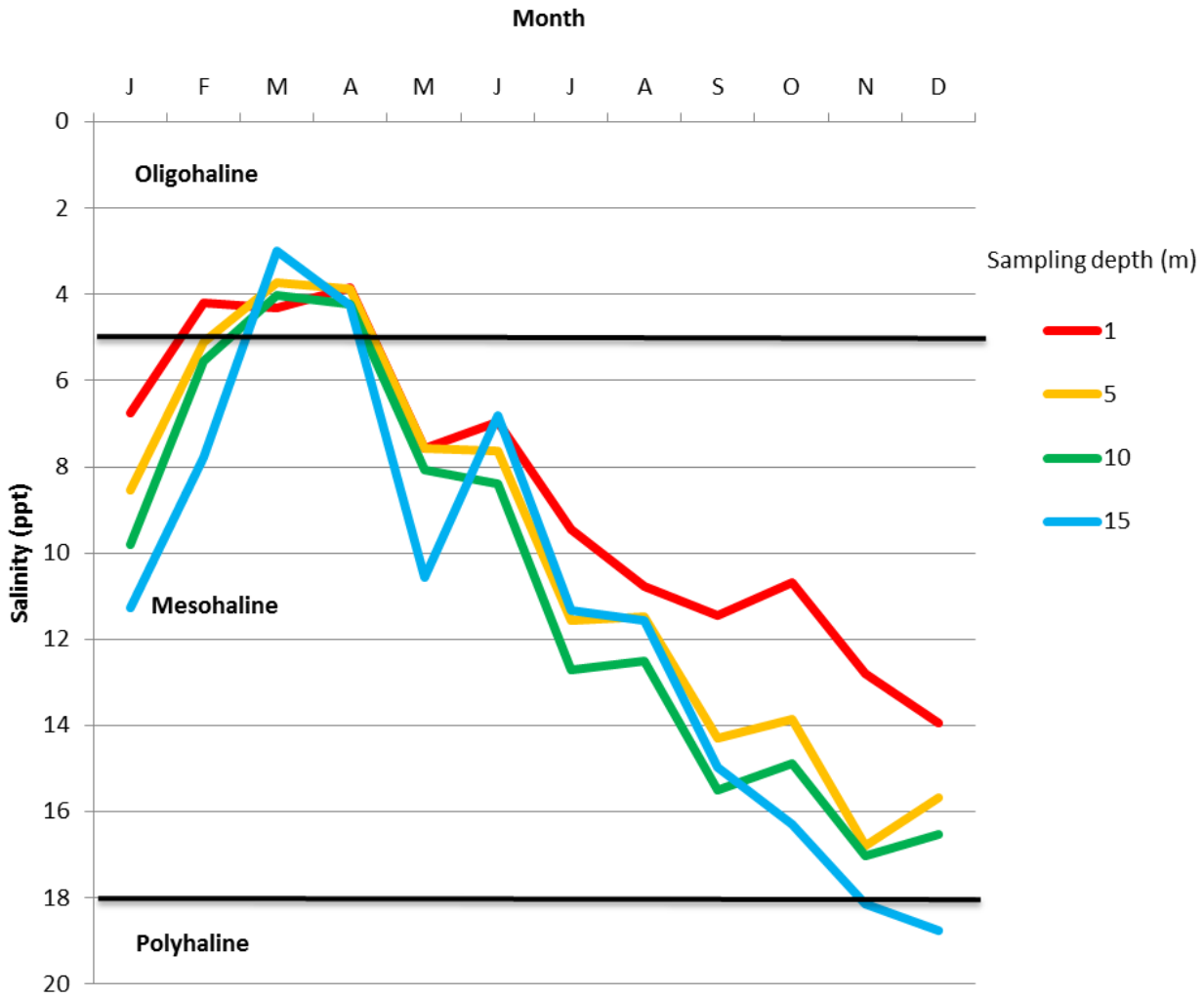
Deep Bay
Diked
Filled Bayland
Fully Tidal
Fully Tidal Bayland
Muted Tidal Bayland
Shallow Bay
Undefined

Proposed CSLC Lease Boundary
Buffer
Clean Water Canal

N

0 1,000 2,000 Feet

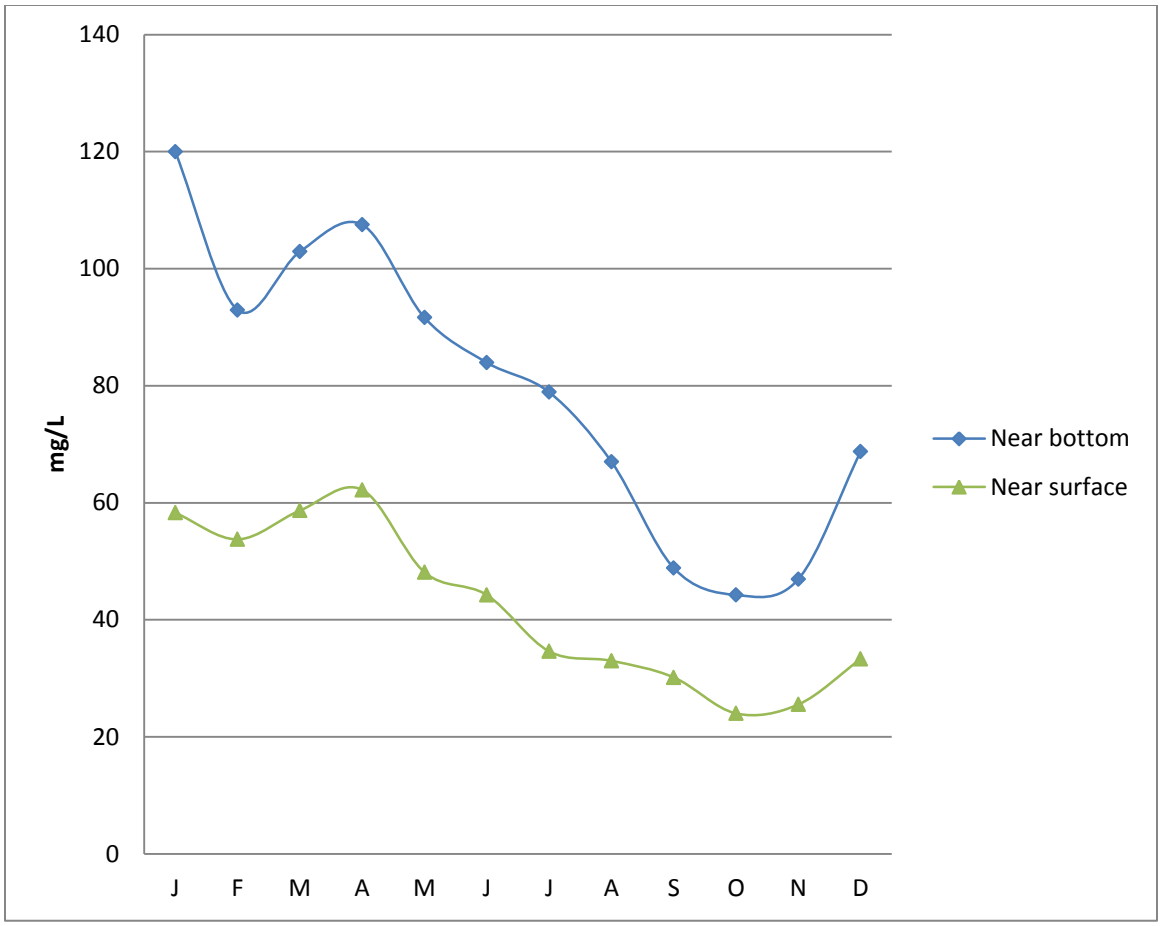
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



Source: USGS 2013

Figure 4.2-5: Salinity Stratification at Avon Terminal
California State Lands Commission
Avon Marine Oil Terminal Lease Consideration Project

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 SFBE 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 4.2-6).



Source: USGS 2007

Figure 4.2-6: Average Suspended Sediment Concentration at Benicia Bridge, 2003-2007
California State Lands Commission
Avon Marine Oil Terminal Lease Consideration Project

Avon Terminal Structures

The Avon Terminal consists of an existing 1,520-foot-long docking facility connected to the shore by an approximately 1-mile-long approachway. The Avon Terminal is constructed of wood, concrete, and metal. Several buildings are located on the Avon Terminal, including buildings for personnel, a pump house, and a tool shed. Lights are placed regularly along the Avon Terminal and approachway, and there is a large light bank under the main loading arm.

The Avon Terminal provides shade and refuge areas for fish, and resting spots and foraging opportunities for fish, birds, and marine mammals. Avon Terminal structures also provide nesting habitat for birds, including a pair of osprey nesting on Berth 5. Support pilings provide attachment areas for sessile invertebrates and a place for fish to spawn. The barren roads, road margins, and dirt parking lots within the Project area

provide nesting habitat for killdeer (*Charadrius vociferous*). The various structures and infrastructure (e.g., light poles, wires, pipelines) provide perch and nest sites for common birds such as black phoebe (*Sayornis nigricans*) and house finch (*Haemorhous mexicanus*). Western fence lizards (*Sceloporus occidentalis*) likely use exposed road beds, metal ladders, and other human-constructed hard surfaces. Most of the mammal species mentioned below under coyote brush scrub also forage and move through developed portions of the study area.

Open Water

Open-water habitat within the study area includes open estuarine waters of Suisun Bay (discussed further below) and associated tidal channels extending into the marsh, the eastern edge of the bio-oxidation pond, and freshwater wastewater treatment features (i.e., bio-oxidation pond and Clean Water Canal). Suisun Bay supports numerous native fish species, and provides foraging and loafing habitat for various species of ducks, gulls, terns, cormorants, and other waterbirds. Diving ducks, such as greater scaup (*Aythya marila*) and ruddy duck (*Oxyura jamaicensis*), are more likely to forage in the waters adjacent to the Avon Terminal, while dabbling ducks, such as mallard (*Anas platyrhynchos*), American wigeon (*Anas Americana*), and green-winged teal (*Anas creccai*), are more likely to forage within the marsh and water treatment features.

Subtidal Estuarine

The estuarine 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 the SFBE, areas of the water column less than 18 feet deep are considered shallow bay, and areas deeper than 18 feet are considered deep bay. Approximately 640 acres of shallow bay and 740 acres of deep bay are found within 1 mile of the Avon Terminal. These habitats provide foraging areas for invertebrates, fish, diving birds, and marine mammals, as well as nursery and spawning habitat for invertebrates and fish.

Compared to other parts of the SFBE, Suisun Bay is not especially rich in phytoplankton. 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 west Suisun Bay from 2003 to 2013 show that chlorophyll α levels in the Carquinez Strait rarely exceed this threshold in either spring or fall (USGS 2013a).

The benthic substrate at the Project site consists of soft bay sediments over bedrock, also known as mudstone. Due to the lack of hard surfaces for rooting, few plants are associated with soft-bottom habitats. However, although mobile, the fine-grained

sediment is stable and compact enough to support a diverse benthic assemblage. The biotic assemblage associated with this habitat is known as the benthos. Due to the variability in salinity, the benthic habitat and community composition fluctuates seasonally. The overbite clam *(Corbula amurensis)*, a NAS, is the most common benthic species observed near the Avon Terminal.

Tidal Flat

Three areas of tidal flat comprising an area of approximately 107 acres are located within 1 mile of the Avon Terminal lease. A 12-acre tidal flat is located between the Avon Terminal and the shoreline, and a band of tidal flat, approximately 54 acres, stretches along the west bank of Pacheco Creek and the southern shoreline of Suisun Bay. Tidal flats are also found at Suisun Shoal, approximately 0.5 mile north of the Avon Terminal. The Project area tidal flats 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 tidal flats provide foraging areas for fish, including longfin smelt.

Tidal Marsh

Approximately 624 acres of fully tidal or muted tidal marsh are found along the southern shore of Suisun Bay within 1 mile of the Avon Terminal. West of the Avon Terminal, the predominantly low/middle marsh plain extends up to 3,500 feet from the edge of the tidal flat; east of the Avon Terminal, the marsh plain is approximately 2,500 feet wide. Both marsh plains contain a fringe of high tidal marsh and abut areas of muted tidal brackish marsh. The 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 channels 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.

Tidal brackish marsh within the study area provides high-quality habitat for a variety of bird species, including great egret, snowy egret, northern harrier (*Circus cyaneus*), Virginia rail (*Rallus limicola*), sora (*Porzana carolina*), marsh wren (*Cistothorus palustris*), salt marsh common yellowthroat (*Geothlypis trichas sinuosa*), Suisun song sparrow, and red-winged blackbird (*Agelaius phoeniceus*). The high saline content and regular inundation of brackish marsh precludes regular use by amphibians, reptiles, and most mammals, but species from these taxa that use adjacent uplands and developed areas likely forage in the marsh on an incidental basis. Common bat species, such as

big brown bat (*Eptesicus fuscus*) and Brazilian free-tailed bat (*Tadarida brasiliensis*), likely forage over the marsh at night.

Muted tidal marsh adjacent to the Avon Terminal provides habitat for a variety of rare, threatened, and endangered species, including California clapper rail and California black rail. Saltmarsh harvest mouse inhabit marshes in the Project area. Several rare plants have potential to be found in the marshes, including soft bird's-beak, delta tule pea, Mason's lilaeopsis, and Suisun thistle.

An additional 104 acres of diked brackish marsh is found within 1 mile of the lease, including the marshlands under the approachway. Diked marshes provide important habitat for waterfowl, shorebirds, and small mammals, and may provide high-tide refugia for small mammals and roosting habitat for shorebirds.

Coyote Brush Scrub

The dense shrub cover and scattered trees growing on the levees and berms within the study area provide nesting and foraging habitat for bird species such as white-tailed kite (*Elanus leucurus*), red-tailed hawk (*Buteo jamaicensis*), great horned owl (*Bubo virginianus*), mourning dove (*Zenaida macroura*), Anna's hummingbird (*Calypte anna*), western scrub-jay (*Aphelocoma californica*), and northern mockingbird (*Mimus polyglottos*). Exposed concrete rubble, or other hard surfaces, provide basking habitat for western fence lizards, and the dense shrub cover may support common amphibians and reptiles such as Sierran treefrog (*Pseudacris sierra*), common garter snake (*Thamnophis sirtalis*), and gopher snake (*Thamnophis sirtalis*). Mammal species expected to occur in scrub and levee slopes include California ground squirrel (*Spermophilus beecheyi*), Botta's pocket gopher (*Thomomys bottae*), California vole (*Microtus californicus*), black-tailed jackrabbit (*Lepus californicus*), coyote (*Canis latrans*), northern raccoon (*Procyon lotor*), and striped skunk (*Mephitis mephitis*), along with the non-native Norway rat (*Rattus norvegicus*) and house mouse (*Mus musculus*).

Special-status Species

Plants

Of the 12 special-status plant species that occur in the tidal marshes of SFBE, seven species have potential to occur at the Project site:

- Salty soft bird's-beak (*Cordylanthus mollis* ssp. *mollis*)
- Mason's lilaeopsis (*Lilaeopsis masonii*)
- Suisun marsh aster (*Symphytrichum lentum*)
- Saline clover (*Trifolium depauperatum* var. *hydrophilum*)
- Delta tule pea (*Lathyrus jepsonii* var. *jepsonii*)
- San Joaquin spearscale (*Atriplex joaquinana*)
- Delta mudwort (*Limosella australis*)

Fish

All special-status fish species of the SFBE with extant populations have potential to occur within the Project site:

- Green sturgeon, Southern Distinct Population Segment (*Acipenser medirostris*)
- Delta smelt (*Hypomesus transpacificus*)
- Longfin smelt (*Spirinchus thaleichthys*)
- Central Valley steelhead (*Oncorhynchus mykiss*)
- Central California Coast steelhead (*Oncorhynchus mykiss*)
- Central Valley spring-run Chinook salmon (*Oncorhynchus tshawytscha*)
- Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*)

Terrestrial Wildlife

Suitable habitat for 20 special-status wildlife species occurs within the Project site:

- Western pond turtle (*Emys marmorata*)
- Cooper's hawk (*Accipiter cooperii*)
- Tricolored blackbird (*Agelaius tricolor*)
- Great blue heron (*Ardea heodiras)*
- Northern harrier (*Circus cyaneus*)
- Short-eared owl (*Asio flammeus*)
- Cackling (=Aleutian Canada) goose (*Branta hutchinsii leucopareia*)
- White-tailed kite (*Elanus leucurus*)
- American peregrine falcon (*Falco peregrinus anatum*)
- Salt marsh common yellowthroat (*Geothlypis trichas sinuosa*)
- Bald eagle (*Haliaeetus leucocephalus*)
- California black rail (*Laterallus jamaicensis coturniculus*)
- California clapper rail (*Rallus longirostris obsoletus*)
- Suisun song sparrow (*Melospiza melodia maxillaris*)
- San Pablo song sparrow (*Melospiza melodia samuelis*)
- Osprey (*Pandion haliaetus*)
- Double-crested cormorant (*Phalacrocorax auritis*)
- Salt marsh harvest mouse (*Reithrodontomys raviventris*)
- Suisun shrew (*Sorex ornatus sinuosus*)
- Big free-tailed bat (*Nyctinomops macrotis*)

Marine Mammals

Marine mammals with potential to occur within the Project site include:

- California sea lion (*Zalophus californianus*)
- Harbor seal (*Phoca vitulina richardii*)

Special-status Habitats

Jurisdictional Waters

LSA Associates (2013) conducted a Preliminary Wetland Delineation within a 47-acre study area, and concluded that potential Clean Water Act (CWA) Section 404 jurisdictional features consist of 22.78 acres of tidal/non-tidal marsh wetlands and 4.79 acres of non-wetland waters (see Figure 4.2-7). Suisun Bay and a single tributary slough that parallels the approachway north of Land's End (located at Bent 168, between Areas B and C, on the approachway; refer to Figure 2-4) are also subject to U.S. Army Corps of Engineers (USACE) jurisdiction, pursuant to Section 10 of the Rivers and Harbors Act. The bio-oxidation pond and the Clean Water Canal are covered under a National Pollutant Discharge Elimination System permit, as part of the Golden Eagle Refinery's wastewater treatment system.

Critical Habitat

The open waters of Suisun Bay within the Project area have been designated as critical habitat for Sacramento River winter-run Chinook salmon (58 Code of Federal Regulations [CFR] 33212), delta smelt (59 CFR 65278), and green sturgeon (74 CFR 52300). Primary constituent elements (PCEs) of designated critical habitat for salmon and sturgeon include the estuarine water column, which includes suitable depth, sediment, and water quality; and adequate food resources and foraging habitat. 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. Due to the fluid nature of the Delta's hydrology, the quality of the PCEs for the delta smelt fluctuate within the designated area.

California Department of Fish and Wildlife Natural Communities

Coastal brackish marsh is found along the shoreline at the Avon Terminal. The coastal brackish marsh is dominated by perennial, emergent, herbaceous monocots that create a dense cover up to 2 meters tall. Due to the saline and semi-aquatic environment, plant species diversity in coastal brackish 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).

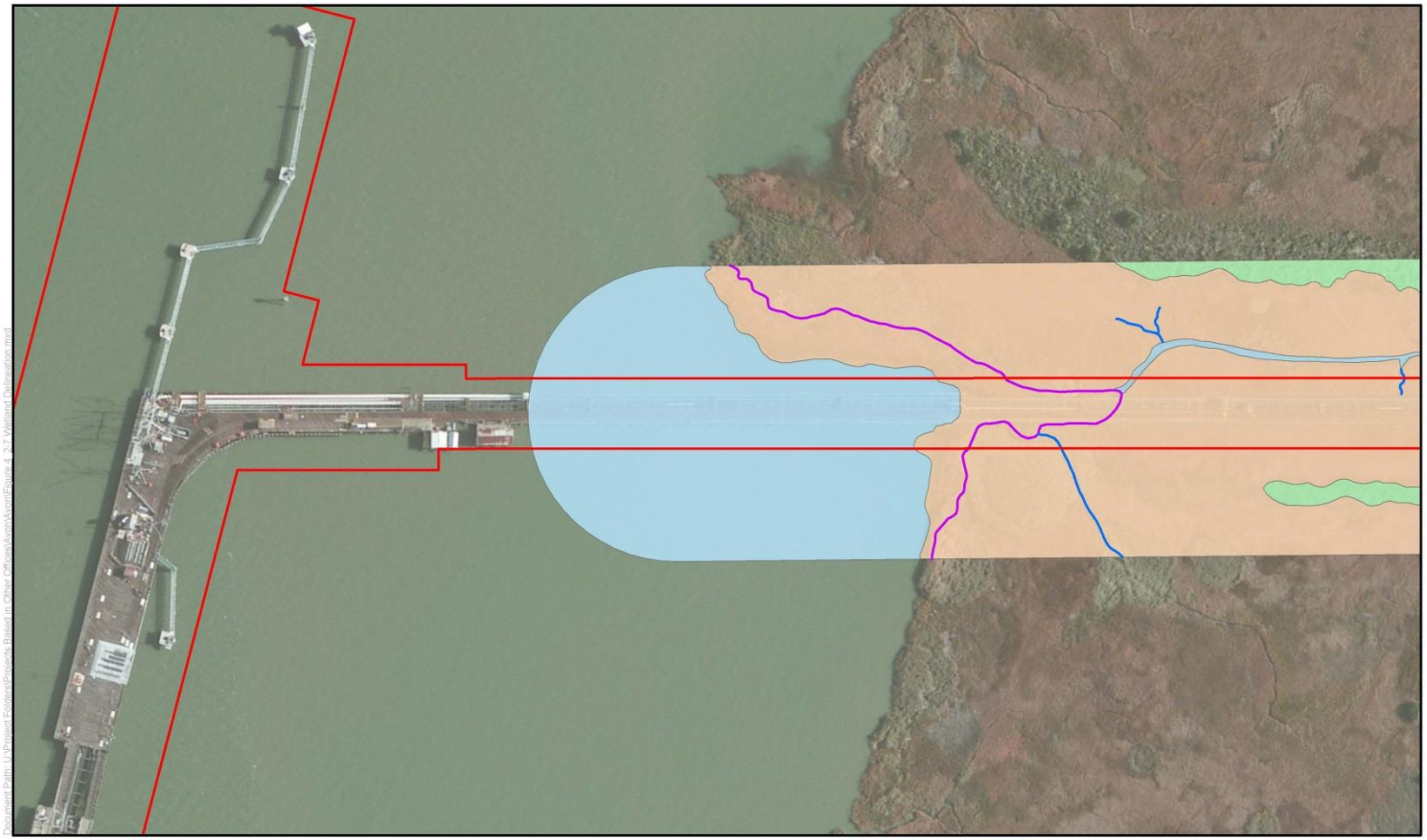


Figure 4.2-7
Wetland Delineation
California State Lands Commission
Avon Marine Oil Terminal Lease Consideration Project

TRC Results you can rely on

8/27/2014

Proposed CSLC Lease Boundary
Sample Points
Streams
Match Line
High Tide Line
Non-Wetland Waters (Open Water)
NonJD Wastewater Treatment
Tidal/Brackish Marsh
Upland

N

0 100 200 Feet

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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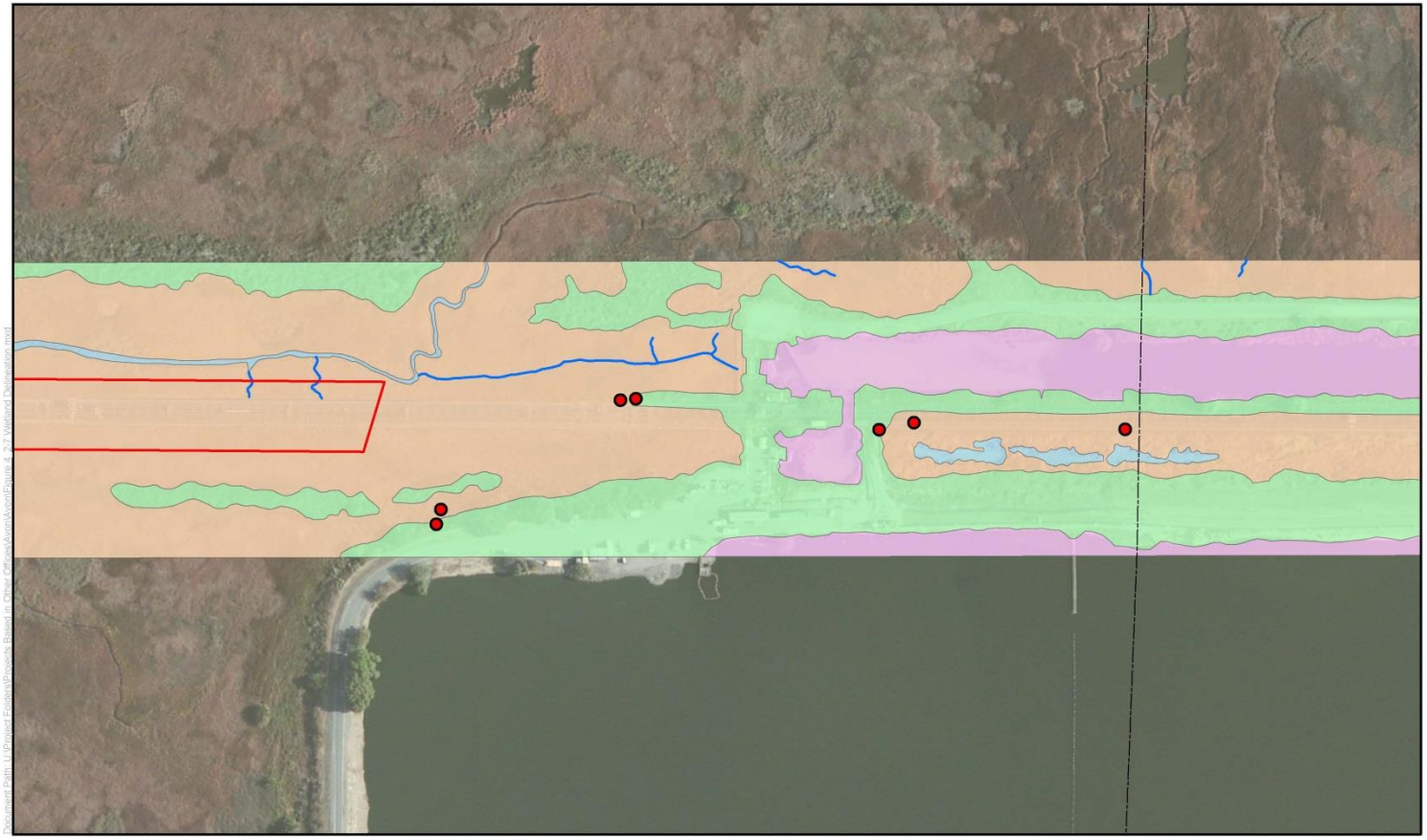

Figure 4.2-7
Wetland Delineation
California State Lands Commission
Avon Marine Oil Terminal Lease Consideration Project

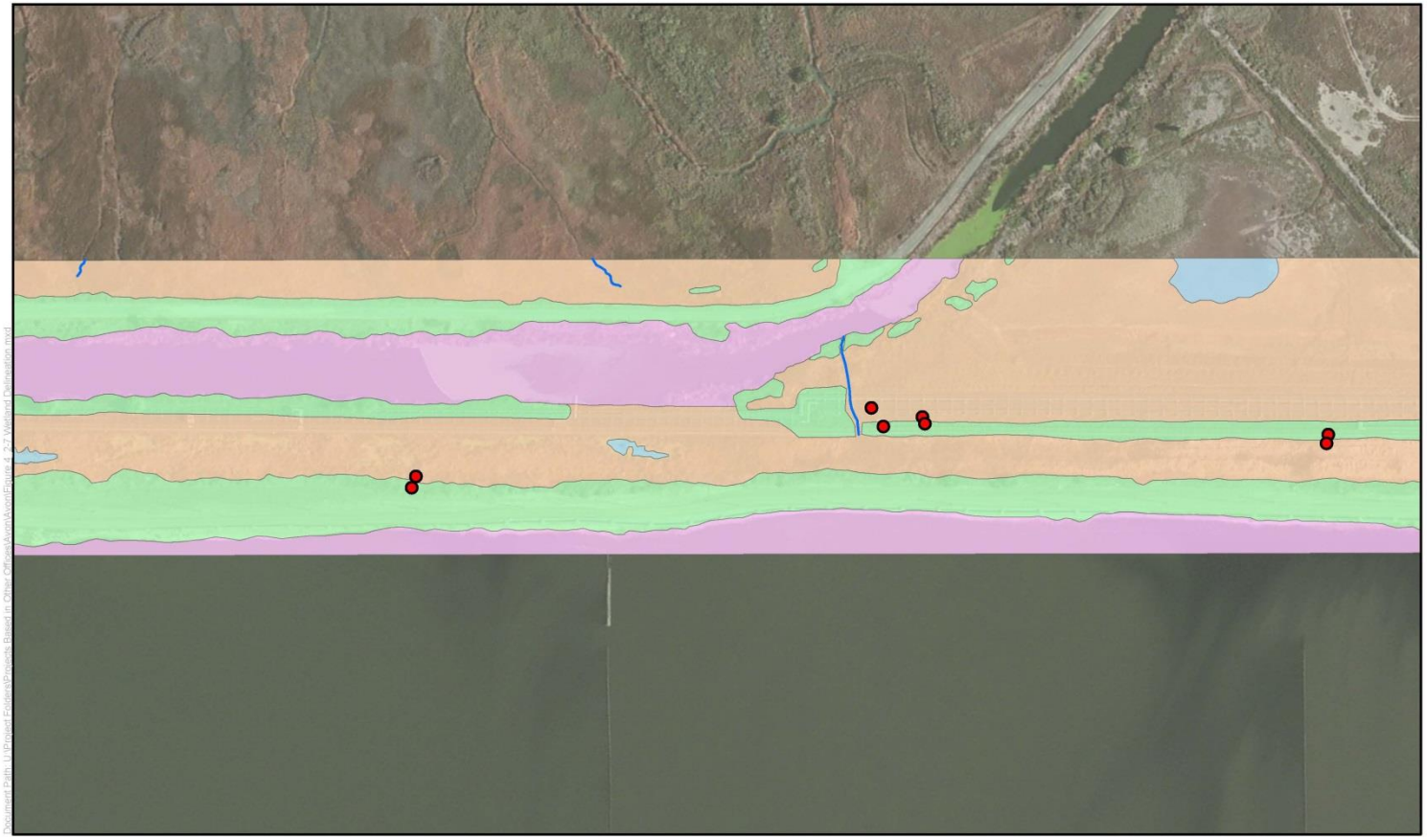

Figure 4.2-7
Wetland Delineation
California State Lands Commission
Avon Marine Oil Terminal Lease Consideration Project

TRC Results you can rely on

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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 4.2-7
Wetland Delineation
California State Lands Commission
Avon Marine Oil Terminal Lease Consideration Project

4.2.2 REGULATORY SETTING

Federal and State laws that may be relevant to the Project are identified in Table 4-1. The regional and local regulatory setting includes the San Francisco Bay Estuary Project, which is a federal-State-local partnership established in 1987 under the CWA Section 320: National Estuary Program (NEP). The NEP's Comprehensive Conservation and Management Plan is administered by the SFEP Implementation Committee. In addition, the Avon Terminal abuts marshes along the shoreline between the Martinez waterfront and the MOTCO, 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 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 of 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 during operation that exceed 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 CWA, 40 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*)

For the purposes of this Environmental Impact Report, potential impacts to biological resources are evaluated based on available literature, previous biological assessments for the Avon Terminal and adjacent wetlands, and publicly available documents that provided information on species status, distribution, habitat, and sensitivity to impacts. Specific biological assessments referenced in the preparation of this analysis include the following:

- *Section 7 Biological Assessment, Avon Marine Terminal MOTEMS Compliance Project* (LSA 2104); and
- *Clean Water Act Jurisdictional Delineation, Avon Marine Terminal MOTEMS Compliance Project* (LSA 2013).

The site was visited on February 27, 2014 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.

4.2.4 IMPACT ANALYSIS AND MITIGATION

The following subsections describe the Project's potential impacts on biological resources. First, impacts from lease renewal and continued operations are considered, followed by temporary and permanent impacts from MOTEMS renovation. Where impacts are determined to be significant, feasible mitigation measures (MMs) are described that would reduce or avoid the impact.

4.2.4.1 Proposed Project

Operations

Impact Biological Resources (BIO)-1: Cause substantial impact to special-status species or sensitive habitat due to increased fill area and bay cover. (Beneficial.)

Installation of new piles for Berth 1A and removal of Berth 5 piles would result in a net increase of 1,548 square feet of solid bay fill, and thus, the removal of benthic habitat. Since Berth 1A would be constructed near two existing berths, the fill would occur in an area historically subject to disturbance. With the removal of Berth 5, the Project would result in a net decrease in 11,609 square feet of pile-supported bay cover, which would increase available benthic habitat. Since the removal of benthic habitat due to fill would

be offset by the substantial increase in available benthic habitat due to the reduced bay cover, this impact would be beneficial.

Mitigation Measure: No mitigation required.

Impact BIO-2: Cause substantial impact to special-status species or sensitive habitat during operations due to marsh vegetation removal on either side of and below the approachway. (Less than significant.)

Marsh vegetation below and immediately adjacent to the approachway would require regularly scheduled clearing to allow visual inspection of the pipelines in continued operation. Vegetation clearing currently occurs in a narrow band of marsh along the approachway, in an area historically subject to disturbance. Under the new approachway configuration, there would be a minor reduction in the amount of vegetation clearance, and all vegetation clearance would remain located within an area of historical disturbance. Therefore, this impact would be less than significant.

Mitigation Measure: No mitigation required.

Impact BIO-3: 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. 2007a). The largest, most prominent plumes are caused by deep-draft vessels turning into the entrance of secondary berth access. Clarke et al. (2007a) 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 one 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 the Richmond Long Wharf was approximately 350 meters across tidal flow and persisted over 75 minutes.

Vessel calls at the Avon Terminal are typically fewer than two calls a week, with no more than 120 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 Avon Terminal. 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 Avon Terminal 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 Avon Terminal is located near the range of the SFBE'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-4: Cause substantial impact to special-status wildlife species, including impact to behavior and the composition of biotic communities, in the vicinity of the Avon Terminal as a result of the use of bright lights during nighttime operations. (Less than significant.)

Vessels may visit the Avon Terminal any time of day or night. Lights at the Avon 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 Avon Terminal and adjacent to the ship, and cast a long light shadow on the surface of the water. Use of bright lights during nighttime continued operations can affect the behavior of animals and the composition of the biotic community in the vicinity of the Avon 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, 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 shoreline in the Project vicinity is subject to industrial use and is well lit at night. Neighboring light sources include the Plains All American Marine Oil Terminal and Benicia-Martinez Bridge. Since the Avon 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. Changes in Avon Terminal lighting would occur with the installation of Berth 1A and the demolition of Berth 5. However, the increase in lighting with installation of Berth 1A would be offset by the removal of lighting from the demolished Berth 5. Therefore, the potential Project impact is not expected to increase significantly above existing conditions and the effect would be less than significant.

Mitigation Measure: No mitigation required.

Impact BIO-5: 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.)

Dredging at the Avon Terminal was most recently conducted in 2012. Approximately 3,827 cubic yards of dredged material was deposited at Winter Island for upland/reuse.

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; 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 Avon Terminal would, therefore, potentially resuspend 191 cy of sediment over the course of the dredging activity. The majority of sediment resuspended during dredging activities resettles within 50 meters of the dredge site within one hour (Anchor Environmental 2003), though plume effects can be observed as far downstream as 400 meters (Clarke et al. 2007b). 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. 2007a). 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 Avon 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 NAS as a result of disturbing the benthic habitat, although dredging would not pose a significant risk of introduction of new NAS. Dredging would create newly disturbed benthic habitat, making it attractive for settlement by opportunistic NAS. However, maintenance dredging disturbs areas that are continually disturbed due to maintenance dredging and vessel traffic. Maintenance dredging at the Avon Terminal is intermittent and minor. As such, it is expected that further introduction of NAS to the SFBE resulting from

maintenance dredging at the Avon 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, USACE, San Francisco Bay Conservation and Development Commission, and San Francisco Bay Regional Water Quality Control Board. Since 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.

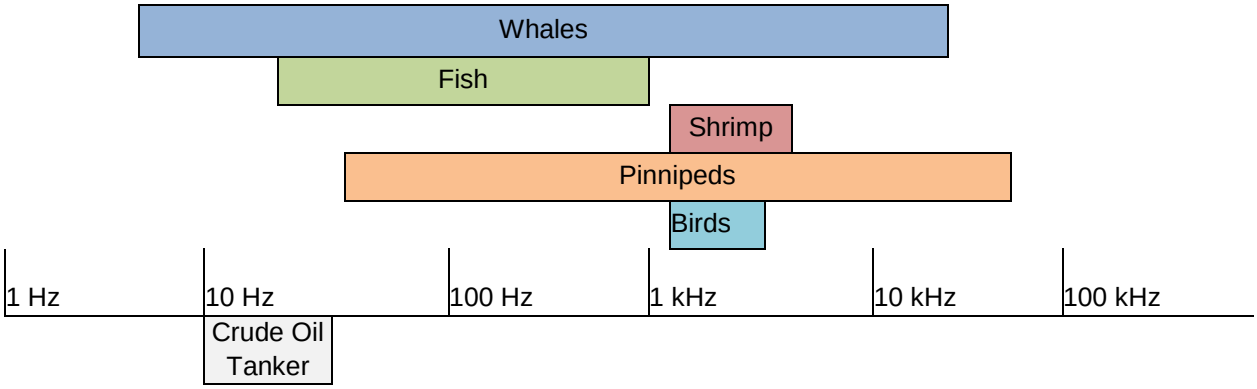
Impact BIO-6: Cause injury or behavioral interruptions to aquatic species as a result of noise from vessels. (Less than significant.)

Ships are the dominant source of low-frequency noise in many highly trafficked coastal zones (OSPAR[1] 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, and tend to emit continuous, broadband (20 – 1,000 Hz) omnidirectional sounds ~~of around 40 hertz while in motion, and produce source levels at 1 meter~~ between 179 and 182 decibel root mean square (dB_{RMS}) at 1 micro Pascal at 1 meter, with highest sound content at 40 Hz (µPa; McKenna 2012). Noise produced by vessels transiting the SFBE tends to be mitigated by the soft-bottom substrate and sediment-rich waters, which help to attenuate sound. Vessel calls at the Avon Terminal are typically fewer than two calls a week. Once inside the San Francisco Bay, it takes each vessel approximately three hours to travel to the Avon 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

[1] OSPAR is named because of the original Oslo and Paris Conventions (“OS” for Oslo; “PAR” for Paris).

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. Noise levels near busy shipping channels may reduce communication space for whales (Williams et al. 2013). Whales may shift to using surface-generated sounds, such as breaching, to communicate with a concomitant reduction in information content (Dunlop et al. 2010). Over the long term, species may adapt the frequency they use to communicate. Figure 4.2-8 shows the typical frequency bands of sounds produced by marine organisms compared with the low-frequency sound associated with crude oil tankers.



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

Figure 4.2-8: Typical Frequency Bands of Sounds Produced by Marine Organisms Compared with the Low-frequency Sounds Associated with Crude Oil Tankers
California State Lands Commission
Avon Marine Oil Terminal Lease Consideration Project

Vessels visiting the Avon 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 Avon Terminal may mask communication. However, due to the low number of weekly vessel calls, and the limited transit time in the SFBE (approximately 12 hours per week), impacts to whales and fish from masking caused by shipping noise are not expected to be significant.

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 Fisheries Hydroacoustic Working Group (FHWG 2008) and NMFS (2013) have established thresholds for disturbance to behavior for fish and pinnipeds. Sound pressure levels 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. The 120 dB_{RMS} at 1 µPa threshold may regularly be met in busy shipping channels (Basset et al. 2012). Although vessels traveling to and from the Avon 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.

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. Since 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. Since direct impacts to prey species from vessels calling at the Avon 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-7: 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 Avon Terminal would remain a potential point location for minor fuel, lubricant, and other boat-related spills. Any material that is not captured by various best management practices (BMPs), and enters the water, would be dispersed around the Avon Terminal, degrading the quality of the water column and benthic habitat in the vicinity of the Avon 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.

No significant adverse impacts are expected to aquatic life from minor spills associated with the ongoing operation of the Avon Terminal. Any minor amounts of contaminants that are released into the water that are not contained through initial response efforts would be quickly dispersed by the swift currents in the Carquinez Strait, such that concentrations of pollutants would not achieve the levels at which harm to aquatic species is observed.

Mitigation Measure: No mitigation required.

Impact BIO-8: 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, as would spills of gasoline, 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, although lighter or mid-range hydrocarbon buried at shallow depths will degrade.

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 on 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 and where the spill occurred. The Avon 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; 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 a 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 SFBE 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. Salt marsh 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 Analysis

As presented in Section 4.1, Operational Safety/Risk of Accidents, the trajectory and extent of an oil spill from the Avon Terminal would depend on the amount of the spill and the season. Based on modeling conducted for the nearby Tesoro Amorco Marine Oil Terminal (Amorco Terminal), during the summer, an oil spill would travel downstream past the Carquinez Bridge and into San Pablo Bay. In winter, spills would

primarily travel upstream into Suisun Bay, with increased impact to the northern reaches of Honker, Suisun, and Grizzly Bays, and further propagation downstream through Carquinez Strait and into San Pablo Bay.

Table 4.2-2 shows impacts to birds, wetlands, fish, and invertebrates from a modeled spill at a Martinez terminal (Applied Science Associates 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.

Table 4.2-2: Biological Impacts of a 100,000-gallon Spill from a Martinez Terminal

	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: Applied Science Associates 2009

As described in Impact OS-4 in Section 4.1, Operational Safety/Risk of Accidents, vessels en route to the Avon Terminal could potentially result in an accidental spill at any location along their transit route; thus, vulnerable resources along the outer coast and in any area of the SFBE eastward to the Antioch area could potentially be impacted by a spill. In addition to the mitigation measures presented below, implementation of MM OS-4b (refer to Section 4.1, Operational Safety/Risk of Accidents) would reduce impacts to biological resources in the event of a spill.

Mitigation Measures:

MM BIO-8a: Bird Rescue Personnel and Rehabilitators. Tesoro Refining and Marketing Company, LLC 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 Avon 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-8b: Cleanup of Oil from Biological Area. If a substantial spill occurs that affects biological resources, Tesoro Refining and Marketing Company, LLC

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-8c: Natural Resource Damage Assessment (NRDA) Team. Tesoro Refining and Marketing Company, LLC (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 California State Lands Commission 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.

Rationale for Mitigation Bird rescue, containment, and cleanup after an oil spill is an important component for minimizing impacts to biological resources. It is important to have plans, procedures, and necessary contractual arrangements in place to enable a rapid response. In addition, in the event of a spill, close coordination and cooperation with the NRDA team would help ensure that restoration and compensation for damages are completed without delay.

Residual Impacts There are limitations to thorough containment and cleanup of a major oil spill. Even with specific procedures to protect sensitive biological resources in the Project vicinity, impacts of a major oil spill would remain significant and unavoidable.

Impact BIO-9: Introduce invasive nonindigenous aquatic species to the San Francisco Bay Estuary. (Significant and unavoidable.)

The SFBE 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 SFBE, 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, 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 SFBE (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. Estuaries and sheltered coastal areas that are historic centers of anthropogenic disturbance from shipping, industrial development, and urbanization are among the most invaded aquatic habitats and the most likely to be invaded in the future (Ray 2005).

Once established, NAS can have severe ecological, economic, and human health impacts in the receiving environment. The overbite clam is believed to be a major contributor to the decline of several pelagic fish species in the Delta, including the threatened delta smelt, by reducing the planktonic food base of the ecosystem (Feyrer 2003, Sommer et al. 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 (CSLC 2013c); these costs represent only a fraction of the cumulative expenses related to NAS 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 NAS through ballast water discharge or vessel biofouling. These vectors are addressed separately in the following paragraphs.

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 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 Avon Terminal must comply with all federal and State ballast water laws, regulations, and permits (see Section 2.4.1, Ballast Water). Ballast water discharges in the United States are under the jurisdiction of the U.S. Coast Guard (USCG) and U.S. Environmental Protection Agency (USEPA), and the CSLC at the State level.

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 NAS 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 United States waters (see Table 4.2-3).

Table 4.2-3: Ballast Water Treatment Performance Standards

Organism Size Class	Federal Standards	State Standards
> 50 µm	< 10 viable organisms per cubic meter	No detectable living organisms
10 to 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

Source: CSLC 2013c

For tankers calling at the Avon Terminal, all new vessels must currently meet the standards, and all existing tankers must meet them by the first scheduled dry docking after January 1, 2016. The vessel owner may request an extension if, despite all best efforts, the tanker would not be able to comply with the standards.

The USEPA regulates ballast water discharge under the Vessel General Permit for Discharges Incidental to 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 exclusive economic zone, 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 United States are required to conduct ballast water exchange at least 50 nm from shore in waters at least 200 meters deep.

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, §§ 71200-71271), the CSLC formulated recommendations to prevent or minimize the introduction of NAS 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 (PCR); Public Resources Code section 71204.3 addresses requirements for vessels whose voyage originated outside of the PCR, a shipping zone that encompasses coastal waters within 200 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 (refer to Table 4.2-3). 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 meters deep) before entering State waters.
- Retain all ballast water on board the vessel.
- Use an alternative, environmentally sound, CSLC- 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 PCR, or with ballast water sourced from outside the PCR, shall manage ballast water at a distance greater than 200 nm from land and 2,000 meters deep, 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 million 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 2013c). However, 25 percent of all arriving tankers discharge ballast water in California, with an average discharge of about 10,000 MT. Between 2010 and the first half of 2012, Carquinez Strait received the majority of ballast water discharged into SFBE (see Table 4.2-4). About 80 percent of the ballast water discharged to Carquinez Strait was of coastal origin.

Table 4.2-4: 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

Source: CSLC 2013c

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 percent) between 2010 and 2012 consisted of water that was exchanged offshore, but in a location not acceptable under California law. Approximately 9 percent of noncompliant 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 2013c).

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 NAS along the North American Pacific coast (Ruiz et al. 2011). Due to 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 NAS to the SFBE 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, which 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 mechanisms for marine NAS introductions in several regions, including Australia, North America, Hawaii, the North Sea, and California (Ruiz 2000b, Ruiz et al. 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 2013c). 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 NAS 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 log book, 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 the Avon 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 nonindigenous aquatic species invasion from biofouling. Under MM BIO-9a, Tesoro would ensure that vessels seeking to call at the Avon 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 nonindigenous aquatic species via ballast water and vessel biofouling in the SFBE 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-9a: Marine Invasive Species Act Reporting Forms. Following the adoption of the Mitigation Monitoring Program for the Project, Tesoro Refining and Marketing Company, LLC (Tesoro) shall advise both agents and representatives of shipping companies having control over vessels that have informed Tesoro of plans to call at the Avon 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 Annual Reporting Form, and/or Ballast Water Treatment Supplemental Reporting Form.

MM BIO-9b: Invasive Species Action Funding. Tesoro Refining and Marketing Company, LLC (Tesoro) shall participate and assist in funding ongoing and future actions related to nonindigenous aquatic species (NAS) 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 California State Lands Commission staff, the DWR, CDFW, and Tesoro, and shall be based on criteria that establish Tesoro's commensurate share of the plan's NAS actions costs.

Rationale for Mitigation Vessels entering the SFBE are the primary vector for transmitting NAS, so working with vessel operators to ensure they are compliant with the implementing regulations of the California Marine Invasive Species Act would be an important component for reducing the risk posed by new NAS. As the risk from NAS cannot be fully mitigated, funding of activities designed to counteract the effects of NAS would help to offset impacts.

Residual Impacts The impact of introducing new NAS via ballast water and vessel biofouling in the SFBE 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.

MOTEMS Renovation

Impact BIO-10: Cause substantial temporary impacts to special-status species due to MOTEMS renovation activity. (Potentially significant.)

MOTEMS renovation activities would include the removal of decks and pilings, pile-driving, deck and facility repairs, vessel movement and mooring, and vegetation clearing. On land and overwater, these activities can injure or harm individuals of special-status species, cause the loss of foraging areas and displacement of prey species, and prompt individuals to avoid the Project area. Implementation of MMs BIO-10a through BIO-10f provides general environmental protection measures to reduce MOTEMS renovation impacts to special-status species. These measures, when applied with species-specific measures described below, would reduce MOTEMS renovation impacts to special-status species to less than significant.

Mitigation Measures:

MM BIO-10a: Pre-renovation Surveys for Key Special-status Species. Pre-renovation surveys for special-status species and other species of concern shall be conducted by a qualified biologist to verify their presence or absence. Key special-status species, including California clapper rail, California black

rail, rare plants, and other species of concern, including nesting birds, shall be avoided during renovation; if avoidance is not feasible, Tesoro Refining and Marketing Company, LLC shall consult with the California Department of Fish and Wildlife and/or the U.S. Fish and Wildlife Service and submit a plan(s) to minimize impacts to California State Lands Commission staff for approval prior to renovation. Plans for minimizing or mitigating impacts to plants and salt marsh harvest mouse are described in mitigation measure (MM) BIO-12c and MM BIO-15b, respectively. The plan(s) for other species shall list the species and anticipated temporary or permanent impacts and describe measures that would be taken to minimize and mitigate impacts, which may include, but not be limited to: translocation to suitable habitat out of work areas, restoration, and compensatory mitigation.

MM BIO-10b: Designated Work Areas. All work areas in sensitive terrestrial and aquatic habitats shall be confined to the smallest feasible size. Terrestrial work in sensitive areas shall be clearly demarcated with exclusion fencing in coordination with the biological monitor. Aquatic work areas shall be clearly identified on renovation drawings. All personnel and their equipment shall be required to stay within the designated work sites to perform job-related tasks, and shall be directed to stay out of surrounding wetlands and waters.

MM BIO-10c: Worker Environmental Awareness Program. All renovation personnel shall receive environmental awareness training provided by a U.S. Fish and Wildlife Service-approved biological monitor (as described below). The training shall provide information about special-status species potentially occurring in the Project area, measures being implemented to avoid impacts to the species, and procedures to follow should a listed species be encountered during routine activities. Training shall be conducted to assure understanding by both Spanish and English speakers. Training materials shall be submitted to California State Lands Commission staff for approval 2 weeks prior to program initiation.

MM BIO-10d: Safe and Clean Work Area Maintenance. Pets shall not be allowed in or near the renovation work areas. Firearms shall not be allowed in or near the renovation areas. No intentional killing or injury of wildlife shall be permitted. No smoking is allowed on the facility. The renovation sites shall be maintained in a clean condition. All trash (e.g., food scraps, cans, bottles, containers, wrappers, and other discarded items) shall be placed in closed containers and properly disposed of off-site.

MM BIO-10e: Biological Monitoring. A qualified biologist shall be present on-site to conduct biological monitoring during vegetation clearing, mouse exclusion fence installation, and pile driving. The biological monitor shall have the authority to stop work if deemed necessary for any reason to protect special-status species. The biological monitor shall have demonstrated experience in monitoring sensitive resource issues on construction projects. Specifically, the biological monitor shall have at least a bachelor's degree in the biological or

allied sciences or the equivalent, at least one field season of prior biological monitoring experience under the supervision of a qualified biological monitor, and knowledge of the natural history of the salt marsh harvest mouse and related sensitive biological resources in the vicinity of the Project area. Resumes of candidate biological monitors shall be submitted to California State Lands Commission staff for their approval at least 2 weeks prior to the biological monitor being deployed in the field.

MM BIO-10f: Post-renovation Cleanup. After renovation is completed, a final clean up shall include removal of all stakes, temporary fencing, flagging, and other refuse generated during renovation. Upon Project completion, all equipment shall be safely demobilized from the area. Any excess debris shall be placed into trucks or barges for proper disposal.

Rationale for Mitigation Surveys for special-status species would help to determine presence or absence, and ensure avoidance. If special-status species cannot be avoided, consultation with resource agencies and development of species-specific plans would ensure that impacts remain less than significant. Fencing and demarcation of sensitive terrestrial habitat and aquatic work areas would ensure that impacts occur only within designated areas. Worker environmental awareness training would ensure that Project personnel are aware of the requirements and their responsibilities. Measures such as prohibiting pets and firearms, and removing trash and excess debris would ensure that inadvertent impacts to special-status species does not occur. A biological monitor would help to ensure compliance with mitigation measures. Implementation of these measures would ensure that temporary impacts to special-status species are less than significant.

Impact BIO-11: Cause disturbance or loss of special-status fish. (Potentially significant.)

Special-status fish with potential to occur in the Project area include longfin smelt, delta smelt, Central California Coast steelhead, California Central Valley steelhead, Central Valley spring-run Chinook salmon, Sacramento River winter-run Chinook salmon, and green sturgeon – Southern Distinct Population Segment. Several elements of MOTEMS renovation, including those that degrade water quality and create noise (as described under Impact BIO-17 and Impact BIO-18, respectively), have the potential to cause adverse impacts to special-status fish species. Which species would be impacted by the Project depends on the timing and sequence of overwater renovation activities. Migrating juvenile and adult steelhead and chinook salmon, longfin smelt, and sturgeon are anticipated to be in the Project area during a portion of the Project's in-water activities. Juvenile, sub-adult, and adult green sturgeon may be present year-round, and thus, exposed to the Project's in-water activities. Implementation of MM BIO-11a would constrain in-water work activities to the extent feasible to hours and work windows that

would minimize the potential for renovation to impact fish, as listed fish species are less likely to utilize the Project area as a migratory corridor during these times.

The Project is located within critical habitat for green sturgeon, delta smelt, and salmon. Implementation of MMs BIO-11a through BIO-11c would also reduce impacts to PCEs of designated critical habitat to less than significant.

Mitigation Measures:

MM BIO-11a: In-water Work Restrictions. Tesoro shall implement the following in-water work restrictions:

- To the extent feasible, in-water work shall be performed between 30 minutes after sunrise and 30 minutes before sunset.
- Pile driving with an impact hammer and in-water deconstruction activity shall only occur during the work window specified by the National Marine Fisheries Service (NMFS) and California Department of Fish and Wildlife (CDFW) for avoidance of potential impacts to fish species in this region of the San Francisco Bay Estuary, from August 1 to November 30. The work window proposed may be adjusted based on the U.S. Fish and Wildlife Service's (USFWS) programmatic consultation on the delta smelt and coordination with the CDFW, NMFS, and USFWS.

MM BIO-11b: Nearshore Habitat Disturbance Minimization. The number of round trips made by barges during renovation activities shall be limited to the extent feasible. Personnel shall be transported daily to the barge by means of a shallow-draft boat. Barge and support vessels shall transit through the shallows at a no-wake-producing speed to minimize disturbance to bottom sediments. Anchoring shall be minimized to the extent possible.

MM BIO-11c: Anchoring Plan. Tesoro Refining and Marketing Company, LLC shall prepare for inclusion in the Project's renovation Work Plan and Anchoring Plan, which shall require that the use of mooring anchors by deconstruction vessels and barges shall be minimized. The Anchoring Plan shall further specify that if mooring anchors must be used, then a secondary support workboat shall be used to deploy and retrieve mooring anchors and that mooring anchors shall not be dragged along the sea floor. The Anchoring Plan must be submitted to California State Lands Commission staff for approval 30 days prior to renovation.

Rationale for Mitigation Constraining in-water work activities to the extent feasible to hours and work windows when listed fish species are less likely to utilize the Project area as a migratory corridor would ensure the impacts to fish species remain less than significant. Minimizing nearshore habitat disturbance and developing an anchoring plan would ensure impacts to critical habitat PCEs remain less than significant.

Impact BIO-12: Cause disturbance or loss of special-status plant populations. (Potentially significant.)

Several special-status plant species have the potential to occur within the Project MOTEMS renovation area (see Table 4.2-5). If present, individuals of these species could be damaged or removed by MOTEMS renovation activities, including vegetation clearing and filling. Substantial loss of individuals or suitable habitat for these species due to renovation could result in a significant impact. However, implementation of MMs BIO-12a through BIO-12c would reduce the Project's impact to rare plants to less than significant.

Table 4.2-5: Blooming Period for Special-Status Plants

Species	Blooming Period												Responsible Agency
	J	F	M	A	M	J	J	A	S	O	N	D	
Salty soft bird's-beak						X	X	X	X	X	X		USFWS, CDFW
Mason's lilaeopsis				X	X	X	X	X	X	X	X		CDFW
Suisun marsh aster					X	X	X	X	X	X	X		CDFW
Saline clover				X	X	X							CDFW
Delta tule pea					X	X	X		X				CDFW
San Joaquin spearscale				X	X	X	X	X	X	X			CDFW
Delta mudwort					X	X	X	X					CDFW

Mitigation Measures:

MM BIO-12a: Pre-renovation Special-status Plant Surveys. Tesoro Refining and Marketing Company, LLC shall retain a qualified botanist to survey suitable habitat in the Project area for the presence of special-status species. Surveys shall be conducted during April through May and in accordance with standardized protocols as determined by the California Department of Fish and Wildlife (CDFW) and/or U.S. Fish and Wildlife Service, including visiting nearby known reference populations, and shall be timed to coincide with the blooming periods of known populations (CDFG 2009). Based on the blooming periods of special-status plants known to occur in the region, two surveys (one in late spring/early summer, one in late summer/early fall) shall be conducted to capture the floristic diversity at a level necessary to determine if special-status species are present. Within 30 days of the completion of each survey, the results of the survey shall be summarized in a botanical survey letter report and submitted to California State Lands Commission staff and the CDFW.

MM BIO-12b: Special-status Plant Avoidance and Protection. If any special-status plants are found during the pre-renovation survey, protective fencing shall be installed under the direction of a qualified biological monitor to ensure that plants are avoided during renovation, if feasible.

MM BIO-12c: Salvage and Recovery Plan for Special-status Plants. If avoidance is not possible (e.g., if plants are found in areas requiring vegetation clearing), Tesoro Refining and Marketing Company, LLC (Tesoro) shall consult with the California Department of Fish and Wildlife (CDFW) and/or U.S. Fish and Wildlife Service (USFWS) to develop and implement a salvage and recovery plan for the affected species. The plan shall incorporate the following, at a minimum:

- preparation by a qualified restoration specialist or botanist experienced in the development and implementation of native plant restoration, mitigation, and monitoring plans;
- salvage and/or recovery requirements, including clearly defined goals focusing on plant establishment (stability, succession, reproduction) monitoring, and non-native species control measures;
- locations and procedures for restoration of salvaged materials or seeds;
- specification of a 5-year post-renovation maintenance and monitoring program by a qualified restoration specialist or botanist to ensure that the Project goals and performance standards are met. The monitoring program shall include provision for remedial action as needed to correct deficiencies. Annual reports and a final report, prepared by Tesoro and subject to approval by the CDFW, shall document the success of the salvage and replanting effort. If replanting is not successful, an additional period of correction and monitoring shall be specified; and
- maintenance requirements and the responsibility for implementation.

If salvage and recovery of special-status plants is infeasible, Tesoro shall consult with the CDFW and/or USFWS to implement a compensation plan, which may consist of the following:

- preservation of an off-site area containing individuals of the affected species so that there is no net loss of special-status plants;
- purchase of plant credits from an off-site, agency-approved mitigation bank; or
- other compensatory measures as required by the CDFW and/or USFWS.

Rationale for Mitigation Surveys would determine presence or absence of special-status plants and allow for implementation of avoidance measures or salvage and recovery. Implementation of these measures would ensure the impacts remain less than significant.

Impact BIO-13: Cause disturbance of nesting migratory birds and raptors. (Potentially significant.)

The Project could have temporary renovation-related adverse impacts on osprey, California black rail, California clapper rail, saltmarsh common yellow-throat, Suisun

song sparrow, and other nesting birds through increased levels of disturbance from increased human presence, noise, and/or equipment vibrations. Such disturbances may disrupt normal behavioral patterns of breeding, foraging, sheltering, and dispersal.

With implementation of MM BIO-13a, the Project would avoid potential impacts to special-status species nesting in or adjacent to the work areas. Removal of vegetation that provides nesting habitat would be a potentially significant impact. Nesting habitat that is temporarily lost due to renovation would be restored with implementation of MM BIO-19b, described under Impact BIO-19.

Berth 5 currently supports an active osprey nest. Osprey nests are protected under the federal Migratory Bird Treaty Act (MBTA) and California Fish and Game Code section 3503. Osprey are a long-lived migratory species that habitually return to and reuse the same nest every year. Due to this, permanent loss of an osprey nest site would be a potentially significant impact.

Mitigation Measures:

MM BIO-13a: Pre-renovation Nesting Bird Surveys. To avoid potentially adverse impacts to bird species identified under the Migratory Bird Treaty Act, Tesoro Refining and Marketing Company, LLC shall ensure that prior to any work in Areas A, B, and C (including adjacent staging areas) of the approachway conducted during the nesting season for small birds (March 15 to August 30), a biologist approved by California State Lands Commission staff shall inspect all shrubs, trees, and emergent marsh vegetation in and within 50 feet of the limits of work for nesting birds. The biologist shall also observe all trees and shrubs within 300 feet of the limits of work for evidence of nesting raptors using binoculars and/or spotting scope. The survey shall be conducted no more than seven (7) days prior to the start of work for a given work area, and shall begin within 0.5 hour of sunrise and last a minimum of 2 hours. If the survey indicates the presence of nesting birds, the biologist shall determine an appropriately sized buffer around the nest in which no work shall be allowed until the young have successfully fledged in consultation with the California Department of Fish and Wildlife and/or U.S. Fish and Wildlife Service. The size of the nest buffer shall be determined by the biologist and shall be based on the nesting species and its sensitivity to disturbance.

MM BIO-13b: Osprey Nest Protection. To avoid and minimize impacts to the osprey pair that nest annually on Berth 5, Tesoro Refining and Marketing Company, LLC (Tesoro) shall consult with the California Department of Fish and Wildlife (CDFW) to remove the nest and replace it in a nearby location not subject to Project disturbance. The nest shall be removed when it is inactive (i.e., does not contain egg or juvenile osprey). The replacement nest shall be located as close to the original nest as feasible. The replacement nest structure shall be of comparable or better quality than the nest support structure removed or destroyed. In addition, prior to any work in Area D of the

approachway and at the Avon Terminal (i.e., Berth 1A installation, Berth 5 demolition) conducted during the osprey nesting season (February 15 to August 31), a qualified biologist approved by California State Lands Commission staff shall survey Berth 5 with a spotting scope to determine whether ospreys are nesting. If nesting is observed, the biologist shall watch the nest for a minimum of 2 hours to establish a baseline for the adults' behavioral response to marine traffic and ongoing Avon Terminal operations. In consultation with the CDFW, the resulting information shall be used to determine an appropriately sized buffer around the nest in which no work shall be allowed until the young have successfully fledged.

Rationale for Mitigation Nesting bird surveys would ensure that osprey and other bird nests are identified such that the biological monitor can establish a protective buffer to avoid impacts to the nest. In addition, creation of a new nest platform would ensure that there is no net loss of osprey nesting habitat. Implementation of these measures would ensure that impacts are less than significant.

Impact BIO-14: Cause disturbance of California clapper rail and California black rail and habitat. (Potentially significant.)

Marginal habitat for California clapper rail and California black rail is present in the brackish marsh portions of the Project area. These species may be impacted by increased levels of disturbance from increased human presence, noise, and/or equipment vibrations. Such disturbances may disrupt normal behavioral patterns of breeding, foraging, sheltering, and dispersal. Protocol-level surveys for California clapper rail were initiated at the Project site in 2014 (LSA 2014). The first year of protocol-level survey, during the 2014 breeding season, did not detect any California clapper rails in or adjacent to the study area; black rails were detected northeast of the Project area in the Point Edith Wildlife Area (LSA 2014). A second year of protocol-level survey is required to complete the protocol. A USFWS-approved biologist shall conduct a second year of California clapper rail and California black rail surveys during the 2015 breeding season prior to the initiation of renovation. Implementation of MM BIO-14a would reduce potentially significant impacts to less than significant.

Mitigation Measure:

MM BIO-14a: Survey and Avoidance Measures for California Capper Rail and California Black Rail. Tesoro Refining and Marketing Company, LLC shall retain a U.S. Fish and Wildlife Service (USFWS)-approved permitted biologist to conduct a second year of protocol-level surveys, including rail-call and rail-track surveys at the Project site for California clapper rail and California black rail during the 2015 breeding season, prior to the initiation of renovation. If breeding California clapper rail or California black rail is determined to be present, activities shall not occur within 500 feet of an identified calling center (or a smaller distance if approved by the USFWS and California Department of

Fish and Wildlife). If the intervening distance is across a major slough channel or across a substantial barrier between the rail calling center and any activity area is greater than 200 feet, work may proceed at that location within the breeding season.

Rationale for Mitigation Implementation of surveys would ensure that Project activities avoid nesting California clapper rails and California black rails during the nesting season such that impacts to these species are less that significant.

Impact BIO-15: Cause disturbance of salt marsh harvest mouse and Suisun shrew and habitat. (Potentially significant.)

Suitable habitat for the salt marsh harvest mouse and Suisun shrew occurs within the brackish marsh at the Project site. MOTEMS renovation activities could result in significant impacts to these species through direct injury or harm to individuals and by temporary and permanent alteration of suitable habitat. To compensate for 0.03 acre of permanent impacts and 6.93 acres of temporary impacts on salt marsh harvest mouse habitat (i.e., tidal brackish marsh and adjacent uplands within 100 meters), per MM BIO-15b, Tesoro would purchase mitigation habitat credits at the Cordelia Slough Preserve. The final amount of mitigation habitat would be based on the ratios shown in Table 4.2-6, which have been provided by the USFWS, and shall be calculated based on the actual duration of various phases of the Project.

Table 4.2-6: Compensatory Mitigation for Salt Marsh Harvest Mouse Habitat

Work Area	Impact Type							
	Permanent		Temporary (< 1 year)		Temporary (1 to 2 years)		Total	
	Wetland	Upland	Wetland	Upland	Wetland	Upland	Wetland	Upland
A	-	-	-	-	1.83	0.87	1.83	0.87
B	0.03	-	-	-	1.82	0.92	1.85	0.92
C	-	-	1.12	0.22	0.07	0.08	1.19	0.30
Subtotal	0.03	-	1.12	0.22	3.72	1.87	4.87	2.09
Total	0.03		1.34		5.59		6.96	
Mitigation Ratio	3:1		1:1		2:1			
Mitigation Acres	0.09		1.34		11.18		12.61	

Source: LSA 2014

Implementation of MMs BIO-15a and BIO-15b would reduce MOTEMS renovation impacts to less than significant.

Mitigation Measures:

MM BIO-15a: Salt Marsh Harvest Mouse and Suisun Shrew Impact Avoidance Measures.

- Any areas dominated by brackish marsh vegetation and adjacent uplands that must be accessed by renovation personnel or equipment shall be cleared of vegetation. All clearing of vegetation shall be done under the direct supervision of a U.S. Fish and Wildlife Service (USFWS)-approved biologist. In renovation and staging areas where habitat is to be disturbed, vegetation shall be cleared to bare ground or stubble no higher than 3 inches, unless otherwise authorized by the USFWS and California Department of Fish and Wildlife (CDFW). Vegetation clearing shall start at the marsh edge closest to the existing approachway and proceed outward toward the marsh interior. Vegetation shall be removed by hand tools.
- If a salt marsh harvest mouse is discovered, the biological monitor shall stop work in the immediate area until the CDFW and USFWS are contacted and the individual has been allowed to leave the work area. If the mouse does not leave the work area, work in the immediate area shall not resume until the CDFW and USFWS are consulted regarding appropriate avoidance measures, and grant permission to commence work. No salt marsh harvest mouse may be handled or captured at any time.
- Exclusion fencing shall be installed around the work areas immediately following vegetation removal. The fence shall be a minimum of 2 feet in height. Openings of at least 10 feet in width shall be established at two to four locations such that habitat connectivity across the marsh is maintained.
- Exclusion fencing shall be extended to the high tide line. Tesoro Refining and Marketing Company, LLC shall monitor tidal heights while the exclusion fencing is installed. If areas within the exclusion fencing are flooded, sections shall be temporarily removed to allow exit of any special-status species from the work area. The area shall then be resurveyed by a USFWS and CDFW-approved biologist, and the exclusion fencing reinstalled.
- Following installation of the fence, the biological monitor shall train a representative to inspect the fencing. The representative shall inspect the fence daily to ensure that it maintains a minimum of 2 feet in height, has no holes or rips, and that the base is still buried. Any necessary repairs to the fencing shall be completed within 24 hours of the initial observance of damage. Work shall not continue within 300 feet of the damaged fencing until the fence is repaired and the site is surveyed by an approved biologist to ensure that salt marsh harvest mice have not entered the work area.
- The biological monitor shall be available on an on-call basis to come to the site in the event that the trained representative finds a salt marsh harvest

mouse in the work area after the vegetation has been cleared and the fence has been installed.

- Work within fenced salt marsh harvest mouse habitat shall be scheduled to avoid extreme high tides (6.5 feet or above at the Golden Gate Bridge) when there is potential for mice to move into adjacent uplands.
- Night lighting shall be minimized and pointed down to the extent possible and still assure the safety of personnel working in the area.

MM BIO-15b: Compensation for Temporary and Permanent Loss of Salt Marsh Harvest Mouse Habitat. To compensate for 0.03 acre of permanent impacts and 6.93 acres of temporary impacts on salt marsh harvest mouse habitat (i.e., tidal brackish marsh and adjacent uplands within 100 meters), Tesoro Refining and Marketing Company, LLC shall purchase mitigation habitat credits at the Cordelia Slough Preserve managed by Wildlands, Inc. in northern Suisun Bay. The Preserve provides high-quality habitat for salt marsh harvest mouse and would be managed in perpetuity for that purpose. The final amount of mitigation habitat shall be calculated based on the actual duration of various phases of the Project.

Rationale for Mitigation Clearing vegetation to bare ground or stubble where access is needed would remove potential habitat and allow the biological monitor to more readily detect salt marsh harvest mouse and Suisun shrew and allow for avoidance of impacts. Exclusion fencing would prevent these species from entering active work areas while maintaining habitat connectivity. Reducing night lighting would minimize disruption of foraging and the potential for predation of these nocturnal species. The acquisition of habitat mitigation credits would offset the temporary and permanent impacts to salt marsh harvest mouse. Implementation of these measures would ensure that impacts to salt marsh harvest mouse, Suisun shrew, and their habitat are less than significant.

Impact BIO-16: Cause disturbance to marine mammals. (Potentially significant.)

The noise from MOTEMS renovation, including pile driving and Avon Terminal deconstruction, has the potential to temporarily impact marine mammals in the water and at haul-out sites; in addition, increased vessel movements resulting from renovation may interfere with the marine mammal movement and could potentially cause collisions. Individual California sea lions and harbor seals are known to visit the wharf area and to rest in the tidal flats between the Avon Terminal and shore. Renovation is not expected to permanently compromise established haul-out sites nor to block migratory corridors or access to and from established haul-out sites. However, noise from renovation could reasonably be expected to cause intermittent and temporary disturbance of individuals, causing them to avoid the area or subjecting them to harmful levels of sound. Noise from pile driving with an impact hammer would be the most significant impact. Implementation of MM BIO-18b would reduce impacts to marine mammals from pile driving to less-than-significant levels. When implemented with MMs BIO-16a through

BIO-16c, impacts from renovation to marine mammals would be reduced to less than significant.

Mitigation Measures:

MM BIO-16a: Adjust Vessel Speed. Vessel operators shall attempt to remain at least 150 feet from marine mammals and shall maneuver their vessel slowly, watching for seal heads that may pop up around the vessel, to avoid collisions when marine mammals are observed in the Project area. In the event of a vessel collision with a marine mammal, Tesoro Refining and Marketing Company, LLC shall immediately report the incident to the National Marine Fisheries Service West Coast Region Stranding Network at 1-866-767-6114.

MM BIO-16b: Implementation of a Marine Mammal Contingency Plan. Tesoro Refining and Marketing Company, LLC shall prepare a Marine Mammal Contingency Plan, which shall be implemented in its entirety. This plan shall be consistent with section 109 (h) of the Marine Mammal Protection Act for dealing with nuisance animals and animals that need to be relocated from a location for their own protection and welfare. This plan shall be submitted for review and approval to the National Marine Fisheries Service and California State Lands Commission staff 60 days prior to Project implementation.

MM BIO-16c: Prioritize Removal of Potential Haul-out Locations. Parts of the Avon Terminal that have the potential to be used by marine mammals as a resting haul out (pilings and structural support components, boat landing) shall be removed as early in the deconstruction schedule as possible. This shall be done to prevent the continued use of these structures by marine mammals during deconstruction.

Rationale for Mitigation Adjusting vessel speed would help avoid collisions with marine mammals when they are in the Project area. Implementation of a marine mammal contingency plan and prioritizing the removal of potential haul-out locations would help ensure that marine mammals are not in harm's way during the MOTEMS renovation activities. Implementation of these measures would ensure that impacts to marine mammals during renovation are less than significant.

Impact BIO-17: Cause substantial impact to special-status species or sensitive habitat due to degradation of water quality. (Potentially significant.)

MOTEMS renovation involving overwater work has the potential to degrade water quality through the release of hazardous materials and an increase of suspended sediment. Hazardous materials may be released by removal of creosote-treated wood pilings or structures that contain lead paint, or through the inadvertent release of fuel or machinery fluids. Disturbance of contaminated substrates, for example, by pile removal or pile driving, can release toxic materials into the water column, which may then become biologically available to special-status species through food chain processes.

Suspended sediment levels in the water may be increased by sediment resuspension caused by pile removal, pile driving, or vessels maneuvering over shallow waters.

Degraded water quality may directly impact special-status species in a number of ways (NMFS 2011):

- Contaminants released into marine environments and taken up by marine organisms are passed along and magnified through the food chain.
- Contaminants from creosote-treated wood can cause cancer, reproductive anomalies, and dysfunction in fish.
- Increased suspended sediment decreases light transmittance in the water, which may lead to decreased phytoplankton productivity, and thus, prey availability.
- Increased suspended sediment loads may increase fish larval mortality, reduce feeding ability, and cause gill injury.
- Increased suspended sediment may also react with dissolved oxygen and cause short-term oxygen depletion.

Piles would be entirely removed if possible. Because of the embedded depth and age of the timber piles, which have a high probability of breaking during removal attempts, it may not be feasible to completely remove them and they may be sheared off below the mudline instead. The standard depth for pile removal during demolition of Berth 5 would be at least 3 feet below the current mudline. Without maintenance dredging, it is anticipated that pile stubs would remain buried under at least 2 feet of sediment. The new Berth 1A and existing Berth 1 provide an impediment to flow through Berth 5, resulting in a slight depositional environment. Therefore, it is unlikely that buried piles would be exposed by scour.

Timber piles would be broken with the expectation that the pile would break off at least 3 feet below the mudline. The breakage depth would be verified by measuring the distance between the mudline stain and the bottom of the pile. If the timber pile breaks higher than 3 feet below the mudline, the stub would be removed using a hydraulic shear to cut the stub a minimum of 3 feet below the bay sediment and a crane or other equipment to cleanly pull out the sheared stub section. To prevent introduction of creosote to the water column, the timber stub would not be "chewed off" with a clam shell dredge or other equipment.

In conjunction with MM WQ-8, described in Section 4.3, Water Quality, implementation of the following mitigation measures to avoid the release of toxic chemicals to the water column during and after renovation would reduce the potential for significant impacts to special-status species and habitats to less than significant.

Mitigation Measures:

MM BIO-17a: Lead-based Paint Management Plan. Because lead-based paint is present on the Avon Terminal, Tesoro Refining and Marketing Company, LLC shall retain a licensed lead-abatement contractor to address lead-based paint prior to the general deconstruction of the Avon Terminal. A lead-based paint management plan shall be prepared and submitted to California State Lands Commission staff for approval 2 weeks prior to deconstruction and included as part of the Project's work plan.

MM BIO-17b: Post-demolition Bathymetric Survey. Tesoro Refining and Marketing Company, LLC shall conduct a post-demolition bathymetric survey, no later than 2 weeks after demolition activities conclude, to confirm that pile stubs are at minimum 3 feet below the mudline and that no renovation debris remains on or above the seafloor.

MM BIO-17c: Stub/scour Monitoring. Tesoro Refining and Marketing Company, LLC (Tesoro) shall conduct monitoring of broken timber piles 2 years after completion of demolition activities to determine whether or not piles have been exposed by erosion. If piles have not remained buried under at least 2 feet of sediment cover, Tesoro shall monitor, consult, and survey to ensure they are not a navigational hazard. Should exposed piles be determined to be a navigational hazard, Tesoro shall take remedial action to remove the navigational hazard and monitor again in another 2 years.

MM BIO-17d: Minimization of Creosote Release. The following measures shall be used to minimize creosote release, sediment disturbance, and total suspended solids generation during pile removal/deconstruction:

- install a floating surface boom to capture floating surface debris;
- keep all equipment out of the water and grip piles above the waterline;
- slowly lift the piles from the sediment and through the water column; and
- dispose of all removed piles, floating surface debris, sediment spilled on work surfaces, and all containment supplies at a permitted upload disposal site that accepts creosote-treated wood and materials contaminated with creosote.

Rationale for Mitigation Implementation of a lead-based paint management plan and minimizing the release of creosote would minimize lead-based paint and creosote releases to the water column during deconstruction. Conducting surveys and monitoring would ensure that piles are not exposed or causing a navigation hazard. Implementation of these measures would avoid the release of toxic chemicals to the water column during and after MOTEMS renovation and would reduce the potential for significant impacts to special-status species and habitats to less than significant.

Impact BIO-18: Cause substantial impact to special-status species or sensitive habitat due to increased sound levels from MOTEMS renovation. (Potentially significant.)

Both vibratory and impact hammers would be used to drive piles during MOTEMS renovation. Table 2-10 in Section 2.0, Project Description, describes piles that would be installed for the Project. The Project would use vibratory hammers to the greatest extent feasible to drive piles. Impact hammers would be used only if site conditions require their use to obtain the pile depth for seismic stability.

Special-status fish that could be present or migrating through the Project area during renovation include delta smelt, green sturgeon, Central California Coast steelhead, California Central Valley steelhead, Central Valley spring-run Chinook salmon, Sacramento River winter-run Chinook salmon, and longfin smelt. Marine mammals in the Project vicinity include California sea lion and harbor seal. The nearest known harbor sea lion haul out is Garner Point, approximately 2 miles northeast of the Avon Terminal (NOAA 1998).

Sound from impact pile driving has the potential to affect fish and marine mammals in several ways, ranging from changing behavior to causing physical injury or death. Loud noise may stop fish and pinnipeds from hearing important sounds (masking), or cause hearing loss (temporary or permanent hearing threshold shifts). Therefore, the impact to special-status species from pile driving could be significant. Interim criteria for evaluating noise-related effects on fish and pinnipeds are shown in Table 4.2-7.

Table 4.2-7: Criteria for Noise-related Impacts to Fish and Marine Mammals

Functional Hearing Group	Behavioral Impacts	Injury Thresholds	
		Peak	Cumulative SEL
Fish ≥ 2 grams	150 dB_{RMS}	206 dB	187 dB Cumulative SEL
Fish < 2 grams			183 dB Cumulative SEL
Phocid pinnipeds	160 dB_{RMS}	PTS: 235 dB TTS: 229 dB	PTS: 192 dB TTS: 177 dB
Otariid pinnipeds	160 dB_{RMS}	PTS: 235 dB TTS: 229 dB	PTS: 215 dB TTS: 200 dB

Source: FHWG 2008, NMFS 2013, NOAA 2012

dB_{RMS} = decibel root mean square; PTS = Permanent threshold shift; TTS = Temporary threshold shift

Harbor seals or sea lions in the area of the Avon Terminal would likely alter their behavior as a result of vibratory and impact pile driving. There are no major haul-out sites nearby but individuals that forage or rest in the vicinity would likely disperse elsewhere during MOTEMS renovation activities. This impact to pinnepeds would be less than significant.

Analysis of potential sound impacts from pile driving determined that, in the absence of mitigation measures, pile driving would exceed the thresholds for behavioral impacts and injury to fish (LSA 2014). The majority of piles would be smaller than 36 inches in diameter; however, a greater area of impact would be caused by use of the impact hammer on piles larger than 36 inches in diameter. Thus, distances for which thresholds would be exceeded were divided into two categories based on diameter. In the interest of determining a conservative estimate of the maximum potential impact area, the threshold for injury for fish weighing less than 2 grams was used. As shown in Table 4.2-8, pile driving with an impact hammer without employing sound-attenuation measures would cause harm and injury to special-status species, resulting in a significant impact.

Table 4.2-8: Estimated Distances to Fish Sound Thresholds during Unattenuated Pile Driving

Threshold	Distance (meters)	
	≤ 36-inch-diameter Pile	> 36-inch-diameter Pile
Fish injury (206 db)	18	18
Fish injury (183 dB SEL)	1,585	2,154
Fish disturbance (150 db)	7,356	10,000

Source: LSA 2014

Implementation of MMs BIO-18a and BIO-18b would reduce this impact to less than significant. Employing sound-attenuation systems for impact driving, such as air bubble curtains, isolation casings, cofferdams, or a sound-reduction system such as cushion blocks, may reduce underwater sound pressure levels substantially (ICF Jones & Stokes 2009). Air bubble curtains surround the pile with air bubbles that attenuate sound pressure levels up to 24 decibels (dB), depending on the size of the pile and the curtain used. Air bubble curtain effectiveness increases with pile size and decreases with current speed. In areas with substantial current, such as the Project site, a sleeve around the pile to confine bubbles increases the air bubble curtain's effectiveness. Cushion blocks are blocks of wood, nylon, or Micarta[2] that are placed on top of pilings prior to driving to reduce the noise generated while driving the pile. They can reduce sound pressure levels between 4 and 26 dB, depending on the material used; wood cushion blocks are more effective than nylon and Micarta. Cushion blocks can be used with other measures, such as bubble curtains, cofferdams, and isolation casings, as they act on a different element of the source, providing additional attenuation.

[2] Micarta is a brand name for composites of linen, canvas, paper, fiberglass, carbon fiber, or other fabric in a thermosetting plastic (Wikipedia 2014).

Implementation of MM BIO-18b would ensure that effective and appropriate sound-attenuation measures are employed, establish criteria for their success, provide for monitoring of their use and effectiveness, and establish remedies should they fail to meet success criteria.

Mitigation Measures:

MM BIO-18a: Sound-attenuation Measures. Pile driving with an impact hammer shall only occur during the work window specified by the National Marine Fisheries Service (NMFS) for avoidance of potential impacts to fish species in this region of the San Francisco Bay Estuary, from August 1 to November 30. The work window proposed may be adjusted based on the U.S. Fish and Wildlife Service's programmatic consultation on the delta smelt and through consultation with the California Department of Fish and Wildlife. Conducting work within the work window would minimize the possibility that work activities may impact fish species as listed fish species are less likely to use the action area as a migratory corridor during this period.

- A cushion block (e.g., wood, nylon, Micarta, etc.) shall be placed between the pile and impact hammer, if feasible based on pile size and type.
- A ~~confined~~ bubble curtain of a design approved by the NMFS shall be properly placed around all in-water piles during impact hammer pile driving activities to attenuate underwater sound levels to below thresholds established by the NMFS.

MM BIO-18b: Hydroacoustic Monitoring Plan. Tesoro Refining and Marketing Company, LLC shall retain a qualified specialist to develop a hydroacoustic monitoring plan to ensure compliance with the injury and disturbance thresholds. The purpose of the hydroacoustic monitoring plan shall be to establish protocols to ensure compliance with the Project's sound-attenuation measures and any additional requirements imposed during permitting by regulatory agencies. The plan shall contain measures to:

- Measure sound pressure levels from ~~vibratory and~~ impact pile driving and any additional construction activities as imposed during permitting by regulatory agencies to establish zones of influence related to sound thresholds for fish and marine mammals.
- Avoid injury to marine mammals through visual monitoring of identified zones of influence and cease pile driving activities if any marine mammals enter the zone in which thresholds are exceeded.
- Establish locations for stationing of biological monitors and provide for access to and use of a small maneuverable boat in the immediate vicinity of the monitoring for use during field data collection.
- Conduct field operations to obtain data as follows:
  - Using sound meters, measure baseline of ambient noise in the vicinity of pile driving locations.

- Measure noise from ~~vibratory and~~ impact pile driving to establish/confirm threshold distances.
- Make daily observations and record presence and locations of marine mammals.
- Observe, document, and report any indication of fish injury or mortality in the immediate vicinity of the proposed pile driving activities.

Rationale for Mitigation: Conducting work within the work window would minimize the possibility that work activities may impact fish species as listed fish species are less likely to utilize the Project area as a migratory corridor during this period. Employing sound-attenuation systems for impact driving may reduce underwater sound pressure levels substantially. Development of a hydroacoustic monitoring plan would ensure that effective and appropriate sound-attenuation measures are employed, establish criteria for their success, provide for monitoring of their use and effectiveness, and establish remedies should they fail to meet success criteria. Implementation of these measures would reduce impacts from increased sound levels to less than significant.

Impact BIO-19: Cause substantial impact to wetlands and other waters of the United States and waters of the State. (Potentially significant.)

The Project would result in temporary and permanent impacts to federally protected seasonal wetlands and other waters, as defined by CWA Section 404. Widening of the access road from the Golden Eagle Refinery to the new Avon Terminal approachway would result in permanent fill of 0.03 acre of tidal brackish marsh. Temporary impacts to 4.84 acres of tidal brackish marsh would result from the use of temporary work areas, staging of MOTEMS renovation materials, and areas for crane pads. Renovation requiring removal of wetlands would be subject to USACE jurisdiction under CWA Section 404, and CDFW and Regional Water Quality Control Board jurisdiction under CWA Sections 401 and 402. Wetland disturbance or removal without avoidance, minimization, or compensation would be a significant impact. Implementation of MMs BIO-19a and BIO-19b would reduce impacts on wetlands to less than significant.

Mitigation Measures:

MM BIO-19a: Avoidance and Minimization Measures for Impacts to Wetlands and Waters. Tesoro Refining and Marketing Company, LLC shall ensure that the following measures are implemented by the contractor during renovation to minimize impacts on wetlands and aquatic resources, including waters of the United States and waters of the State:

- Renovation activities shall be avoided in saturated or ponded wetlands and streams. Where wetlands or other water features must be disturbed as authorized by permitting resource agencies, the minimum area of disturbance necessary for renovation shall be identified and the area outside of that necessary area shall be avoided.

- Prior to renovation, silt fencing shall be installed along the work limits in areas within 50 feet of designated wetlands and drainages.
- To minimize the degradation of designated wetlands in the Project vicinity, protective practices such as use of geotextile cushions or other materials (e.g., timber pads, prefabricated equipment pads, geotextile fabric, or other permeable material) or vehicles with balloon tires shall be employed.
- The contractor shall stabilize exposed slopes immediately upon completion of renovation activities. Erosion control measures shall be installed adjacent to suitable aquatic habitat to prevent soil from eroding or falling into these areas. Restoration shall be completed and monitored as described in MM BIO-19b.
- Natural/biodegradable erosion control measures (i.e., straw wattles and hay bales) shall be used. Plastic monofilament netting (erosion control matting) shall not be allowed because wildlife can become entangled in this type of erosion control material.

MM BIO-19b: Revegetation and Restoration Plan. Tesoro Refining and Marketing Company, LLC (Tesoro) shall retain a qualified restoration specialist or botanist to develop a Revegetation and Restoration Plan that describes how marsh habitats shall be enhanced or recreated and monitored over a minimum period of 5 years. Tesoro shall be responsible for ensuring that the revegetation and restoration plan is implemented under the guidance of the restoration specialist. The plan shall be designed such that it meets the following success criteria, or other equally protective success criteria as approved by the resource agencies through the permitting process:

- The restored site is composed of a mix of appropriate native species.
- The restored site has at least 75 percent of the absolute cover of native vegetation present in areas immediately adjacent to the renovation area.
- Plantings are self-sustaining after a reasonable establishment period without human support (e.g., weed control, rodent control, irrigation).
- Functions and values of the restored habitat are comparable to those of adjacent, undisturbed marsh habitat.

After revegetation and restoration are completed, monitoring shall be conducted by a restoration specialist or biologist for a minimum of 5 years to ensure that the success criteria, as identified in the revegetation and restoration plan, are met, and to identify any necessary remedial actions during the monitoring period. At a minimum, the success criteria shall be met for the final 2 years of the monitoring period. Remedial action shall be required of Tesoro if the restoration specialist finds that any of the above criteria are not met by the end of the monitoring period. Annual monitoring reports shall be submitted to California State Lands Commission staff.

Rationale for Mitigation Demarcating and fencing work limits and taking protective steps when working with equipment in saturated wetlands would restrict impacts to what is authorized by resource agencies. Installation of erosion and sediment controls and development of a revegetation and restoration plan would reduce the risk of impacts to wetland areas post-renovation, and ensure that temporarily impacted areas are restored. Implementation of these measures would reduce impacts to wetlands and other waters to less than significant.

Impact BIO-20: Cause substantial impact to Essential Fish Habitat (EFH) due to renovation of new and replacement overwater structures. (Potentially significant.)

New and replacement overwater structure renovation and modification of existing structures may adversely affect EFH and Habitat Areas of Particular Concern (HAPC) for federally managed fish species within the Pacific groundfish, Pacific salmon, and coastal pelagic fishery management plans (NMFS 2011d). Potential adverse effects of new and replacement overwater structure renovation to EFH and the HAPC include increased shading, wave energy regime and substrate effects, water quality degradation, elevated levels of sound pressure waves, support or spread of nonindigenous species, and cumulative effects (NMFS 2011c). Specific Project impacts are described in Table 4.2-9. Implementation of the mitigation measures identified in Table 4.2-9 is expected to reduce impacts to EFH to less than significant.

Table 4.2-9: Potential Impacts to Essential Fish Habitat from New and Replacement Overwater Structures

Impact	Project Impact	Applicable MM
Increased shading	Permanent Impacts: The Project would result in a net decrease of 11,609 square feet of bay fill.	Beneficial impact, no mitigation required
Support or spread of nonindigenous species	Transoceanic vessel traffic has potential to support or spread nonindigenous species.	BIO-9a: Marine Invasive Species Act Reporting Forms BIO-9b: Invasive Species Action Funding
Water quality degradation	Removal of creosote-treated piles and structures containing lead-based paint has potential to degrade water quality. Spills of hazardous material during Avon Terminal operations would degrade water quality. Barges can increase sediment resuspension.	BIO-8b: Cleanup of Oil from Biological Area BIO-8c: Natural Resource Damage Assessment (NRDA) Team BIO-11b: Nearshore Habitat Disturbance Minimization BIO-17b: Post-demolition Bathymetric Survey WQ-8: Update existing Stormwater Pollution Prevention Plan
Wave energy regime and substrate effects	Removal of dense pile structures could create local scour.	BIO-17c: Stub/scour Monitoring

Impact	Project Impact	Applicable MM
Elevated levels of sound pressure waves	Pile driving with an impact hammer and pile removal would increase sound pressure.	BIO-18a: Sound-attenuation Measures BIO-18b: Hydroacoustic Monitoring Plan
Cumulative impacts	Any projects in Suisun Bay within the Project vicinity that are not covered by existing programmatic biological opinions with the NMFS would require separate consultation pursuant to Section 7. Thus, the Project is not expected to have any cumulative effects on Essential Fish Habitat.	No mitigation required

Mitigation Measure: MMs BIO-9a, Marine Invasive Species Act Reporting Forms; BIO-9b, Invasive Species Action Funding; BIO-8b, Cleanup of Oil from Biological Area; BIO-8c, Natural Resource Damage Assessment (NRDA) Team; BIO-11b, Nearshore Habitat Disturbance Minimization; BIO-17b, Post-demolition Bathymetric Survey; WQ-8, Update Existing Stormwater Pollution Prevention Plan; BIO-17c, Stub/scour Monitoring; BIO-18a, Sound-attenuation Measures; and BIO-18b, Hydroacoustic Monitoring Plan apply to this impact.

Impact BIO-21: Isolate wildlife populations and/or disrupt wildlife migratory or movement corridors, or use of native wildlife nursery sites. (Potentially significant.)

Exclusion fencing around the work area in Area C, which extends from Land's End to the high tide line at Suisun Bay, could temporarily isolate wildlife populations in the 22-acre area of fully tidal marshland west of the Avon Terminal approachway. This area is currently connected to tidal marshland east of the approachway, including Point Edith Wildlife Area. As described in MM BIO-15a, exclusion fencing would be installed such that habitat connectivity in this area is maintained.

Increased noise from pile driving can cause fish to avoid the area, and thus, disrupt fish migratory or movement corridors. Implementation of MM BIO-11a would restrict pile driving with an impact hammer and in-water deconstruction activity to periods outside of major fish migratory periods.

The open waters and tidal/brackish marshes in the Project area are used as nursery sites by native wildlife species, including fish and birds. Implementation of MM BIO-10b would minimize work areas to the smallest feasible size; MM BIO-13a requires pre-renovation surveys for nesting birds and protective buffers; and MM BIO-19b would ensure that marsh areas are revegetated and restored following renovation.

Implementation of these measures would minimize impacts to native nursery sites and restore them following renovation such that impacts would be less than significant.

Mitigation Measure: MMs BIO-15a, Salt Marsh Harvest Mouse and Suisun Shrew Impact Avoidance Measures; BIO-11a, In-water Work Restrictions; BIO-10b, Designated Work Areas; BIO-13a, Pre-renovation Nesting Bird Surveys; and BIO-19b, Revegetation and Restoration Plan apply to this impact.

Impact BIO-22: 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. (Less than significant.)

The Conservation Element of the *Contra Costa County General Plan* (2005) provides policies to protect the county's natural resources and their uses. The Avon Terminal lies on the shoreline between the Martinez waterfront and MOTCO, an area identified by the county as a Significant Ecological Resource Area. Mitigation measures in this section are adopted to ensure that the salt marshes and tidelands in the Project area, and the native species that they support, are recognized and protected during MOTEMS renovation. The Project would be consistent with the county's general plan; therefore, this impact would be less than significant.

Mitigation Measure: No mitigation required.

4.2.4.2 Alternative 1: No Project

Impact BIO-23: 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 3.3.1, No Project, under the No Project alternative, the Avon Terminal lease would not be renewed, and the Avon Terminal would be decommissioned and either abandoned in place or partially or completely removed. Decommissioning the Avon Terminal would have the potentially insignificant beneficial impact of locally reducing the amount of sediment resuspension caused by vessels docking at the Avon Terminal and removing a potential point source for minor spills.

Export vessel traffic would most likely be transitioned to the nearby Amorco Terminal, so there would be little reduction in crude oil tanker traffic transiting the SFBE. Thus, there would be no overall reduction in shipping noise, and the risk of hazards from an oil spill and from the introduction of NAS introduced via ballast water and vessel biofouling would be shifted downstream rather than reduced, and the potential impact to the SFBE and associated biota would be continue to be significant and unavoidable.

Mitigation Measures: Should this alternative be selected, MMs would be determined during a separate environmental review under the California Environmental Quality Act (CEQA).

Impact BIO-24: Cause impacts to the San Francisco Bay Estuary and associated biota resulting from the partial or complete removal of Avon Terminal structures. (Potentially significant.)

MOTEMS renovation activities associated with partial or complete removal of the Avon Terminal would cause temporary disturbances to habitat and wildlife that inhabit the Project area. Removal of Avon Terminal structures would potentially result in physical harm or injury to fish and wildlife, and increased levels of noise that could cause harm to fish and wildlife. Depending on MOTEMS renovation 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 nesting sites for birds and a potential sea lion haul out. Beneficially, removal of the Avon Terminal structures would result in a small but probably insignificant lessening of night lights along the south shoreline of Suisun Bay; removal of the Avon Terminal approachway would present an opportunity for revegetation of barren areas within the marsh plain. Mitigation would be required to ensure that removal of the Avon 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 Avon 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.

Mitigation Measures: Should this alternative be selected, MMs would be determined during a separate environmental review under CEQA.

Impact BIO-25: Cause impacts to the San Francisco Bay Estuary and associated biota by decommissioning and removing the Avon Terminal and shifting import and refined crude oil exports to the Amorco Terminal, overland transport, or some combination of these. (Significant and unavoidable.)

Under this alternative, the Avon Terminal would not be in use, and export of refined crude oil products from the Golden Eagle Refinery would be transitioned to the Amorco Terminal, transported overland by rail, tanker, and/or pipeline, or by some combination of these two. Decommissioning and removing the Avon Terminal and shifting imports and exports to the Amorco Terminal would result in the same level of impacts as described in Impact BIO-24. Expansion of the Amorco Terminal to accommodate

additional tankers would possibly require a larger terminal, resulting in potential impacts to fish and wildlife from pile driving noise and construction activities associated with other ancillary equipment, facilities, and pipelines. In addition, the overall number of vessels transiting the estuary would not likely be reduced, as exports would be shifted to the Amorco Terminal. Thus, there would not be any expected reduction of shipping noise, sediment resuspension, or reduction in the potential for a major oil spill or the introduction of NAS via ballast water or vessel biofouling.

Overland transportation of crude oil or refined products via rail car, truck, or pipelines could result in potentially adverse environmental impacts, including loss of habitat and impacts to riparian areas, wetlands, and 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.

Mitigation Measures: Should this alternative be selected, MMs would be determined during a separate environmental review under CEQA.

4.2.4.3 Alternative 2: Restricted Lease Taking Avon Terminal Out of Service for Oil Transport

Impact BIO-26: Cause impacts to the San Francisco Bay Estuary and associated biota by using the Avon Terminal for other purposes and shifting imports and refined crude oil exports to the Amorco Terminal or overland transport. (Significant and unavoidable.)

Under this alternative, Tesoro's Avon Terminal lease would be renewed with modification to restrict its allowed use such that the existing Avon Terminal would be left in place, taken out of service, and placed into caretaker status for any petroleum product transfer, and not decommissioned or demolished. Impacts associated with the decommissioning and demolition, as described in Impact BIO-23 and Impact BIO-24, would not occur. The Avon Terminal could potentially be re-purposed for other activities if authorized by a separate lease action by the CSLC. Depending on the other uses, impacts to fish and wildlife would need to be assessed.

As with the No Project alternative, Tesoro could transition the Amorco Terminal to absorb import and export operations from the Avon Terminal, or utilize other overland transport options as described in Impact BIO-25.

Mitigation Measures: Should this alternative be selected, MMs would be determined during a separate environmental review under CEQA.

4.2.5 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 nighttime lights, routine dredging, shipping noise, and potential minor oil spills as a result of Avon Terminal operations. (Less than significant.)

Sediment Resuspension. Large vessels traveling inside the SFBE are slowly guided along the navigation channels by tug boat. Since 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 SFBE tend to be turbid; therefore, the incremental impact is expected not to be cumulatively considerable.

Light. The Project would not result in a significant net increase of 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 cy 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 SFBE. Tesoro would conduct dredging under the provisions of the 2001 Long-term Management Strategy 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 2012 and removed less than 4,000 cy 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 Avon Terminal represent a small fraction of the total number of vessel trips within the SFBE, 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 section 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 Avon Terminal or from vessels visiting the Avon Terminal would affect a wide range of marine and terrestrial biological resources. As discussed in Section 4.1, Operation Safety/Risk of Accidents, Avon Terminal operations contribute incrementally to the cumulative risk of an oil spill. Vessel traffic associated with the Avon Terminal is approximately 5.3 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, Amorco Terminal, and the Plains All American Marine Oil Terminal. As discussed in Impact BIO-8, 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 SFBE from different sources within the same season would cause even greater adverse impacts to the biota and habitats. Mitigation Measures BIO-8a through BIO-8c 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 Measures: MMs BIO-8a, Bird Rescue Personnel and Rehabilitators; BIO-8b, Cleanup of Oil from Biological Area; and BIO-8c, Natural Resource Damage Assessment Team apply to this impact.

Rationale for Mitigation Implementation of Project-specific MMs would help to reduce the impacts of a Project-related oil spill.

Residual Impacts Even with specific procedures to reduce the risk of a Project-related oil spill, the cumulative impacts of an oil spill would remain significant and unavoidable.

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, §§ 71200-71271) specify required ballast water and vessel biofouling management practices. These laws and associated regulations were developed to prevent future introductions of NAS to California waters. Prior to the introduction of these management practices, however, a considerable number of NAS had been introduced into the SFBE, resulting in a realignment of the biotic communities in the bay. All commercial vessel traffic to the SFBE has the potential to introduce NAS. Although vessels that call at the Avon 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 MMs BIO-9a and BIO-9b.

Mitigation Measures: MMs BIO-9a, Marine Invasive Species Act Reporting Forms and BIO-9b, Invasive Species Action Funding apply to this impact.

Rationale for Mitigation Implementation of Project-specific MMs would help to reduce the risk of future NAS introductions to the SFBE.

Residual Impacts Even with specific procedures to reduce the risk of future NAS introductions, the cumulative impacts could be so devastating that they remain significant and unavoidable.

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 Avon 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 SFBE 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 SFBE is from Central Valley rivers, local watershed sources, and erosion of buried sediment (see Table 4.2-10; Looker 2007).

Table 4.2-10: Estimated Inputs of Total Copper to San Francisco Bay, 2000-2004

Source	Load (kilograms/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	**1,314.0**

Source: 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 SFBE each day, about 2 percent of the daily load (Looker 2007). The Avon Terminal receives approximately 124 vessel visits a year, which is a small fraction of the total vessel traffic to the SFBE. Although the continuing operation of the Avon Terminal would contribute to this impact cumulatively, its incremental contribution is not cumulatively significant.

Mitigation Measure: No mitigation required.

Impact CUM-BIO-5: Cause cumulative adverse impacts to special-status species, biotic communities, and habitat through MOTEMS renovation and replacement of Avon Terminal structures. (Potentially significant.)

Impacts from MOTEMS renovation would be temporary and confined to the immediate Project vicinity. Within the impact area, the Project would cause temporary and permanent impacts to habitat for special-status plant and wildlife species. Following renovation, implementation of MM BIO-19b would ensure that marshlands are restored. In addition, temporary and permanent impacts to marsh habitat would be compensated at the ratios identified in MM BIO-15b; thus, the Project would result in a net increase in higher quality habitat available to special-status species. Cumulative impacts to habitat and jurisdictional waters would be less than significant.

Mitigation Measure: MMs BIO-19b, Revegetation and Restoration Plan, and BIO-15b, Compensation for Temporary and Permanent Loss of Salt Marsh Harvest Mouse Habitat, apply to this impact.

4.2.6 SUMMARY OF FINDINGS

Table 4.2-11 includes a summary of anticipated impacts to biological resources and associated mitigation measures.

Table 4.2-11: Summary of Biological Resources Impacts and Mitigation Measures

Impact	Mitigation Measure(s)
Proposed Project	
BIO-1: Cause substantial impact to special-status species or sensitive habitat due to increased fill area and bay cover.	No mitigation required
BIO-2: Cause substantial impact to special-status species or sensitive habitat during operations due to marsh vegetation removal on either side of and below the approachway.	No mitigation required
BIO-3: 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-4: Cause substantial impact to special-status wildlife species, including impact to behavior and the composition of biotic communities, in the vicinity of the Avon Terminal as a result of the use of bright lights during nighttime Avon Terminal operations.	No mitigation required
BIO-5: 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.	No mitigation required
BIO-6: Cause injury or behavioral interruptions to aquatic species as a result of noise from vessels.	No mitigation required
BIO-7: 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-8: 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-8a: Bird Rescue Personnel and Rehabilitators BIO-8b: Cleanup of Oil from Biological Area BIO-8c: Natural Resource Damage Assessment (NRDA) Team (Also refer to MM OS-4b)
BIO-9: Introduce invasive nonindigenous species to the San Francisco Bay Estuary.	BIO-9a: Marine Invasive Species Act Reporting Forms BIO-9b: Invasive Species Action Funding
BIO-10: Cause substantial temporary impact to special-status species due to MOTEMS renovation activity.	BIO-10a: Pre-renovation Surveys for Key Special-status Species BIO-10b: Designated Work Areas

Impact	Mitigation Measure(s)
	BIO-10c: Worker Environmental Awareness Program BIO-10d: Safe and Clean Work Area Maintenance BIO-10e: Biological Monitoring BIO-10f: Post--renovation Cleanup
BIO-11: Cause disturbance or loss of special-status fish.	BIO-11a: In-water Work Restrictions BIO-11b: Nearshore Habitat Disturbance Minimization BIO-11c: Anchoring Plan
BIO-12: Cause disturbance or loss of special-status plant populations.	BIO-12a: Pre-renovation Special-status Plant Surveys BIO-12b: Special-status Plant Avoidance and Protection BIO-12c: Salvage and Recovery Plan for Special-status Plants
BIO-13: Cause disturbance of nesting migratory birds and raptors.	BIO-13a: Pre-renovation Nesting Bird Surveys BIO-13b: Osprey Nest Protection (Also refer to MM BIO-19b)
BIO-14: Cause disturbance of California clapper rail and California black rail and habitat.	BIO-14a: Survey and Avoidance Measures for California Capper Rail and California Black Rail
BIO-15: Cause disturbance of salt marsh harvest mouse and Suisun shrew and habitat.	BIO-15a: Salt Marsh Harvest Mouse and Suisun Shrew Impact Avoidance Measures BIO-15b: Compensation for Temporary and Permanent Loss of Salt Marsh Harvest Mouse Habitat
BIO-16: Cause disturbance to marine mammals.	BIO-16a: Adjust Vessel Speed BIO-16b: Implementation of Marine Mammal Contingency Plan BIO-16c: Prioritize Removal of Potential Haul-out Locations (Also refer to MM BIO-18b)
BIO-17: Cause substantial impact to special-status species or sensitive habitat due to degradation of water quality.	BIO-17a: Lead-based Paint Management Plan BIO-17b: Post-demolition Bathymetric Survey BIO-17c: Stub/scour Monitoring BIO-17d: Minimization of Creosote Release (Also refer to MM WQ-8)
BIO-18: Cause substantial impact to special-status species or sensitive habitat due to increased sound levels from MOTEMS renovation.	BIO-18a: Sound-attenuation Measures BIO-18b: Hydroacoustic Monitoring Plan

Impact	Mitigation Measure(s)
BIO-19: Cause substantial impact to wetlands and other waters of the United States and waters of the State.	BIO-19a Avoidance and Minimization Measures for Impacts to Wetlands and Waters BIO-19b: Revegetation and Restoration Plan
BIO-20: Cause substantial impact to Essential Fish Habitat due to MOTEMS renovation of new and replacement overwater structures.	Refer to MMs BIO-8b, BIO-8c, BIO-9a, BIO-9b, BIO-11b, BIO-17b, BIO-17c, BIO-18a, BIO-18b, and WQ-8
BIO-21: Isolate wildlife populations and/or disrupt wildlife migratory or movement corridors, or use of native wildlife nursery sites.	Refer to MMs BIO-15a, BIO-11a, BIO-10b, BIO-13a, and BIO-19b
BIO-22: Conflict with any local policies or ordinance 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.	No mitigation required
Alternative 1: No Project	
BIO-23: 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, MMs would be determined during a separate environmental review under CEQA
BIO-24: Cause impacts to the San Francisco Bay Estuary and associated biota resulting from the partial or complete removal of Avon Terminal structures.	Should this alternative be selected, MMs would be determined during a separate environmental review under CEQA
BIO-25: Cause impacts to the San Francisco Bay Estuary and associated biota by decommissioning and removing the Avon Terminal and shifting import and refined crude oil imports to the Amorco Terminal, overland transport, or some combination of these.	Should this alternative be selected, MMs would be determined during a separate environmental review under CEQA
Alternative 2: Restricted Lease Taking Avon Out of Service for Oil Transport	
BIO-26: Cause impacts to the San Francisco Bay Estuary and associated biota by using the Avon Terminal for other purposes and shifting imports and refined crude oil exports to the Amorco Terminal or overland transport.	Should this alternative be selected, MMs 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 nighttime lights, routine dredging, shipping noise, and potential minor oil spills as a result of Avon Terminal operations.	No mitigation required
CUM-BIO-2: Cause cumulative impacts to San Francisco Bay Estuary and associated biota from	Refer to MMs BIO-8a, BIO-8b, and BIO-8c

Impact	Mitigation Measure(s)
oil spills from all marine oil terminals combined, or from all tankering combined.	
CUM-BIO-3: Cause cumulative impacts by increasing the risk of introduction of nonindigenous aquatic species from vessel traffic to San Francisco Bay Estuary.	Refer to MMs BIO-9a and BIO-9b
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 Avon Terminal that are coated with antifouling paints.	No mitigation required
CUM-BIO-5: Cause cumulative adverse impacts to special-status species, biotic communities, and habitat through MOTEMS renovation and replacement of Avon Terminal structures.	Refer to MMs BIO-19b and BIO-15b

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