3.2 Biological Characteristics

This section describes the existing aquatic and terrestrial habitats of the study area, and evaluates potential impacts of the Proposed Project and alternatives on fish and other aquatic organisms, benthic communities, aquatic and terrestrial vegetation, and terrestrial wildlife. Emphasis is placed on special status species, including federal (Endangered Species Act [ESA]) and state (California Endangered Species Act [CESA]) endangered or threatened species, candidate ESA and CESA species, and species of concern. The descriptions of aquatic and terrestrial biological resources incorporate information from the U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), CALFED Bay-Delta Program (CALFED), Interagency Ecological Program (IEP), San Francisco Estuary Institute (SFEI), Delta Long Term Management Strategy (LTMS), California Department of Fish and Game (CDFG), the most recent vegetation survey conducted in support of this Draft SEIS/SEIR (USACE 2008c, 2010g), and other sources as noted.

Regional Ecological Setting

The SRDWSC ecosystem is a component of the Delta. The Delta is characterized by tidal wetlands and interweaving water channels. The original wetland landscape has been diked, drained, and converted into islands surrounded by artificial levees for agricultural and urban development. Despite the dominance of farmland today, the Delta continues to provide essential habitat for aquatic and terrestrial species that are endemic to the region. Several important ecological areas occur within or in the immediate vicinity of the study area, including the Yolo Bypass, Cache Slough, and the main-stem of the Sacramento River.

The Yolo Bypass is a 59,000-acre flood bypass (which includes a 16,000-acre wildlife area) that runs adjacent to the western bank of the SRDWSC, through part of Reach 4 and most of Reach 5, extending south from the confluence of the Feather and Sacramento rivers. During high-flow years, the Yolo Bypass empties back into the Sacramento River approximately 3 kilometers (km) upstream of Rio Vista. The channel is dominated by seasonal wetlands, with some permanent ponds. The southern reach of the Yolo Bypass includes Liberty Island; Cache, Prospect, and Lindsey Sloughs; and the Yolo Bypass toe drain. Portions of the Yolo Bypass are inundated in winter and early spring and provide migration, spawning, and nursery habitat for Chinook salmon (*Oncorhynchus tshawytscha*), steelhead (*O. mykiss*), sturgeon (*Acipenser* spp.), delta smelt (*Hypomesus transpacificus*), longfin smelt (*Spirinchus thaleichthys*), and lamprey (*Lampetra* spp.; CALFED 2000; Sommer et al. 2001a, 2001b, 2005). Historical records indicate the Yolo Bypass was flooded during more than 70% of years from 1935 to 2000 (Yolo Bypass Working Group et al. 2001). During the dry season, much of the bypass is used as agricultural farmland for rice, corn, tomatoes, and other crops.

Cache Slough, adjacent to the southern end of the Yolo Bypass, is located in Solano County

at the confluence of the main-stem of the Sacramento River and the man-made portion of the SRDWSC. Cache Slough was identified as a potential delta smelt, longfin smelt, and Chinook salmon restoration area by the State of California, the Delta Vision group, and the Delta Risk Management Strategy (CRA 2008; CDWR 2008b). In 2007, Cache Slough had large numbers of pre-spawning adult delta smelt, a species that is federally listed as threatened, state listed as endangered, and endemic to the Delta region (CDWR 2008a).

The Sacramento River is the largest river in California, supporting more than 250 wildlife species. The river and its riparian forests are the focus of several conservation programs, including the Sacramento National Wildlife Refuge (NWR) Complex. Three Mile Slough; Horseshoe Bend; Sherman Lake; Marshall Cut; and Broad, Middle, and New York Sloughs all merge with the Sacramento River. The Sacramento River overlaps with the SRDWSC in Reaches 1 and 2 and turns to the northeast at the confluence of Cache Slough near the City of Rio Vista in Reach 3. The William G. Stone Locks, located to the east of the Port's turning basin, once connected the SRDWSC with the Sacramento River farther to the east. The 600-foot-long, 86-foot-wide, and 13-foot-deep locks were constructed in 1963 as part of the SRDWSC project. Historically, the City of West Sacramento allowed water and boats to pass to and from the SRDWSC and the Sacramento River (Trout 1981). Due to decreased usage and concern over increasing costs, the City of West Sacramento stopped regular operation of the locks in the mid 1980s. The locks were permanently deauthorized in 2000, leaving the Port a dead-end slough (Fishsniffer 2008). The non-operating locks now block most of the water flow between the Sacramento River and the SRDWSC in Reach 5, and prevent fish from moving between the SRDWSC and the Sacramento River.

The SRDWSC includes both natural habitat and man-made navigational features, beginning within the Sacramento River near Suisun Bay. The SRDWSC accounts for approximately 13% of the Sacramento River's overall area where the two overlap. The SRDWSC diverges from the Sacramento River into the man-made channel approximately 2 miles north of Rio Vista. In total, the SRDWSC comprises an approximately 17-mile section of the Sacramento River and a 29-mile navigation channel, of which 25 miles are man-made.

Tidal wetlands, tidal mudflats, and riparian habitat are present along portions of levees and the banks of the SRDWSC. Land adjacent to the banks of the SRDWSC as it passes through the Delta is used primarily for agricultural purposes with pockets of residential, commercial, and industrial development. Within the man-made portion of the SRDWSC, warm water temperatures (in summer, generally 10 degrees Fahrenheit [°F] warmer than in the Sacramento River portion), higher salinities, lack of riparian vegetation, and the presence of predators combine to create conditions that generally are unfavorable to rearing and outmigrating juvenile salmonids (NMFS 2006). At one time, USACE and USFWS considered

using the SRDWSC as a juvenile bypass channel to reduce the high mortality rates of juvenile salmonids exposed to the Delta Cross Channel and Georgiana Slough (USACE 1995). However, USFWS (1995) concluded that poor habitat conditions in the SRDWSC, including a lack of freshwater flow-through, lack of riparian habitat, and high levels of predation, were not suitable for juvenile rearing or outmigration, and that use of the channel would likely result in higher losses than if the fish were to remain in the main channel Sacramento River.

Local Regulatory Context, Wildlife Management Areas, and Preserves

A review of local General Plans and zoning regulations identified several plans, policies, and regulations that would influence dredging and discharge of dredged material in the study area.

Solano County requires preservation of heritage trees, which include those with a diameter of 15 inches or more measured at 54 inches above natural grade, any oak tree native to California with a diameter of 10 inches above natural grade, or any group of trees specified by Solano County (Solano County 1999). Trees are protected from removal as well as disturbance (including root zones; Solano County 1999). Mitigation is required for unavoidable adverse effects to heritage trees (Solano County 1999). Within Solano County, the Suisun Marsh is protected from upland encroachment and dredging operations that may affect critical wildlife activities as well as increase erosion (Solano County 1999).

Within Sacramento County, protection of vernal pools and wetlands is a high priority with a goal of no net loss of these resources (Sacramento County 2009). The County has established an in lieu mitigation fee of $35,000 per acre for unmitigated/uncompensated wetland impacts (Sacramento County 2009). The County's Open Space Strategy Map also identifies areas targeted for wetland restoration. The County is in the process of establishing a Habitat Conservation Plan (HCP) for South Sacramento County, which would limit development in designated areas to protect sensitive habitats (Sacramento County 2010a). The South Sacramento HCP is being designed to consolidate environmental conservation effects to protect and enhance wetlands, especially vernal pools and upland habitat, while streamlining permitting approvals (Sacramento County 2010b). The South Sacramento HCP will cover 40 different species of plants and wildlife, including 10 that are state or federally listed as threatened and endangered (Sacramento County 2010b).

Sacramento County also requires preservation of endangered and threatened species' habitat and administers a tree preservation ordinance. Non-oak native species, measuring 6-inches in diameter at 4.5 feet above ground, should be preserved, and no net loss of native oak canopy should occur (Sacramento County 2009). The Resource Conservation Areas (RCA) land use classification is not regulatory but voluntary in nature and encourages conservation

of habitat (Sacramento County 2009).

The City of West Sacramento seeks to preserve populations of rare, threatened, and endangered species by requiring avoidance or fully mitigating adverse effects, and will not approve unmitigable impacts (City of West Sacramento 1990). The City also strives to manage future development in a manner that protects fisheries within the Sacramento River (City of West Sacramento 1990). Since 2004, the City has had a Tree Ordinance in place to protect urban forests, in particular landmark trees (designated as historically significant by City Council) or heritage trees (based on 75-inch trunk circumference at 4 feet 6 inches from the ground), from permanent damage or removal without proper cause (City of West Sacramento 2004).

Within Yolo County, the General Plan discourages the conversion of existing wildlife habitat and mandates the development of a tree preservation ordinance (Yolo County 2009). Within the County's Natural Heritage Overlay and Agricultural District Overlay, conservation and agricultural land uses, respectively, are encouraged and land uses are limited (Yolo County 2009). Yolo County also requires the preservation of buffers between potentially conflicting land uses and agricultural or conservation land uses. Under the General Plan's Open Space and Recreation Element, protection of open space and habitat, including vernal pools, is a direct objective (Yolo County 2009). Yolo County is establishing a HCP designed to result in "no net loss" of wildlife habitat value or agricultural land (EIP Associates 1996). The HCP will allow incidental take if mitigation fees are provided by the party involved in the take; mitigation by the party responsible for the take would involve a series of conservation easements to offset impacts (EIP Associates 1996). The HCP intends to require a development fee of $2,630 per acre (EIP Associates 1996). The process of defining the HCP continues and preservation areas are under study (Yolo County 2010a).

The Yolo Bypass Wildlife Area (YBWA) is located to the east of the SRDWSC within Yolo County (CDFG 2010a). The area consists of approximately 16,770 acres and is designed to protect and enhance habitat for wildlife species and provide the public with compatible, wildlife-related recreational uses (CDFG 2010b). With the exception of ongoing restoration and enhancement, and operations and maintenance activities, any substantive physical changes that are not currently approved by the area's Land Management Plan will require subsequent authorizations and approvals (CDFG 2010b).

The City of Rio Vista regulates development to avoid alterations of scenic landforms as well as sensitive vegetation (City of Rio Vista 2002). Habitat and species targeted for preservation include riparian; marsh; vernal pool and swales; herbaceous upland; and special status aquatic species, plants, and wildlife (City of Rio Vista 2002). Special status fish and aquatic species

include Chinook salmon, steelhead trout, green sturgeon (*Acipenser medirostris*), delta smelt, longfin smelt, and Sacramento splittail (*Pogonichthys macrolepidotus*; City of Rio Vista 2002). Alteration of areas identified as potential habitat requires an EIR and mitigation (City of Rio Vista 2002).

Wildlife Management Areas, or refuges, are managed by USFWS or similar entities; in these areas, land is either enhanced for wildlife that would use it or permanently protected from development (USFWS 2010b). The Antioch Dunes NWR is located along the southern shore of the San Joaquin River (USFWS 2010c). It was the first NWR in the United States established to protect endangered plants and insects (USFWS 2010d). Established in 1980, the refuge provides protection for three endangered species: Lange's metalmark butterfly (*Apodemia mormo langei*), Antioch Dunes evening primrose (*Oenothera deltoides* ssp. *howellii*), and Contra Costa wallflower (*Erysimum capitatum*) (USFWS 2010d). The Sherman Island Waterfowl Management Area, or Lower Sherman Island Wildlife Area (LSIWA), is located at the confluence of the Sacramento and San Joaquin rivers (CDFG 2010c). It accounts for approximately 3,100 acres, primarily marsh and open water habitat, in the western Delta (CDFG 2010d).

A review of CDFG data suggests no other state ecological reserves are within the study area (CDFG 2010e).

3.2.1 Aquatic Species and Habitat

This section provides baseline information on aquatic species and habitat, and assesses potential impacts to aquatic species and habitat from the Proposed Project and alternatives.

3.2.1.1 Baseline Conditions

This section provides baseline information on aquatic habitat, plants, and organisms, including special status species, federal and state listed threatened and endangered species, and their designated critical habitat. It also provides information on federally designated Essential Fish Habitat (EFH) occurring in the study area.

3.2.1.1.1 Aquatic Habitat

Aquatic habitats that are important within the Delta and the study area include tidal marsh and tidal mudflats; and intertidal, shallow sub-tidal, and deep sub-tidal habitats (Figure 15). The majority of aquatic habitat within the study area is found in the man-made portion of the SRDWSC, which tends to exhibit lower biological functions than the natural river. Specifically, Reaches 1 through 3 of the study area, which occur in the natural Sacramento River, contain important habitats for native fish species.

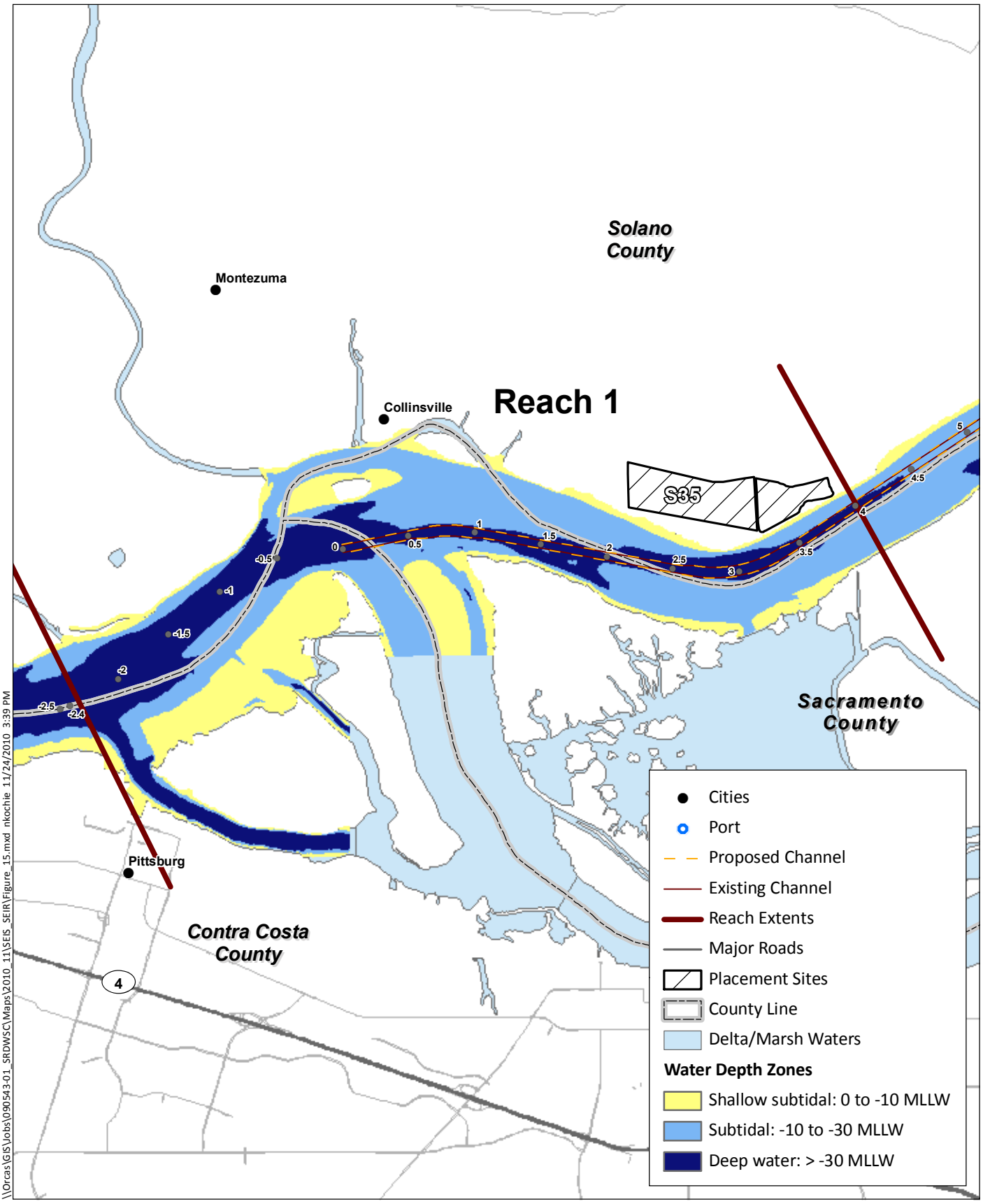

Figure 15a
Aquatic Habitat Types by Water Depth within the Study Area
SEIS/SEIR
Sacramento River Deep Water Ship Channel

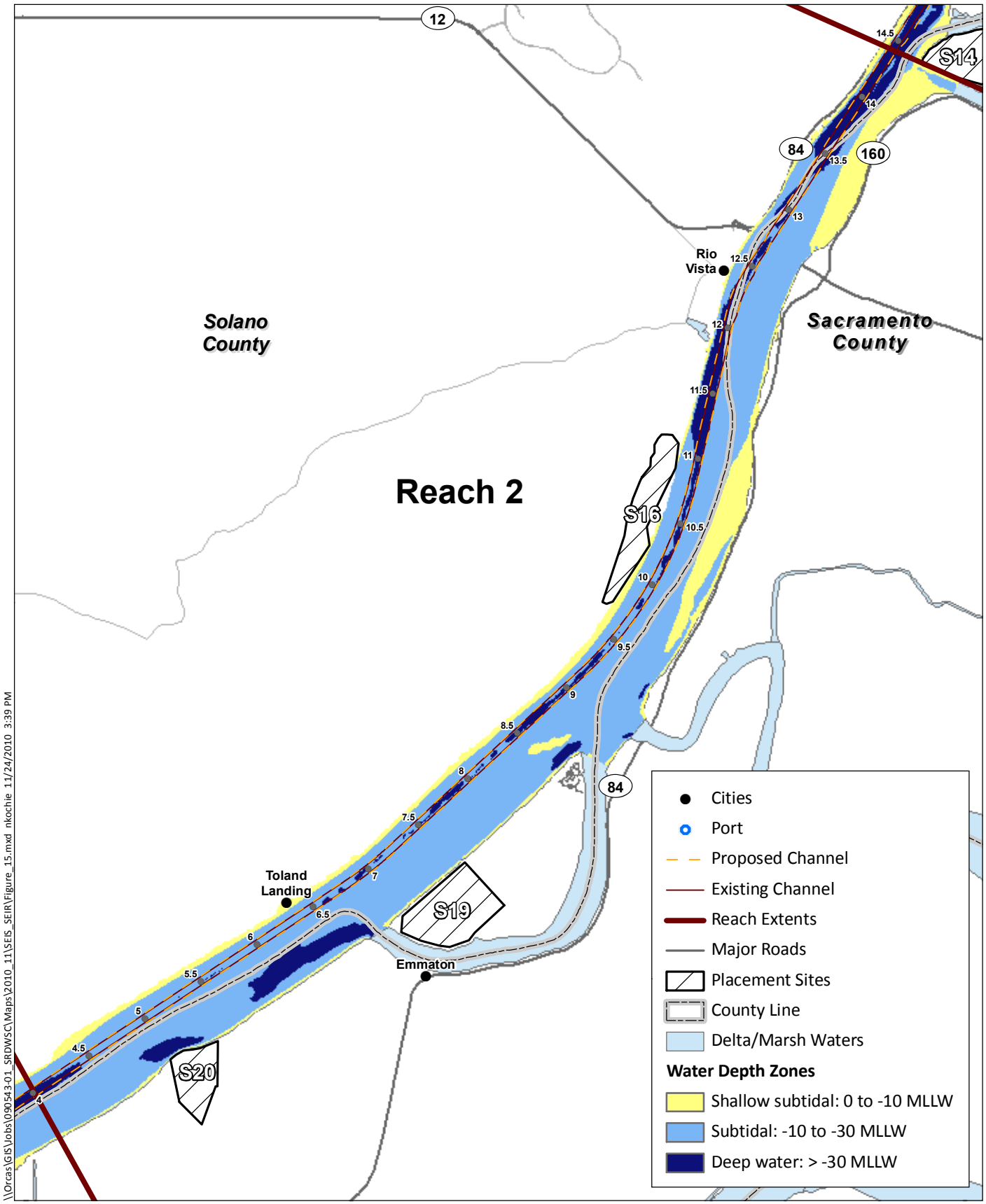

Figure 15b
Aquatic Habitat Types by Water Depth within the Study Area
SEIS/SEIR
Sacramento River Deep Water Ship Channel

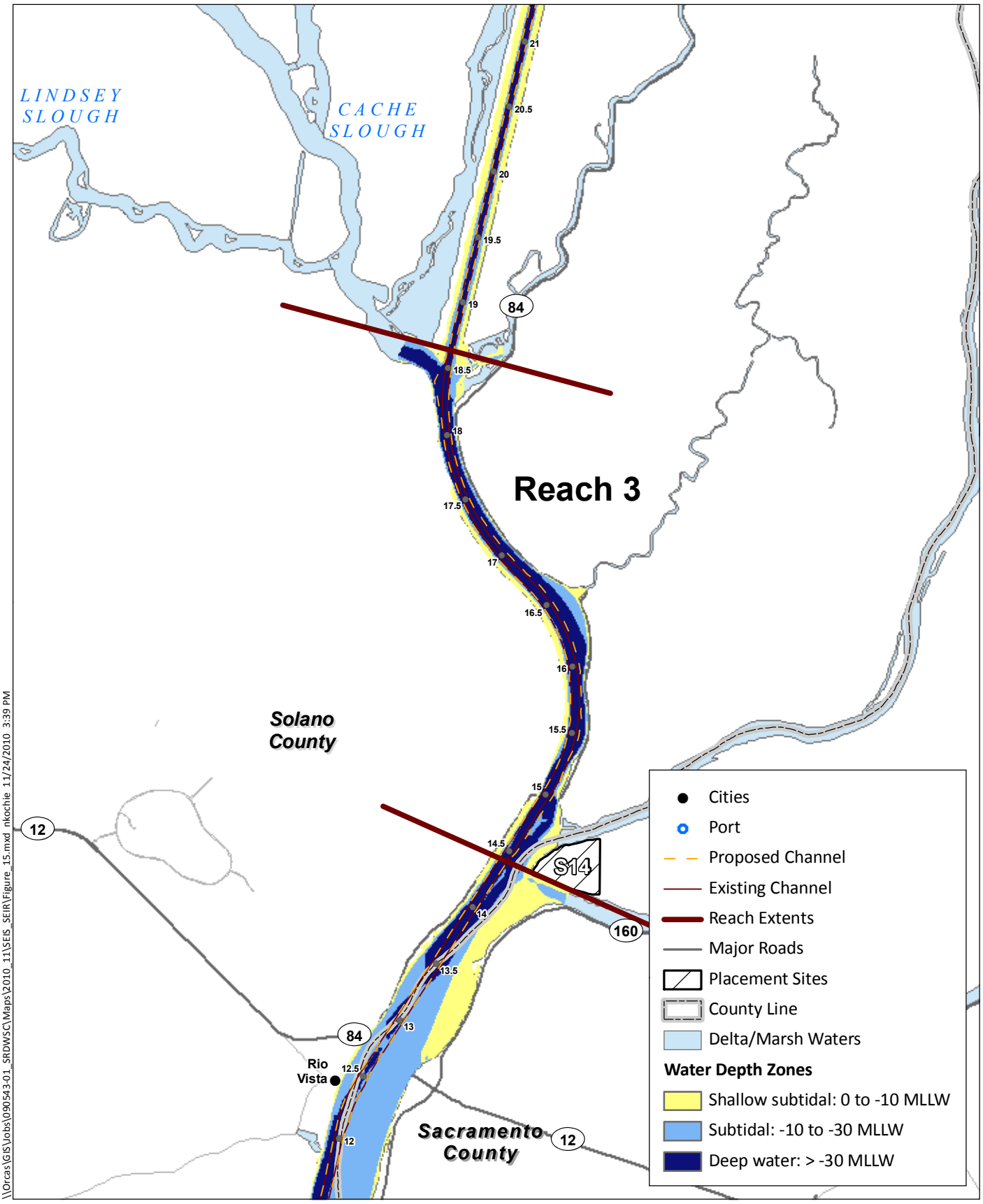

Figure 15c
Aquatic Habitat Types by Water Depth within the Study Area
SEIS/SEIR
Sacramento River Deep Water Ship Channel

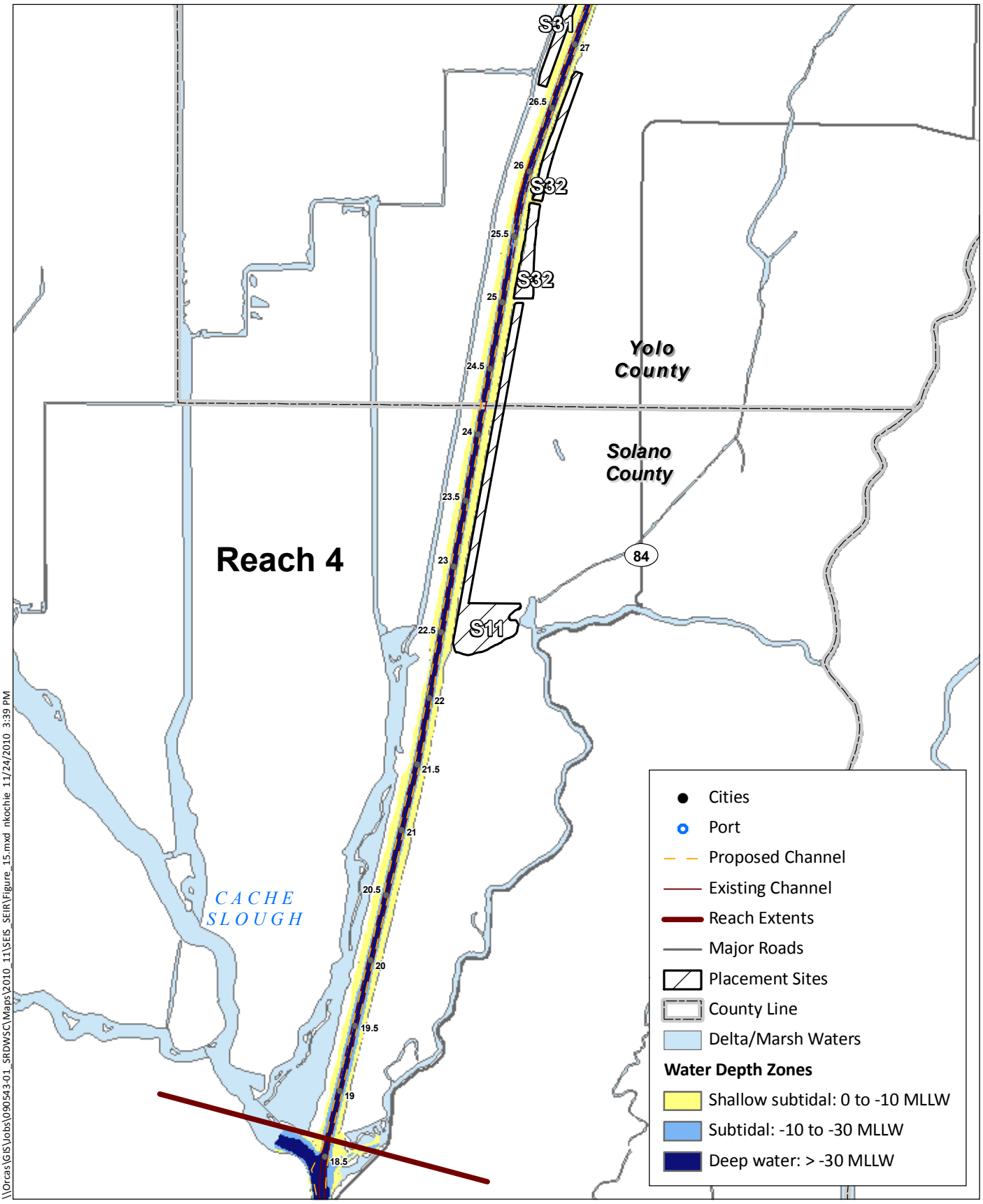

Figure 15d
Aquatic Habitat Types by Water Depth within the Study Area
SEIS/SEIR
Sacramento River Deep Water Ship Channel

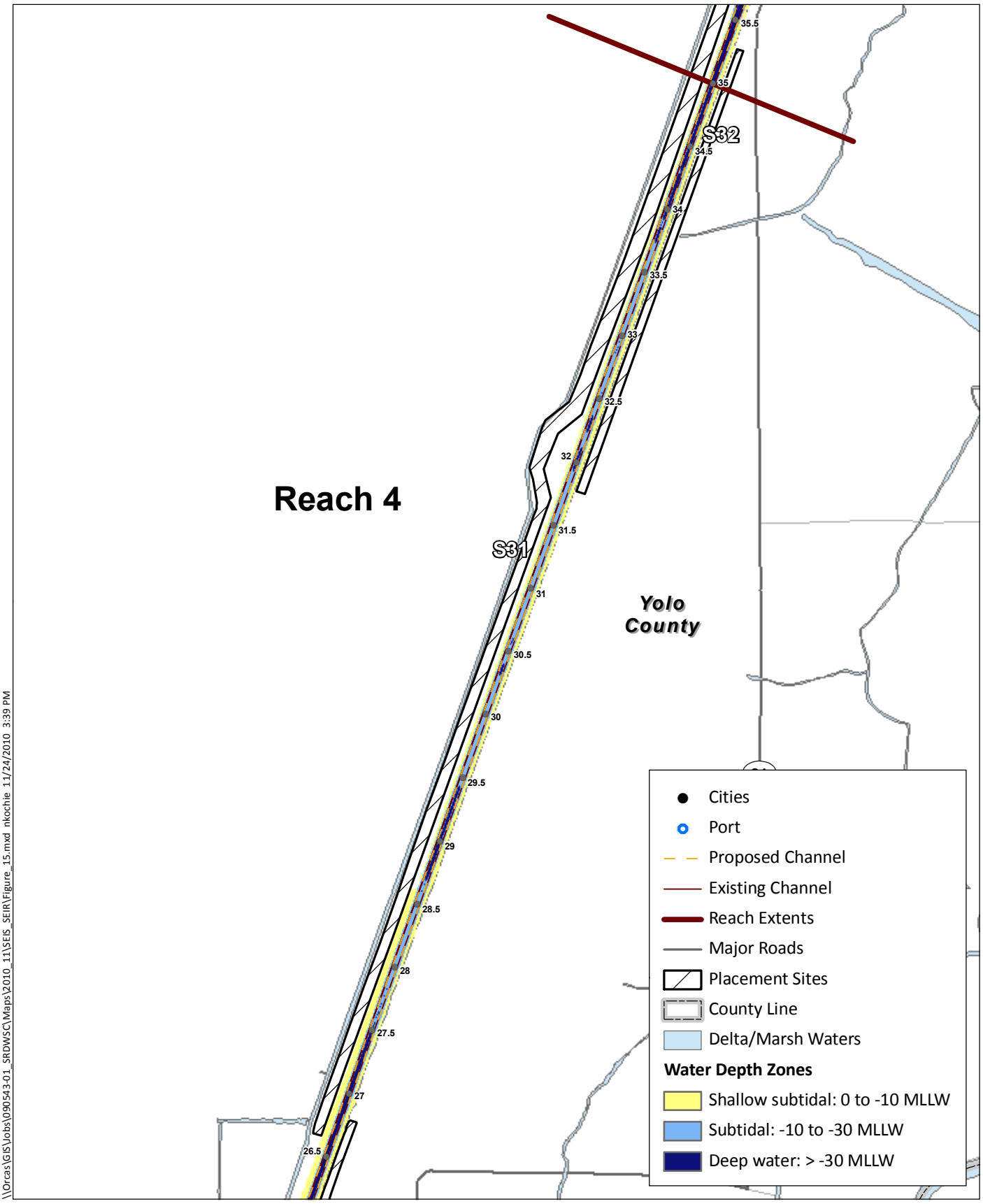

Figure 15e
Aquatic Habitat Types by Water Depth within the Study Area
SEIS/SEIR
Sacramento River Deep Water Ship Channel

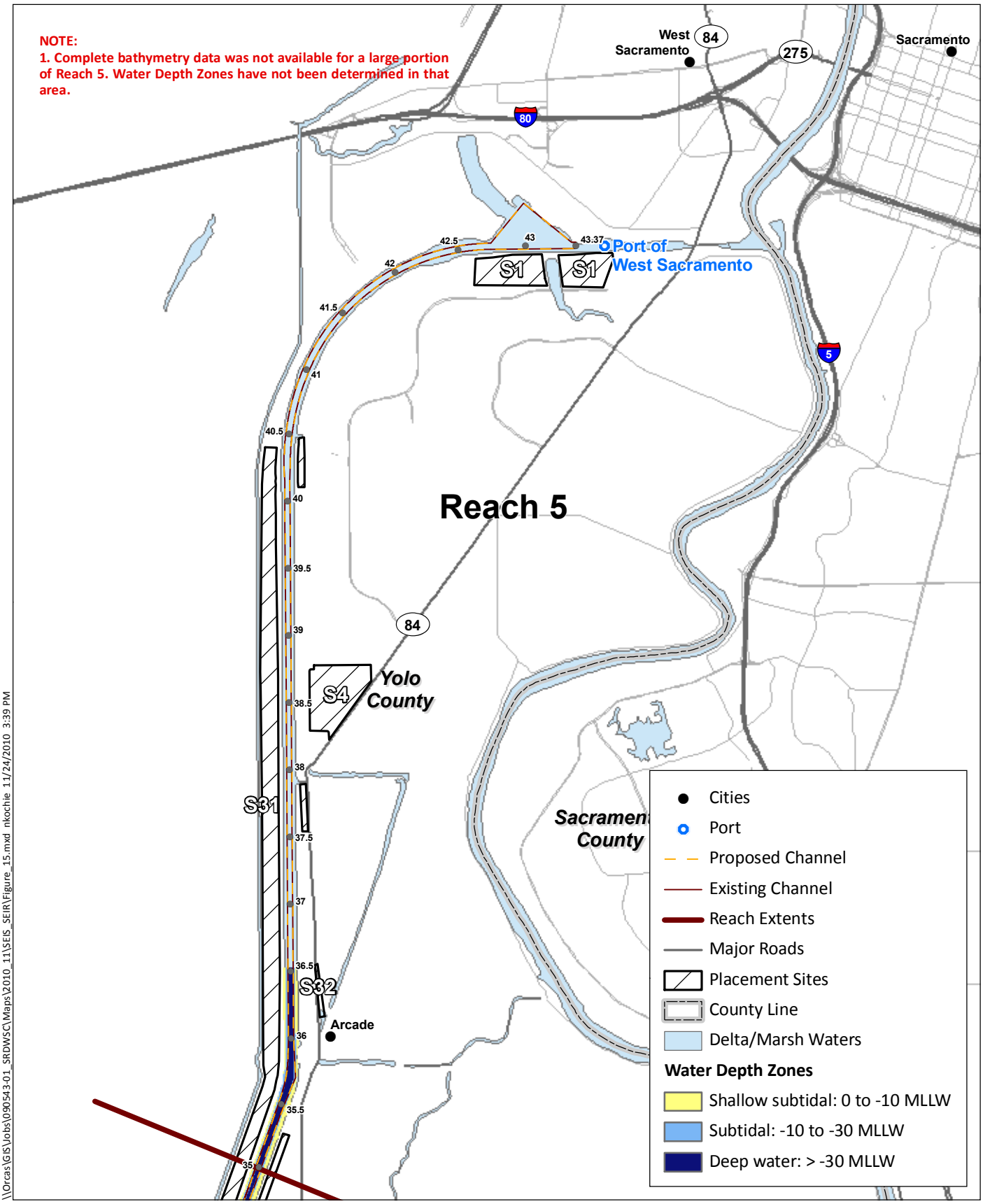

Figure 15f
Aquatic Habitat Types by Water Depth within the Study Area
SEIS/SEIR
Sacramento River Deep Water Ship Channel

Tidal Marsh

Tidal marsh habitat is comprised of tidally-inundated vegetated wetland. The tidal marsh may be salt or brackish, depending on the extent of freshwater influence. The plant communities found in this marsh type are influenced by salinity, substrate, wave energy, marsh age, erosion, and accretion. Marshes provide important rearing and refuge habitat for juvenile and adult salmon, steelhead (*Oncorhynchus mykiss*), and longfin smelt (*Spirinchus thaleichthys*), and a wide variety of birds use tidal marshes for nesting, foraging, and refugia.

Emergent marshes of the Delta have been categorized into three distinct zones based on frequency and duration of tidal inundation (USACE 2008b):

- Low marsh occupies the elevations between mean tide level and mean high water (MHW), and is therefore inundated daily. In the study area, low marsh is adjacent to the waters of the SRDWSC in the main-stem Sacramento River and is dominated by California cordgrass (*Spartina foliosa*).
- Middle marsh habitat occupies the elevations between MHW and mean higher high water (MHHW) and is dominated by common pickleweed (*Salicornia virginica*). Middle marsh is inundated frequently throughout each month, although for shorter periods than low marsh.
- High transitional marsh habitat occupies the elevations between MHHW and the highest tide level. This habitat is inundated infrequently and for short periods, and is discussed in Section 3.2.2. The high marsh may be characterized by salt grass.

The SRDWSC begins near Suisun Marsh, one of largest contiguous brackish water marshes remaining on the west coast of North America at approximately 116,000 acres (IEP n.d.). The Suisun Marsh includes 52,000 acres of managed wetlands, 27,700 acres of upland grasses, 6,300 acres of tidal wetlands, and 30,000 acres of bays and sloughs, and serves as the resting and feeding ground for thousands of waterfowl migrating on the Pacific Flyway. The area is considered EFH for salmonids, and critical habitat for salmonids, delta smelt, and green sturgeon. Suisun Marsh supports 80% of the state's commercial salmon fishery by providing important tidal rearing areas for juvenile fish, which allows them to grow twice as fast as those reared in the upper watershed, thus, greatly enhancing their survival (IEP n.d.).

Dredging is not expected to impact tidal marsh habitat because this habitat type is located above the elevations where dredging will occur. However, some areas of salt and brackish marsh have been found to exist at placement site S35 (Artho 2003) and SI-PR2 (USACE 2010g). As a result, marshes are included in the discussion of terrestrial species and habitat in Section 3.2.2.

Tidal Mudflats

Tidal mudflats occur from below mean lower low water (MLLW) to mean tide level, and are exposed twice daily during low tide (USACE 2008b). These flats are characterized by a fine-grained silt and clay substrate, and usually include minimal vascular vegetation. Tidal mudflats support significant benthic communities, including aquatic worms (Oligochaeta), crustaceans (Crustacea), and mollusks (Mollusca), and provide fertile feeding grounds for various shorebird species.

Tidal mudflats were noted in the 1986 Supplemental EIS as existing in the upper reaches of the SRDWSC, outside of the current study area (USACE 1986). Dredging will thus not impact mudflats. Additionally, dredged material placement site surveys (Artho 2003) have not identified any mudflats; therefore, construction of the Proposed Project or alternatives is not expected to impact tidal mudflats.

Eelgrass Beds

Literature research has yielded little information on eelgrass (*Zostera marina*) abundance outside of the San Francisco Bay. Eelgrass requires specific conditions to flourish, primarily related to water quality conditions such as salinity, light transmittance, and depth. Construction of the Proposed Project or alternatives would take place in waters generally too deep, turbid, and fresh for eelgrass to survive, and thus eelgrass is not expected to be present or impacted by proposed dredging operations.

3.2.1.1.2 Aquatic Organisms

Benthos

Benthic communities are largely composed of macro-invertebrates, such as annelids (Annelida), mollusks, and crustaceans. These organisms inhabit the bottom substrates of aquatic habitats and play a vital role in maintaining sediment and water quality. They are also an important food source for bottom-feeding fish, invertebrates, and birds. Communities of benthic organisms are important indicators of environmental stress because they are particularly sensitive to pollutant exposure. This sensitivity arises from the close relationship between benthic organisms and sediments that accumulate contaminants over time, and the fact that these organisms receive prolonged exposure to contaminants because they live in the sediment and filter sediment-laden water.

Annelids (such as polychaetes) are found in the benthic communities within the study area. Mollusks present include limpets and snails (Gastropoda), and clams and mussels (Bivalvia). Crustaceans known to occur include barnacles and copepods (Maxillopoda), crabs (Brachyura), mysid shrimp (*Mysidopsis bahia*), and crayfish (*Pacifastacus leniusculus*). The most abundant species reported in several studies of benthic communities within the Delta

are the invasive Asian clam (*Corbicula fluminea),* Amur River clam (*Corbula amurensis*), the tubeworm *Varichaetadrilus angustipenis*, the arthropod *Americorophium stimpsoni*, invasive Siberian prawn (*Exopalaemon modestus)*, and invasive jellyfish (Medusozoa; SWCA 2009; USGS and CDWR 2010).

Several invasive benthic species have been identified as potential links to declines in fish species in the Delta (i.e., Pelagic Organism Decline [POD]; IEP 2007). The mysid shrimp are largely carnivorous, feed on copepod adults, and provide an energetic (trophic) conduit between plankton and planktivorous fishes, including juvenile fishes, green sturgeon (*Acipenser medirostris*), white sturgeon (*Acipenser transmontanus*), Chinook salmon (*Oncorhynchus tshawytscha*), and American shad (*Alosa sapidissima*). Historically, they were very abundant until a mysid, *Acanthomysis bowmani*, was introduced to the Delta, leading to the decline of the native mysid *Neomysis mercedis*. Copepods are linked to declines under high predation from the recently introduced Amur River clam (Kimmerer and Orsi 1996). In addition, a number of non-indigenous predatory copepods exist in the Delta—*Sinocalanus doerri, Acartiella sinensis,* and *Tortanus dextrilobatus*—about which relatively little is known (Orsi and Ohtsuka 1999).

Phytoplankton and Zooplankton

High phytoplankton (open-water algae) concentrations are an indicator of high rates of primary productivity. Phytoplankton are the microscopic, drifting, often unicellular plants that comprise the base of the aquatic food chain. In the Delta, and by extension the study area, phytoplankton have historically existed in relatively high concentrations. The Yolo Bypass (in Reaches 4 and 5 of the study area) produces high concentrations of phytoplankton, and recent research indicates that this food resource is transported downstream to other reaches of the Delta. Phytoplankton concentration also varies with flow in the river, and tends to increase when the inflow from the main-stem of the Sacramento River decreases and the floodplain area is drained (Schemel et al. 2004).

Zooplankton are microscopic free-swimming or drifting animals that feed primarily on phytoplankton and detritus. Their distribution is controlled largely by tides, current, and wind. Zooplankton are consumed by other organisms, such as shrimp and small fish. The mysid shrimp is an abundant and extremely important zooplankton species in the Delta, because it is the principal food of young fish, notably striped bass.

Chlorophyll and primary productivity levels have shifted greatly over different locations in the Delta over the past four decades, and since 1999, the phytoplankton community composition has changed. The community has generally shifted from diatoms (Bacillariophyceae) toward green algae or cyanobacteria (blue-green algae or Cyanophyta).

In addition to phytoplankton community composition shifts, suppressed phytoplankton growth is also occurring and is believed to be related to high ammonium and turbidity levels in the Delta (CALFED 2009). The Sacramento Regional Wastewater Treatment Plant is the largest point source of ammonium and ammonia in the Delta. Additional sources of ammonium include other wastewater treatment plants, agricultural run-off, atmospheric deposition, internal cycling, and possibly discharges from wetlands. Ammonium is known to be important to food webs because it can stimulate plant growth, but it also suppresses plant uptake of another important nutrient, nitrate, and can suppress growth for some sensitive plants. For example, in Suisun Bay, once considered one of the most productive areas of the San Francisco estuary, high ammonium levels were shown to suppress the growth of phytoplankton even when there was sufficient light (Dugdale et al. 2007; Wilkerson et al. 2006). Nonetheless, these relationships have not been clearly resolved; studies at two different areas, both within the study area, have shown that in some cases phytoplankton growth is limited in the presence of high ammonium concentrations while unaffected in other locations (CALFED 2009).

Although overall correlations are not well studied, overall primary productivity in the Delta is a concern because of a notable decline in four pelagic fish (delta smelt [*Hypomesus transpacificus*], longfin smelt, juvenile striped bass [*Morone saxatilis*], and threadfin shad [*Dorosoma petenense*]) since the early 2000s. In 2004, monitoring of aquatic organisms and water quality in the San Francisco estuary revealed an unexpected decline of several pelagic fish species (Baxter et al. 2008). This decline, specifically known as POD, is currently under investigation to understand how stock-recruitment effects, declines in habitat quality, increased mortality rates, and reduced food availability due to invasive species may be working separately and/or cumulatively to cause POD. Although there are a variety of factors that are thought to contribute to this trend, impacts to the food web (primary productivity) are thought to be one factor (CALFED 2009; IEP 2007).

Fish

Table 38 lists the anadromous and resident fish species with the potential to use habitats of the SRDWSC for migration, spawning, and rearing.

Table 38
Fish Species with Potential to Occur in the Study Area

Common Name	Scientific Name	Origin
American shad	*Alosa sapidissima*	Introduced
Black crappie	*Pomoxis nigromaculatus*	Introduced
Blue catfish	*Ictalurus furcatus*	Introduced
Bluegill	*Lepomis macrochirus*	Introduced

Common Name	Scientific Name	Origin
Brown bullhead	*Ameiurus nebulosus*	Introduced
Channel catfish	*Ictalurus punctatus*	Introduced
Chinook salmon	*Oncorhynchus tshawytscha*	Native
Coho salmon	*Oncorhynchus kisutch*	Native
Common carp	*Cyprinus carpio*	Introduced
Delta smelt	*Hypomesus transpacificus*	Native
Flathead catfish	*Pylodictis olivaris*	Introduced
Golden shiner	*Notemigonus crysoleucas*	Introduced
Green sturgeon	*Acipenser medirostris*	Native
Largemouth bass	*Micropterus salmoides*	Introduced
Longfin smelt	*Spirinchus thaleichthys*	Native
Mississippi silverside	*Menidia audens*	Introduced
Pacific lamprey	*Lampetrea tridentate*	Native
Pacific staghorn sculpin	*Leptocottus armatus*	Native
Prickly sculpin	*Cottus asper*	Native
River lamprey	*Lampetra ayresii*	Native
Sacramento blackfish	*Orthodon microlepidotus*	Native
Sacramento perch	*Archoplites interruptus*	Native
Sacramento pikeminnow	*Ptychocheilus grandis*	Native
Sacramento splittail	*Pogonichthys macrolepidotus*	Native
Shimofuri goby	*Tridentiger bifasciatus*	Introduced
Shokihaze goby	*Tridentiger barbatus*	Introduced
Smallmouth bass	*Micropterus dolomieui*	Introduced
Spotted bass	*Micropterus punctulatus*	Introduced
Starry flounder	*Platichthys stellatus*	Native
Steelhead	*Oncorhynchus mykiss*	Native
Striped bass	*Morone saxatilis*	Introduced
Threadfin shad	*Dorosoma petenense*	Introduced
Tule perch	*Hysterocarpus traskii*	Native
Wakasagi	*Hypomesus nipponensis*	Introduced
White catfish	*Ictalaurus catus*	Introduced
White crappie	*Pomoxis annularis*	Introduced
White sturgeon	*Acipenser transmontanus*	Native
Yellowfin goby	*Acanthogobius flavimanus*	Introduced

Table sources: CDFG 2009a; USACE 2010h; California State University, Chico, Geographical Information Center n.d.; Nico and Fuller 2009

Special status fish species and designated critical habitat are further discussed in Section 3.2.1.1.3.

Invasive Aquatic Species

The introduction and spread of invasive or introduced species in the Delta is common and becoming increasingly prevalent. Striped bass, largemouth bass (*Micropterus salmoides*), American shad, and threadfin shad are introduced fish species that are now commonly found

in the study area. Adults pass through Reaches 1 and 2 and continue up the main-stem of the Sacramento River to spawn in its upper reaches or tributaries. Like other fish species, it is possible that striped bass, largemouth bass, American shad, and threadfin shad use the man-made portion of the SRDWSC as habitat, but they do not use it as a migration corridor.

The shimofuri goby (*Tridentiger bifasciatus*) is another non-native species present in the Delta, thought to have been introduced to Suisun Bay in 1985 via ballast water transport. It is currently one of the most abundant fishes in the region and has continued to expand through brackish and freshwaters of the San Francisco estuary. Shimofuri goby are generalist predators that feed on benthic invertebrates, consuming seasonally abundant prey but also hydroids and barnacles, which most other fishes in the estuary do not. The goby's feeding ecology appears well suited to the fluctuating environment of the San Francisco Bay estuary, which may partially explain its population increase (Matern and Brown 2005).

Other introduced fish found in the SRDWSC include yellowfin goby (*Acanthogobius flavimanus*) and shokihaze goby (*Tridentiger barbatus*; SWCA 2009). Dredge entrainment monitoring studies indicate that white catfish (*Ictalurus catus*) and channel catfish (*I. punctatus*) comprise more than 76% of the fish entrained within the SRDWSC (SWCA 2009).

The invasive Chinese mitten crab (*Eriocheir sinensis*) was introduced to the Delta in 1996; their burrowing activities can accelerate bank erosion, reduce levee stability, and consume benthic invertebrates. Chinese mitten crabs spread quickly because they are able to walk over land to invade neighboring river systems. During their upstream migration, they readily move across banks or levees to bypass obstructions, such as dams. Chinese mitten crabs pose an economic threat to commercial and recreational fishing, as well a public health threat to humans because they are a secondary intermediate host for the Oriental lung fluke, although no cases have been reported in California to date (National Sea Grant Network n.d.).

Commercial crayfish species within the Delta and study area are all non-native (New Orleans red swamp crayfish [*Procambarus clarkia*], northern (virile) crayfish [*Orconectes virilis*], and signal crayfish [*Pacifastacus leniusculus*]). Few if any native crayfish species remain in the Delta; sooty crayfish *(P. nigrescens*) are extinct. New Orleans red swamp crayfish and northern (virile) crayfish are moderately abundant, preferring sloughs, canals, and ditches where the water is relatively warm and vegetation is plentiful (CDFG 2008a).

Virtually all of the crayfish entering the commercial crayfish fishery in the Delta and lower Sacramento River belong to the genus *Pacifastacus*. Only an occasional crayfish species from

the genus *Procambarus* has been found in the commercial catch. Signal crayfish prefer streams, rivers, and lakes, and may also survive in brackish waters. They mate and lay eggs in fall (October), after which time they may become dormant. While active, signal crayfish prefer depths above 33 feet (10 meters) but may go to deeper waters as adults (Flint 1977). Signal crayfish generally prefer a rocky substrate as opposed to soft, silty sediment (Flint 1977; Klosterman and Goldman 1983; Shimizu and Goldman 1983; Elser et al. 1994; Lewis and Horton 1997) and avoid flat, soft bottoms (Goldman and Rundquist 1977; Elser et al. 1994). In addition, high numbers gather around rocky areas and submerged trees (Lowery and Holdich 1988; Guan and Wiles 1996; Kirjavainen and Westman 1999). Mason (1979) noted that current velocity and direction may also be involved in the habitat choice of signal crayfish. Although not generally classified as a burrowing species, many authors report finding deep signal crayfish burrows when the substrate is appropriate (Kirjavainen and Westman 1999; Guan 1994; Bondar et al. 2005).

Invasive benthic species can also plague native species. Predation from the recently introduced Amur River clam has led to a decline in the copepod population of the Delta (Kimmerer and Orsi 1996), which in turn impacts fish species that rely on them for food, especially delta smelt. In addition, a number of non-indigenous predatory copepods exist in the Delta—*Sinocalanus doerri, Acartiella sinensis,* and *Tortanus dextrilobatus*—about which relatively little is known (Orsi and Ohtsuka 1999).

Invasive Aquatic Plants

Invasive aquatic plants are introduced species that can thrive in areas beyond their natural range of dispersal. These plants are characteristically adaptable, aggressive, and have a high reproductive capacity. Their vigor, combined with a lack of natural enemies, often leads to outbreak populations.

There are two primary invasive aquatic plant species in the study area and throughout the Delta: water hyacinth (*Eichhornia crassipes*) and Brazilian elodea (*Egeria densa)* (California Invasive Plant Council 2009). Water hyacinth was introduced to the Delta more than 100 years ago (CDBW 2009). It is an attractive floating plant that is extremely prolific and can quickly become a dense floating mat of vegetation. The hyacinth mats can cause problems for boaters as well as impair habitat for aquatic and benthic organisms. Mechanical removal of water hyacinth is conducted in areas throughout the Delta. Brazilian elodea is a shallow-water submerged aquatic plant that was introduced to the Delta more than 40 years ago. It also spreads at a very rapid rate and currently affects 12% of the Delta (CDBW 2009). Mechanical removal of Brazilian elodea causes the plant to multiply because new plants can develop from plant fragments.

The California Department of Boating and Waterways (CDBW) is tasked with controlling these species, although it is not expected that either will ever be eradicated from the Delta. The only successful control measure is herbicide application, which is conducted annually between July and October to minimize impacts to Endangered Species Act (ESA)-listed species. The CDBW operates a water quality monitoring program to show compliance with water quality standards for herbicide use (CDBW 2009).

3.2.1.1.3 Special Status Aquatic Species and Critical Habitat

A number of special status aquatic species exist in the study area including federal and/or state endangered or threatened species, candidate ESA and California Endangered Species Act (CESA) species, and species of concern. The study area also includes designated critical habitat for some federally listed species. A species list was obtained from the U.S. Fish and Wildlife Service (USFWS) on March 18, 2010, covering the eight U.S. Geological Service (USGS) 7.5 minute quads (Rio Vista, Jersey Island, Antioch North, Clarksburg, Saxon, Liberty Island, Courtland, and Sacramento West) and four counties (Sacramento, Contra Costa, Yolo, and Solano), in which the study area is located. Federal or state listed endangered or threatened species that are most likely to occur in open-water habitat areas of the SRDWSC are described below, including a brief species description, potential for occurrence in the study area, and associated critical habitat designations (if applicable). Listed species that are terrestrial nesting or dwelling are discussed in Section 3.2.2.

Table 39 provides a summary of the occurrence, life stage, and timing information for special status fish species that are expected to occur in the study area. Descriptions of special status species are provided following the table.

Table 39
Occurrence, Life Stage, and Residence Time of Special Status Fish Species in the SRDWSC

DPS/ESU	Legal Status	Summary of Habitat Requirements	Occurrence in Project Area	Life Stage and Timing			
				Adult Migration	Spawning/ Incubation	Juvenile Rearing	Juvenile Migration
Southern DPS green sturgeon	Federal threatened/state species of concern	Spawns in fast-moving, cool freshwater habitat in Sacramento River; juveniles rear in estuarine waters	Juveniles may use entire SRDWSC for rearing; adults migrate through the Sacramento River, including lower reaches of the SRDWSC, to upstream spawning grounds; one green sturgeon identified in SRDWSC dredge monitoring trawl surveys (SWCA 2009); lower reaches of SRDWSC are within designated critical habitat	February to late fall	N/A	Year-round	Year-round
Delta smelt	Federal threatened/state endangered	Inhabit open surface water; spawning occurs primarily in sloughs and shallow edge-waters of channels in the upper Delta and Sacramento River	Spawning occurs in shallow edgewaters and sloughs adjacent to lower reaches of the SRDWSC, including Cache Slough; spawning location is dependent on freshwater outflow; critical habitat includes the Delta west to Carquinez Bridge	December to July	December to July	February to August	August to December
Sacramento River winter-run ESU Chinook salmon	Federal endangered/ state endangered	Spawns in freshwater; juveniles rear in fresh and estuarine water before migrating to ocean	Juveniles migrating to the ocean may mainly use lower reaches of the SRDWSC for rearing, they may also use man-made portion of the SRDWSC for rearing, but to a lesser degree; adults migrate through Sacramento River to reach freshwater spawning grounds; Sacramento River is designated critical habitat	December to July	N/A	November to March	July to October
Central Valley spring-run ESU Chinook salmon	Federal threatened/state threatened	Spawns in freshwater; juveniles rear in fresh and estuarine water before migrating to ocean	Juveniles migrating to the ocean may use lower reaches of the SRDWSC for rearing, they may also use man-made portion of the SRDWSC for rearing, but to a lesser degree; adults migrate through Sacramento River to reach freshwater spawning grounds; lower reaches of SRDWSC are designated critical habitat	March to July	N/A	March to December	December to March, may be as early as November and as late as June
Central Valley DPS steelhead	Federal threatened/state threatened	Spawns in freshwater; juveniles rear in fresh and estuarine water before migrating to ocean	Juveniles migrating to the ocean may use lower reaches of the SRDWSC for rearing; may also use man-made portion of the SRDWSC for rearing, but to a lesser degree; adults migrate through Sacramento River; lower reaches of SRDWSC are designated critical habitat	December to July	N/A	March to December	December to June
Longfin smelt	State threatened	Spawns in lower Sacramento River and Suisun Bay	Occur in lower reaches of SRDWSC especially in Suisun Marsh; spawn from Suisun Bay into upper area of estuary near Rio Vista; observed during SRDWSC dredge monitoring trawl surveys in lower reaches; entrained in dredging in 2006, 2007, and 2008 (SWCA 2009)	January to March	February to April	December to June	December to June
River lamprey and Pacific lamprey	State species of concern	Spawn in freshwater habitats in riffles; ammocoetes rear in freshwater benthos for 3 to 5 years before emerging and migrating to Ocean (Moyle 2002; Kostow 2002)	Lower Sacramento River; found during SRDWSC dredging entrainment and community monitoring trawl surveys in lower reaches (SWCA 2009)	Unconfirmed; fall (September to November)	Unconfirmed; winter (November to February)	Unconfirmed; spring (February to May); juveniles remain for several years; metamporph from juvenile to macrophthalmia July to April	May to July
Sacramento splittail	State species of concern/federal status pending review	Generally restricted to tidal freshwater and low-salinity habitat	Suisun Bay and Marsh; found at depths less than 1 to 2 m in tidal, turbid, brackish, soft-bottomed habitat; prefer channels with significant current; move upstream to forage, spawn in flooded vegetation, primarily in the Yolo and Sutter bypasses and shallow vegetated sloughs	Year-round	February to July	Year-round	Year-round
Sacramento perch	State species of concern	Sloughs, lakes, slow moving rivers; reservoirs and ponds; turbid to clear waters near bottom	May be extirpated from native Delta (Crain et al. 2007); abundant elsewhere in highly turbid waters with vegetative cover; spawn in shallow water with macrophytes and algae	Year-round	March to August	Year-round	Year-round

DPS/ESU	Legal Status	Summary of Habitat Requirements	Occurrence in Project Area	Life Stage and Timing			
				Adult Migration	Spawning/ Incubation	Juvenile Rearing	Juvenile Migration
White sturgeon	NA	Similar to green sturgeon; remains in estuary habitats	May be found throughout San Francisco Estuary and Sacramento-San Joaquin Delta	Year-round	NA	Year-round	Year-round
Striped bass	Federally protected game fish	Unrestricted to salt or freshwater; require large cool rivers for spawning, protective estuary for juveniles	Adults and juveniles may be found throughout San Francisco Estuary and Sacramento-San Joaquin Delta; spawning typically occurs outside of study area	Year-round	NA	NA	Year-round

Notes:
DPS – Distinct Population Segment
ESU – Evolutionarily Significant Unit
NA – Not applicable

ESA and CESA-Listed Species

Southern Distinct Population Segment (DPS) Green Sturgeon (Acipenser medirostris; Federal Threatened; State Species of Concern)

Green sturgeon is a long-lived, slow-growing, anadromous fish that is the most marine-oriented of the sturgeon species. Mature fish range from 4 to 7 feet in length; females mature between 16 to 20 years, males from 14 to 16 years. Green sturgeon utilize both freshwater and marine habitat, spawning every 2 to 4 years in deep pools in freshwater rivers with large cobble substrate (but also utilize a range of substrates) (Moser and Lindley 2007; NMFS 2008; Emmett et al. 1991; Moyle et al. 1995 as cited in Bennett 2005). Southern DPS green sturgeon spawning is documented in the Sacramento River in recent times; a northern DPS, spawning in the Klamath and Rogue rivers in Oregon, is not a listed species. In the Sacramento River, green sturgeon spawn in late spring and early summer, but the general spawning period is March to July (Emmett et al. 1991). Spawning on the main-stem Sacramento River is documented over 240 miles (391 kilometers [km]), both downstream and upstream of Red Bluff Diversion Dam (Brown 2007).

Green sturgeon embryos have poor swimming ability and exhibit a strong drive to remain in contact with structure, preferring cover and dark habitats to open bottom and illuminated habitats in laboratory experiments (Kynard et al. 2005). Upon onset of feeding at 10 days post hatch (dph; 23.0 to 25.2 millimeters [mm] length) (Deng et al. 2002), larvae are believed to initiate downstream migration from spawning areas, staying close to the bottom and periodically interrupting downstream movement with upstream foraging bouts (Kynard et al. 2005). Laboratory experiments indicate juveniles may occupy fresh to brackish water at any age, but are able to completely transition to saltwater at around 1.5 years in age (Allen and Cech 2007). Prolonged exposure to higher salinities may result in decreased growth and activity levels, and even mortality (Allen and Cech 2007). Juveniles exhibit nocturnal behavior for almost all activities, and generally spend 1 to 4 years in freshwater before migrating to the ocean. Studies on juvenile feeding in San Pablo Bay, Suisun Bay, and the Delta identified prey items of shrimp (*Neomysis awatchensis, Crangon franciscorum*), amphipods (*Corophium* spp., *Photis californica*), isopods (*Synidotea laticauda*), clams (*Macoma* spp.), annelid worms (Annelida), and unidentified crabs and fishes (Ganssle 1966 as cited in NMFS 2008; Radtke 1966). Adult green sturgeon are believed to feed primarily upon benthic invertebrates such as clams, mysid shrimp, grass shrimp (*Palaemonetes* sp.), and amphipods (Radtke 1966).

Sampling efforts at Glen Colusa Irrigation District on the Sacramento River indicated that the average length of green sturgeon is approximately 29 mm, indicating a bias towards juveniles, and that peak abundance occurs in July (Adams et al. 2002). Since 1980, trawling studies in the San Francisco Bay estuary and Delta have collected a total of 61 juvenile green

sturgeon ranging in size from 20 to 112 centimeters (cm) total length and, although most juveniles are captured between April and October, they have been captured in nearly every month of the year (CDFG 2002). Reports of entrainment and fish community studies conducted as part of the maintenance dredging operations within the SRDWSC from 2006 to 2008 indicate only two green sturgeon were encountered, compared to approximately 55 white sturgeon (SWCA 2009).

Green sturgeon are generally associated with deep pools (greater than or equal to 5 meters) for adult spawning and holding, but juveniles are also found in shallower depths (1 to 3 meters) (Radtke 1966; NMFS 2008). Use of summer holding sites is documented in the Rogue River (Erickson et al. 2002) and in the Sacramento River (NMFS 2008). Adults and sub-adults also occupy the San Francisco, San Pablo, and Suisun Bays and the Delta adjacent to the Sacramento River in the summer months (although some individuals that remain in the river until late fall/early winter migrate through the bays and Delta during their winter outmigration), during which time they are likely feeding and optimizing growth (Kelly et al. 2007; Moser and Lindley 2007). Green sturgeon may use the man-made portion of the SRDWSC as rearing or holding habitat. Green sturgeon do not typically use the man-made portion of the SRDWSC for migration or spawning; they migrate within the main-stem of the Sacramento River.

The primary factor for the decline of the green sturgeon species is the reduction of spawning habitat to a limited area below Keswick Dam on the Sacramento River. Sufficient flows are needed to attract adult green sturgeon to the Sacramento River to initiate the upstream spawning migration (Kohlhorst et al. 1991 as cited in CDFG 2002; NMFS 2008). Reduced flows are identified as a factor in weakened year class recruitment in the white sturgeon population, and are believed to have the same effect on green sturgeon recruitment. In addition to the adverse effects of impassable barriers, numerous agricultural water diversions exist in the Sacramento River and the Delta along the migratory route of larval and juvenile sturgeon. Entrainment and impingement in water pumps are considered serious threats to sturgeon during their downstream migration. Sturgeon are susceptible to uptake of contaminants from contaminated sediments through both dermal contact and incidental ingestion of sediments while feeding. Bioaccumulation is also a concern due to their long life. All of the above threats are identified by the National Marine Fisheries Service (NMFS) Biological Review Team as potentially affecting the continued existence of the southern DPS of green sturgeon (70 FR 17386).

Critical Habitat – Critical habitat for the green sturgeon was proposed on September 2008 and was designated on October 9, 2009 (50 FR 226). In California, critical habitat for green sturgeon in the Delta includes all waterways up to the elevation of MHHW within the area

defined in California Water Code 12220, though some waterways, such as the man-made portion of the SRDWSC, are specifically excluded. The Yolo and Sutter Bypasses are also included in the critical habitat designation because these areas are adjacent to the lower Sacramento River and serve as important migratory corridors for Southern DPS adults, sub-adults, and juveniles on their upstream or downstream migration and provide a high macro-invertebrate forage base that may support green sturgeon feeding. Green sturgeon critical habitat is shown on Figure 16. Primary Constituent Elements (PCEs[18]) for southern DPS green sturgeon for freshwater and estuarine systems include:

- Food resources – abundant prey items for larval, juvenile, sub-adult, and adult life stages
- Substrate type or size (i.e., structural features of substrates) – substrates suitable for egg deposition and development (e.g., bedrock sills and shelves, cobble and gravel, or hard clean sand, free of excessive silt and debris), larval development (e.g., substrates with interstices or voids providing refuge from predators and high flow conditions), and sub-adults and adults (e.g., substrates for holding and spawning)
- Water flow – a flow regime (i.e., the magnitude, frequency, duration, seasonality, and rate-of-change of freshwater discharge over time) necessary for normal behavior, growth, and survival of all life stages
- Water quality – including temperature, salinity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages; suitable salinity levels range from freshwater (less than 3 parts per thousand[19] [ppt]) for larvae and early juveniles (about 100 dph) to brackish water (10 ppt) for juveniles prior to their transition to saltwater
- Migratory corridor – a migratory pathway necessary for the safe and timely passage of southern DPS fish within riverine habitats and between riverine and estuarine habitats (e.g., an unobstructed river or dammed river that still allows for safe and timely passage)
- Water depth – deep (greater than or equal to 5 meters) holding pools for both upstream and downstream holding of adult or sub-adult fish, with adequate water quality and flow to maintain the physiological needs of the holding adult or sub-adult fish
- Sediment quality – sediment quality necessary for normal behavior, growth, and

[18] PCEs are defined as physical or biological features essential to the conservation of a species for which its designated or proposed critical habitat is based on, such as space for individual and population growth, and for normal behavior; food, water, air, light, minerals, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal; and habitats that are protected from disturbance or are representative of the species' historic geographic and ecological distribution.

[19] Salinity is measured in both ppt and practical salinity units (psu). The two measurements are nearly equivalent and often used interchangeably.

viability of all life stages; this includes sediments free of elevated levels of contaminants that may adversely affect green sturgeon

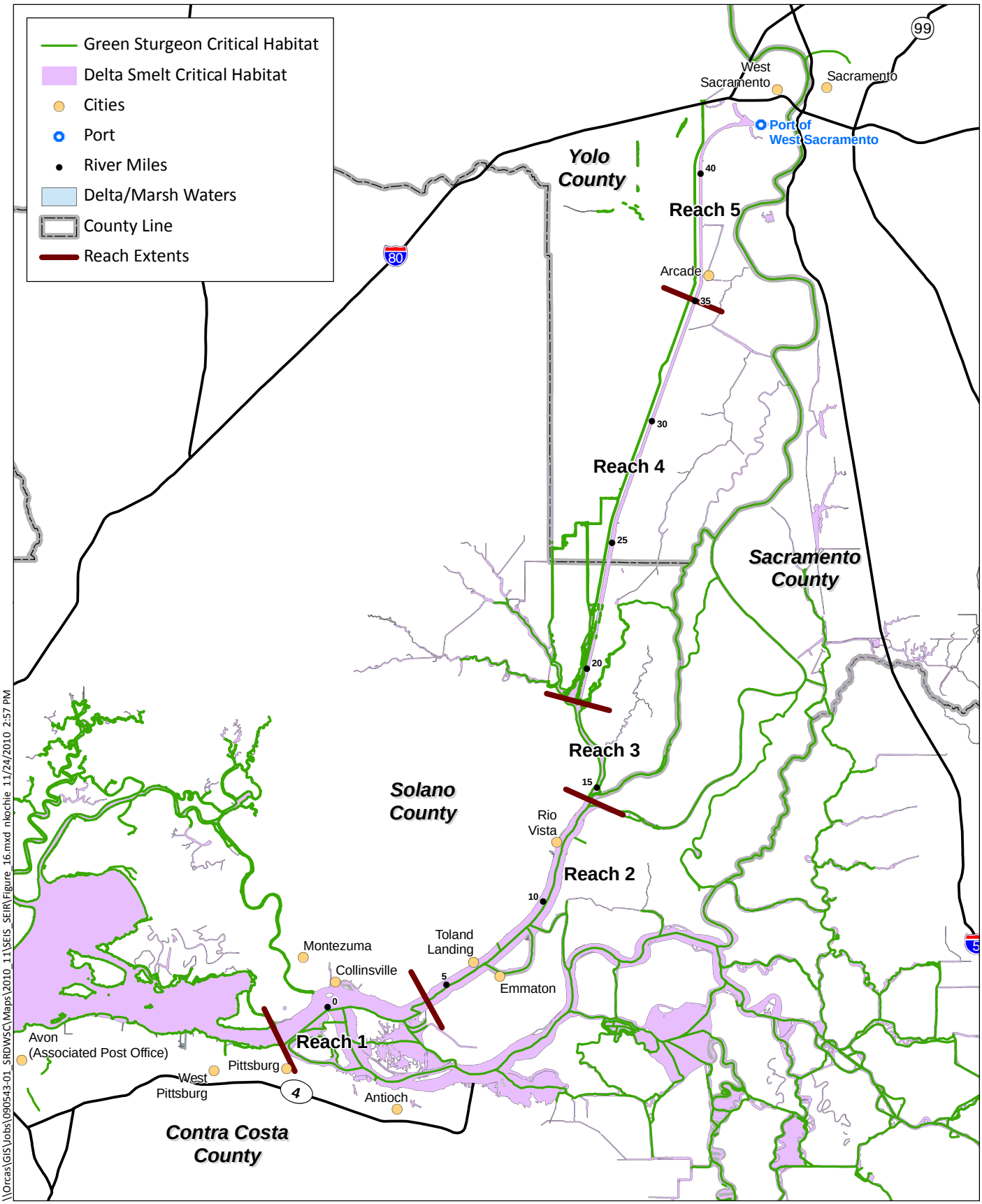

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Figure 16
Critical Habitat Designations within the Study Area
for Green Sturgeon and Delta Smelt
SEIS/SEIR
Sacramento River Deep Water Ship Channel

Central Valley DPS Steelhead (*Oncorhynchus mykiss*; Federal Threatened, State Threatened)

The Central Valley DPS of steelhead includes all populations in the Sacramento and San Joaquin rivers and their tributaries. The current distribution ranges from Keswick Dam in the Upper Sacramento River to the Merced River in the San Joaquin River Basin, with distribution primarily limited by impassable dams.

Steelhead typically migrate to marine waters after spending 2 years in freshwater (McEwan and Jackson 1996). In the marine environment, they typically rear for 1 to 3 years prior to returning to their natal stream to spawn primarily as 3- and 4-year-olds. Peak spawning in California occurs between December and April in small streams and tributaries with cool, oxygenated water (McEwan 2001). Central Valley steelhead have the potential to be present in the study area from early August through late February (NMFS 1996). The California Department of Fish and Game (CDFG) conducted sampling in the 1970s in the man-made portion of the SRDWSC and recorded four steelhead between 1973 and 1976 (NMFS 2006). Steelhead are not known to be common within the man-made portion of the study area, because no steelhead have been captured as part of fish community studies or dredged material entrainment monitoring undertaken in the man-made portion of the SRDWSC (SWCA 2009). Adult Central Valley DPS steelhead may be present in the natural portion of the study area from June through March, with the peak occurring between August and October (Bailey 1954; Hallock et al. 1957, both as cited in NMFS 2006). Juvenile steelhead emigrate through the natural portion of the study area from late fall to spring. Snider and Titus (2000) observed that juvenile steelhead emigration primarily occurs between November and June. Unlike other Pacific salmon, steelhead are iteroparous, meaning they are capable of spawning more than once before they die, returning to the ocean between each spawning migration (USACE 2004).

Depending on water temperature, steelhead eggs incubate in "redds" (nesting gravel) for 1.5 to 4 months) before hatching as "alevins" (a larval life stage dependent on food stored in a yolk sac). Following yolk sac absorption, alevins emerge from the gravel as young juveniles or "fry" and begin actively feeding. Juveniles rear in freshwater from 1 to 4 years (usually 2 years) and then migrate to the ocean as "smolts" (NMFS 1998). Central Valley DPS steelhead typically occupy the top 20 feet of the water column (USACE 2004). Rearing habitat may include areas of tidal mudflats, tidal brackish emergent wetland, and tidal freshwater emergent wetland (BDCP 2009b).

Because there is no hydrologic connection between the SRDWSC and the Sacramento River in Reach 5 through the locks, steelhead do not use the man-made portion of the SRDWSC for migration or spawning; they migrate within the main-stem of the Sacramento River and

are documented in the Yolo Bypass. It is possible that steelhead use the upper portion of the water column within the man-made portion of the SRDWSC as habitat for rearing; however, steelhead have not been found during any recent fish community surveys within the SRDWSC (SWCA 2009).

Factors that limit productivity of steelhead populations include periodic reversed flows due to high water exports (drawing juveniles into large diversion pumps); loss of fish into unscreened agricultural diversions; predation by introduced species; and reduction in the quality and quantity of rearing habitat due to channelization, pollution, riprapping, and other factors (Dettman et al. 1987; CACSST 1988; Kondolf et al. 1996a, 1996b as cited in NMFS 2006).

Critical Habitat – Central Valley DPS steelhead critical habitat was designated on September 2, 2005, along with several additional California salmon and steelhead evolutionary significant units (ESUs) and DPSs. Critical habitat for Central Valley steelhead extends throughout the Delta laterally across the width of river and stream channels between ordinary high water (OHW) elevations on each bank for the freshwater reaches, and to all areas inundated at extreme high tide for estuarine reaches; however, it does not include the man-made portion of the SRDWSC (Figure 17). The salmon and steelhead species present within the rivers and estuaries of the study area have similar life history characteristics and therefore share many of the same PCEs under designated critical habitat. The following PCEs include characteristics essential to support one or more life stages of Central Valley DPS steelhead (i.e., spawning, rearing, migration, and foraging). These PCEs contain physical or biological features essential to the conservation of the DPS (for example, spawning gravels, water quality and quantity, side channels, and forage species). PCEs developed for Central Valley DPS steelhead include (70 FR 170):

- Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development
- Freshwater rearing sites with water quantity and floodplain connectivity, water quality and forage, and habitat complexity
- Freshwater migration corridors free of obstruction with adequate water quantity and quality conditions and natural habitat complexity
- Estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting the physiological transitions for both juveniles and adults between fresh- and saltwater; natural habitat complexity; and forage opportunity

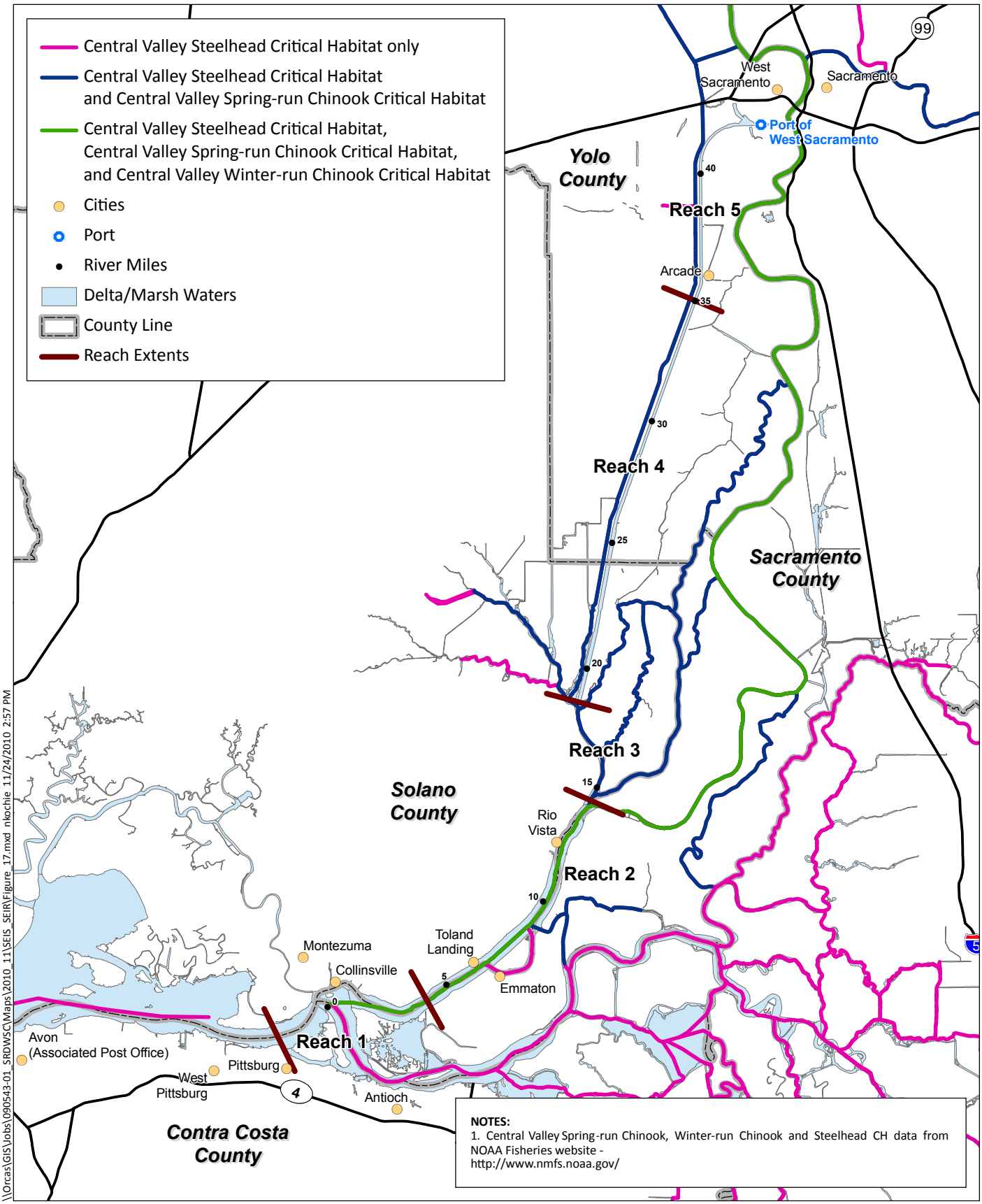


Figure 17

Critical Habitat Designations within the Study Area for Central Valley Spring-run Chinook, Central Valley Steelhead, and Sacramento River Winter-run Chinook

SEIS/SEIR

Sacramento River Deep Water Ship Channel

Central Valley Spring-Run ESU Chinook Salmon (*Oncorhynchus tshawytscha*; Federal Threatened, State Threatened)

The Central Valley spring-run ESU of Chinook salmon is one of four distinct runs of salmon that spawn in the Sacramento-San Joaquin River system and were historically the most abundant salmon species in the Central Valley. Populations remain in some tributaries of the Sacramento River, including Butte, Mill, Deer, Antelope, and Beegum Creeks, and the Yolo Bypass. In general, spring-run Chinook salmon are found in the Suisun Marsh/North San Francisco Bay, Delta, Sacramento River, Feather River/Sutter Basin, Butte Basin, and North Sacramento Valley Ecological Zones (CDFG 1998).

Spring-run Chinook enter the Sacramento River from late March to September (CDFG 2008c). Adults stay in cool, deeper water habitats through the summer before spawning in mid-August through October (CDFG 2008c, 1998). Spring-run juveniles frequently reside in freshwater habitat for 12 to 16 months, but many young migrate to the ocean during spring within 5 to 8 months after hatching. Kjelson et al. (1982) indicated that fry arrive at the Delta from January to March, and rear for about 2 months before continuing to migrate seaward. Fry will not enter brackish waters until they become smolts. The San Francisco Bay and Delta are important rearing areas for these migrants, because outmigrants are known to rear in non-natal tributaries to the Sacramento River and the Delta (CDFG 1998). Chinook salmon spend 2 to 4 years maturing in the ocean before returning to their natal streams to spawn. Historically, spring-run Chinook spawned in the upper reaches of the Sacramento River tributaries, including the McCloud, Pit, and Little Sacramento rivers (CDFG 1998). Shasta and Keswick Dams now block access to historical spawning areas, and restrict the current population to areas downstream. Spring-run Chinook salmon do not use the man-made portion of the SRDWSC for migration or spawning; they migrate within the main-stem of the Sacramento River. However, it is possible they use the man-made portion of the SRDWSC as habitat for rearing.

Central Valley spring-run Chinook salmon typically occupy the top 20 feet of the water column, but are known to be distributed within the water column based on size and age (Kjelson et al. 1982; CDFG 1998; USACE 2004). Fresh et al. (2005), studying salmon in the Columbia River estuary, reported that "Estuarine research has demonstrated that juvenile salmon are generally distributed based on water depth" (e.g., Healey 1991; Levy and Northcote 1982; Simenstad et al. 1982; Bottom et al. 1985; Levings et al. 1986 as cited in Emmett and Schiewe 1997; McCabe et al. 1986; Miller and Sadro 2003). This is substantiated by research conducted on salmon in the Delta, as well (Kjelson et al. 1982; McClain and Castillo 2010). McClain and Castillo (2010) determined that in the northwestern Delta, highest densities of Chinook salmon fry were observed in shallow beaches. In addition, they found that shallow nearshore environments in conveyance channels, such as Steamboat

Slough and the Sacramento River, are important for Chinook salmon fry rearing. Kjelson et al. (1982) found that in the Delta, fry distribution changed from day to night and with fish size: fry were found concentrated nearshore and in shallow water, in the upper portion of the water column during the day, but moved offshore and throughout the water column at night. Larger fish are found farther offshore and throughout the middle and upper portions of the water column.

Several investigations over the last 30 years have found Chinook (unidentified ESU) within the man-made portions of the SRDWSC. CDFG conducted sampling in the 1970s in the SRDWSC and recorded eight Chinook salmon between 1973 and 1976 (NMFS 2006). USFWS investigations conducted in the upper section of the SRDWSC from May 1994 to November 1994 found that adult Chinook salmon were present behind the locks throughout the summer and fall months, and could potentially be present year-round (USFWS 1995). In 1994, 90 fall-run Chinook salmon were radio-tagged and released in the Suisun Bay as part of an IEP migration study; one of these fish was subsequently detected in the upper SRDWSC (NMFS 2006). Juvenile Chinook salmon and steelhead outmigrate past the upstream entrance (currently closed locks) to the SRDWSC from late fall to spring. Although discontinued use of the locks system has probably reduced the attraction of salmonids to the upper SRDWSC, a limited, yet unknown, number of fish currently enter the upper section of the SRDWSC and are observed staging below the locks (CDWR 2002).

As mentioned for Central Valley steelhead, factors that limit productivity of salmonid populations include periodic reversed flows due to high water exports (drawing juveniles into large diversion pumps); loss of fish into unscreened agricultural diversions; predation by introduced species; and reduction in the quality and quantity of rearing habitat due to channelization, pollution, riprapping, and other factors (Dettman et al. 1987; CACSST 1988; Kondolf et al. 1996a, 1996b as cited in NMFS 2006).

Critical Habitat – Critical habitat for Central Valley spring-run ESU Chinook salmon was designated at the same time as Central Valley steelhead and includes the same PCEs listed for that species. As with steelhead, critical habitat is designated for Central Valley spring-run ESU Chinook salmon for the entire Delta, with the exception of the man-made portion of the SRDWSC (70 FR 170; Figure 17).

Sacramento River Winter-run ESU Chinook Salmon (*Oncorhynchus tshawytscha*; Federal Endangered, State Endangered)

The Sacramento River winter-run ESU of Chinook salmon differs from other Chinook ESUs in that they have characteristics of both stream- and ocean-type races (Healey 1991). Adults enter freshwater in winter or early spring and delay spawning until spring or early summer

(stream-type); however, juvenile winter-run Chinook salmon migrate to sea after only 4 to 7 months of river life (ocean-type) (Moyle et al. 1989). Adequate instream flows and cool water temperatures are more critical for the survival of Chinook salmon exhibiting a stream-type life history due to over-summering by adults and/or juveniles.

Adults may spawn in the upper reaches of the main-stem Sacramento River, although the ESU has been completely displaced from its historical spawning habitat by the construction of Shasta and Keswick Dams (70 FR 123). The remaining spawning habitat is artificially maintained by cold-water releases from the reservoir behind Shasta Dam. Spawning typically occurs during late spring and early summer in the Sacramento River and some tributaries below Shasta Dam (Moyle et al. 1989). Generally, winter-run Chinook salmon spawn from near Keswick Dam downstream to Red Bluff, California. The largest concentrations of spawning fish occur in the first 5 to 10 miles below Keswick Dam (NMFS 2006). Females deposit their eggs in nests in gravel bottom areas of relatively swift water. After emerging, many Chinook salmon fry tend to seek shallow, nearshore habitat with slow water velocities and move to progressively deeper, faster water as they grow. Juvenile salmon rear in the Sacramento River in summer and fall, gradually moving downstream before entering the Delta from November to March. Some emerging fry are transported downstream into lower portions of the Sacramento River and lower tributaries, where they rear in shallow marsh and streamside habitats. Juveniles typically rear in freshwater for up to 5 months before migrating to sea when they reach a length of 4 to 6 inches. They migrate out of the Delta to the San Francisco Bay from February through April. Observations of other estuaries indicate that Chinook fry rear where salinity is commonly 15 to 20 parts per million (ppm) or more (Healey 1991, 1982; Levings et al. 1986 cited in Groot and Margolis 1991), but Chinook fry are able to survive transfer to salinity of 20 ppm or less (Clarke and Shelbourn 1985 as cited in Groot et al. 1995; Groot and Margolis 1991). As with other Chinook ESUs, winter-run Chinook are known to utilize the upper 20 feet of the water column (USACE 2004). Sacramento River winter-run Chinook salmon are not known to use the man-made portion of the SRDWSC for migration or spawning; they migrate within the main-stem of the Sacramento River that is part of the study area. However, it is possible they still use the man-made portion of the SRDWSC as habitat for rearing.

Activities identified by NMFS (1994) that affect winter-run Chinook habitat include water management operations by the Central Valley Project and the State Water Project, small and large water diversions by other private entities, bank restoration, dredging, and other construction-related activities in the Sacramento River and Delta.

Critical Habitat – Critical habitat was designated for Sacramento River winter-run ESU Chinook salmon on June 16, 1993, and includes the entire Delta: the Sacramento River from

Keswick Dam; Shasta County to Chipps Island at the westward margin of the Delta; all waters from Chipps Island westward to Carquinez Bridge including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait; all waters of San Pablo Bay westward to Carquinez Strait; and all water in the San Francisco Bay north of the San Francisco/Oakland Bay Bridge (Figure 17).

Important habitat requirements for Sacramento River winter-run ESU Chinook salmon were defined at the time of critical habitat designation (58 FR 33212) and include the following:

- Access from the Pacific Ocean to appropriate spawning areas in the upper Sacramento River
- Availability of clean gravel for spawning substrate
- Adequate river flows for successful spawning, incubation of eggs, fry development and emergence, and downstream transport of juveniles
- Water temperatures between 42.5 and 57.5 degrees Fahrenheit (°F) for successful spawning, egg incubation, and fry development
- Habitat areas and adequate prey that are not contaminated
- Riparian habitat that provides successful juvenile development and survival
- Access downstream so that juveniles can migrate from spawning grounds to San Francisco Bay and the Pacific Ocean.

Delta Smelt (*Hypomesus transpacificus*; Federal Threatened, State Endangered)

Delta smelt is endemic to the Delta and occurs seasonally in Cache Slough, Suisun Bay, Carquinez Strait, and San Pablo Bay. They are found in various areas of the SRDWSC including near the confluence of the SRDWSC and Broad Slough, along Sherman Island and Decker Island, and in the man-made portion of the channel (SWCA 2009; CDFG 2009e). Historically, delta smelt ranged from Suisun Bay to the City of Sacramento on the Sacramento River and also in the San Joaquin River (59 FR 242). In years of low discharge, delta smelt occur primarily in the lower Sacramento River and northern Delta; in high discharge years, their distribution extends throughout Suisun Bay and into San Pablo Bay (Sweetnam 1999). The abundance of this species has generally been low since 1982, while varying substantially from year to year due to climate, environmental, and anthropogenic factors.

Delta smelt is a euryhaline species (tolerant of a wide salinity range) but is more closely associated with lower salinity zones ranging from 0 to 7 psu (Moyle 2002). For a large part of their lifespan, delta smelt occupy the freshwater edge of the mixing zone (freshwater-saltwater interface). In the SRDWSC, delta smelt are among the fish and zooplankton species noted to undergo tidal vertical migrations, occurring near the surface during flood tides and at depth on ebbs (Bennett 2005; Bennett et al. 2002; Kimmerer et al. 1998).

Delta smelt spawn in shallow, fresh, or slightly brackish water. Spawning is most common in tidally influenced backwater sloughs and channel edgewaters, particularly in shallow freshwater channels of the Delta and Suisun Bay between February and June (SWCA 2009; Moyle 2002; CDFG 2009e). Eggs are adhesive and demersal, and may be deposited over vegetation, submerged trees, or in open water over sandy and rocky substrates. Larvae are most abundant during April to July, peaking in May (Baxter 1999), and follow tides and discharge. Juveniles move downstream to San Pablo Bay and Carquinez Strait prior to returning to Suisun Bay or upstream channels to spawn (Moyle 2002; CALFED 2005; Bennett 2005; SWCA 2009). Juveniles and adults can be found in spring and summer in Suisun Bay and the Delta, with adult fish swimming in large schools. During low outflow and drought years, pre-spawning congregations occur farther upstream, primarily in the Sacramento River channel, and most fish do not occur farther downstream. Delta smelt feed entirely on zooplankton (Stevens et al. 1990; Moyle et al. 1992). Juveniles consume planktonic crustaceans, insect larvae, and mysid shrimp (Moyle 2002; CDFG 2009e; SWCA 2009). Larval smelt consume primarily calanoid copepods, especially *Eurytemora* sp. and *Pseudodiaptomus* sp. (Stevens et al. 1990; Lott 1998 as cited in SWCA 2009). As the smelt grow, their primary prey become larger adult copepods (CDFG 1993) and their diet becomes more varied in the late winter and early spring months (Lott 1998 as cited in SWCA 2009). Delta smelt mature quickly and most adults die after spawning in the first year. Surviving adults may spawn a second year and are typically much more fecund (SWCA 2009; CDFG 2009e).

Delta smelt are threatened by loss of estuarine habitat; entrainment during water diversion operations for the Central Valley Project, State Water Project, and myriad agricultural diversions; pulses of pesticides; food shortages; and predation by invasive species (Bennett 2005; CDFG 2009e; SWCA 2009). In 2004, scientific monitoring of aquatic organisms and water quality in the San Francisco estuary revealed an unexpected decline of several pelagic fish species (delta smelt, longfin smelt, striped bass, and threadfin shad) (Baxter et al. 2008). This decline, specifically known as POD, is currently under investigation to understand how stock-recruitment effects, declines in habitat quality, increased mortality rates, and reduced food availability due to invasive species may be working separately and/or cumulatively to cause POD.

Critical Habitat – Critical habitat for delta smelt was designated on December 19, 1994, and exists throughout the entire project area. It includes all water and all submerged lands below OHW and the entire water column bounded by and contained in Suisun, Grizzly, and Honker Bays; the lengths of Goodyear, Suisun, Cutoff, First Mallard, and Montezuma Sloughs; and all waters within the legal Delta including the Sacramento River, as defined by Section 12220 of the California Water Code (USFWS 1994) (Figure 16). PCEs considered

essential for the conservation of delta smelt include (59 FR 65260 No. 242):

- Spawning habitat – Spawning season varies from year-to-year, and may start as early as December and extend until July. Smelt require shallow, fresh, or slightly brackish areas with suitable water quality. Specific areas identified as important delta smelt spawning habitat include Barker, Lindsey, Cache, Prospect, Georgiana, Beaver, Hog, and Sycamore Sloughs; the Sacramento River in the Delta; and the tributaries of northern Suisun Bay.
- Larval and juvenile transport – Adequate river flow is necessary to transport larvae from the area where they hatch to shallow, productive rearing or nursery habitat; the Sacramento and San Joaquin rivers and their tributary channels must be protected from physical disturbances (mining, diking, dredging, etc.) and flow disruption (e.g., water diversion). Additionally, river flow must be adequate to prevent interception of larval transport by the various state and federal water project and small agricultural diversions. The 2 ppt isohaline (X2) must be located westward of the Sacramento-San Joaquin River confluence during the period when larvae or juveniles are being transported.
- Rearing habitat – Maintenance of the 2 ppt isohaline (X2) according to historical salinity conditions, along with suitable water quality within the estuary, is necessary to provide delta smelt larvae and juveniles a shallow, protective, food-rich environment in which to mature to adulthood. The specific geographic area critical to the maintenance of suitable rearing habitat extends east from Carquinez Strait; including Suisun Bay, Grizzly Bay, Honker Bay, Montezuma Slough, and its tributary sloughs; up the Sacramento River to its confluence with Three Mile Slough; and south along the San Joaquin River including Big Break.
- Adult migration – Unrestricted access to suitable spawning habitat must be provided in a period that may extend from December to July. Adequate flow and suitable water quality may need to be maintained to attract migrating adults in the Sacramento and San Joaquin River channels and their associated tributaries, including Cache and Montezuma Sloughs and their tributaries.

Longfin Smelt (*Spirinchus thaleichthys*; State Threatened)

Longfin smelt is a euryhaline pelagic fish found in both fresh and brackish waters. Longfin smelt inhabits various depths of the water column depending on the life stage and potentially other factors such as temperature and salinity. The current range of longfin smelt is from Alaska to the San Francisco Bay Delta region. The only areas in California where longfin smelt were collected in the 1990s were the Klamath River and San Francisco Bay. Longfin smelt were collected in fish community trawl sampling from within the Sacramento River, all in the vicinity of Decker Island (SWCA 2009).

Adult and juvenile longfin smelt are found near the middle to lower portions of the water column, while larvae are found in the upper part (Wang 1986; Fujimura 1991; CDFG 2009b). Post-larval longfin smelt were recently reported to be associated with deep-water habitats (Rosenfield and Baxter 2007). Studies (Bennet et al. 2002) have shown that juvenile and adult longfin smelt exhibit a vertical tidal migration, for example occurring near the surface during flood tides and nearer to the bottom on ebb tides. This type of vertical movement appears to depend on freshwater flow and the position of the low salinity zone in the estuary. Longfin smelt in deeper, more turbid, and more saline waters are shown to have decreased feeding and growth (Bennett et al. 2002). Adult longfin smelt are often concentrated in deepwater habitats (CDFG 2009b). Longfin smelt are reported to tolerate salinities ranging from freshwater to pure seawater and can survive summer temperatures up to 20 degrees Celsius (°C; 68°F) (UCCE 2010).

At least part of the San Francisco Bay Delta population of longfin smelt is known to be anadromous, living in the ocean and returning to spawn in the Delta. Longfin smelt mature at age two and gradually move upstream during fall and winter to spawn. Spawning typically occurs between February and April, but may occur as early as November and as late as June. Recent trawl survey data suggest that spawning may not occur only during this time period, but varies between individuals (CDFG 2009b). Longfin smelt are known to spawn in the study area, from Suisun Bay around Pittsburg and Montezuma Slough in Suisun Marsh (Wang 1986, 1991; Moyle 2002), into the upper estuary near the city of Rio Vista in the Sacramento River (CDFG 2009b). Eggs are adhesive and are generally released over a firm substrate (Moyle 2002). Longfin smelt embryos hatch after about 40 days, the larvae quickly move into the upper part of the water column, and are transported downstream into more brackish areas of the estuary (Moyle 2002). Metamorphosis into juveniles begins 30 to 60 days after hatching, depending on water temperature (Emmett et al. 1991; Moyle 2002). Larvae are most abundant in the water column from January through April (CDFG unpublished data as cited in USBR 2008). During years when high freshwater outflows occur when larvae are being transported downstream, most larvae are transported to Suisun and San Pablo Bays; during years with lower outflow, larvae are transported into the western Delta and Suisun Bay (Baxter 2000 as cited in LTMS 2009; Baxter 1999; Moyle 2002). In April and May, juveniles are believed to migrate downstream to San Pablo Bay; juvenile longfin smelt are collected throughout the San Francisco Bay during the late spring, summer, and fall. Longfin smelt reach an adult size of approximately 150 mm.

Within the SRDWSC, longfin smelt are common in Suisun Bay during winter and spring, and disperse throughout San Francisco Bay in late spring, summer, and fall (Messersmith 1966; Hieb and Baxter 1993). The annual abundance of longfin smelt is also significantly and positively correlated with the amount of freshwater flow during spawning and larval periods

(Stevens and Miller 1983; Heib and Baxter 1993; Jassby et al. 1995; Baxter 1999). Three factors were identified as potentially responsible for this significant correlation: 1) a reduction in predation during high flows; 2) increased habitat availability that may improve survival by reducing intraspecies competition; and 3) an increase in nutrients stimulating the base of the food chain (Stevens and Miller 1983). However, the relationship changed to substantially lower longfin smelt abundance with outflow after the introduction of the invasive Amur River clam in the late 1980s. This corresponded with a decline in phytoplankton and zooplankton abundance due to grazing by Amur River clam (Bennett et al. 2002). Other introduced species such as striped bass and inland silversides have had an impact on longfin smelt populations due to predation (CDFG 2009b). In 2004, numbers of longfin smelt (along with other pelagic species) exhibited a sharp decline in abundance that has continued to the present time. The POD phenomenon is currently under investigation to understand how stock-recruitment effects, declines in habitat quality, increased mortality rates, and reduced food availability due to invasive species may be working separately and/or cumulatively to lead to the declining abundance of longfin smelt and other pelagic species.

Species of Concern/Other Protected Species

Several aquatic species bear additional discussion because they have been, or are reasonably likely to be, named as a state species of concern, or are likely to be listed on the ESA or CESA threatened or endangered lists during the timeframe of the Proposed Project and alternatives (SWCA 2009; UCCE 2010). These aquatic species are described below.

Sacramento Splittail (*Pogonichthys macrolepidotus*; State Species of Concern)

The Sacramento splittail was federally listed as threatened from 1999 to 2003 (68 FR 55140). However, the USFWS was petitioned to make a new 12-month finding on whether listing the splittail is warranted, with a final listing determination required by September 29, 2011, if warranted (ENS 2010). It is currently a CDFG species of special concern. These fish may be found in the lower reaches of the study area.

Young-of-the-year and yearling splittail are most abundant in the summer months in shallow water areas such as Suisun Marsh (Moyle 2002). Adults move upstream during the winter and spring to forage and spawn in flooded areas (Moyle 2002). The summer through fall distribution of adult Sacramento splittail within the study area is primarily limited to tidal fresh and brackish waters of the Delta, Suisun Bay, and Suisun Marsh (UCCE 2010). Adults begin their migration to spawning grounds in the Sacramento River above Hamilton City in December. Some adult fish may spend the summer in the main-stem Sacramento River instead of migrating back to the estuary after spawning. Sacramento splittail can tolerate relatively high salinities (up to 29 ppt) and low oxygen levels (less than 1.0 mg/L), though they are generally found in estuarine environments and with salinities from 10 to 18

ppt (UCCE 2010). Sacramento splittail feed on bottom-dwelling invertebrates (clams, crustaceans, and insect larvae) and detritus in low to moderate currents, and they show an ability to swim against strong tides and currents (Moyle 2002). In the Delta, splittail feed opportunistically during the day with peak feeding early in the morning. During high flows, they may enter the floodplain where they feed on earthworms. In the Suisun Marsh, splittail are known to prefer to consume opossum shrimp (*Bermudamysis speluncola*) and mysid shrimp (UCCE 2010).

Sacramento splittail may live up to 7 years, with females living longer. Sexual maturity is reached by the end of their second year (around 170 mm). After their third year, splittail grow an average of 35 mm per year for the remainder of their life. During winter and spring, adult splittail move upstream to forage and later spawn between late February and early July, peaking in March and April (UCCE 2010; Moyle 2002). Spawning is presumably triggered by day length, increased flows, and water temperatures rising to a range of 14 to 19°C. Spawning occurs in flooded vegetation with older fish spawning first. Typically, egg production increases with body size and one large female may produce more than 100,000 eggs. Fertilized eggs stick to the flooded vegetation until the embryos hatch 3 to 7 days later. Hatch time is temperature dependent. Active feeding and swim bladder function in the larvae begins 5 to 7 days after the hatch. The larvae remain in the vegetation for 10 to 14 days where they have adequate cover and access to small prey. Young-of-year splittail move into the estuary in April to August, where they occupy water less than 7 feet (2 meters) deep.

Populations have declined due to impassable barriers and modifications to flood basins that have reduced spawning grounds (UCCE 2010; Moyle 2002).

River Lamprey (*Lampetra ayresii*; State Species of Concern) and Pacific Lamprey (*L. [Entosphenus] tridentate*; State Species of Concern)

Pacific and river lampreys are anadromous species that, like salmon, return to freshwater from saltwater and migrate upstream to spawn and die. Lamprey begin their life cycle as an ammocoete, or larva, within a freshwater river or stream. Ammocoetes burrow tail-first into mud or soft substrate where they filter-feed on algae and organic matter for several years (Kostow 2002). When the ammocoetes reach a length of around 14 to 16 cm total length, they enter the macrophthalmia stage, which is the transition from the ammocoete to adult stage, and involves a significant change in physiology and physical appearance as they elongate and develop the characteristic sucking disc (Kostow 2002).

The newly metamorphosed lampreys swim downstream to the estuary where they continue their transition and prepare for movement into the ocean and a parasitic lifestyle. Adult Pacific lamprey generally attach and feed on fish including salmon and flatfish. Their stay at

sea usually lasts 3 to 4 years in Canada but may be shortened in more southern populations (UCCE 2010). River lamprey are believed to spend only 3 to 4 months at sea where they grow rapidly by attaching to fish such as salmon and herring and feeding on muscle tissue (UCCE 2010).

Lamprey return to freshwater typically occurs in the fall, at night, and under high flow conditions (Kostow 2002; Moyle 2002). Runs may be different in the timing of entry to freshwater or in the amount of time spent in freshwater before breeding occurs (UCCE 2010). Adults returning to spawn typically do not feed (Kostow 2002). Breeding males and females dig a nest in moderately swift water by removing rock and gravel from the stream floor. The female releases 10,000 to 200,000 eggs, and the male releases his milt (Kostow 2002; UCCE 2010). The nest is then covered by stirring the substrate upstream of the fertilized eggs. Often, one female will have her eggs fertilized by multiple males because individual nests may be constructed in close proximity to others. Usually the male and female then die, though studies have shown that some adult lamprey live to spawn again the following year. The embryos hatch after approximately 19 days, and the resulting ammocoetes often stay within the safety of the gravel substrate before venturing into the current.

Lamprey were the most common native species collected from samples of dredged materials in the dredging entrainment 2008 monitoring study, but were not identified to the species level (SWCA 2009).

Sacramento Perch (*Archoplites interruptus*; State Species of Concern)

The Sacramento perch is a benthopelagic freshwater fish found in the Sacramento, San Joaquin, Parajo, and Salinas River drainages (UCCE 2010). They prefer vegetated sloughs, pools of sluggish rivers, and lakes. They are most common in ponds and impoundments where they have been introduced throughout the state; however, they may be mostly extirpated from the Delta (Moyle 2002; FISHBIO 2010). Perch may be found in the lower reaches of the study area, but based on the known habitat preferences, would not likely be found within the upper reaches of the SRDWSC due to the lack of preferred vegetation in the man-made portion. These fish may be impacted by potential saltwater intrusion into freshwater habitat, though they are capable of surviving high temperatures, high salinities (up to 17 ppt), high turbidity, and low water clarity (UCCE 2010). Sacramento perch are found along the bottom of inshore regions, feeding opportunistically throughout the day on small crustaceans within the sediment. Adult fish may feed on other fish, including juvenile perch. Sacramento perch reach sexual maturity in year 2 or 3 and generally spawn from March through early August when water temperatures range from 18 to 29°C. Prior to spawning, perch gather in shallow areas abundant with filamentous algae and macrophytes.

Male perch create shallow nests, which are visited by a female. Upon release of eggs and milt, the female abandons the nest and the male remains to guard the nest and embryos for several days. Emergent larvae are planktonic for approximately 2 weeks.

White Sturgeon (*Acipenser transmontanus*)

White sturgeon are anadromous, highly migratory fish that may travel hundreds of km between their natal estuary and other estuaries. Early growth patterns, feeding, and habitat preferences are similar to those described for green sturgeon. White sturgeon typically grow much larger (up to 6 meters) than green sturgeon.

Larger sturgeon begin to feed on other fish such as anchovies (Engraulidae), starry flounder (*Platichthys stellatus*), smelt, and striped bass. The opportunism of the white sturgeon is illustrated by their documented consumption of crayfish, trout, frogs, salmon, and even one domestic cat (UCCE 2010). Male sturgeon reach sexual maturity before the females, though time of onset of maturity for both varies with photoperiod and temperature. Typically, males are at least 10 to 12 years old and have a fork length of 75 to 105 cm. Females mature when they are 12 to 16 years old and have a fork length of 95 to 135 cm. White sturgeon do not necessarily breed annually and only a small percentage of the adult population spawn in a given season. Males may spawn every 1 to 2 years and females every 2 to 4 years. The sturgeon begin migrating in streams during winter, with large peak flows triggering the spawning between February and early June. The optimal water temperature for spawning falls in the range of 8 to 19°C. Fish biologists believe the white sturgeon pick deep, swiftwater areas to spawn such as riffles or pools with rock and gravel substrate. Female sturgeon produce many eggs, with the Sacramento white sturgeon producing an average of 5,648 eggs per kilogram of body weight. Male sturgeon fertilize the eggs, giving them a tacky property that allows the eggs to stick to the substrate until the larvae emerge 4 to 12 days later. White sturgeon have a long life span that may have historically exceeded 100 years.

Striped Bass (*Morone saxatilis*; Federally Protected Game Fish)

Striped bass are a federally protected game fish (72 FR 205) that was introduced to the Delta. They move readily between salt- and freshwater, spending most of their life cycle in estuaries. They are sensitive to temperatures above 25°C, but adults can also withstand the rapid changes in temperature that come with changes in salinity. Striped bass need three very specific habitat structures: 1) a large cool river for spawning, with enough flow to keep larvae suspended into the estuary; 2) a large waterbody with plenty of fish to eat; and 3) a protective estuary for juveniles to grow by feeding on invertebrates. In California, the only area that satisfies these criteria is the San Francisco estuary and its surrounding waterbodies (UCCE 2010). These striped bass populations spend the majority of their time in bays, but will move out into the ocean during El Nino years, and winter in the Delta until the end of

the spawning season.

Juveniles feed mainly on invertebrates, especially amphipods and copepods, gradually incorporating more fish in their diet as they get larger. Once they become large enough, striped bass are almost entirely piscivorous, and are both voracious and opportunistic. Some individuals have been observed waiting by man-made diversions to ambush juvenile salmon as they come out of the tube that allows passage downstream through the diversion. Males mature in 2 to 3 years, females mature in 4 to 6 years, and spawning usually begins in April (NMFS 2010). However, the exact start of the spawning season varies and is based on the interactions of temperature, flow, and salinity. When conditions are right, including temperatures between 14 and 21°C, groups of 5 to 30 females and males swim to the surface and release their eggs and milt simultaneously, so that the eggs are fertilized as they float downward (UCCE 2010). The eggs need to stay suspended in the water column to survive, and therefore hatch quickly (after approximately 48 hours). The larvae live off their yolk sac for the next 7 to 8 days as they are pushed by the current downstream to the entrapment zone where fresh and brackish water meet and the amount of zooplankton is high (NMFS 2010). Fecundity increases with size, and larger females also produce larger eggs with more yolk and oil, leading to a greater rate of survival. Growth is most rapid in the first 4 years, but varies with food availability. On average, striped bass reach 9 to 11 cm fork length their first year and 44 to 54 cm fork length in their fourth year. Individuals older than 10 years or larger than 85 cm fork length are uncommon.

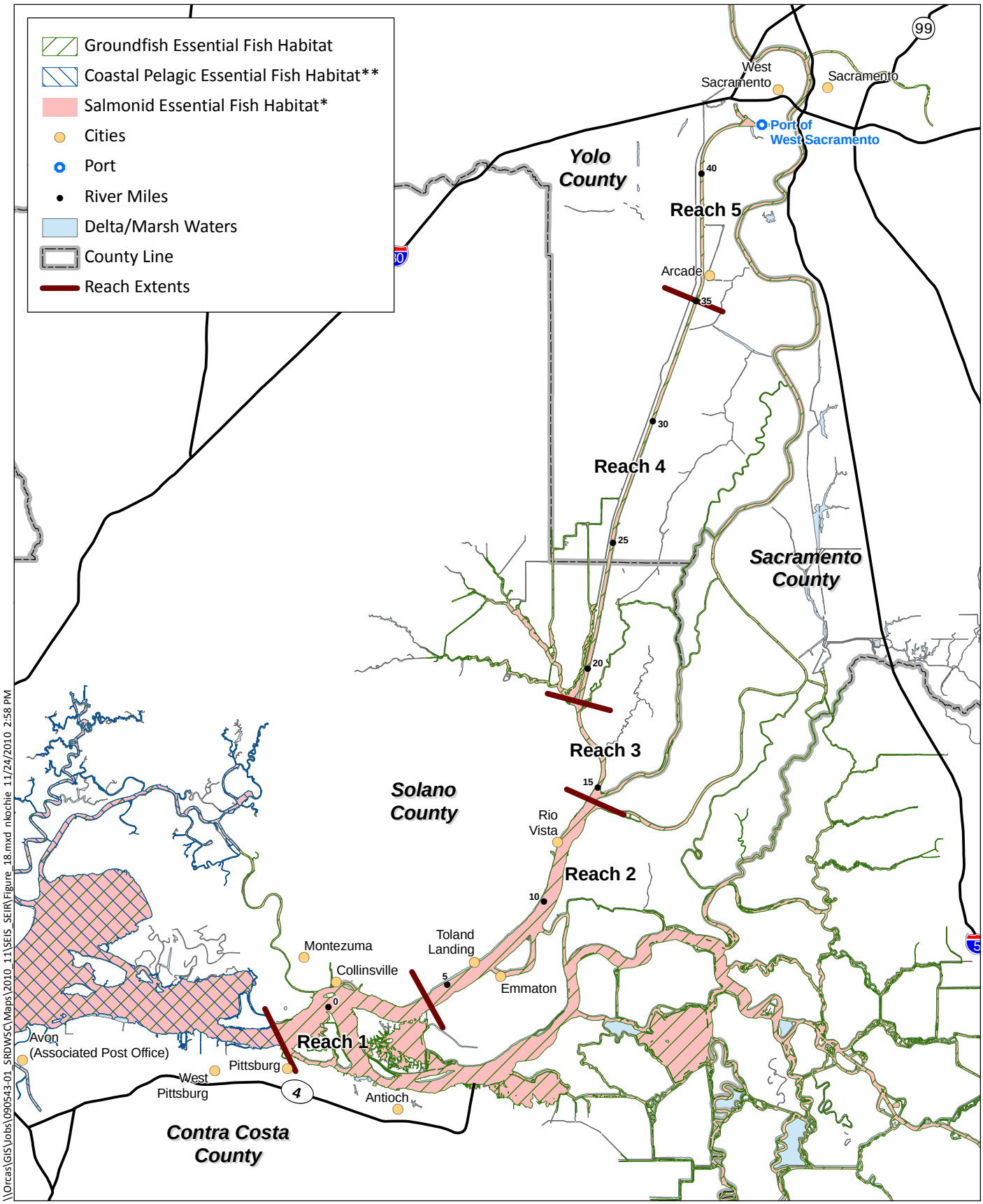
3.2.1.1.4 Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) was enacted to maintain healthy population sizes of fish species that are of commercial importance, via the creation of eight regional Fishery Management Councils (FMCs). FMCs have enacted Fishery Management Plans (FMPs) to implement the management of these species. The 1996 provisions to the Magnuson-Stevens Act included protecting habitat of species for which there is an FMP, called EFH. EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." EFH can consist of both the water column and the underlying surface (e.g., seafloor) of a particular area, and it includes those habitats that support the different life stages of each managed species. A single species may use many different habitats throughout its life to support breeding, spawning, nursery, feeding, and protection functions.

The study area is within EFH for Pacific salmon and Pacific groundfish FMPs, and adjacent to EFH for the coastal pelagic species FMP. The Pacific salmon FMP includes Chinook and coho salmon (*Oncorhynchus kisutch*), and on occasion includes pink salmon (*O. gorbuscha)*, sockeye (*O. nerka*), and chum (*O. keta*). The entire project area is designated as EFH for

California Central Valley Chinook salmon, Sacramento River fall-run Chinook salmon, Sacramento River spring-run Chinook salmon, and Sacramento River winter-run Chinook salmon (Figure 18). The Pacific groundfish species expected in the study area include English sole (*Parophrys vetulus*), starry flounder, and brown rockfish (*Sebastes auriculatus*); the Pacific groundfish FMP includes many additional species but none of the other species are expected to occur in the study area. The coastal pelagic species EFH is defined as all marine and coastal waters from the shoreline offshore to the limits of the exclusive economic zone, and would therefore fall adjacent to the study area's Reach 1 (the legal limit of the estuary is Suisun Bay). The coastal pelagic FMP includes market squid (*Loligo opalescens)*, Pacific sardine (*Sardinops sagax*), Pacific mackerel (*Scomber japonicas)*, jack mackerel (*Trachurus symmetricus*), and northern anchovy (*Engraulis mordax)*, but only northern anchovy are known to inhabit estuarine waters (PFMC 1998) near the study area.

Additional information about the EFH for these specific species is provided after Figure 18.



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NOTES:
1. Salmonid EFH provided by USACE.
2. Groundfish EFH from NOAA Fisheries website - http://www.nmfs.noaa.gov/
3. Coastal Pelagic EFH found in: Pacific Fisheries Management Council Appendix D: Description and identification of Essential Fish Habitat for the Coastal Pelagic Species Fishery Management Plan.

Figure 18
Essential Fish Habitat within the Study Area
SEIS/SEIR
Sacramento River Deep Water Ship Channel

Pacific Salmon

Freshwater EFH for Pacific salmon is described in the NMFS 2006 Maintenance Dredging Biological Opinion and FMP documents (PFMC 1999). Within the California Central Valley, EFH for Pacific salmon includes waters currently or historically accessible to salmon within the Central Valley ecosystem as described in Myers et al. (1998), and includes the Delta hydrologic unit (i.e., number 18040003), Suisun Bay hydrologic unit (18050001), and the Lower Sacramento hydrologic unit (18020109). Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley fall-/late fall-run Chinook salmon are species managed under the FMP that occur in the Delta, Suisun Bay, and Lower Sacramento hydrologic units (NMFS 2006).

Factors limiting salmon populations in the Delta were discussed above in relation to status of listed salmonids and their critical habitat. Factors affecting salmon populations in Suisun Bay include heavy industrialization within the watershed and discharge of waste water effluents into San Francisco Bay. Loss of vital wetland habitat along the fringes of San Francisco Bay reduce rearing habitat and diminish the functional processes that wetlands provide for the San Francisco Bay ecosystem (NMFS 2006).

Pacific Groundfish

Starry Flounder – The starry flounder is a flatfish found throughout the eastern Pacific Ocean, from the Santa Ynez River in California to the Bering and Chukchi Seas in Alaska, and east to Bathurst Inlet in Arctic Canada. Adults are found in marine waters to a depth of 1,230 feet (375 meters), but may be found in muddy substrates between 0 to 1,230 feet (PFMC 1998; CALFED 2005). Spawning takes place during the fall and winter months in marine to polyhaline waters, in shallow coastal waters near rivers and sloughs. Eggs are broadcast in nearshore estuaries and the buoyant eggs drift with wind and tidal currents. Juveniles are found almost exclusively in estuaries, including the San Francisco Bay estuary (PFMC 1998; NMFS 2006). The juveniles often migrate up freshwater rivers, but are estuarine dependent. Juveniles gradually settle to the bottom after undergoing metamorphosis from a pelagic larva to a demersal juvenile by the end of April. Juveniles feed mainly on small crustaceans, barnacle larvae, cladocerans, clams, and dipteran larvae. Juveniles are extremely dependent on the condition of the estuary for their health. Polluted estuaries and wetlands decrease the survival rate for juvenile starry flounder because they have a tendency to accumulate many of the anthropogenic contaminants found in the environment. Starry flounder were captured during fish community surveys within the SRDWSC near the Suisun Bay reach (SWCA 2009).

English Sole – The English sole is a flatfish found from Mexico to Alaska. It is abundant in the San Francisco Bay estuary system (PFMC 1998; NMFS 2006). Adults are found in

nearshore environments. Juveniles and adults are known to be abundant from Carquinez Strait to Chipps Island (NMFS 2006). Generally, juveniles prefer shallow-water coastal bays and estuaries; as they grow, they move to deeper water (in the fall/winter). English sole generally spawn during late fall to early spring at depths of approximately 165 to 230 feet (50 to 70 meters) over soft mud bottoms. Eggs are initially buoyant, and then begin to sink just prior to hatching in coastal estuaries. Incubation may last only a couple of days to a week depending on temperature. Newly hatched larvae are bilaterally symmetrical and float near the surface. Wind and tidal currents carry the larvae into bays and estuaries where the larvae undergo metamorphosis into the demersal juvenile. The young depend heavily on the intertidal areas, estuaries, and shallow nearshore waters for food and shelter. Juvenile English sole primarily feed on small crustaceans (i.e., copepods and amphipods) and on polychaete worms in the rearing areas.

Polluted estuaries and wetlands decrease the survival rate for juvenile English sole. The juveniles also have a tendency to accumulate many of the contaminants found in their environment; this exposure manifests itself as tumors, sores, and reproductive failures. English sole have not been encountered during maintenance dredge monitoring operations in the SRDWSC (SWCA 2009).

Brown Rockfish – Brown rockfish range from Baja California to southeast Alaska. They inhabit shallow waters and bays with less than 175 feet of water depth, though sometimes adults are found in water of approximately 400 feet. Brown rockfish prefer hard bottom substrates or sandy substrates. They tend to aggregate near rocks or anthropogenic structures such as oil platforms or sewer pipes. Sub-adults occupy bays and coastal areas in other vegetation. Juvenile brown rockfish are found in the estuary and they are known to inhabit Suisun Bay up to Chipps Island at depths less than 135 feet; however, their abundance is considered limited by NMFS (NMFS n.d.). Older fish apparently move into deeper water. Only fish aged 5 years or younger occur in San Francisco Bay; the older fish inhabit offshore areas (Stein and Hassler 1989).

Brown rockfish are known to consume crabs and small fish, as well as shrimp, isopods, and polychaetes. They are expected to be relatively tolerant of salinity and temperature changes due to their occurrence in both estuarine and marine environments (Stein and Hassler 1989).

Females produce between 55,000 and 339,000 eggs per season; in some cases they are released in multiple batches. The eggs of the brown rockfish are fertilized internally and develop for some time within the female before they are released (Stein and Hassler 1989). In central and northern California, the release season is December to June. Estuaries, such as the San Francisco Bay, may be used as nursery grounds (Stein and Hassler 1989). All brown

rockfish mature by 10 years of age (Love 2002).

Coastal Pelagic Species

Northern anchovy are distributed from the Queen Charlotte Islands, British Columbia, to Magdalena Bay, Baja California, and anchovy have colonized the Gulf of California. Northern anchovy are known to inhabit Suisun Bay and are considered the most abundant species in the San Francisco Bay area (PFMC 1998). They are unlikely to be found in the study area because they prefer estuarine waters; EFH for anchovy extends to the Suisun Bay boundary of the San Francisco estuary.

3.2.1.2 Methodology for Determining Impacts

Impacts of the Proposed Project and alternatives were evaluated based on the known habitat preferences for various life stages of species known or suspected to be in the study area, and the quantity and quality of existing habitat. Potential impacts were analyzed using professional expertise and judgment in evaluating how the Proposed Project and alternatives could interact and impact aquatic species and habitat. For the analysis of threatened and endangered species, impacts are considered on the individual level, while impacts for non-threatened or endangered (state or federal) species are considered on the population level.

3.2.1.3 Thresholds of Significance

An alternative could have an impact on aquatic species and habitat (abbreviated as ASH in the thresholds and mitigation measures in this section) if it would cause the loss, either directly or through habitat modification (including EFH and designated critical habitat), of any individual within a species identified as a state or federally listed endangered, threatened, rare, or candidate species; or of any population of non-listed species, such as sensitive or special status species. Specifically, the analysis considers the following thresholds:

- **ASH-1:** Potential for fish or other aquatic organisms to be entrained by hydraulic cutterhead dredging equipment
- **ASH-2:** Potential for fish or other aquatic organisms to be entrained in vessel propwash or struck by vessel propellers
- **ASH-3:** Potential for loss or degradation of designated critical habitat or EFH for listed species

Impacts related to water quality parameters, such as turbidity, dissolved oxygen (DO), and dissolved concentrations of constituents of concern, are addressed in Section 3.1.4.4.

The following thresholds were considered but found to not cause any potential adverse impacts to fish or other aquatic organisms resulting from construction of the Proposed

Project or alternatives, and therefore are not considered further in this Draft SEIS/SEIR.

Increase in underwater noise from construction equipment

Dredging activities would require use of equipment (e.g., cutterhead hydraulic dredge, tug boats, other small boats) that could increase in-water noise levels. Cutterhead suction dredges are reported to produce underwater noise levels of approximately 165 to 185 decibels (dB) relative to 1 micropascal at 3.3 feet (1 meter) from operation (Clarke et al. 2002; Fischer 2004; Sakhalin Energy 2004). In comparison, typical shipping noises within the SRDWSC are expected to range from 160 to 190 dB for small boats to large vessels (MALSF 2009). The noise levels expected from the dredging operations are thus expected to be within the range of typical noise levels from vessels traversing the SRDWSC and it is therefore unlikely that any aquatic species would be impacted by noise generated by dredging operations. Therefore, no impacts would result from noise due to dredging and construction equipment under any of the alternatives.

Disturbance of non-motile benthic species and their function as prey

The SRDWC covers 11% (1,062 acres of deep sub-tidal and deep water benthic areas) of the total available habitat for benthic species. Approximately 60% of the dredging footprint of the Proposed Project would occur in the man-made portion of the SRDWSC, where sturgeon, salmon, delta smelt, bottom-fish, and other species are not typically found. Impacts would be phased over the overall construction periods specific to each alternative. Once dredging in a given area is complete, the area would not sustain further impacts except in select areas where future maintenance dredging may be required.

NMFS has indicated that the benthic community is expected to recolonize dredged areas relatively quickly (NMFS 2006). In another project, NMFS found that maintenance dredging in the navigation channel of the Columbia River would likely temporarily reduce the suitability of the sediment for recolonization by salmonids by reducing the organic matter content of the sediments and altering sediment particle size; therefore, some prey species would be lost. However, the agency stated that "these changes in prey availability are unlikely to be of a magnitude or extent that would appreciably diminish forage resources in the action area" (NMFS 2005). McCabe et al. (1998), studying the recovery of benthic invertebrates after maintenance dredging for the Puget Island ferry in February 1994, found no effect on benthic invertebrates as a result of the dredging. In addition, dredging would have a minimal effect on the availability of the ubiquitous pelagic species or their primary food sources *Daphnia* spp. and *Corophium* spp., because new zooplankton from upstream of the study area would be introduced into the study area with river flow, albeit more slowly due to lower flow in the upper reaches of the SRDWSC due to lack of connection with the Sacramento River near the Port (NMFS 2006).

Small invertebrates such as annelids, crustaceans (amphipods, isopods), and other benthic fauna would be unable to escape the suction of the hydraulic dredge and be entrained (NMFS 2006). Many benthic invertebrates have pelagic, surface-oriented larvae; therefore, the loss of these benthic invertebrates may reduce the abundance of localized zooplankton populations in the upper regions of the water column where juvenile salmonids migrate and other aquatic species live. The timing of the dredging cycle (summer-fall) may preclude forage base replacement by recruitment from surrounding populations prior to the following winter and spring migration period of juvenile steelhead through the dredging action area (Nightingale and Simenstad 2001). Additionally, because these organisms occupy habitat types that are prone to disturbance under natural conditions, they would likely rapidly recolonize dredged areas by drifting and crawling from adjacent nondisturbed areas (e.g., Mackay 1992). Although the intensity of the dredging would initially remove benthic organisms, it is likely that the benthic fauna would recolonize quickly (within 3 months) following dredging, with a mature community requiring approximately 1 to 2 years to return (Bradwood Landing 2008; McCauley et al. 1977; Oliver et al. 1977; Rosenberg 1977; Van Dolah et al. 1984; Nichols et al. 1990; Kenny and Rees 1994; Harvey et al. 1998).

Although dredging operations would likely remove a source of forage for green sturgeon in the dredge areas, this is not likely to be a long-term impact because these organisms also occupy habitat types that are adjacent to the dredge area and would likely rapidly re-colonize dredged areas (NMFS 2006; Mackay 1992).

Salmonids are expected to feed in other areas of the channel that are not impacted by dredging activities. Pelagic prey of juvenile salmon, such as aquatic insects, and pelagic prey of adult salmon, such as juvenile rockfish and anchovy, are not dependent on the benthos and are not likely to be affected by material removal.

The lower reaches of the SRDWSC are within prime habitat for delta smelt and provide habitat and rearing areas for other mid-water fish species. Some individuals of these species may spend time in the SRDWSC; evidence from community trawl surveys conducted within the man-made portion encountered one delta smelt but 12 striped bass and several other introduced species (SWCA 2009). Pelagic prey (such as phytoplankton and aquatic insects) are the main prey for mid-water fish species, are not dependent on the benthos, and are not likely to be affected by material removal. The benthic community is expected to recolonize these areas relatively quickly and dredging will only occur over a small portion of the benthic area at one time. Mid-water fish species are expected to move to areas where their benthic prey has not been removed by dredging.

Therefore, it is not anticipated that continuing maintenance dredging under Future without

Project Conditions or deepening the SRDWSC under the Proposed Project or -33 Feet MLLW Alternative would cause long-term impacts to the benthic community or to species dependent on this community.

Interference of dredging operations and dredge equipment with movement of migratory aquatic species

Dredge vessels and hydraulic pipeline placement might cause migratory disturbances for larger green sturgeon utilizing the deep waters of the SRDWSC as part of their migratory corridor, where the migratory corridor for green sturgeon overlaps with the study area in Reaches 1, 2, and 3. Migrating juvenile salmonids would be able to easily avoid the portion of the SRDWSC that is being dredged, but adult salmon using deeper water migration pathways might encounter delays.

However, the overall footprint of these activities is negligible when considering the total area of the channel. Furthermore, only a small portion of the SRDWSC would be occupied by dredging vessels or dredged material placement site pipelines at any one time. Therefore, there would be no potential to adversely impact the migration of any species through the continuation of maintenance dredging or construction of the Proposed Project or alternatives.

Adverse impact to aquatic habitat, including designated critical habitat or EFH from the placement of rock along the shoreline of the man-made channel for bank stabilization

The man-made portion of the SRDWSC requires armoring in shallow water bank areas. Rock placement would continue to be conducted in the same manner under all alternatives. Typically, rock placement only occurs between approximately -1 to -2 feet MLLW on an infrequent, as-needed basis. Therefore, continuation of bank stabilization activities poses no potential for adverse impacts to aquatic species or habitat.

3.2.1.4 Impacts and Mitigation Measures

This section discusses specific impacts, mitigation measures, and residual impacts after mitigation for each alternative. The impacts within each alternative are organized according to common life histories of species and species use of aquatic habitat as follows:

- Sturgeon: green sturgeon and white sturgeon
- Salmonids: Sacramento River winter-run Chinook, Central Valley spring-run Chinook, and Central Valley steelhead
- Mid-water fish: longfin smelt, delta smelt, striped bass, and others
- Groundfish: Sacramento splittail, starry flounder, English sole, river lamprey, Pacific lamprey, and others

ASH-1: Potential for fish or other aquatic organisms to be entrained by hydraulic cutterhead dredging equipment

Aquatic organisms present within the immediate dredging vicinity could potentially be injured or killed by being drawn into the suction field of the dredge head; by contact with the dredging apparatus during dredging activities; or by vessel strikes, or entrainment in vessel propwash.

The entrainment potential for aquatic organisms is based on factors related to the dredging operation and the behavior of the organism itself, including the strength of the entrainment field generated by hydraulic dredging, the abundance of organisms in the area, swimming ability of the organism (positively related to size of the organism), behavioral responses of the organism to dredging activities, total area dredged, and the speed of dredging (Klimley et al. 2009). Larval, juvenile, and adult life stages that may be present in the vicinity of the dredge head may not be able to escape the entrainment field. However, larger organisms are known to be stronger swimmers, so they may be less likely to become entrained than smaller organisms (Klimley et al. 2009; SWCA 2009). Organisms swimming close to the bottom that are not able to swim away from and escape the entrainment field are the most likely to be entrained during hydraulic dredging operations. The likelihood of entrainment may increase in narrow channels with slower and shallower waters (Killgore et al. 2010; Reine and Clark 1998).

Entrainment monitoring was conducted as part of the USFWS and NMFS' Biological Opinion for maintenance dredging of the SRDWSC and the Stockton Deep Water Ship Channel from 2006 through 2009. The monitoring consisted of otter trawling the water column on opposite days of dredging to determine the fish communities present in the areas being dredged. Monitoring results indicated that demersal fish are entrained at higher rates than pelagic fish, and that species that comprise most of the trawl catch also comprise the majority of the entrained fish (catfish and gobies). Table 40 provides an overview of the fish entrained in dredged material samples and caught during community trawling. ESA-listed species are highlighted in green and EFH-managed species are highlighted in blue. No listed species were encountered in the entrainment monitoring (SWCA 2007, 2008, 2009; Mari-Gold and Novo Aquatics 2010).

Table 40
Results of Stockton Deep Water Ship Channel and SRDWSC Entrainment Monitoring

Species	2006 (November 16 – December 17) Number Entrained/Number Caught in Trawling Efforts	2007 (December 2 – December 11) Number Entrained/Number Caught in Trawling Efforts	2008 (August 1 – September 7) Number Entrained/ Number Caught in Trawling Efforts	2009 (August 16 – August 26) Number Entrained/ Number Caught in Trawling Efforts
American shad	0/26	0/0	0/12	0/7
Blue catfish	0/1	0/0	0/10	0/0
Brown bullhead	0/2	0/0	0/0	0/0
Channel catfish	0/173	0/14	1/30	0/8
Common carp	0/0	0/0	0/0	0/1
Delta smelt	0/0	0/10	0/22	0/0
Goby, unidentified	0/2	0/0	0/5	0/0
Green sturgeon	0/2	0/0	0/0	0/0
Lamprey spp.	8/20	0/1	13/0	0/0
Longfin smelt	0/893	0/1	0/21	0/0
Pacific staghorn sculpin	0/0	0/0	0/3	0/0
Prickly sculpin	0/25	0/0	0/2	0/0
Sacramento splittail	0/9	0/0	0/0	0/3
Sacramento blackfish	0/1	0/0	0/0	0/0
Sacramento pikeminnow	0/1	0/0	0/0	0/0
Shimofury goby	0/45	0/3	1/11	45/15
Shokihaze goby	1/47	0/0	0/28	2/1
Starry flounder	0/55	0/0	0/11	0/0
Striped bass	0/292	0/19	1/137	0/49
White catfish	0/20	0/29	5/79	2/219
White sturgeon	0/81	0/3	0/7	0/5
Yellowfin goby	0/58	1/3	0/9	3/5

Sources: SWCA 2007, 2008, 2009; Mari-Gold and Novo Aquatics 2010
Notes:
ESA-listed species are highlighted in green
EFH-managed species are highlighted in blue

Another entrainment study conducted in the San Francisco Bay area, *Results of the 2006 Investigation of Juvenile Chinook Salmon and Steelhead Entrained into a Hydraulic Suction Dredge During Sand Mining Operations within the Sacramento-San Joaquin Bay-Delta Estuary* (USACE 2010h), indicated that Sacramento splittail, Chinook salmon, yellowfin goby, striped bass, Pacific staghorn sculpin (*Leptocottus armatus*), starry flounder, and threespine stickleback (*Gasterostreus aculeatus*) were entrained. The study was not indicative of dredging activities under the Proposed Project or alternatives because the hydraulic suction method used was an open pipe positioned about 3 feet above the sediment surface entraining only water, not sediment. As discussed below, the dredging methodology proposed to be employed in the Proposed Project and alternatives involves submerging the cutterhead in the sediment, and using a slow rotational speed of approximately 3 to 10 revolutions per minute (RPM), thereby further reducing impacts.

Future without Project Conditions (NEPA and CEQA Baseline)

Sturgeon

Past entrainment monitoring studies in the SRDWSC have not indicated sturgeon were entrained (SWCA 2007, 2008, 2009; Mari-Gold and Novo Aquatics 2010; USACE 2010h). Entrainment monitoring conducted on hydraulic dredges in the Atlantic and Gulf Coasts indicate that sturgeon are entrained in very low numbers. Between 1990 and 2005, fewer than 25 sturgeon were confirmed entrained on dredges (ERDC 2005). White sturgeon are documented in the man-made portion of the SRDWSC; however, the results of past monitoring indicate the species was not entrained by hydraulic dredging equipment. As a result, impacts to white sturgeon on the population level from entrainment in dredging equipment are not expected.

Green sturgeon may be present year-round in the SRDWSC; consequently, no environmental work window exists to protect them. When dredging activities are conducted, adults may be migrating through the natural Sacramento River portion of the SRDWSC to spawning grounds and juveniles may be outmigrating downriver to the rearing habitat in San Francisco Bay. Juveniles may also stray into the man-made portion of the SRDWSC. Adults migrating to spawning grounds are not expected to enter the man-made portion of the SRDWSC because they tend to migrate uni-directionally and fairly quickly to spawning grounds (USACE 2010h); however, there is a slight chance that they may enter the channel during adult outmigration back to marine waters.

The likelihood of green sturgeon being entrained in dredging equipment is considered minimal due to their nominal presence in the man-made portion of the SRDWSC, the ability of both juveniles and adults to escape a hydraulic dredge's flow field, and the lack of past documentation showing entrainment of the species in the study area. However, green

sturgeon could be present in the study area during maintenance dredging activities and could potentially be entrained in dredging equipment, which would constitute a significant impact due to their protected status. Thus, there could be potentially significant impacts to green sturgeon from entrainment in dredging equipment under Future without Project Conditions due to their protected status. The mitigation measures below are proposed to reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-1: Submerge cutterhead and utilize a slow rotational speed, where feasible
- ASH-MM-2: Conduct entrainment monitoring during dredging operations

Residual Impact after Mitigation: As described above, past entrainment monitoring studies in the SRDWSC have not indicated green sturgeon were entrained during dredging. The results of these studies validate the effectiveness of ASH-MM-1, and continued monitoring will occur as described under ASH-MM-2. The residual impact to sturgeon would be less than significant.

Salmonids

The SRDWSC maintenance dredging work window for salmonids is June 1 through February 27; dredging is restricted to the man-made portion of the channel only beginning December 1 (NMFS 2006). Hydraulic dredging activities could entrain juvenile salmonids if they are within the area being dredged. Smaller fish are generally more at risk of entrainment than larger fish (SWCA 2009); however, due to their typical location in the nearshore and upper portion of the water column, the risk of entrainment for juvenile salmon is lower than for green sturgeon. Adult salmon are unlikely to be entrained because negligible dredging within the SRDWSC would occur in waters deeper than 20 feet. Adult salmonids will swim in deeper waters; however, they are predominantly a mid-water pelagic fish and are not expected to be travelling at the bottom depths where dredging activities would occur (NMFS 2006).

Studies from the Columbia and Frasier rivers have indicated salmonids are generally less likely to become entrained in dredging activities than non-anadromous fish species (McGraw and Armstrong 1990; Larson and Moehl 1990; Reine and Clarke 1998). NMFS (2006) indicated in the SRDWSC Biological Opinion for maintenance dredging that the probability of entraining Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, or Central Valley steelhead in the hydraulic dredge is very low because these fish are likely to avoid the immediate vicinity of dredging operations, and because dredging operations proceed slowly and would allow adult salmonids adequate time to escape. The entrainment monitoring conducted on the SRDWSC and Stockton Deep Water Ship Channel between 2006 and 2009 indicated that no salmonids were entrained during hydraulic dredging (SWCA 2007, 2008, 2009; Mari-Gold and Novo Aquatics 2010).

Overall, it is anticipated that no adult, and potentially few juvenile, listed salmonids could be entrained in dredging equipment during maintenance dredging activities under Future without Project Conditions. Thus, there could be potentially significant impacts to juvenile salmonids from entrainment in dredging equipment under Future without Project Conditions due to their protected status. The mitigation measures below are proposed to reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-1: Submerge cutterhead and utilize slow rotational speeds, where feasible
- ASH-MM-2: Conduct entrainment monitoring during construction
- ASH-MM-3: Constrain construction to applicable environmental work windows

Residual Impact after Mitigation: As described above, past entrainment monitoring studies in the SRDWSC have not indicated salmonids were entrained during dredging. The results of these studies validate the effectiveness of ASH-MM-1, and continued monitoring will occur as described under ASH-MM-2. Construction during applicable environmental work windows will further reduce these impacts under baseline conditions. The residual impact to salmonids would be less than significant.

Mid-water Fish

The established USFWS SRDWSC maintenance dredging work window for delta smelt is August 1 to November 30 (USFWS 2008c). There is no established CDFG programmatic maintenance dredging work window for longfin smelt in the SRDWSC; however, CDFG has restricted other in-water work in the SRDWSC to August 1 through October 31.

Dredging conducted in the lower reaches of the SRDWSC near longfin and delta smelt spawning areas (in Suisun Marsh and nearshore areas of Reach 1) could entrain eggs, and larvae during winter spawning periods (LFR 2004; CDFG 2009b). Adults of both smelt species could also be entrained in hydraulic dredge equipment during dredging activities. It is anticipated that longfin smelt are more likely to be entrained in dredge equipment because they feed or rear on the bottom (USACE 2010h). In contrast, delta smelt are less likely to become entrained because they inhabit the middle and upper reaches of the water column (LFR 2004).

Studies from around the San Francisco Bay and Delta have not identified entrainment in dredge equipment as a significant issue for delta smelt, longfin smelt, or other mid-water fish species. For dredging activities that occur at locations throughout the lower estuary, the *Longfin Smelt Status Report* (CDFG 2009b) concluded that effects to larvae, mobile juveniles, and adults of mid-water fish species are expected to be small and localized. During a fish entrainment study conducted at Port Sonoma, in 51 hours of active cutterhead dredging, 51 fish were entrained including non-native shimofuri goby, yellowfin goby, striped bass, one

native prickly sculpin (*Cottus asper*), and one native longfin smelt (Woodbury and Swedberg 2007). The entrainment monitoring conducted on the SRDWSC and Stockton Deep Water Ship Channel between 2006 and 2009 indicated that no delta smelt or longfin smelt were entrained during hydraulic dredging (SWCA 2007, 2008, 2009; Mari-Gold and Novo Aquatics 2010).

Under Future without Project Conditions, entrainment of adult delta smelt in dredging equipment is anticipated to occur at very low levels. Because longfin smelt often feed near the bottom of the channel, entrainment in dredging equipment could have potentially significant impacts on individuals of this species. Entrainment in dredging equipment could also have potentially significant impacts on longfin smelt eggs or larvae in the lower reaches of the SRDWSC (Reaches 1 through 3). The mitigation measures below are proposed to reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-1: Submerge cutterhead and utilize slow rotational speeds, where feasible
- ASH-MM-2: Conduct entrainment monitoring during construction
- ASH-MM-3: Constrain construction to applicable environmental work windows

Residual Impact after Mitigation: As described above, past entrainment monitoring studies in the SRDWSC and Delta have not indicated entrainment is a significant issue for delta smelt or longfin smelt. The results of these studies validate the effectiveness of ASH-MM-1, and continued monitoring will occur as described under ASH-MM-2. Although entrainment of eggs, larvae, or individuals of non-listed mid-water fish species could occur, the mitigation measures proposed would prevent significant impacts at the population level. Construction during applicable environmental work windows will further reduce these impacts. The residual impact to mid-water fish would be less than significant.

Groundfish

Groundfish species are typically located on the benthos within the lower reaches of the study area. These species could become entrained in dredging equipment during routine maintenance dredging. However, entrainment is not expected to result in declines in groundfish populations that would adversely affect these species. Groundfish, such as starry flounder and English sole, are not anticipated to be within the man-made portion of the SRDWSC due to its distance from the estuary where the juveniles of these species are most likely to occur. Starry flounder and English sole were captured within the natural portion of the SRDWSC near Sherman Island in fish community surveys (SWCA 2009). Maintenance dredging entrainment surveys conducted in the man-made portions of the SRDWSC have not encountered any groundfish (SWCA 2007, 2008, 2009; Mari-Gold and Novo Aquatics 2010).

Due to their location within the bottom of the water column or within the benthos, individual groundfish could become entrained in dredging equipment during routine maintenance dredging. However, entrainment is not expected to result in declines in groundfish populations that would adversely affect these species at a population level. Thus, there would be less than significant impacts to groundfish due to entrainment in dredging equipment under Future without Project Conditions. The mitigation measures below are proposed to reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-1: Submerge cutterhead and utilize slow rotational speeds, where feasible
- ASH-MM-2: Conduct entrainment monitoring during construction

Residual Impact after Mitigation: As described above, past entrainment monitoring studies in the SRDWSC and Delta have not indicated entrainment is a significant issue for groundfish. These studies validate the effectiveness of ASH-MM-1, and continued monitoring will occur as described under ASH-MM-2. Thus, the residual impact to groundfish would be less than significant.

Proposed Project: Channel Deepening to -35 Feet MLLW and Selective Widening

Sturgeon

Similar to the impacts to sturgeon under Future without Project Conditions and based on the results of past monitoring, white sturgeon are not expected to be impacted at the population level from entrainment in dredging equipment as a result of the Proposed Project. However, green sturgeon may be entrained in dredging equipment. The duration of dredging activities in the SRDWSC would be approximately 4.5 months longer than maintenance dredging under Future without Project Conditions, resulting in some incremental increase in the potential for entrainment. In addition, dredging activities would occur over a greater area of the SRDWSC, including Reaches 1 through 3 where sturgeon are most often found. While past monitoring indicated that green sturgeon were not entrained, some potential still exists for entrainment (SWCA 2007, 2008, 2009; Mari-Gold and Novo Aquatics 2010). Thus, as compared to the environmental baseline, there could be increased incremental, potentially significant impacts to green sturgeon from entrainment in dredging equipment. Any increased entrainment of green sturgeon would be considered significant due to their protected status. The mitigation measures below are proposed to reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-1: Submerge cutterhead and utilize slow rotational speeds, where feasible
- ASH-MM-2: Conduct entrainment monitoring during construction

Residual Impact after Mitigation: As previously discussed, past entrainment monitoring studies in the SRDWSC have not indicated green sturgeon were entrained during dredging.

The results of these monitoring studies validate the effectiveness of ASH-MM-1, and continued monitoring will occur as described under ASH-MM-2. Thus, despite the increased duration and wider area of dredging, the residual impact to sturgeon would be less than significant and similar to baseline conditions.

Salmonids

Similar to the impacts to salmonids associated with Future without Project Conditions, the risk for adult salmonids to be entrained in dredging equipment is low, even with an increase of dredging operations by 4.5 months annually over a 4-year period. The proposed 6-month construction duration on an annual basis is consistent with the salmonid construction window. The entrainment monitoring conducted on the SRDWSC and Stockton Deep Water Ship Channel between 2006 and 2009 indicated that no salmonids were entrained during hydraulic dredging (SWCA 2007, 2008, 2009; Mari-Gold and Novo Aquatics 2010). Overall, it is anticipated that no adult, and potentially few juvenile, listed salmonids could be entrained in dredging equipment during dredging activities. Thus, as compared to the environmental baseline, there could be increased incremental, potentially significant impacts to juvenile salmonids from entrainment in dredging equipment. Any increased entrainment of salmonids would be considered significant due to their protected status. The mitigation measures below are proposed to reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-1: Submerge cutterhead and utilize slow rotational speeds, where feasible
- ASH-MM-2: Conduct entrainment monitoring during construction
- ASH-MM-3: Constrain construction to applicable environmental work windows

Residual Impact after Mitigation: As described above, past entrainment monitoring studies in the SRDWSC have not indicated salmonids were entrained during dredging. The results of these studies validate the effectiveness of ASH-MM-1, and continued monitoring will occur as described under ASH-MM-2. Construction during applicable environmental work windows will further reduce these impacts. Thus, despite the increased duration and wider area of dredging, the residual impact to salmonids would be less than significant and similar to baseline conditions.

Mid-water Fish

In order to construct the Proposed Project, USACE and the Port will request expanding the existing dredging work windows for delta smelt by 2 months such that the overall construction timeframe is feasible. The requested work window would start on or about June 1 of the construction year and end by November 30, with the potential of extending into December of each year that deepening would occur. Future maintenance dredging, however, would be conducted within the current dredging windows for the SRDWSC.

Similar to the impacts to mid-water fish species associated with Future without Project Conditions, adult delta smelt are not anticipated to be impacted from entrainment in dredging equipment (SWCA 2007, 2008, 2009; Mari-Gold and Novo Aquatics 2010). Construction dredging activities would occur on the SRDWSC approximately 4.5 months longer annually with the Proposed Project than under Future without Project Conditions. As discussed previously, because longfin smelt often feed near the bottom of the channel, entrainment in dredging equipment could have potentially significant impacts on individuals of this species. Entrainment in dredging equipment could also have potentially significant impacts on longfin smelt, eggs, or larvae in the lower reaches of the SRDWSC (Reaches 1 through 3).

Thus, as compared to the environmental baseline, there could be increased incremental, potentially significant entrainment impacts to adult longfin smelt, and longfin smelt eggs and larvae due to entrainment in dredging equipment. Any increased entrainment of smelt would be considered significant due to their protected status. The mitigation measures below are proposed to reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-1: Submerge cutterhead and utilize slow rotational speeds, where feasible
- ASH-MM-2: Conduct entrainment monitoring during construction

Residual Impact after Mitigation: As described above, past entrainment monitoring studies in the SRDWSC and Delta have not indicated entrainment is a significant issue for delta smelt or longfin smelt. These studies validate the effectiveness of ASH-MM-1, and continued monitoring will occur as described under ASH-MM-2. While entrainment of eggs, larvae, or individuals of non-listed mid-water fish species could occur, the mitigation measures proposed would prevent significant impacts at the population level. Thus, despite the potential for work to occur outside of established work windows, as well as the increased duration and wider area of dredging, the residual impact to mid-water fish would be less than significant and similar to baseline conditions.

Groundfish

Similar to the impacts to groundfish species associated with Future without Project Conditions, due to their preference for benthic habitats, individual groundfish could become entrained in dredging equipment during construction dredging. However, past monitoring during maintenance dredging did not indicate that groundfish were entrained (SWCA 2007, 2008, 2009; Mari-Gold and Novo Aquatics 2010). If entrainment occurs, it would not be expected to result in declines in groundfish populations that would adversely affect the species at a population level. Thus, as compared to the environmental baseline, there could be incrementally increased but less than significant impacts due to entrainment of

groundfish species. The mitigation measures below are proposed to reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-1: Submerge cutterhead and utilize slow rotational speeds, where feasible
- ASH-MM-2: Conduct entrainment monitoring during construction

Residual Impact after Mitigation: As described above, past entrainment monitoring studies in the SRDWSC and Delta have not indicated entrainment is a significant issue for groundfish. These studies validate the effectiveness of ASH-MM-1, and continued monitoring will occur as described under ASH-MM-2. Thus, despite the increased duration and wider area of dredging, the residual impact to groundfish would be less than significant and similar to baseline conditions.

Channel Deepening to -33 Feet MLLW and Selective Widening Alternative

Sturgeon

Impacts to sturgeon from the -33 Feet MLLW Alternative would be consistent with those of the Proposed Project, with the exception that they would cease approximately 1 to 2 years earlier. Thus, as compared to the environmental baseline, there could be increased incremental, potentially significant entrainment impacts to green sturgeon due to an increased duration of dredging in areas where sturgeon are found. Any increased entrainment of sturgeon would be considered significant due to their protected status. The mitigation measures below are proposed to reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-1: Submerge cutterhead and utilize slow rotational speeds, where feasible
- ASH-MM-2: Conduct entrainment monitoring during construction

Residual Impact after Mitigation: The residual impact would be less than significant for the reasons described under the Proposed Project, and further reduced given the shorter construction duration.

Salmonids

Impacts to salmonids from the -33 Feet MLLW Alternative would be consistent with those of the Proposed Project, with the exception that they would cease approximately 1 to 2 years earlier. Thus, as compared to the environmental baseline, there could be increased incremental, potentially significant impacts to juvenile salmonids from entrainment in dredging equipment as a result of the -33 Feet MLLW Alternative. The mitigation measures below are proposed to reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-1: Submerge cutterhead and utilize slow rotational speeds, where feasible

- ASH-MM-2: Conduct entrainment monitoring during construction
- ASH-MM-3: Constrain construction to applicable environmental work windows

Residual Impact after Mitigation: The residual impact would be less than significant for the reasons described under the Proposed Project, and further reduced given the shorter construction duration.

Mid-water Fish

Impacts to mid-water fish species from the -33 Feet MLLW Alternative would be consistent with those of the Proposed Project, with the exception that they would cease approximately 1 to 2 years earlier. Thus, as compared to the environmental baseline, there could be increased incremental, potentially significant entrainment impacts to longfin smelt and individual longfin smelt eggs and larvae as a result of the -33 Feet MLLW Alternative. The mitigation measures below are proposed to reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-1: Submerge cutterhead and utilize slow rotational speeds, where feasible
- ASH-MM-2: Conduct entrainment monitoring during construction

Residual Impact after Mitigation: The residual impact would be less than significant for the reasons described under the Proposed Project, and further reduced given the shorter construction duration.

Groundfish

Impacts to groundfish species from the -33 Feet MLLW Alternative would be consistent with those of the Proposed Project, with the exception that they would cease approximately 1 to 2 years earlier. Thus, as compared to the environmental baseline, there could be incrementally increased but less than significant impacts due to entrainment of groundfish species as a result of the -33 Feet MLLW Alternative (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-1: Submerge cutterhead and utilize slow rotational speeds, where feasible
- ASH-MM-2: Conduct entrainment monitoring during construction

Residual Impact after Mitigation: The residual impact would be less than significant for the reasons described under the Proposed Project, and further reduced given the shorter construction duration.

ASH-2: Potential for fish or other aquatic organisms to be entrained in vessel propwash or struck by vessel propellers

Fish species may be struck by propellers or entrained in propwash from tugs and other vessels during dredging operations. In addition, during normal operation of the SRDWSC,

fish may be struck or entrained by deep draft vessels using the SRDWSC to access the Port. The impact on fish species varies based on their typical location within the water column and the size of the fish (SWCA 2009). In a study of entrainment in propwash and propeller strikes on the Mississippi River, large-body species such as sturgeon showed a higher probability of being struck by a vessel propeller (Kilgore et al. 2010).

Future without Project Conditions (NEPA and CEQA Baseline)

Sturgeon

Sturgeon are known to experience direct injury and mortality due to propeller strikes and entrainment in propwash (Kilgore and Clarke 2009). In a study by the Engineer Research and Development Center (ERDC) on the Mississippi River to assess impacts of propeller strikes on Atlantic sturgeon (*Acipenser oxyrinchus*), 2% of all fish entrained behind a large tugboat were found to have been injured by propeller strikes. The study also noted that entrainment of sturgeon in propwash of deep draft vessels produced mortality rates substantially exceeding those associated with dredging entrainment (Killgore and Clarke 2009).

A recent survey of Atlantic sturgeon and vessel-strike mortality indicates that because large vessels in shipping channels typically draft close to the bottom of the channel, they pose a greater threat to fish positioned close to the bottom of the channel, such as sturgeon (Brown and Murphy 2010). For example, between 2005 and 2008, a total of 14 Atlantic sturgeon mortalities were reported in the Delaware Estuary that were attributable to propeller strikes, and 23 Atlantic sturgeon were reported to have been struck and killed by vessels in the James River, Virginia (Brown and Murphy 2010). The James River and Delaware Estuary are similar to the SRDWSC in that commercial vessels transit many miles via an upriver ship channel to reach port.

Based on available evidence for other types of sturgeon, white sturgeon may be struck by vessel propellers or entrained in vessel propwash. However, impacts to white sturgeon on the population level would not be expected under Future without Project Conditions. Green sturgeon could also be struck or injured by propellers from deep draft ships utilizing the SRDWSC. This impact is expected to be minimal to green sturgeon because they are not expected to be present in the man-made portion of the SRDWSC. However, because adults and juveniles may be present in the natural portion of the SRDWSC, there is a potential for vessel strikes or entrainment in propwash from construction or commercial vessels. A minimum of 2 feet of under-keel clearance is required for all vessels on the SRDWSC, which would allow limited space near the bottom of the water column for green sturgeon to avoid vessels.

With the estimated annual increase in the number of vessels on the SRDWSC to approximately 143 under Future without Project Conditions, the potential for green sturgeon to be struck by vessel propellers or entrained in vessel propwash would increase. Thus, there could be potentially significant impacts to green sturgeon from vessel strikes and entrainment in vessel propwash under Future without Project Conditions. Any increase is potentially significant due to their protected status. Although literature indicates that mortality due to commercial vessel traffic presents a substantially greater risk than strikes by dredging equipment, the following mitigation measure is proposed to further reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-4: Limit speeds for construction vessels during dredging

Residual Impact after Mitigation: The residual impact to green sturgeon from vessel strikes and entrainment in vessel propwash is expected to be potentially significant under Future without Project Conditions, due to the increase in vessel traffic on the SRDWSC.

Salmonids

Juvenile salmonids have a low potential for impacts from propeller strikes and entrainment in propwash because they tend to occupy shallower, nearshore areas outside of the navigation channel in the upper 20 feet of the water column. Adult salmonids may swim in the deeper waters of the channel, but are similarly not expected to be oriented on or near the bottom. Thus, there would be less than significant impacts to salmonids from vessel strikes and entrainment in vessel propwash under Future without Project Conditions. The following mitigation measure is proposed to further reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-4: Limit speeds for construction vessels during dredging

Residual Impact after Mitigation: The residual impact would be less than significant.

Mid-water Fish

Juvenile and adult delta and longfin smelt and other mid-water fish species have a small potential to be impacted by vessel propeller strikes and entrainment in propwash due to their size and mid-depth position in the water column. Thus, there would be less than significant impacts to mid-water fish species from vessel strikes and entrainment in vessel propwash under Future without Project Conditions. The following mitigation measure is proposed to further reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-4: Limit speeds for construction vessels during dredging

Residual Impact after Mitigation: The residual impact would be less than significant.

Groundfish

Propeller strikes are not likely to affect groundfish. Vessels may generate propwash that could potentially entrain groundfish located in the study area; however, this impact is not expected to occur to the degree that it would significantly impact any species of groundfish at the population level. Thus, there would be less than significant impacts to groundfish species from vessel strikes and entrainment in vessel propwash under Future without Project Conditions. The following mitigation measure is proposed to further reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-4: Limit speeds for construction vessels during dredging

Residual Impact after Mitigation: The residual impact would be less than significant.

Proposed Project: Channel Deepening to -35 Feet MLLW and Selective Widening

Sturgeon

As described under Future without Project Conditions, it is possible that sturgeon could be struck and injured by propellers from deep draft ships utilizing the SRDWSC. Literature indicates that mortality due to commercial vessel traffic presents a substantially greater risk than strikes by dredging equipment. This impact is expected to be minimal in the man-made portion of the SRDWSC because green sturgeon are not expected to be present in this area; however, adults and juveniles may be present in the natural portion of the SRDWSC. Impacts to white sturgeon are not expected at the population level from propeller strikes or entrainment in vessel propwash as a result of the Proposed Project.

The Proposed Project would reduce the annual estimated number of vessels on the SRDWSC to approximately 100, which is 43 fewer vessels than under Future without Project Conditions. As such, the potential for green sturgeon to be struck by vessel propellers or entrained in vessel propwash would decrease as compared to the environmental baseline. Thus, there would be less than significant impacts to green sturgeon from vessel strikes and entrainment in vessel propwash as a result of the Proposed Project. This represents a project benefit as compared to Future without Project Conditions. The following mitigation measure is proposed to further reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-4: Limit speeds for construction vessels during dredging

Residual Impact after Mitigation: The residual impact would be less than significant.

Salmonids

Similar to Future without Project Conditions, risk is low for juvenile or adult salmonids to be struck by vessels or entrained in vessel propwash. Juvenile salmonids tend to be located in

shallower, nearshore waters outside of the navigation channel and in the upper 20 feet of the water column. Adult salmonids may swim in the deeper waters of the channel, but are not expected to be oriented on the bottom, entrained in propwash, or struck by vessel propellers. In addition, the Proposed Project would reduce the annual estimated number of vessels on the SRDWSC to approximately 100, which is 43 fewer vessels than under Future without Project Conditions. Thus, as compared to the environmental baseline, there would be less than significant impacts to salmonids from vessel strikes and entrainment in vessel propwash as a result of the Proposed Project. This represents a project benefit as compared to Future without Project Conditions. The following mitigation measure is proposed to further reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-4: Limit speeds for construction vessels during dredging

Residual Impact after Mitigation: The residual impact would be less than significant.

Mid-water Fish

Similar to Future without Project Conditions, impacts to mid-water fish species from vessel strikes or entrainment in vessel propwash is unlikely due to the species' size and position in the water column. In addition, under the Proposed Project, approximately 43 fewer vessels would be needed to carry the same amount of cargo to the Port than under Future without Project Conditions; therefore, the potential for vessel strikes and entrainment in vessel propwash would be reduced for mid-water fish. Thus, as compared to the environmental baseline, there would be less than significant impacts to mid-water fish from vessel strikes and entrainment in vessel propwash as a result of the Proposed Project. This represents a project benefit as compared to Future without Project Conditions. The following mitigation measure is proposed to further reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-4: Limit speeds for construction vessels during dredging

Residual Impact after Mitigation: The residual impact would be less than significant.

Groundfish

Similar to Future without Project Conditions, propeller strikes are not likely to affect groundfish. Vessels may generate propwash that could potentially entrain groundfish located in the study area; however, this impact is not expected to occur to the degree that it would significantly impact any species of groundfish at the population level. In addition, the Proposed Project would reduce the annual estimated number of vessels on the SRDWSC to approximately 100, which is 43 fewer vessels than under Future without Project Conditions. Thus, as compared to the environmental baseline, there would be less than significant impacts to groundfish from vessel strikes and entrainment in vessel propwash as a result of

the Proposed Project. This represents a project benefit as compared to Future without Project Conditions. The following mitigation measure is proposed to further reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-4: Limit speeds for construction vessels during dredging

Residual Impact after Mitigation: The residual impact would be less than significant.

Channel Deepening to -33 Feet MLLW and Selective Widening Alternative

Sturgeon

Impacts to sturgeon from the -33 Feet MLLW Alternative would be consistent with those of the Proposed Project, with the exception that there would be approximately 29 fewer vessels on the SRDWSC than under Future without Project Conditions. Thus, as compared to the environmental baseline, there would be less than significant impacts to green sturgeon from vessel strikes and entrainment in vessel propwash as a result of the -33 Feet MLLW Alternative. This represents a project benefit as compared to Future without Project Conditions. The following mitigation measure is proposed to further reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-4: Limit speeds for construction vessels during dredging

Residual Impact after Mitigation: The residual impact would be less than significant.

Salmonids

Impacts to salmonids from the -33 Feet MLLW Alternative would be consistent with those of the Proposed Project, with the exception that there would be approximately 29 fewer vessels on the SRDWSC than under Future without Project Conditions. Thus, as compared to the environmental baseline, there would be less than significant impacts to salmonids from vessel strikes and entrainment in vessel propwash as a result of the -33 Feet MLLW Alternative. This represents a project benefit as compared to Future without Project Conditions. The following mitigation measure is proposed to further reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-4: Limit speeds for construction vessels during dredging

Residual Impact after Mitigation: The residual impact would be less than significant.

Mid-water Fish

Impacts to mid-water fish from the -33 Feet MLLW Alternative would be consistent with those of the Proposed Project, with the exception that there would be approximately 29 fewer vessels on the SRDWSC than under Future without Project Conditions. Thus, as compared to the environmental baseline, there would be less than significant impacts to mid-

water fish from vessel strikes and entrainment in vessel propwash as a result of the -33 Feet MLLW Alternative. This represents a project benefit as compared to Future without Project Conditions. The following mitigation measure is proposed to further reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-4: Limit speeds for construction vessels during dredging

Residual Impact after Mitigation: The residual impact would be less than significant.

Groundfish

Impacts to groundfish from the -33 Feet MLLW Alternative would be consistent with those of the Proposed Project, with the exception that there would be approximately 29 fewer vessels on the SRDWSC than under Future without Project Conditions. Thus, as compared to the environmental baseline, there would be less than significant impacts to groundfish from vessel strikes and entrainment in vessel propwash as a result of the -33 Feet MLLW Alternative. This represents a project benefit as compared to Future without Project Conditions. The following mitigation measure is proposed to further reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-4: Limit speeds for construction vessels during dredging

Residual Impact after Mitigation: The residual impact would be less than significant.

ASH-3: Potential for Loss or Degradation of Designated Critical Habitat or EFH

Critical habitat for aquatic species in the action area includes designated habitat for Central Valley steelhead, Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, green sturgeon, and delta smelt. Direct impacts to aquatic critical habitat would be from direct removal of substrate during deepening and widening the SRDWSC. However, most of the area that would be dredged is part of the existing SRDWSC, portions of which are disturbed annually by maintenance dredging, and these impacts are thus temporary, recurrent impacts. The SRDWSC is continually disturbed by deep draft vessel use.

Future without Project Conditions (NEPA/CEQA No Action Alternative)

Sturgeon

Green sturgeon critical habitat in the study area includes the tidal waters downstream of the manmade portion of the SRDWSC and the adjacent Yolo Bypass; the manmade portion of the SRDWSC is not considered critical habitat. Dredging and material placement activities may impact the following critical habitat PCEs for green sturgeon:

- *Food resources* in the dredged areas may be impacted through removal or disturbance

of the benthic prey community. This impact is expected to be short-term and occur in the area directly impacted by dredging. Proposed dredging footprints within the SRDWSC will sequentially disturb no more than 11% of the total available habitat for benthic prey. Once dredged, areas would return to functioning as a source of food.

- *Sediment quality* is not expected to be impacted by maintenance dredging activities (Section 3.1.3.4).
- *Water quality* may be impacted through increased suspended sediment and turbidity, especially close to the dredging activities and the area where return water would discharge to surface water from the upland placement sites. These impacts are expected to be short-term and would not permanently alter the existing function of the critical habitat.
- Small portions of *migratory corridors* may be impeded by presence of dredge vessels and commercial ships; however, the vessels would be on the surface and would only occupy a small percentage of the channel, allowing free passage over a majority of the channel area.
- *Water depths* would increase slightly in some areas as a result of maintenance dredging operations, potentially adding greater area specified for adult and subadult holding (greater than or equal to 16.4 feet).

Under Future without Project Conditions, green sturgeon critical habitat would likely be disturbed as a result of maintenance dredging activities within the study area for an average of 1.5 months per year. However, maintenance dredging activities are not expected to permanently alter the function of green sturgeon critical habitat. Thus, there would be less than significant impacts to green sturgeon critical habitat under Future without Project Conditions. The following mitigation measures are proposed to further reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-1: Submerge cutterhead and utilize slow rotational speeds, where feasible
- WQ-MM-1: Implement standard construction BMPs and requirements of the WDR

Residual Impact after Mitigation: The residual impact would be less than significant.

Salmonids

Salmonid critical habitat in the action area includes all waters downstream of the man-made channel, the Cache Slough complex near the confluence of the natural portion and the man-made portion of the channel, and sloughs that run through the Yolo Bypass. The following PCEs for salmonid critical habitat may be temporarily affected by dredging activities:

- *Freshwater rearing sites* would not be significantly impacted. Dredging will disturb less than 10 square feet of area in depths less than 20 feet. Rearing sites do not occur in the deeper portions of the main-stem SRDWSC (greater than 20 feet in depth)

where dredging is expected to occur; however, salmonids do rear within the SRDWSC, therefore, temporary impacts are possible due to plumes of resuspended sediments that may impact shallower areas.

- The *freshwater migration corridor* of juvenile and adult salmonids occurs within the dredging areas of the SRDWSC. As a result, salmonids migrating through the dredging areas of the channel could experience increased potential for entrainment, suspended sediment, and turbidity levels. However, it is expected that only a small portion of the migration corridor would be impacted at one time and fish could swim through un-impacted areas.
- *Estuarine areas* provide essential habitat to juvenile and adult salmonids in the SRDWSC. Estuarine areas could experience elevated suspended sediment and turbidity levels, as well as elevated concentrations of resuspended sediment resulting from cutterhead dredging within maintenance dredging areas. However, these impacts are expected to be localized and temporary. In addition, it is expected that only a small portion of the estuarine habitat available to salmonids would be impacted at one time and fish could swim to un-impacted areas.
- *Food resources* in the dredged areas may be impacted through removal or disturbance of benthic macroinvertebrates. This impact is expected to be short-term and occur in the area directly impacted by dredging.

Current and future maintenance dredging would cause temporary disturbances of critical habitat and EFH in the study area for an average of 1.5 months per year; no permanent loss or change in function is anticipated in the portion of the SRDWSC that overlaps with the main-stem of the Sacramento River. There is no critical habitat for salmonids in the man-made portion of the SRDWSC. Thus, there would be less than significant impacts on salmonid critical habitat and EFH under Future without Project Conditions. The following mitigation measures are proposed to further reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-1: Submerge cutterhead and utilize slow rotational speeds, where feasible
- ASH-MM-3: Constrain construction to applicable environmental work windows
- WQ-MM-1: Implement standard construction BMPs and requirements of the WDR

Residual Impact after Mitigation: The residual impact would be less than significant.

Mid-water Fish

Critical habitat exists within the study area for delta smelt. Delta smelt critical habitat includes all submerged lands below OHW and the entire water column bounded by and including the Suisun Bay (including Grizzly and Honker Bays); Good Year, Suisun, Cutoff First Mallard, and Montezuma Sloughs; and the water contained within the Sacramento-San

Joaquin Delta in Contra Costa, Sacramento, San Joaquin, Solano, and Yolo counties. Therefore, the entire SRDWSC and the adjacent aquatic area is designated critical habitat. As a result, the following critical habitat PCEs are likely to be directly affected by dredging activities:

- *Rearing habitat* requires suitable water quality, which may be temporarily impacted by dredging activities.
- *Adult migration* requires adequate water quality to attract adults to the sloughs and tributaries, which may be temporarily impacted by dredging activities.

Delta smelt critical habitat is likely to be disturbed as a result of maintenance dredging activities within the study area for an average of 1.5 months per year. However, maintenance dredging activities are not expected to permanently alter the function of critical habitat. Thus, there would be less than significant long-term impacts on critical habitat for delta smelt under Future without Project Conditions. The following mitigation measures are proposed to further reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-1: Submerge cutterhead and utilize slow rotational speeds, where feasible
- ASH-MM-3: Constrain construction to applicable environmental work windows
- WQ-MM-1: Implement standard construction BMPs and requirements of the WDR

Residual Impact after Mitigation: The residual impact would be less than significant.

Groundfish

The degradation of benthic habitat is not likely to adversely affect survival of groundfish or the productivity of the groundfish fishery. Under Future without Project Conditions, EFH for groundfish is expected to be disturbed by maintenance dredging operations for a period of 1.5 months annually. Thus, there would be less than significant impacts on groundfish EFH under Future without Project Conditions. The following mitigation measures are proposed to further reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-1: Submerge cutterhead and utilize slow rotational speeds, where feasible
- WQ-MM-1: Implement standard construction BMPs and requirements of the WDR

Residual Impact after Mitigation: The residual impact would be less than significant.

Proposed Project: Channel Deepening to -35 Feet MLLW and Selective Widening

Sturgeon

Green sturgeon critical habitat would be temporarily altered by channel deepening and widening. Dredging the SRDWSC downstream of the manmade portion of the channel is

expected to directly remove 650 acres of green sturgeon critical habitat. Portions of this area would otherwise be continually disturbed by maintenance dredging activities under Future without Project Conditions. Ample critical habitat would remain around the dredging that offers the PCEs for green sturgeon. Additional deep water habitat favored by green sturgeon would also be created by the Proposed Project. No long-term impacts to water quality or prey availability are anticipated. Thus, as compared to the environmental baseline, there would be incrementally increased but less than significant impacts to green sturgeon critical habitat as a result of the Proposed Project. The following mitigation measures are proposed to further reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-1: Submerge cutterhead and utilize slow rotational speeds, where feasible
- WQ-MM-1: Implement standard construction BMPs and requirements of the WDR

Residual Impact after Mitigation: The residual impact would be less than significant.

Salmonids

Salmonid critical habitat and EFH would be temporarily altered and disturbed as a result of the Proposed Project. Dredging the SRDWSC downstream of the manmade portion of the channel is expected to directly remove 650 acres of salmonid critical habitat. Portions of this area would otherwise be continually disturbed by maintenance dredging activities under Future without Project Conditions. The areas that are proposed for deepening and widening as part of the Proposed Project are in sub-tidal and deep benthic habitat types, which are not limiting in the SRDWSC. Thus, as compared to the environmental baseline, there would be incrementally increased but less than significant impacts to salmonid critical habitat and EFH as a result of the Proposed Project. The following mitigation measures are proposed to further reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-1: Submerge cutterhead and utilize slow rotational speeds, where feasible
- ASH-MM-3: Constrain construction to applicable environmental work windows
- WQ-MM-1: Implement standard construction BMPs and requirements of the WDR

Residual Impact after Mitigation: The residual impact would be less than significant.

Mid-water Fish

The entire SRDWSC and adjacent aquatic areas are designated critical habitat for mid-water fish. Dredging and intermittent widening of the SRDWSC would result in approximately 1,160 acres of temporary direct loss of critical habitat. According to CDFG, the Cache Slough complex and the manmade portion of the SRDWSC may be important spawning habitat for delta smelt and year-round populations in this area were recently verified in 2009 (USACE 2010h). This temporary removal of large amounts of critical habitat would constitute a

potentially significant impact to delta smelt critical habitat. Short-term increases in turbidity could also have significant impacts on delta smelt critical habitat if the requested work window for the Proposed Project (which is 2 months longer than the existing work window) is authorized. Thus, as compared to the environmental baseline, there could be potentially significant impacts to delta smelt critical habitat as a result of the Proposed Project. The USACE and the Port are currently in early coordination with USFWS and CDFG regarding potential effects to delta smelt critical habitat. As part of the coordination and subsequent Section 7 consultation, mitigation and compensation measures will be developed and will be incorporated into the Proposed Project. Until such coordination and consultation is completed, no mitigation is proposed to mitigate for this impact. The following mitigation measures are proposed to further reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-1: Submerge cutterhead and utilize slow rotational speeds, where feasible
- WQ-MM-1: Implement standard construction BMPs and requirements of the WDR

Residual Impact after Mitigation: After inclusion of the mitigation measures, the residual impact of the Proposed Project on delta smelt critical habitat would remain potentially significant.

Groundfish

The Proposed Project would deepen and widen areas that have never been dredged, which could impact groundfish EFH; however, when considered relative to existing conditions, the impact is expected to be less than significant in the long-term. The areas that are proposed for deepening and widening are sub-tidal and deep benthic habitat types, which are not limiting in the SRDWSC. As such, the long-term function of groundfish EFH is not expected to be significantly impacted relative to baseline conditions. Thus, there would be less than significant impacts to groundfish EFH as a result of the Proposed Project. The following mitigation measures are proposed to further reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-1: Submerge cutterhead and utilize slow rotational speeds, where feasible
- WQ-MM-1: Implement standard construction BMPs and requirements of the WDR

Residual Impact after Mitigation: The residual impact would be less than significant.

Channel Deepening to -33 Feet MLLW and Selective Widening Alternative

Sturgeon

Impacts to green sturgeon critical habitat from the -33 Feet MLLW Alternative would be consistent with those of the Proposed Project, with the exception that impacts would cease approximately 1 to 2 years earlier. Thus, as compared to the environmental baseline, there

would be incrementally increased but less than significant impacts to green sturgeon critical habitat as a result of the -33 Feet MLLW Alternative. The following mitigation measures are proposed to further reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-1: Submerge cutterhead and utilize slow rotational speeds, where feasible
- WQ-MM-1: Implement standard construction BMPs and requirements of the WDR

Residual Impact after Mitigation: The residual impact would be less than significant.

Salmonids

Impacts to salmonid critical habitat and EFH from the -33 Feet MLLW Alternative would be consistent with those of the Proposed Project, with the exception that impacts would cease approximately 1 to 2 years earlier. Thus, as compared to the environmental baseline, there would be incrementally increased but less than significant impacts to salmonid critical habitat and EFH as a result of the -33 Feet MLLW Alternative. The following mitigation measures are proposed to further reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-1: Submerge cutterhead and utilize slow rotational speeds, where feasible
- ASH-MM-3: Constrain construction to applicable environmental work windows
- WQ-MM-1: Implement standard construction BMPs and requirements of the WDR

Residual Impact after Mitigation: The residual impact would be less than significant.

Mid-water Fish

Impacts to delta smelt critical habitat from the -33 Feet MLLW Alternative would be consistent with those of the Proposed Project, with the exception that impacts would cease approximately 1 to 2 years earlier. Thus, as compared to the environmental baseline, there could be potentially significant impacts to delta smelt critical habitat as a result of the -33 Feet MLLW Alternative. The USACE and the Port are currently in early coordination with USFWS and CDFG regarding potential effects to delta smelt critical habitat. As part of the coordination and subsequent Section 7 consultation, mitigation and compensation measures will be developed and will be incorporated into the -33 Feet MLLW Alternative. Until such coordination and consultation is completed, no mitigation is proposed to mitigate for this impact. The following mitigation measures are proposed to further reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-1: Submerge cutterhead and utilize slow rotational speeds, where feasible
- WQ-MM-1: Implement standard construction BMPs and requirements of the WDR

Residual Impact after Mitigation: After inclusion of the mitigation measures, the residual impact of the -33 Feet MLLW Alternative on delta smelt critical habitat would remain potentially significant.

Groundfish

Impacts to groundfish EFH from the -33 Feet MLLW Alternative would be consistent with those of the Proposed Project, with the exception that impacts would cease approximately 1 to 2 years earlier. Thus, there would be less than significant impacts to groundfish EFH as a result of the -33 Feet MLLW Alternative. The following mitigation measures are proposed to further reduce impacts (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- ASH-MM-1: Submerge cutterhead and utilize slow rotational speeds, where feasible
- WQ-MM-1: Implement standard construction BMPs and requirements of the WDR

Residual Impact after Mitigation: The residual impact would be less than significant.

3.2.1.4.1 Summary of Impacts and Mitigation Measures

Table 41 summarizes the impact determinations, mitigation measures, and residual impacts after mitigation, if applicable, for each alternative with respect to the aquatic species and habitat described above.

Table 41
Summary of Aquatic Species and Habitat Impacts and Mitigation Measures

Alternative	Impact	Mitigation	Residual Impact After Mitigation
ASH-1: Potential for fish or other aquatic organisms to be entrained by hydraulic cutterhead dredging equipment			
Future without Project Conditions (NEPA and CEQA Baseline)	Sturgeon: Potentially significant impact	ASH-MM-1 and 2	Less than significant impact
	Salmonids: Potentially significant impact	ASH-MM-1, 2, and 3	Less than significant impact
	Mid-water Fish: Potentially significant impact	ASH-MM-1, 2, and 3	Less than significant impact
	Groundfish: Less than significant impact	ASH-MM-1 and 2	Less than significant impact
Proposed Project: Channel Deepening to -35 Feet MLLW and Selective Widening	Sturgeon: Potentially significant impact	ASH-MM-1 and 2	Less than significant impact
	Salmonids: Potentially significant impact	ASH-MM-1, 2, and 3	Less than significant impact
	Mid-water Fish: Potentially significant impact	ASH-MM-1 and 2	Less than significant impact
	Groundfish: Less than significant impact	ASH-MM-1 and 2	Less than significant impact

Channel Deepening to -33 Feet MLLW and Selective Widening Alternative	Sturgeon: Potentially significant impact	ASH-MM-1 and 2	Less than significant impact
	Salmonids: Potentially significant impact	ASH-MM-1, 2, and 3	Less than significant impact
	Mid-water Fish: Potentially significant impact	ASH-MM-1 and 2	Less than significant impact
	Groundfish: Less than significant impact	ASH-MM-1 and 2	Less than significant impact
ASH-2: Potential for fish or other aquatic organisms to be entrained in vessel propwash or struck by vessel propellers			
Future without Project Conditions (NEPA and CEQA Baseline)	Sturgeon: Potentially significant impact	ASH-MM-4	Potentially significant impact
	Salmonids: Less than significant impact	ASH-MM-4	Less than significant impact
	Mid-water Fish: Less than significant impact	ASH-MM-4	Less than significant impact
	Groundfish: Less than significant impact	ASH-MM-4	Less than significant impact
Proposed Project: Channel Deepening to -35 Feet MLLW and Selective Widening	Sturgeon: Less than significant impact	ASH-MM-4	Less than significant impact
	Salmonids: Less than significant impact	ASH-MM-4	Less than significant impact
	Mid-water Fish: Less than significant impact	ASH-MM-4	Less than significant impact
	Groundfish: Less than significant impact	ASH-MM-4	Less than significant impact
Channel Deepening to -33 Feet MLLW and Selective Widening Alternative	Sturgeon: Less than significant impact	ASH-MM-4	Less than significant impact
	Salmonids: Less than significant impact	ASH-MM-4	Less than significant impact
	Mid-water Fish: Less than significant impact	ASH-MM-4	Less than significant impact
	Groundfish: Less than significant impact	ASH-MM-4	Less than significant impact
ASH-3: Potential for loss or degradation of designated critical habitat or EFH for listed species			
Future without Project Conditions (NEPA and CEQA Baseline)	Sturgeon: Less than significant impact	ASH-MM-1 and WQ-MM-1	Less than significant impact
	Salmonids: Less than significant impact	ASH-MM-1 and 3; WQ-MM-1	Less than significant impact
	Mid-water Fish: Less than significant impact	ASH-MM-1 and 3; WQ-MM-1	Less than significant impact
	Groundfish: Less than significant impact	ASH-MM-1 and WQ-MM-1	Less than significant impact
Proposed Project: Channel Deepening to -35 Feet MLLW and Selective Widening	Sturgeon: Less than significant impact	ASH-MM-1 and WQ-MM-1	Less than significant impact
	Salmonids: Less than significant impact	ASH-MM-1 and 3; WQ-MM-1	Less than significant impact

	Mid-water Fish: Potentially significant impact	ASH-MM-1 and WQ-MM-1	Potentially significant impact
	Groundfish: Less than significant impact	ASH-MM-1 and WQ-MM-1	Less than significant impact
Channel Deepening to -33 Feet MLLW and Selective Widening Alternative	Sturgeon: Less than significant impact	ASH-MM-1 and WQ-MM-1	Less than significant impact
	Salmonids: Less than significant impact	ASH-MM-1 and 3; WQ-MM-1	Less than significant impact
	Mid-water Fish: Potentially significant impact	ASH-MM-1 and WQ-MM-1	Potentially significant impact
	Groundfish: Less than significant impact	ASH-MM-1 and WQ-MM-1	Less than significant impact

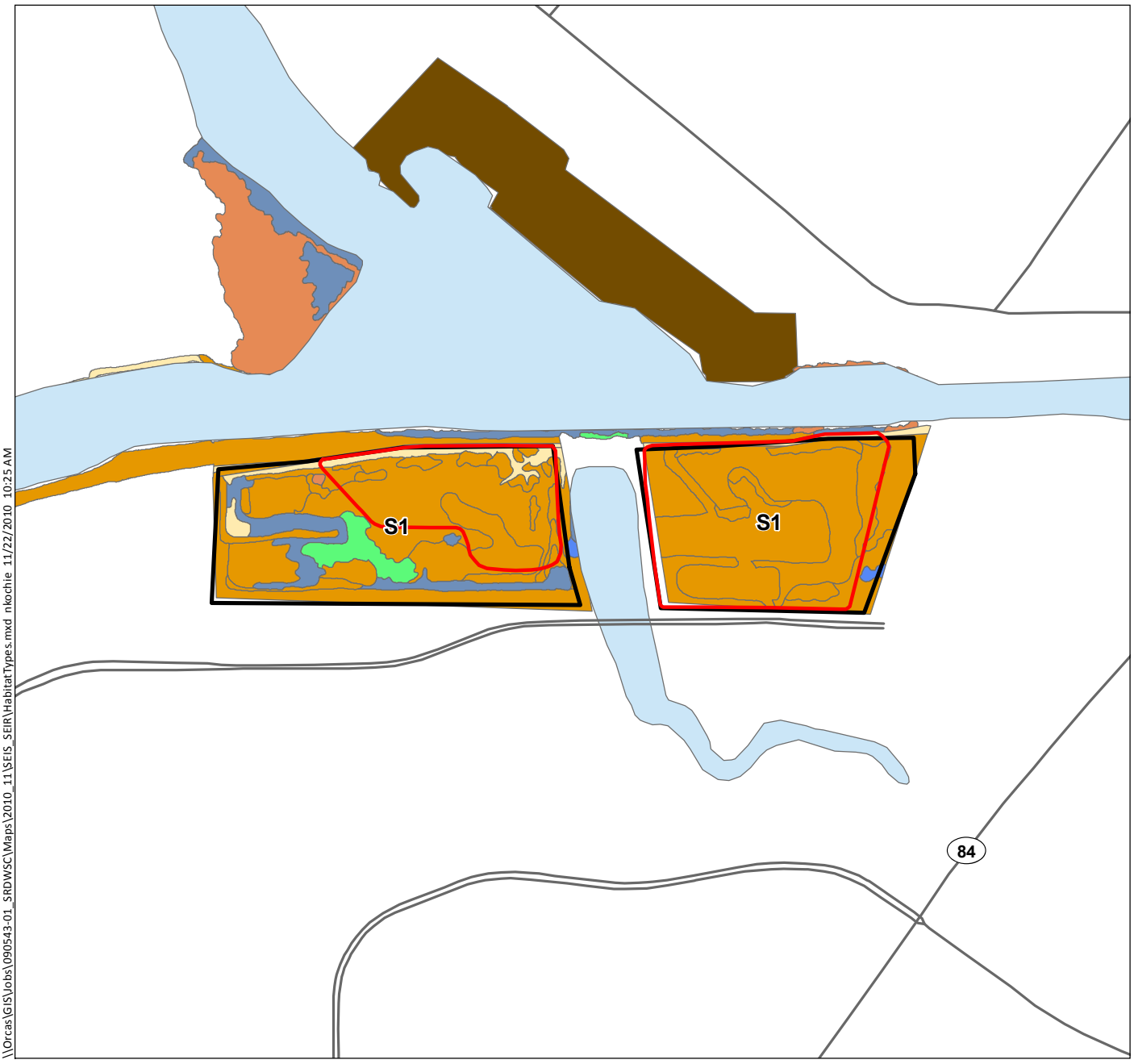
3.2.2 Terrestrial Species and Habitat

This section describes existing information on the terrestrial, riparian, and wetland habitats and species within the study area, and evaluates potential project impacts on these species and habitats.

3.2.2.1 Baseline Conditions

Surveys were conducted by USACE to identify vegetation and terrestrial wildlife along the banks of the SRDWSC in the vicinity of the proposed dredging and widening footprint and in the proposed dredged material placement sites (USACE 2008c; USACE 2009b; Fowler 2010; CDFG 2010f). Proposed placement sites were surveyed by USACE in August 2008 using aerial photography and field mapping with ArcGIS (USACE 2008c). The USACE then categorized vegetation communities and habitat types using the Holland classification for natural communities. A subsequent survey was completed in July 2010, which investigated river banks, additional potential dredged material placement sites, and previously studied sites to evaluate any changes in the dominant vegetation or habitat during the previous 3 years (Fowler 2010). Due to the occurrence of seasonal vegetation in the proposed dredged material placement sites, both living and dead species were considered in the identification process. The surveys identified non-submerged habitat types of non-native grassland, wetlands, agriculture, riparian woodland and scrubs, and others.

Placement sites S1, S4, S11, S14, S16, S19, S20, S31, S32, and S35 are considered in detail. Figures 19 through 35 show habitat conditions in each proposed dredged material placement site, and the complete vegetation surveys can be found in Appendix O.



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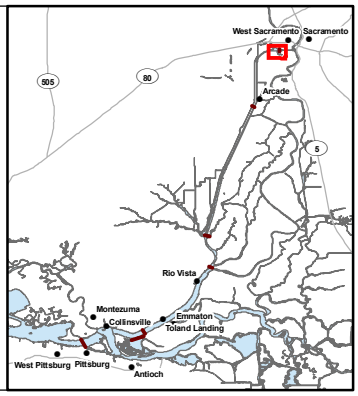
Vegetation

- Alkali meadow
- Cultivated field
- Developed
- Freshwater marsh
- Freshwater seep
- Marsh and swamp
- Non-native grassland
- Riparian forests
- Riparian scrub
- Riparian woodland
- River
- Tamarisk scrub
- Unvegetated
- Valley and foothill grasslands
- Valley oak woodland
- Valley saltbush scrub
- Water

- River Miles
- Cities
- Placement Site
- Placement Site Usable Portion
- Major Roads
- Roads
- Delta/Marsh Waters



Feet
0 600 1,200 1,800 2,400

N

Figure 19
Habitat Types Identified at Placement Site S1
SEIS/SEIR
Sacramento River Deep Water Ship Channel

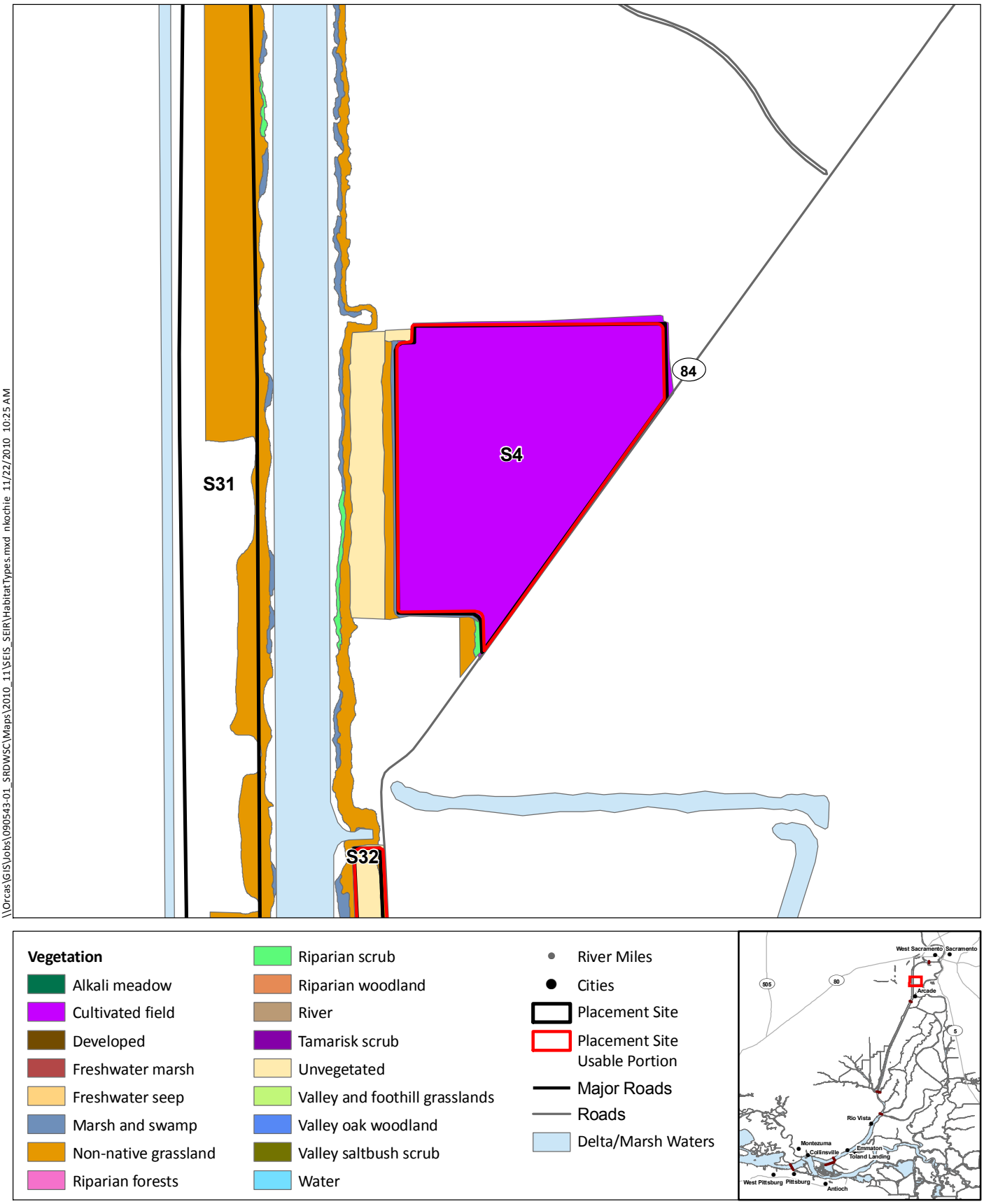


Figure 20

Habitat Types Identified at Placement Site S4

SEIS/SEIR

Sacramento River Deep Water Ship Channel

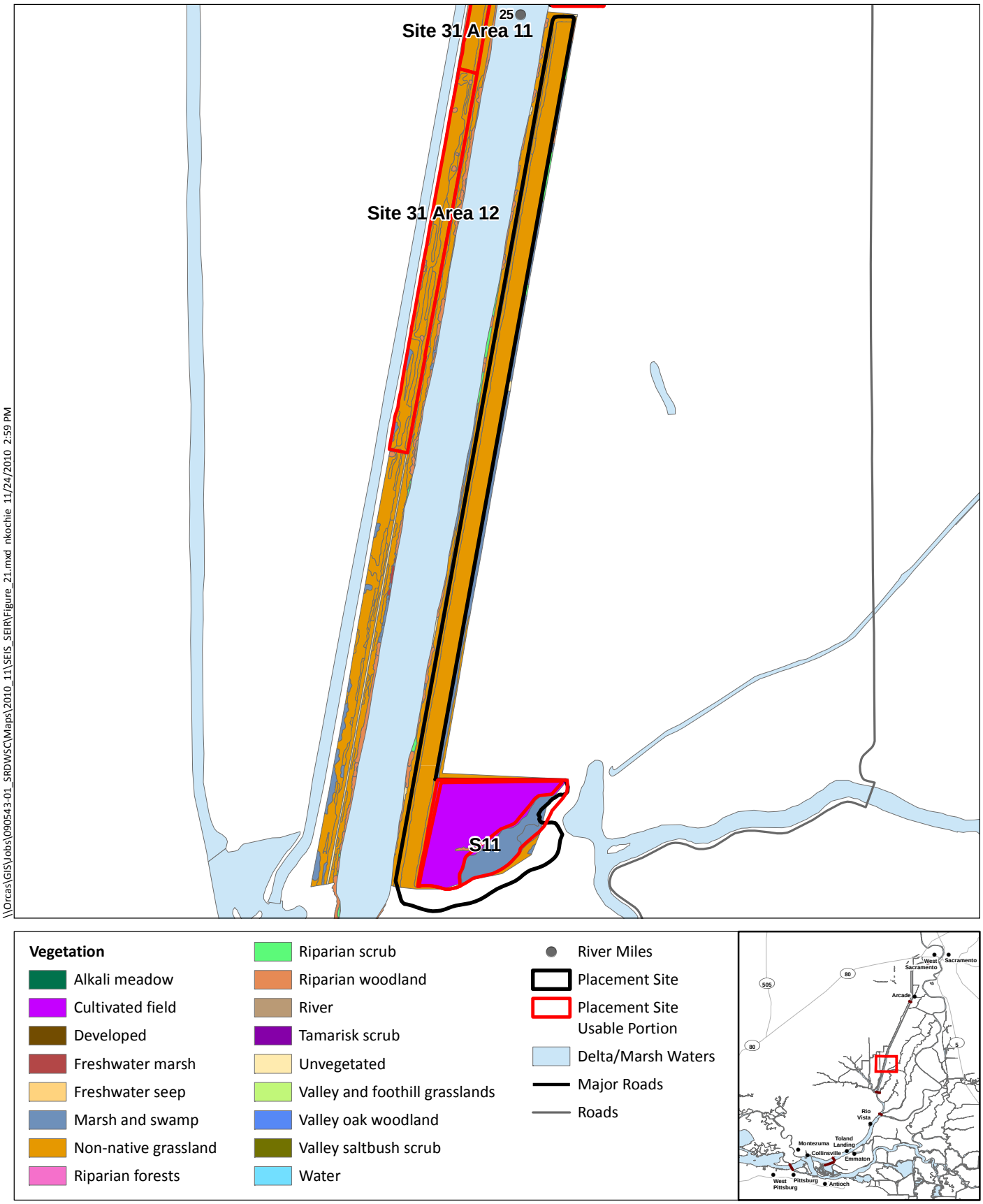
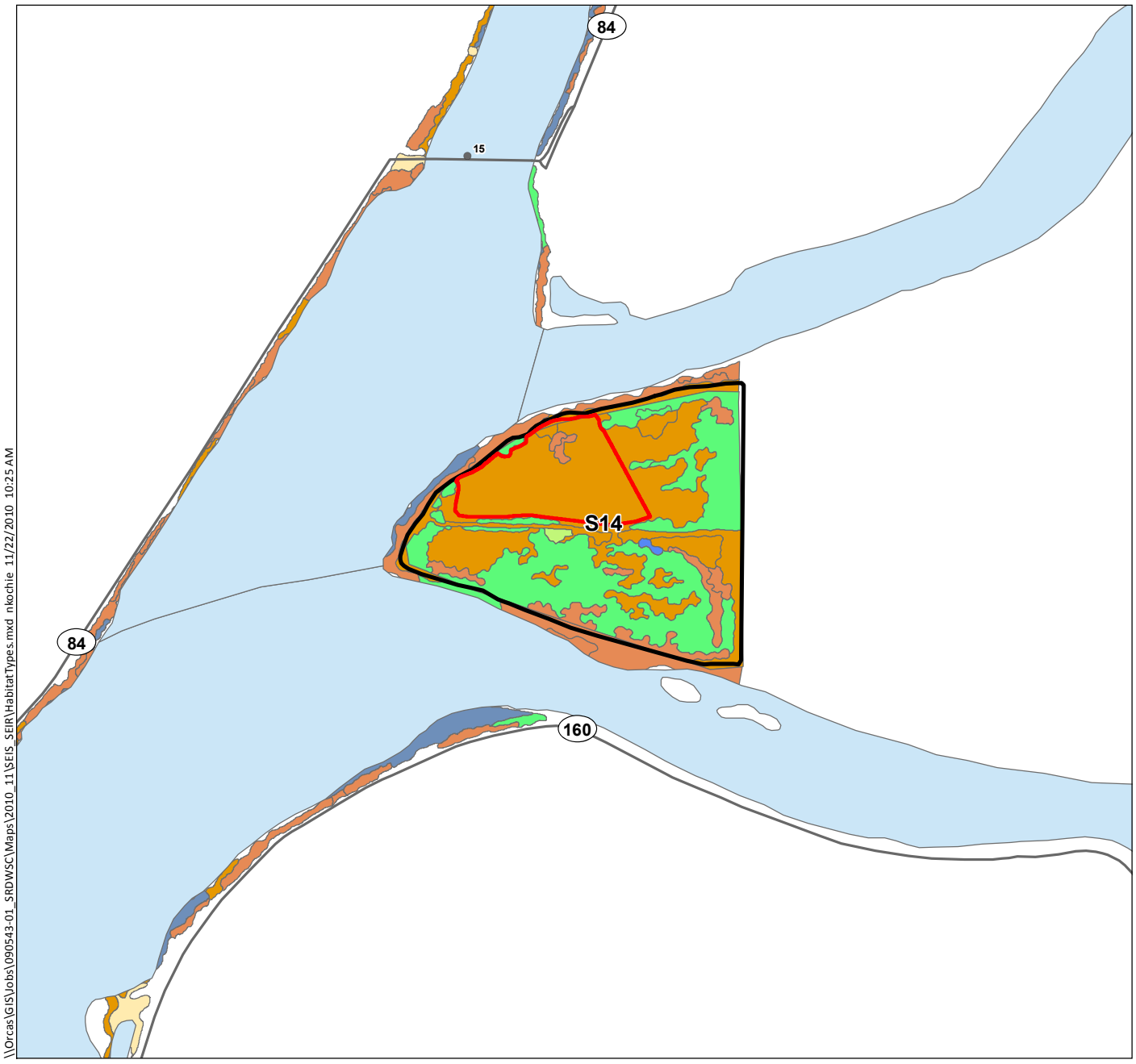


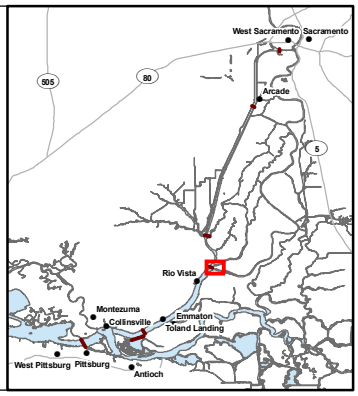
Figure 21
Habitat Types Identified at Placement Site S11
SEIS/SEIR
Sacramento River Deep Water Ship Channel



Vegetation

- Alkali meadow
- Cultivated field
- Developed
- Freshwater marsh
- Freshwater seep
- Marsh and swamp
- Non-native grassland
- Riparian forests
- Riparian scrub
- Riparian woodland
- River
- Tamarisk scrub
- Unvegetated
- Valley and foothill grasslands
- Valley oak woodland
- Valley saltbush scrub
- Water

- River Miles
- Cities
- Placement Site
- Placement Site Usable Portion
- Major Roads
- Roads
- Delta/Marsh Waters



Feet
0 600 1,200 1,800 2,400

N

Figure 22
Habitat Types Identified at Placement Site S14
SEIS/SEIR
Sacramento River Deep Water Ship Channel

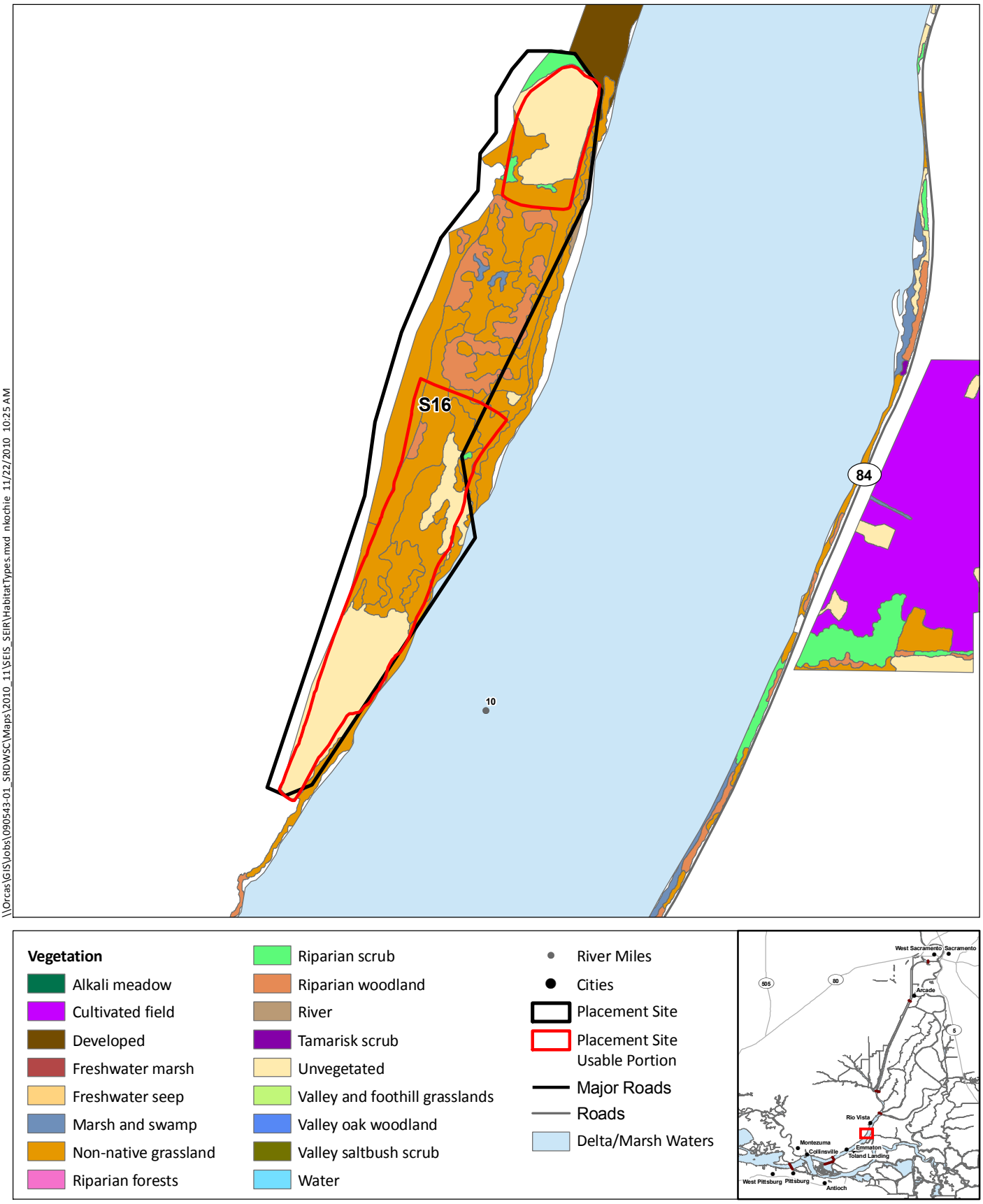


Figure 23
Habitat Types Identified at Placement Site S16
SEIS/SEIR
Sacramento River Deep Water Ship Channel

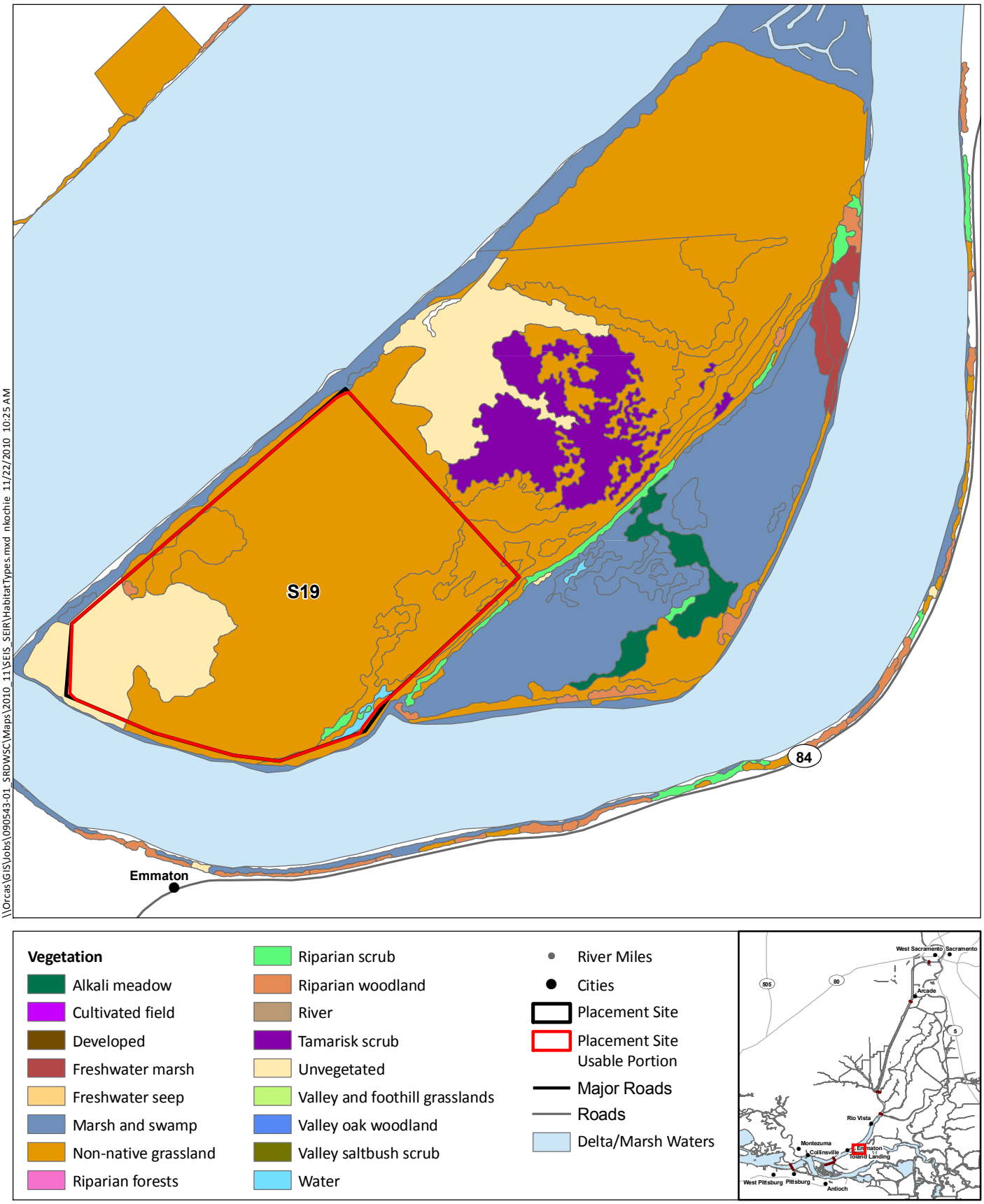
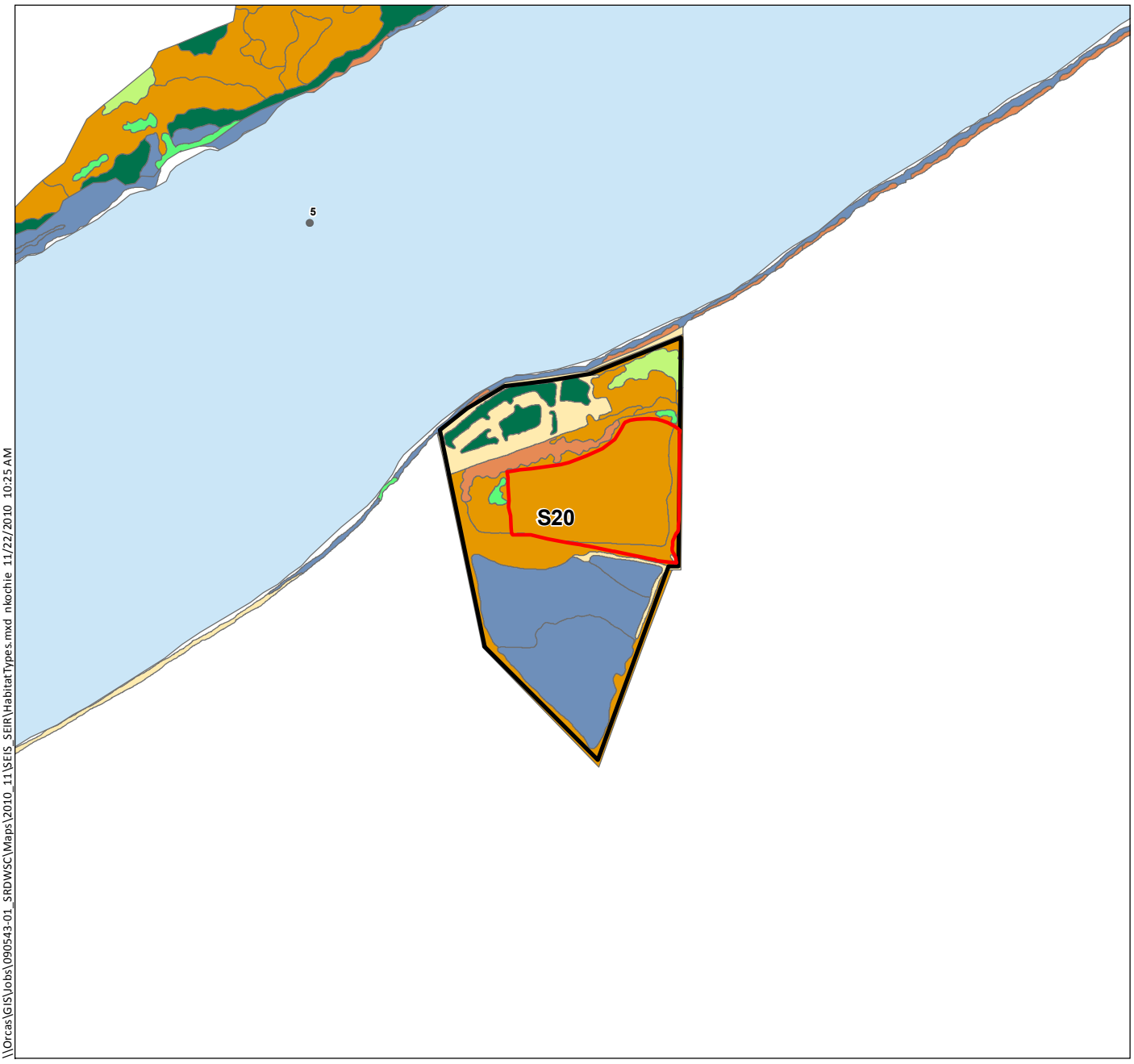


Figure 24
Habitat Types Identified at Placement Site S19
SEIS/SEIR
Sacramento River Deep Water Ship Channel



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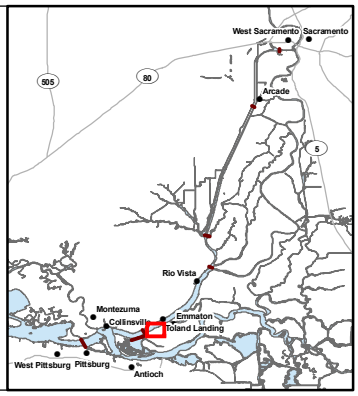
Vegetation

- Alkali meadow
- Cultivated field
- Developed
- Freshwater marsh
- Freshwater seep
- Marsh and swamp
- Non-native grassland
- Riparian forests
- Riparian scrub
- Riparian woodland
- River
- Tamarisk scrub
- Unvegetated
- Valley and foothill grasslands
- Valley oak woodland
- Valley saltbush scrub
- Water

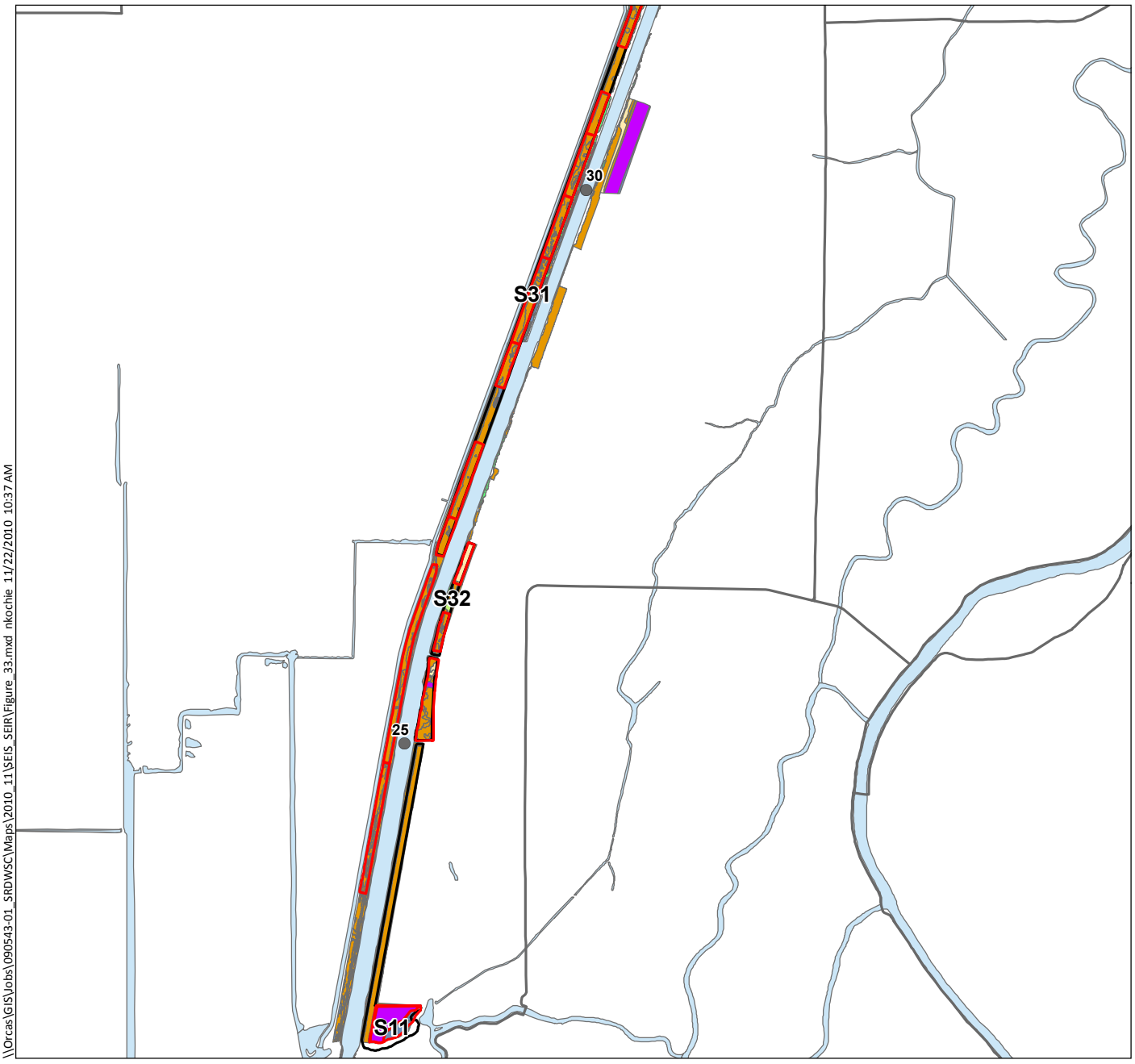
- River Miles
- Cities
- Placement Site
- Placement Site Usable Portion
- Major Roads
- Roads
- Delta/Marsh Waters



Feet
0 600 1,200 1,800 2,400

N

Figure 25
Habitat Types Identified at Placement Site S20
SEIS/SEIR
Sacramento River Deep Water Ship Channel



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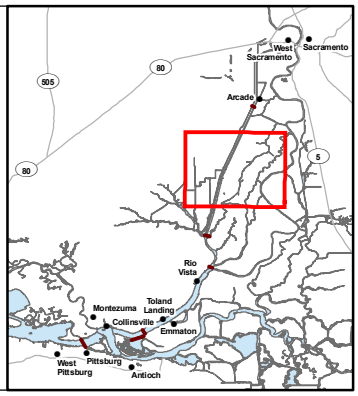
Vegetation

- Alkali meadow
- Cultivated field
- Developed
- Freshwater marsh
- Freshwater seep
- Marsh and swamp
- Non-native grassland
- Riparian forests
- Riparian scrub
- Riparian woodland
- River
- Tamarisk scrub
- Unvegetated
- Valley and foothill grasslands
- Valley oak woodland
- Valley saltbush scrub
- Water
- Cities
- River Miles
- Placement Site
- Placement Site Usable Portion
- Delta/Marsh Waters
- Major Roads
- Roads



Feet
0 3,500 7,000 10,500 14,000

N

Figure 26a
Habitat Types Identified at Placement Site S31
SEIS/SEIR
Sacramento River Deep Water Ship Channel

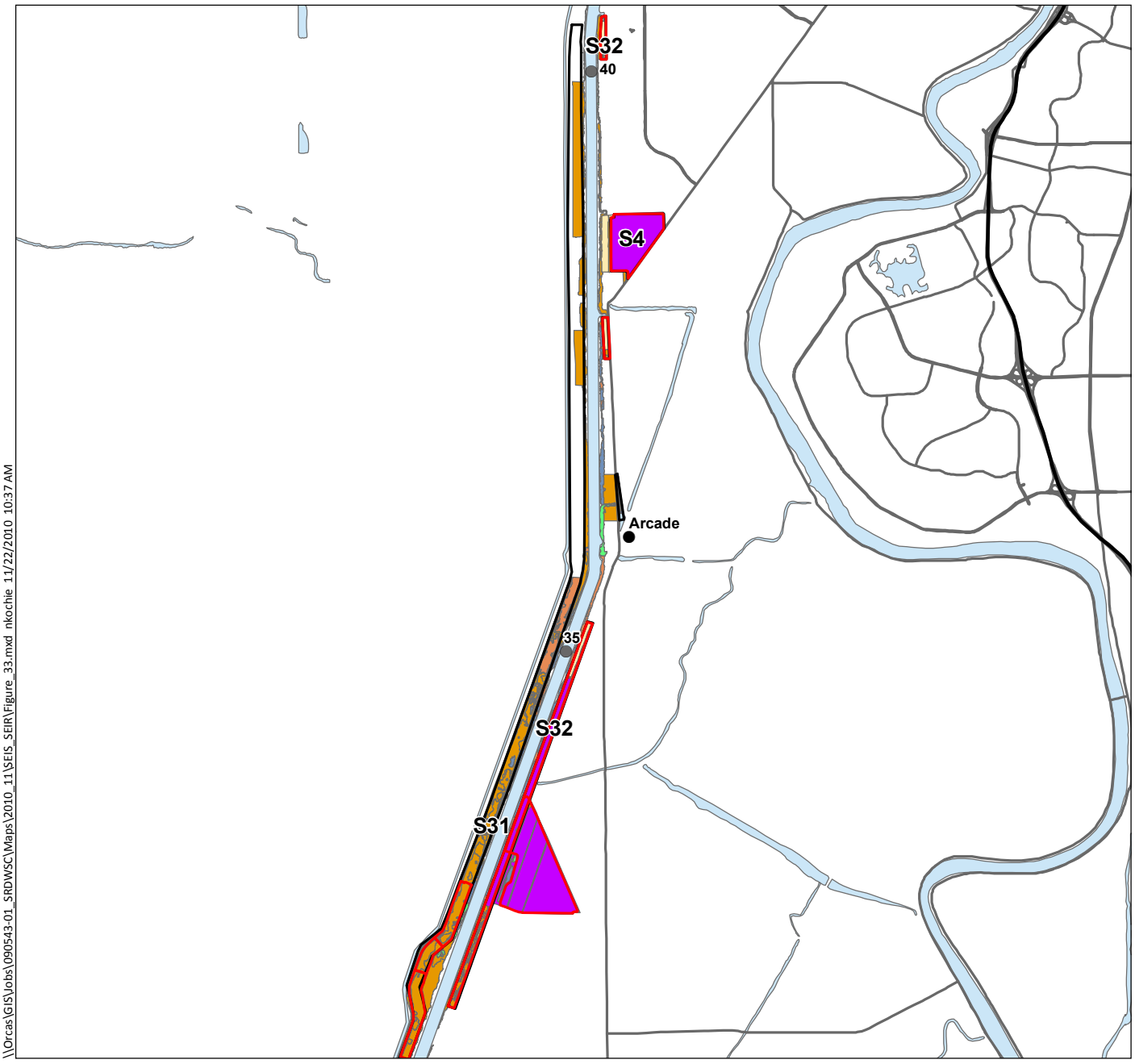


Figure 26b

Habitat Types Identified at Placement Site S31

SEIS/SEIR

Sacramento River Deep Water Ship Channel

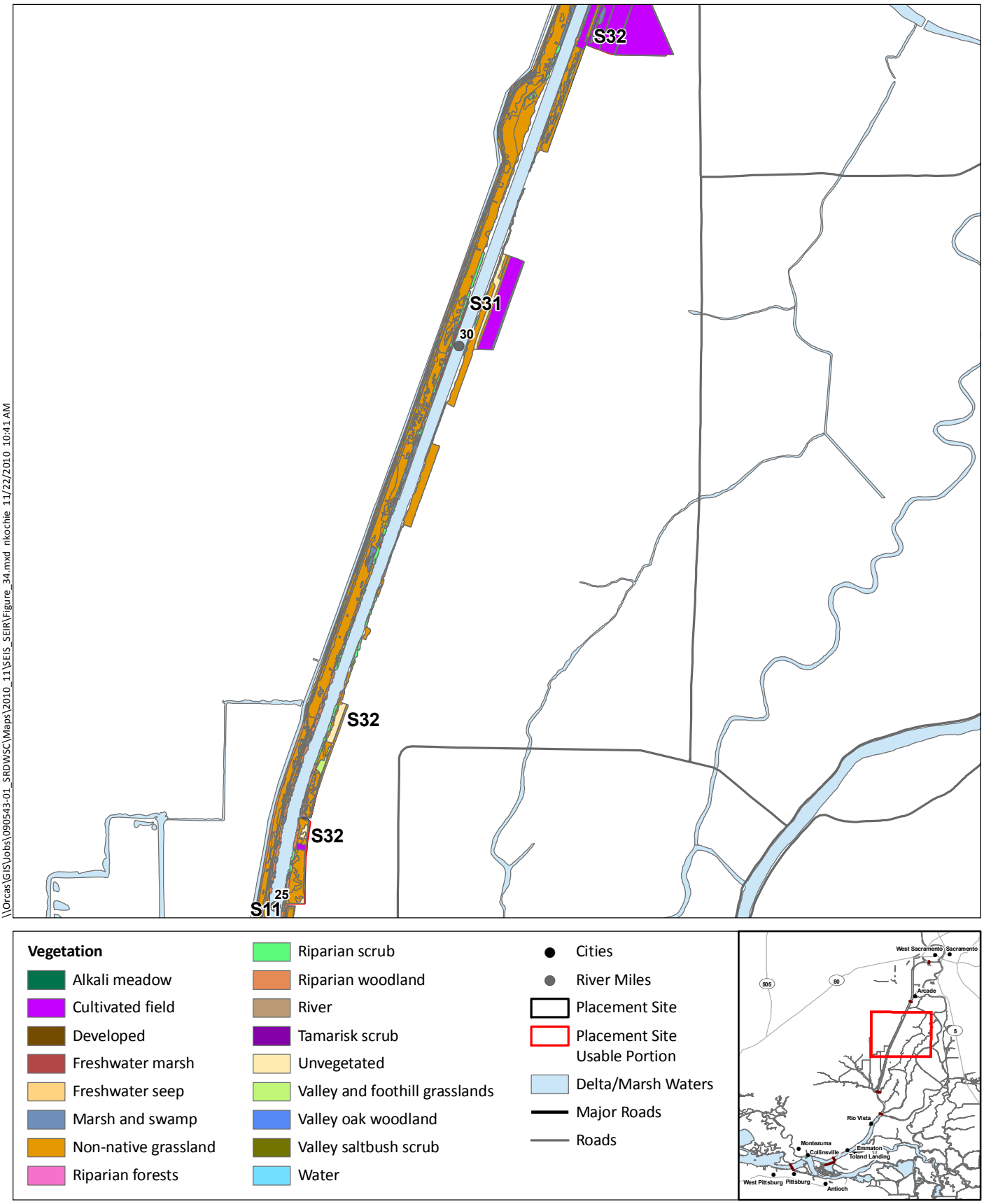


Figure 27a
Habitat Types Identified at Placement Site S32
SEIS/SEIR
Sacramento River Deep Water Ship Channel

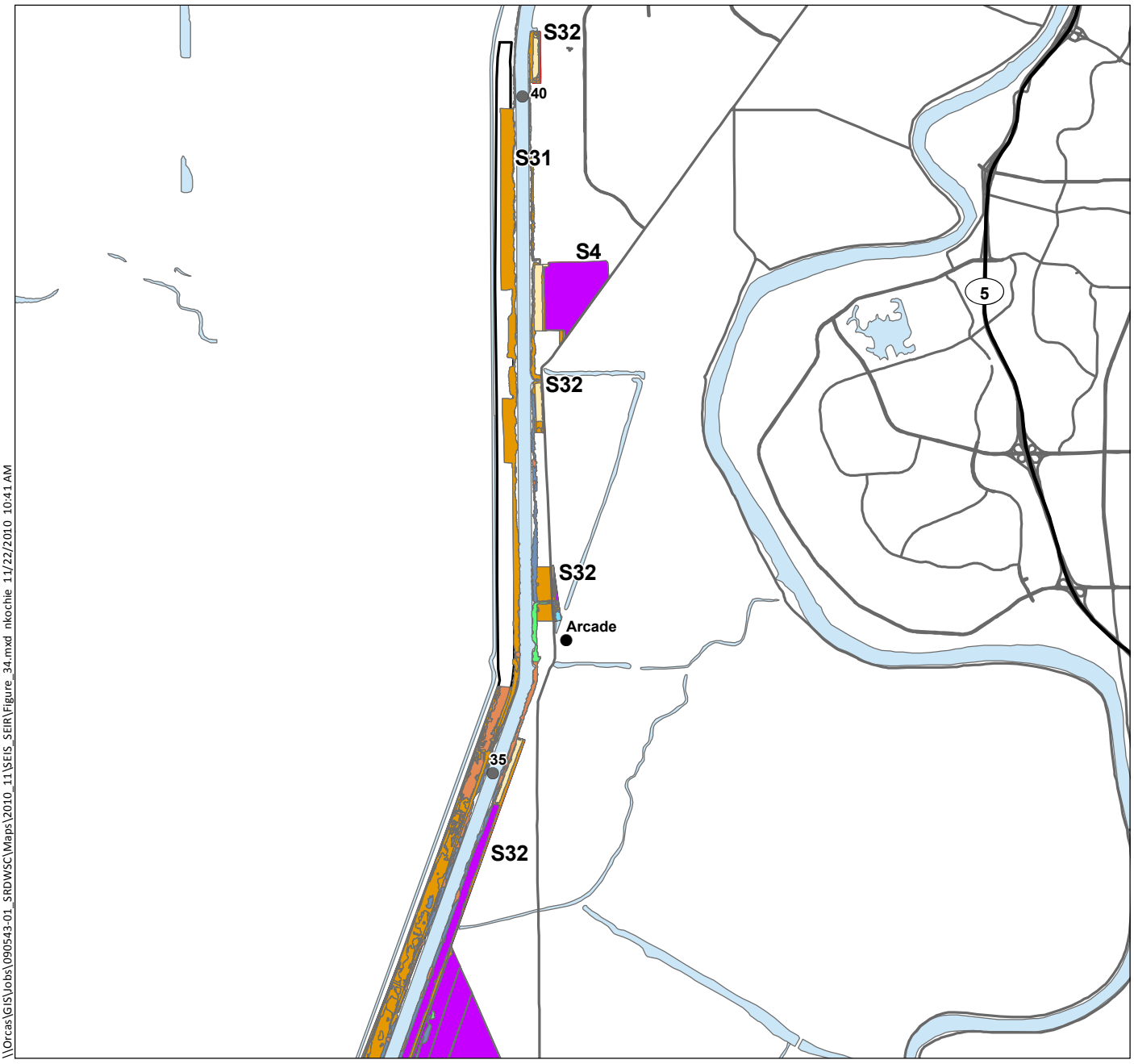


Figure 27b
Habitat Types Identified at Placement Site S32
SEIS/SEIR
Sacramento River Deep Water Ship Channel

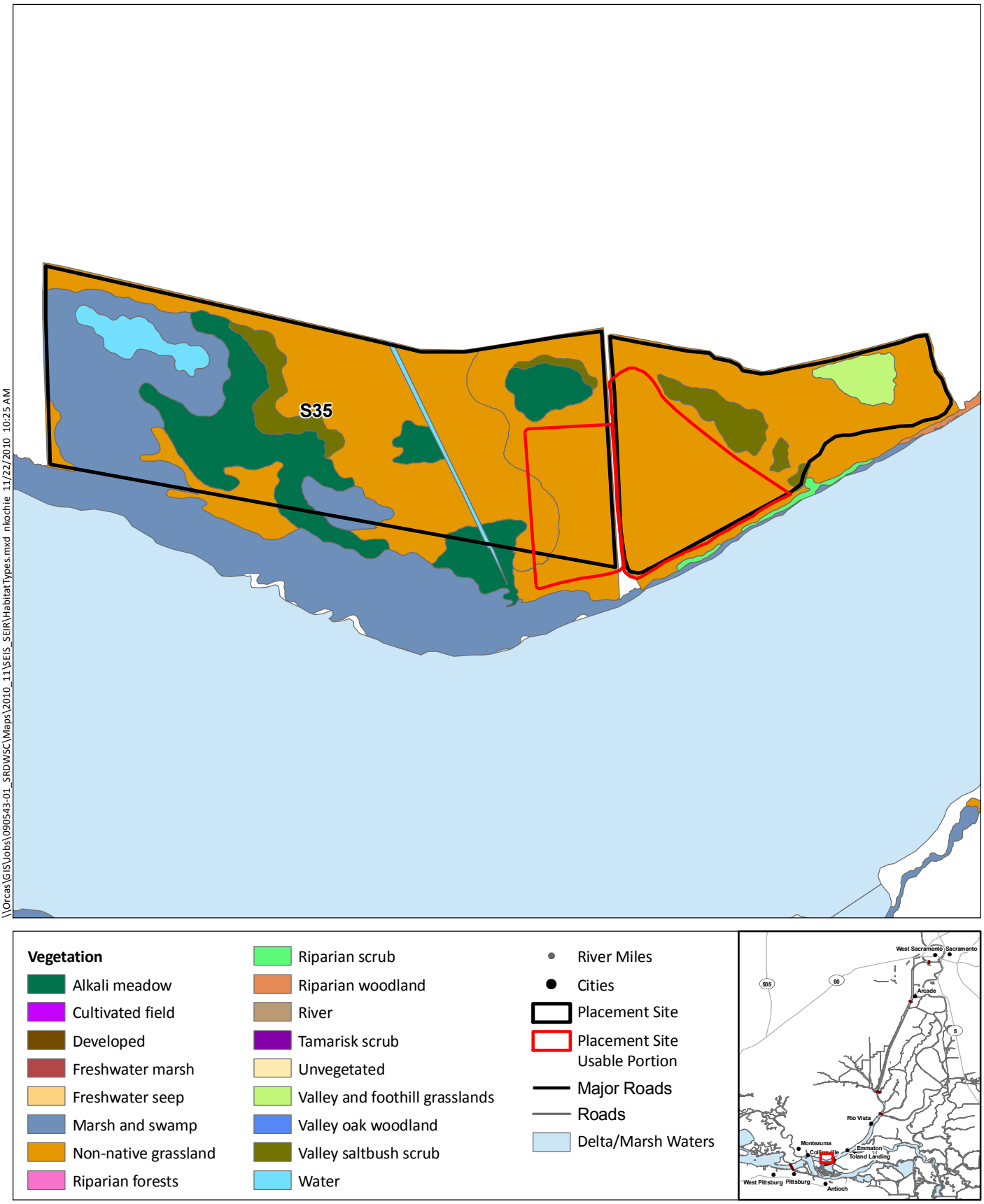


Figure 28

Habitat Types Identified at Placement Site S35

SEIS/SEIR

Sacramento River Deep Water Ship Channel

The following sub-sections provide the resulting detail on habitat types, vegetation, threatened and endangered species and their critical habitat, and other terrestrial species and habitat that may occur in the study area.

3.2.2.1.1 Habitat and Vegetation Types

Land use changes (such as residential development, agricultural use, and flood protection) coupled with water diversions from northern and southern California have greatly contributed to the alteration of ecological communities in the study area. In general, the vegetation communities present within the Delta can be divided into four major groups: agricultural land, non-native grassland, wetlands, and riparian areas. For this discussion, the focus is on the vegetation communities found within the dredged material placement sites because these communities have the potential to be impacted by the alternatives. A summary of the habitat types mapped in placement sites is provided in Table 42 (also see Appendix O). The categories are described below. The alternatives will only use a portion of these placement sites (herein referred to as the "usable portion"), and have been designed to minimize filling of wetlands and other sensitive habitats.

Table 42
Summary of Habitat Types Mapped in Proposed Dredged Material Placement Sites

Habitat Type	Acres	Percentage of Total
Non-native grassland	1,833.2	65
Wetlands	236.9	8
Freshwater wetlands	8.3	
Marsh and swamp	228.6	
Agriculture	233.6	8
Riparian woodland and scrub	203.1	7
Riparian forests	0.6	
Riparian scrub	50.8	
Non-native riparian scrub	3.3	
Riparian woodland	148.4	
Other	325.4	11
Alkali meadow	53	
River	3.3	
Tamarisk scrub	34.6	
Unvegetated	165.6	
Valley and foothill grasslands	25.9	
Valley oak woodland	1.5	
Valley saltbush scrub	15.3	
Water	9.8	
Developed	16.4	

Agricultural Land

Large tracts of agricultural land exist in the San Francisco Bay-Delta region, representing a wide variety of crops including rice, corn, safflower, sugar beets, winter wheat, various nuts, and grapes. Agricultural lands comprise approximately 8% (234 acres) of the habitat surveyed within the ten proposed dredged material placement sites (USACE 2009a). These low-lying fields are near sea level or below in many locations and are protected by artificial levees (USACE 2009a). This habitat type is characterized by flat, cultivated land in various stages of farming. Much of the agricultural land within the study area is protected by local use controls.

Non-native Grassland

Non-native grassland is the primary habitat type within the ten proposed dredged material placement sites, comprising approximately 65% (1,833 acres) of the area surveyed (USACE 2009a; 2010g). This habitat is dominated by grasses, shrubs, and herbs, such as peppergrass (*Lepidium* spp.), bromes (*Bromus* spp.), and thistle (*Centaurea sp.*). Grasslands are used primarily for cattle and sheep grazing.

Wetlands

Wetlands comprise approximately 8% (237 acres) of the habitat surveyed with the ten proposed dredged material placement sites. As is shown in Table 42, the 2008 and 2010 vegetation surveys identified the primary habitat types as freshwater wetlands, marshes, and swamps (including tidal wetlands and seasonal marshes). All wetlands were classified with U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) codes, and a detailed table of all wetland types mapped is in Appendix O.

Vernal Pools

Vernal pools can be defined as seasonally flooded landscape depressions underlain by a subsurface that limits drainage (Keeler-Wolf et al. 1998). Vernal pools typically result from an unusual combination of soil conditions, summer-dry Mediterranean climate, topography, and hydrology; they support a specialized biota, including a relatively large number of threatened and endangered species (Keeler-Wolf et al. 1998). Vernal pools are protected by land use regulations within Solano County, Sacramento County, the City of West Sacramento, Yolo County, and the City of Rio Vista. No vernal pools were identified in the 2008 or 2010 surveys.

Freshwater Wetlands

Freshwater wetlands comprise approximately 8.3 acres of the total wetland habitat surveyed. Approximately 1.33 acres of uncategorized wetlands occur within the usable portion of the placement sites. In these habitats, water is relatively shallow and is dominated by cattails

(*Typha latifolia*), rushes (*Juncus effusus*) and other freshwater plants associated with standing water (such as smartweed [*Polygonum hydropiper*], horsetail [*Equisetum arvense*], and other sedges [Cyperaceae]). Freshwater wetlands were primarily coded with NWI codes PUBA (palustrine, unconsolidated bottom, temporarily flooded) and Pf (palustrine farmed). PUBA wetland is non-tidal and typically characterized by trees, shrubs, emergents, and mosses. Pf-coded wetlands represent farmed wetlands and are typical of former tidelands in California that have been diked. These wetlands are characterized by land altered for the production of crops, but if farming were discontinued, hydrophytes would become re-established (USACE 2009a). Freshwater wetlands are also protected by local land use regulations.

Marsh and Swamp

Seasonal marshes were found in portions of proposed dredged material placement sites in swales at low elevations. Also characterized as emergent wetlands (coded by PEM1R [palustrine, emergent, persistent, seasonal-tidal] and PEMC [palustrine, emergent, temporarily flooded]), seasonal marsh vegetation is typically dominated by perennial plants that are erect, herbaceous hydrophytes that remain standing until the next growing season. This habitat is also marked by seasonal flooding from tidal or freshwater influxes present during the growing season but absent thereafter. The water table after the wet season is variable.

Some seasonal marshes and tidal wetlands were classified under marshes and swamps as part of the vegetation survey. Marshes and swamps comprise approximately 228.6 acres of the habitat in the ten proposed dredged material placement sites. Approximately 1.33 acres of uncategorized wetlands occur within the usable portion of the placement sites. Tidal wetlands refer to habitat that is periodically flooded by waters of the SRDWSC and occupies the elevations between mean higher high water (MHHW) and the highest tide level. This habitat is inundated infrequently and for short periods, and may be characterized by salt grass (*Distichlis spicata*). This habitat is typically found along the margins of Delta islands, in narrow bands along the levees, and near the Port in the SRDWSC (USACE 1986).

Tidal mudflats were not identified in the vegetation survey, though they were noted in the 1986 Supplemental EIS to exist in the upper reaches of the SRDWSC, outside of the current study area (USACE 1986). Tidal mudflat habitat is exposed at low tide and provides feeding grounds for various shorebird species. These habitat types are also protected by local land use regulations.

Riparian Woodland and Scrub

Riparian communities are not restricted to specific climates or soil types, but they are primarily dependent on a permanent supply of water. Variables that affect the community

structure and composition include the nature of the water supply (i.e., the amount of water carried by a stream or present within a lake, and the lateral extent and depth of subterranean aquifers), altitudinal gradients, north-south and east-west axes, historical land uses, and the nature and size of the stream banks and floodplains (Holland and Keil 1995).

Riparian woodland and scrub comprise approximately 7% (203.1 acres) of the habitat surveyed within the ten proposed dredged material placement sites. These areas include approximately 149 acres of riparian woodland and forests and 54.1 acres of riparian scrub. Approximately 9.35 acres of riparian habitat exists within the usable portion of the placement sites. Woodland areas are dominated by willows (*Salix* sp.), oaks (*Quercus* sp.), cottonwoods (*Populus* sp.), and walnut (*Juglans* sp.) species characteristic of the Delta region. Riparian buffers and heritage trees are protected by land use regulations in most of the study area.

Other

Alkali Meadow

Alkali meadows comprise approximately 2% (53 acres) of the habitat surveyed within the ten proposed dredged material placement sites. Alkali meadows occur in areas where the water table is shallow (1 to 3 meters deep), and soils are alkaline. Alkali meadows provide valuable forage for livestock and, without proper management, may suffer grazing impacts. They are also reliable indicators of shallow water tables (Sawyer and Keeler-Wolf 1995). Dredged material placement does not occur in these areas, nor would it occur under the alternatives.

SRDWSC (Sacramento River and Man-made Portion of Channel)

Waters of the SRDWSC minimally enter some of the ten proposed dredged material placement sites. The SRDWSC comprises less than 1% (approximately 3 acres) of the habitat surveyed within the placement sites.

Tamarisk Scrub

Tamarisk scrub comprise less than 1% (approximately 34.6 acres) of the habitat surveyed within the ten proposed dredged material placement site. Tamarisk scrub is dominated by tamarisk (*Tamarix* sp.) but also may contain willows, salt bushes (*Atriplex* spp.), catclaw acacia (*Acacia greggii*), and salt grass (Holland 1986; Sawyer and Keeler-Wolf 1995). Tamarisk is an invasive shrub that was introduced to the region in the early 1900s from southern Eurasia.

Unvegetated

Unvegetated areas comprise approximately 6% (approximately 165.6 acres) of the habitat areas surveyed within the ten proposed dredged material placement sites (USACE 2008c,

2010g).

Valley and Foothill Grasslands

Valley and foothill grasslands comprise less than 1% (approximately 25.9 acres) of the habitat areas surveyed within the ten proposed dredged material placement sites (USACE 2008c, 2010g). This is a relict community still grazed by sheep that is dominated by purple needlegrass (*Stipa pulchra*), the State Grass of California. This native pasture often existed as a consociation of purple needlegrass or sometimes was co-dominant with nodding needlegrass (*S. cernua*). This is the most common form of the California perennial bunchgrass prairie, which in turn has been interpreted as the Pacific slope form of the general bunchgrass steppe (Barbour and Major 1977).

Valley Oak Woodland

Valley oak woodlands comprise less than 1% (approximately 1.5 acres) of the habitat areas surveyed within the ten proposed dredged material placement sites (USACE 2008c, 2010g). This habitat is made up of savanna-like stands with partially closed canopies, comprised mostly of winter-deciduous, broad-leaved species. Ground cover consists of a well-developed carpet of annual grasses and forbs. Mature valley oaks with well-developed crowns range in height from 15 to 35 meters (49 to 115 feet) (Conard et al. 1977).

In § 21083.4 of the CEQA, local counties have the authority to determine if conversion of oak woodlands would represent a significant effect on the environment. Oak is defined as a native species in the genus *Quercus*, not designated as Group A or B commercial species by the State Board of Forestry and Fire Protection, and equal to or greater than 5 inches in diameter at breast height. If considered a significant impact, the county may elect mitigation including conservation easements to protect oak woodlands, plantings with a minimum survival of 7 years, and funding. In addition to CEQA, woodlands are protected by local land use regulations.

Valley Saltbush Scrub

Valley saltbrush scrub comprises less than 1% (approximately 15.3 acres) of the habitat areas surveyed within the ten proposed dredged material placement sites (USACE 2008c, 2010g). It is dominated by open, gray, or blue-green chenopod scrubs (10 to 40% cover), usually over a low herbaceous annual understory. Cover types are dominated by saltbush (*Atriplex polycarpa)* or spiny saltbush (*A. spinifera)* (Holland 1986).

Water

Less than 1% (approximately 9.8 acres) of the habitat areas surveyed within the ten proposed dredged material placement sites is composed of water in the form of streams and ponds

(USACE 2010g).

Habitat and Vegetation Types at Dredged Material Placement Sites

This section documents the distribution of the aforementioned terrestrial habitats at the ten proposed dredged material placement sites, by reach, starting from the westernmost extent of the study area (Reach 1) and moving northeast to the Port (Reach 5). The analysis focuses on the identified usable placement footprints within each proposed placement site, which have been designed to minimize filling of wetland and other sensitive habitats. Table 43 shows the proposed impacted and mitigated habitat types and each placement site.

Table 43
Summary of Impacted and Mitigated Habitat Types in Usable Portions of Placement Sites

Site Number	Site Area (acres)[f]	Usable Area (acres)	Estimated Volume (cubic yards)[g]	Maximum Berm Height (feet)	Area Requiring Mitigation (acres)[a]	Area of Non-Sensitive Habitat Impacted (acres)[b]	Area of Riparian Habitat Impacted (acres)	Area of Wetland Impacted (acres)	Area of Oak Woodland Habitat Impacted (acres)
S1	129.00	79.00	659,009	10	0	79.0	0	0	0
S4	111.90	111.29	1,436,367[e]	10	0	111.29	0	0	0
S11	183.62	40.30	447,000	10	0.30	40.0	0.30	0	0
S14	91.00	18.80	349,292	17	0.61	18.19	0.61	0	0
S16	136.12	61.28	474,266	22	0.67	61.28	0.67	0	0
S19	173.15	172.41	2,620,256[c]	21	1.77	170.64	0.87	0	0
S20	91.18	23.49	407,321	14	0	23.49	0	0	0
S31	1,086.03	381.88	4,000,000[d]	9	8.12	373.76	6.79	1.33	0
S32	243.21	212.68	173,009	6	3.68	212.31	0.11	0	0.07
S35	280.93	60.14	364,857	8	0	60.14	0	0	0

Notes:

a Habitat types identified according to the definitions from the Holland Natural Communities of California (Holland 1986)

b Includes "cultivated field," "non-native grassland," "unvegetated," and drainage ditches

c Volumes were estimated using the "Surface Volume" tool from 3D Analyst, an ArcGIS software extension; volume changes as a result of the proposed berm are not included in this estimate

d Sum of volumes for individual basins within Site S31; fill elevations for each basin were based on a maximum berm height of 9 feet from the lowest point along the perimeter of each given basin

e Volumes were estimated assuming a given fill depth over a flat surface, because no site topographic data were available

f All area calculations were completed in the "NAD_1983_UTM_Zone_10N" coordinate system because the habitat mapping was completed in this (UTM) coordinate system, due to the habitat extent covering several State Plane Zones

g Volume calculations were completed in the "NAD_1983_StatePlane_California_II_FIPS_0402_Feet" coordinate system, because the base digital terrain model was created in this projection

Reach 1

S35 (Figure 28) is divided into two distinctive sections: the eastern section is dominated by non-native grassland with a small area of valley and foothill grasslands and several pockets of valley saltbush (*Atriplex fruticulosa*) scrub; the western section is predominately emergent wetland with a valley saltbrush scrub border. Upland areas within the western section are dominated by non-native grassland. A tributary draining the Montezuma Hills runs through the western section. The area bordering the SRDWSC is characterized by an emergent wetland. The habitat was previously characterized as grassland and seasonal marshland in the 1986 Supplemental EIS.

The usable portion of S35 is comprised primarily of dryland agriculture and non-native grassland. There are no wetlands, riparian areas, or other sensitive habitats occurring within the usable portion of placement site S35, as summarized in Table 43.

Reach 2

S20 (Figure 25) has three distinctive areas: the northern portion is the Rio Viento RV Park and dominated by unvegetated paved surfaces with an upland field of non-native grasslands and valley and foothill grasslands on the eastern side, the middle portion is bermed on all sides and dominated by non-native grasslands with pockets of riparian scrub and riparian woodland, and the southern portion is characterized by an emergent wetland bounded by berms and dominated by non-native grassland on all sides. Water on the site may pond within areas excavated in the uplands, and as such, the areas are not considered jurisdictional waters of the United States. Additional seasonal wetlands in the form of a drainage ditch and a small area in the northeastern portion of the site contain cattails, tules (*Scirpus* spp.), and willows. S20 is surrounded by fields currently used for grazing. The habitat was previously characterized as grassland and seasonal marsh in the 1986 Supplemental EIS.

The usable portion of S20 is located in the middle area of the site. It is mainly composed of irrigated agriculture with a small area of non-native grassland and bermed on all sides with Willow scrub-shrub on the northern side and peppergrass on the remaining east, west, and southern sides. Within the bermed area, the vegetation is dominated by wild lettuce (*Lactuca* sp.) with minor pockets of willow shrubs (USACE 2008c; USFWS 2010e). No wetlands, riparian areas, or other sensitive habitat are found within the usable portion of S20 as summarized in Table 43.

S19 (Figure 24) encompasses most of Decker Island, except for a northern parcel owned by USFWS, which is a wetland restoration site. A large berm running from northeast to southwest through the site divides it into two distinctive parts: the area east of the berm is characterized by wetlands that transition to an emergent marsh in the southern portion, and

the area west of the berm is dominated by non-native grassland, marked by a tamarisk community and recent disturbance at the site's center. At the time of survey, active pumping in the southern extent of the western portion led to flooding, creating a temporary wetland. A wetland margin borders the western edge of the site and the SRDWSC. The habitat was previously characterized as agriculture, grassland, barren, and riparian in the 1986 Supplemental EIS.

The usable portion of S19 is located northwest of the berm that divides the site into two sections. This area is primarily composed of non-native grassland, irrigated agriculture, and general shrubs (USFWS 2010e) and dominated by peppergrass, bromes, and thistle (*Silybum* spp.). There is a large tamarisk community around the center of the northern half of S19, surrounding a recently disturbed area next to an old landing. No wetlands occur within the usable portion of S19. Sensitive habitats occurring within the usable portion of S19 include 0.87 acres of riparian habitat and 0.90 acres of open water, as summarized in Table 43.

S16 (Figure 23) consists predominately of unvegetated fill material, except for an area of non-native grassland located in the middle portion of the site. Riparian vegetation and a 5.4-acre open-water lake characterize the wetland at the center of this site. A small impoundment of water at the base of the Montezuma Hills may have contributed to the hydrology supporting this wetland at the time of the survey. The adjacent Montezuma Hills supports mainly non-native grasslands and contains little to no wetlands. Invasive arundo (*Arundo donax*) borders the edge of the SRDWSC. The habitat was previously characterized as grassland in the 1986 Supplemental EIS. A large wetland complex and open water lake exist in the central portion of the placement site. The major seasonal wetland onsite is designated as L2UBFh (NWI), which is defined as "lacustrine, littoral, unconsolidated bottom, semi-permanently flooded, dike/impounded wetland." Vegetation in the wetland areas bordering the lake is composed primarily of willow scrub-shrub and non-emergent herbaceous wetland (peppergrass and wild lettuce) (USACE 2008c).

The usable portion of S16 is broken into two separate locations—one at the north end of the site and one in the central-south end. The areas are mainly composed of dryland agriculture, non-native grassland, and general urban designations (USACE 2010e). Both sites are predominately unvegetated fill material and dominated by peppergrass. No wetlands occur within the usable portion of S16. Sensitive habitats occurring within the usable portion of S16 include 0.67 acres of riparian habitat as summarized in Table 43.

Reach 3

S14 (Figure 22) is bisected into distinctive northern and southern halves by a narrow berm. The northern half is dominated by non-native grassland with riparian woodland along the

northern margin; the southern half is dominated by riparian scrub, with scattered areas of riparian woodland and non-native grassland. A small wetland was surveyed within a stand of riparian trees at the southeast corner of the site. An area roughly the size of S14 lies between this placement site and Grand Island Road to the north and is covered by scrub habitat and emergent marsh wetlands that are seasonally flooded. The habitat was previously characterized as grassland, disturbed woodland, and barren in the 1986 Supplemental EIS. Additionally, there are shallow ponds adjacent to the Sacramento River/Steamboat Slough, and water is available year-round from the river, runoff, and seeps.

The usable portion of S14 is located in the northwestern quadrant of the site. It is primarily composed of non-native grassland and valley foothill riparian habitat designations (USACE 2010e). A narrow berm bisects the site into northern and southern halves, with the usable portion sitting to the north of the berm. The northern half is dominated by peppergrass, with minor amounts of willow along the northern margin. No wetlands exist on the usable portion of S14. Sensitive habitats occurring within the usable portion of S14 include 0.61 acres of riparian habitat as summarized in Table 43.

Reaches 4 and 5

S11 (Figure 21) is distinguished by two parts: a northern portion that borders the east levee of the SRDWSC and a southern end that is dominated by a cultivated field. The SRDWSC forms the entire western border of S11. The northern section consists mostly of non-native grassland with alternating wetland, riparian scrub, riparian woodland, and valley and foothill grassland areas on the eastern border of the site. A small drainage ditch parallels the entire length of the site and is marked by riparian woodlands, non-native grassland, and unvegetated areas. The site is bordered on the north and west by significant drainage ditches. The southern portion of S11 is dominated by agricultural crops, and a large area of valley and foothill grasslands on the southeastern side of the site is consistent with the habitat type of the adjacent Miner Slough. The habitat was previously characterized as agriculture in the 1986 Supplemental EIS.

One part of S11 borders the length of the SRDWSC east levee and is dominated by mustard (*Brassica* sp.) along the levee flank and bromes along the base. The second section of S11 is the southernmost extent and extends into an agricultural field dominated with agricultural crops. Both areas are bordered by drainage ditches and are dominated by tules and willows. There are no wetlands within the usable portion of S11, but adjacent wetlands exist along the perimeter of its boundaries. Sensitive habitats occurring within the usable portion of S11 include 0.3 acres of riparian habitat as summarized in Table 43.

S31 (Figure 26) is dominated by non-native grassland with intermittent areas of wetland and

riparian woodland on the western edge near the toe-drain. The southern portion of the site is characterized by non-native grasslands on the sides of the levee and non-vegetated area on top of the levee. A large, fragmented wetland with interspersed riparian woodland areas also occupies the southern portion. The edge of the SRDWSC is marked by large tracts of riparian vegetation and more heavily forested wetland in the south, and characterized by riparian scrub and emergent marsh wetlands in the north. The habitat was previously characterized as agriculture in the 1986 Supplemental EIS.

The usable portion of S31 comprises the southern half of the entire placement site. The southernmost half includes both sides of the levee, and a toe-drain exists on portions of the western side of the levee. The area between the levee and the SRDWSC is dominated by mustard, peppergrass, thistle, and unvegetated land (USACE 2008c). Along the entire western border of the site's usable portion is a toe-drain that maintains a thin riparian buffer consisting of forested and scrub-shrub wetlands. The forested wetlands are dominated by willows with minor amounts of cottonwoods. The scrub-shrub wetlands are dominated by willows, and the emergent wetlands are dominated by tules (USACE 2008c; USACE 2010e). Sensitive habitats occurring within the usable portion of S31 include 6.79 acres of riparian habitat and 1.33 acres of wetland, as summarized in Table 43.

S32 (Figure 27) consists of six distinct segments and is dominated by non-native grassland and unvegetated habitats. The unvegetated tracks within S32 may have received recent dredged material, and the dominance of grasses also points to recent disturbance. In all segments, the margin along the SRDWSC is predominately riparian woodland and emergent wetlands. All segments of S32 are bordered by agricultural fields to the east, with the exception of the northernmost section that is adjacent to a residential neighborhood. The habitat was previously characterized as grassland in the 1986 Supplemental EIS.

To avoid impacts to wetlands, the usable portion of S32 comprises a small area in the northern reaches, which is separate from the other subsections that make up the site. This usable portion is surrounded by irrigated agriculture and may have had recent dredged material placement (USACE 2008c). This area is dominated by grasses and unvegetated areas (USACE 2008c). There are no wetlands inside the usable portion of S32. Sensitive habitats occurring within the usable portion of S32 include 0.11 acres of riparian habitat and 0.07 acres of oak woodland, as summarized in Table 43.

S4 (Figure 20) is entirely composed of an agricultural field. During the 2008 survey, the field was a monotypic stand of lettuce, while during the 2010 survey the field was recently plowed and unvegetated. S4 is bordered to the west by the east levee of the SDWSC. A small drainage ditch at the base of the levee runs along the western side of the site. The

usable portion of S4 includes the entire parcel. There are no wetlands, riparian areas, or other sensitive habitats within the usable portion of S4 as summarized in Table 43.

S1 (Figure 19) is dominated by ruderal species, primarily mustard, wild lettuce, and thistle. In the northwest portion of the site, an extensive wetland exists (approximately 8.6 acres) that is dominated by sorrel (*Rumex* sp.) and that holds a wide variety of plant species. The wetland is surrounded by a large levee preventing any drainage from the S1 site into the wetland (USACE 2008c).

The usable portion of S1 comprises a west area and an east area, separated by a wetland (Lake Washington). The areas are dominated by irrigated agriculture, with a small portion of non-native grassland in the northwestern corner of the west area. The areas are dominated by mustard, wild lettuce, and thistle. There are no wetlands, riparian areas, or other sensitive habitats within of the usable portion of S1 as summarized in Table 43.

3.2.2.1.2 Terrestrial Species and Habitat without Special Status

Terrestrial species are known to use habitats within all of the proposed placement sites of the SRDWSC. Table 44 lists common species without special status that may occur within the study area. Invasive plant and wildlife species in the study area are discussed following the table. Special status species are discussed in Section 3.2.2.1.3.

Table 44
Terrestrial Species without Special Status
with Potential to Occur in the Study Area

Common Name	Scientific Name
American avocet	*Recurvirostra americana*
American goldfinch	*Carduelis tristis*
Belted kingfisher	*Ceryle alcyon*
Black-crowned night heron	*Nycticorax nycticorax*
Black phoebe	*Sayornis nigricans*
California gull	*Larus californicus*
Coyote	*Canis latrans*
Great egret	*Casmerodius albus*
Least sandpiper	*Erolia minutilla*
Lesser goldfinch	*Carduelis psaltria*
Long and short-billed dowitcher	*Limnodromus spp*
Muskrat	*Ondatra zibethica*
Northern harrier	*Circus cyaneus*
Pied-billed grebe	*Podilymbus podiceps*
Red-tailed hawk	*Buteo jamaicensis*
Red-winged blackbird	*Agelaius phoeniceus*
Ring-necked pheasant	*Phasianus colchicus*

Common Name	Scientific Name
River otter	*Lutra Canadensis*
Snowy egret	*Leucophoyx thula*
Tree swallow	*Iridoprocne bicolor*
Western pond turtle	*Clemmys marmorata marmorata*
Western sandpiper	*Calidris mauri*
White-tailed kite	*Elanus leucurus*

Source: CDFG 2008d

Invasive Species – Plants

Invasive plants are introduced species that can thrive in areas beyond their natural range of dispersal. These plants are characteristically adaptable, aggressive, and have a high reproductive capacity. Their vigor, combined with a lack of natural enemies, often leads to outbreak populations. There are several invasive plant species in the study area that have the potential to impact listed species and habitats (Fowler 2010), as follows:

- Oat (*Avena* spp.)
- Mustard (*Brassica* sp.)
- Thistle (*Centaurea* spp.)
- Fennel (*Foeniculum vulgare*, invasive, non-native fennel)
- Floating water primrose (*Ludwigia peploides)*
- Sweetclover (*Melilotus* sp.)
- Milkthistle (*Silybum marianum*)
- Tamarisk (*Tamarix* sp.)

Invasive Species – Other Wildlife

The introduction and spread of invasive or introduced wildlife species in ecosystems in the Delta is common and increasingly prevalent. There are several invasive wildlife species in the study area that have the potential to impact listed species and habitats, the majority of which are associated with the aquatic environment, as discussed in Section 3.1. Terrestrial invasive species within the Delta include red fox (*Vulpes vulpes*) and the American bullfrog (*Rana catesbeiana*).

3.2.2.1.3 Special Status Species and Critical Habitat Associated with Dredged Material Placement Sites

The structural diversity of the Delta as a whole and its associated riparian and grassland habitats provide nesting, cover, and foraging habitat for many wildlife species. A number of endangered and threatened species and their critical habitat currently exist in the study area. A species list was obtained from the USFWS on March 18, 2010, covering the eight U.S. Geological Service (USGS) 7.5 minute quads (Rio Vista, Jersey Island, Antioch North, Clarksburg, Saxon, Liberty Island, Courtland, and Sacramento West) and four counties

(Sacramento, Contra Costa, Yolo, and Solano) in which the study area is located. Table 45 lists the threatened and endangered terrestrial species with recorded occurrences in the study area. Federal or state listed endangered or threatened plant and animal species that are most likely to occur in terrestrial, riparian, or wetland habitat areas of the SRDWSC are described after Table 45, including a brief species description, potential for occurrence in the study area (unless provided in other sections of this report), and critical habitat designations. Designated critical habitat for several species exists within the vicinity of the study area, though none occurs within the proposed placement sites or within the dredging footprint.

Table 45
Federal and State Special Status Species with the Potential to Occur within the Study Area

Species	Federal	State	Habitat Association	Potential Areas of Occurrence
Invertebrates				
Lange's metalmark butterfly (*Apodemia mormo langei*)	E		Inhabits stabilized dunes along the San Joaquin River; endemic to Antioch Dunes and Contra Costa County; primary host plant is *Eriogonum nudum var auriculatum*; feeds on nectar of other wildflowers, as well as host plant	None
Conservancy fairy shrimp (*Branchinecta conservatio*)	E		Vernal pools and swales	None
Vernal pool fairy shrimp (*Branchinecta lynchi*)	T		Vernal pools and other seasonal wetlands	None
Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*)	T		Elderberry shrubs, typically in riparian habitats	S1, S14, S19, and along the levees of the SRDWSC
Vernal pool tadpole shrimp (*Lepidurus packardi*)	E		Vernal pools, swales, and other ephemeral wetlands	None
Amphibians				
California tiger salamander (*Ambystoma californiense*)	T	T	Small ponds, lakes, or vernal pools in grasslands or oak woodlands	S35
Silvery legless lizard (*Anniella pulchra pulchra*)		SSC	Sandy or loose loamy soils under sparse vegetation; soil moisture is essential; prefer soils with a high moisture content	None
Western pond turtle (*Emys marmorata*)		SSC	Aquatic turtle of ponds, marshes, rivers, streams, and irrigation ditches with aquatic vegetation below 6,000 feet; need basking sites and suitable (sandy banks or grassy open fields) upland habitat up to 0.5 km from water for egg-laying	S4, S16, S19, S20, and S35
Reptiles				
Giant garter snake (*Thamnophis gigas*)	T	T	Streams, sloughs, ponds, and irrigation/drainage ditches; also requires upland refugia not subject to flooding during its inactive season	S1, S4, S11, S16, S19, S20, S31, S32, and S35

Species	Federal	State	Habitat Association	Potential Areas of Occurrence
Birds				
Tricolored blackbird (*Agelaius tricolor*)		SSC	Highly colonial species, most numerous in central valley and vicinity; largely endemic to California; requires open water, protected nesting substrate, and foraging area with insect prey within a few km of the colony	S1 and S31
Great blue heron (*Ardea herodia*)			Colonial nester in tall trees, cliffsides, and sequestered spots on marshes; rookery sites in close proximity to foraging areas: marshes, lake margins, tide-flats, rivers and streams, wet meadows	S19
Grasshopper sparrow (*Ammodramus savannarum*)		SSC	Dense grasslands on rolling hills, lowland plains, in valleys, and on hillsides on lower mountain slopes; favors native grasslands with a mix of grasses, forbs, and scattered shrubs; loosely colonial when nesting	None
Burrowing owl (*Athene cunicularia*)		SSC	Open, dry annual or perennial grasslands, deserts, and scrublands characterized by low-growing vegetation; subterranean nester, dependent upon burrowing mammals, most notably, the California ground squirrel	Eastern portion of the study area, Yolo Bypass, and along levees in portions of the dredged material placement sites
Swainson's hawk (*Buteo swainsoni*)		T	Breeds in grasslands/agricultural areas with scattered trees and riparian areas with adjacent foraging habitat	S1, S11, S14, S16, S19, S31, and S32
Western yellow-billed cuckoo (*Coccyzus americanus occidentalis*)	Candidate	E	Riparian forest nester, along the broad, lower flood-bottoms of larger river systems; nests in riparian jungles of willow, often mixed with cottonwoods, with lower story of blackberry, nettles, or wild grape	None
White-tailed kite (*Elanus leucurus*)		FP	Rolling foothills and valley margins with scattered oaks and river bottomlands or marshes next to deciduous woodland; open grasslands, meadows, or marshes for foraging close to isolated, dense-topped trees for nesting and perching	S20, S31, and S35
Saltmarsh common yellowthroat (*Geothlypis trichas sinuosa*)		SSC	Resident of the San Francisco Bay region, in fresh and salt water marshes; requires thick, continuous cover down to water surface for foraging; tall grasses, tule patches, and willows for nesting	Lower westernmost portion of the study area

Species	Federal	State	Habitat Association	Potential Areas of Occurrence
California black rail (*Laterallus jamaicensis coturniculus*)		T, FP	Inhabits freshwater marshes, wet meadows, and shallow margins of saltwater marshes bordering larger bays; needs water depth of about 1 inch that does not fluctuate during the year and dense vegetation for nesting habitat	S19, S20, and S35
Suisun song sparrow (*Melospiza melodia maxillaries*)		SSC	Resident of brackish-water marshes surrounding Suisun Bay; inhabits cattails, tules and other sedges, and *Salicornia*; also known to frequent tangles bordering sloughs	S4, S20, and S35
Purple martin (*Progne subis*)		SSC	Inhabits woodlands, low elevation coniferous forest of douglas-fir, ponderosa pine, and monterey pine; nests in old woodpecker cavities mostly, also in human-made structures; nest often located in tall, isolated tree/snag	S31
Bank swallow (*Riparia riparia*)		T	Nests in colonies in sandy or gravel vertical embankments adjacent to creeks, ponds, and lakes; banks must be at least 1 meter in height and soils around embankments must be friable	S16, S19 and near the Port
Yellow-headed blackbird (*Xanthocephalus xanthocephalus*)		SSC	Nests in freshwater emergent wetlands with dense vegetation and deep water; often along borders of lakes or ponds; nests only where large insects such as odonata are abundant, nesting timed with maximum emergence of aquatic insects	S1, S31, and S32
Mammals				
Western red bat (*Lasiurus blossevillii*)		SSC	Roosts primarily in trees, 2 to 40 feet above ground, from sea level up through mixed conifer forests; prefers habitat edges and mosaics with trees that are protected from above and open below with open areas for foraging	S14, S16, S19, S20 and S35
Salt marsh harvest mouse (*Reithrodontomys raviventris*)	E	E, FP	Saline emergent wetlands only; requires pickleweed	S35, and near the western terminus of the SRDWSC
American badger (*Taxidea taxus*)		SSC	Most abundant in drier open stages of most shrub, forest, and herbaceous habitats, with friable soils; needs sufficient food, friable soils, and open, uncultivated	S1, S31, S32

Species	Federal	State	Habitat Association	Potential Areas of Occurrence
			ground; preys on burrowing rodents; digs burrows	
Plants				
Mt. Diablo manzanita (*Arctostaphylos auriculata*)		1B.3	Chaparral; in canyons and on slopes; on sandstone 120 to 500 meters	None
Ferris' milk-vetch (*Astragalus tener* var. *ferrisiae*)		1B.1	Meadows, valley and foothill grassland; subalkaline flats on overflow land in the central valley; usually seen in dry, adobe soil; 5 to 75 meters	None
Alkali milk-vetch (*Astragalus tener* var. *tener*)		1B.2	Alkali playa, valley and foothill grassland, vernal pools; low ground, alkali flats, and flooded lands; in annual grassland or in playas or vernal pools; 1 to 170 meters	None
San Joaquin spearscale (*Atriplex joaquiniana*)		1B.2	Chenopod scrub, alkali meadow, valley and foothill grassland; in seasonal alkali wetlands or alkali sink scrub with salt grass, alkali heath, etc.; 1 to 250 meters.	S1 and S32
Bolander's water-hemlock (*Cicuta maculata* var. *bolanderi*)		2.1	Marshes, fresh or brackish water; 0 to 200 meters	None
Soft bird's-beak (*Cordylanthus mollis* ssp. *Mollis*)	E	R, 1B.2	Coastal salt marsh with salt grass, pickleweed, and alkali heath, etc.; 0 to 3 meters	None
Hoover's cryptantha (*Cryptantha hooveri*)		1A	Valley and foothill grassland	None
Dwarf downingia (*Downingia pusilla*)		2.2	Valley and foothill grassland (mesic sites), vernal pools; vernal lake and pool margins with a variety of associates; in several types of vernal pools; 1 to 485 meters	None
Kings River buckwheat (*Eriogonum nudum* var. *regirivum*)		1B.2	Cismontane woodland; rocky limestone slopes along the Kings River; 210 to 610 meters	None
Mt. Diablo buckwheat (*Eriogonum truncatum*)		1B.1	Chaparral, coastal scrub, valley and foothill grassland; dry, exposed clay or sandy substrates; 100 to 600 meters	None
Contra Costa wallflower (*Erysimum capitatum* var.	E	E, 1B.1	Inland dunes; stabilized dunes of sand and clay near Antioch along the San Joaquin River; 3 to 20 meters	None

Species	Federal	State	Habitat Association	Potential Areas of Occurrence
angustatum)				
Diamond-petaled California poppy (*Eschscholzia rhombipetala*)		1B.1	Valley and foothill grassland; alkaline, clay slopes and flats; 0 to 975 meters	None
Fragrant fritillary (*Fritillaria liliacea*)		1B.2	Coastal scrub, valley and foothill grassland, coastal prairie; often on serpentine; various soils reported though usually clay, in grassland; 3 to 410 meters	None
Brewer's western flax (*Hesperolinon breweri*)		1B.2	Chaparral, cismontane woodland, valley and foothill grassland; often in rocky serpentine soil in serpentine chaparral and serpentine grassland; 30 to 885 meters	None
Woolly rose-mallow (*Hibiscus lasiocarpos* var. *occidentalis*)		2.2	Marshes and swamps (freshwater); moist, freshwater-soaked river banks and low peat islands in sloughs; in California, known from the delta watershed; 0 to 150 meters	None
Carquinez goldenbush (*Isocoma arguta*)		1.B.1	Valley and foothill grassland; Alkaline soils, flats, lower hills; on low benches near drainages and on tops and sides of mounds in swale habitat; 1 to 20 meters	Utility relocation areas (Species projected to occur within S35 based on recorded occurrences in CNDDB; no individuals observed during 2008 and 2010 vegetation surveys)
Northern California black walnut (*Juglans hindsii*)		1B.1	Riparian forest, riparian woodland; few extant native stands remain; widely naturalized; deep alluvial soil associated with a creek or stream; 0 to 395 meters	Utility relocation areas (Species projected to occur within S14 based on recorded occurrences in CNDDB; no individuals observed during 2008 and 2010 vegetation surveys)
Contra Costa goldfields (*Lasthenia conjugens*)	E	1B.1	Valley and foothill grassland, vernal pools, cismontane woodland; extirpated from most of its range; extreme; vernal pools, swales, low depressions, in open grassy areas; 1 to 445 meters	None
Delta tule pea (*Lathyrus jepsonii* var. *jepsonii*)		1B.2	Freshwater and brackish marshes; often found with *Typha, Aster lentus, Rosa calif., Juncus* spp., *Scirpus* spp., etc.; usually on marsh and slough edges	None (Species projected to occur within S14 based on recorded

Species	Federal	State	Habitat Association	Potential Areas of Occurrence
				occurrences in CNDDB; no individuals observed during 2008 and 2010 vegetation surveys)
Heckard's pepper-grass (*Lepidium latipes* var. *heckardii*)		1B.2	Valley and foothill grassland, vernal pools; grassland, and sometimes vernal pool edges; alkaline soils; 3 to 30 meters	S1, S14, S16, S19, S20, S31, and S32
Mason's lilaeopsis (*Lilaeopsis masonii*)		R, 1B.1	Freshwater and brackish marshes, riparian scrub; tidal zones, in muddy or silty soil formed through river deposition or river bank erosion; 0 to 10 meters	None (Species projected to occur within S14 based on recorded occurrences in CNDDB; no individuals observed during 2008 and 2010 vegetation surveys)
Delta mudwort (*Limosella subulata*)		2.1	Riparian scrub, freshwater marsh, brackish marsh; probably the rarest of the delta rare plants; usually on mud banks of the delta in marshy or scrubby riparian associations; often with *Lilaeopsis masonii*; 0 to 3 meters	None
Baker's navarretia (*Navarretia leucocephala ssp. Bakeri*)		1B.1	Cismontane woodland, meadows and seeps, vernal pools, valley and foothill grassland, lower montane coniferous forest; vernal pools and swales; adobe or alkaline soils; 5 to 950 meters	None
Colusa grass (*Neostapfia colusana*)	T	E, 1B.1	Vernal pools; usually in large, or deep vernal pool bottoms; adobe soils; 5 to 110 meters	None
Antioch Dunes evening-primrose (*Oenothera deltoides* ssp. *howellii*)	E	E, 1B.1	Interior dunes; remnant river bluffs and sand dunes east of Antioch; 0 to 30 meters	None
Eel-grass pondweed (*Potamogeton zosteriformis*)		2.2	Marshes and swamps; ponds, lakes, streams; 0 to 1,860 meters	None
Side-flowering skullcap (*Scutellaria lateriflora*)		2.2	Meadows and seeps, marshes and swamps; wet meadows and marshes; -3 to 500 meters	None

Species	Federal	State	Habitat Association	Potential Areas of Occurrence
Keck's checkerbloom or checkermallow (*Sidalcea keckii*)	E	1B.1	Cismontane woodland, valley and foothill grassland; grassy slopes in blue oak woodland; 180 to 425 meters	None
Suisun Marsh aster (*Symphyotrichum lentum*)		1B.2	Marshes and swamps (brackish and freshwater); most often seen along sloughs with *Phragmites*, *Scirpus*, blackberry, *Typha*, etc.; 0 to 3 meters	Utility relocation areas
Crampton's tuctoria or Solano grass (*Tuctoria mucronata*)	E	E, 1B.1	Vernal pools, valley and foothill grassland; clay bottoms of drying vernal pools and lakes in valley grassland; 5 to 10 meters	None

Source: California Natural Diversity Database search of the seven project quadrangles (Antioch North, Jersey Island, Rio Vista, Liberty Island, Saxon, Clarksburg, and Sacramento West)

Notes:

E - endangered
T - threatened
FP - fully protected
R - rare
SSC - state species of special concern
1B.1 - RTE in CA and elsewhere; Seriously threatened in CA
1B.2 - RTE in CA and elsewhere; Fairly threatened in CA
1B.3 - RTE in CA and elsewhere; Not very threatened in CA
2.2 - RTE in CA only; Fairly threatened in CA
2.1 - RTE in CA only; Seriously threatened in CA

Valley Elderberry Longhorn Beetle (Desmocerus californicus dimorphus; Federal Threatened, Critical Habitat Designated)

Status and Description – The valley elderberry longhorn beetle was listed as a federally threatened species on August 8, 1980 (45 FR 52803). Adult beetles are large and stout-bodied. Male beetles, measured from head to abdomen, are 13 to 21 mm in length with their antenna about as long as their body (USFWS 1999c). Females are more robust than males and range from 18 to 25 mm in length with a slightly shorter antenna. Valley elderberry longhorn beetles are black or very dark gray in color with a red-orange border on their elytra (forewings). Males' elytra have four oblong dark spots and prominently show the bright red-orange coloration. Females and some males are colored mostly dark with only a small band of red-orange color along the front margin of the elytra.

Range, Populations, and Activity – The historical range of this taxon is restricted to the Central Valley of California. Prior to 1984, the valley elderberry longhorn beetle was known only from a few sites along the American River (Sacramento County), Putah Creek (Solano and Yolo counties), and a single site along the Merced River (Merced County) (Linsley and Chemsak 1972; USFWS 1984d). After 1985, additional observations of this species were made along the Sacramento River near Knights Landing (Yolo County), Grimes (Colusa County), Red Bluff (Tehama County), Colusa (Colusa County), Butte City (Glenn County), and Sidds Landing (Butte County) (Jones & Stokes 1985, 1987a, 1987b). The valley elderberry longhorn beetle has also been observed near Sloughhouse (Sacramento County) (Kellner 1986, 1992).

The valley elderberry longhorn beetle's current distribution is sparse throughout the Central Valley in the remaining elderberry habitat from Redding to Bakersfield. Recent surveys have only located the species in scattered localities along the Sacramento, American, San Joaquin, Kings, Kaweah, and Tule rivers and their tributaries (UC Berkeley 2000). In 1991, Barr found beetle activity at 28% of the 230 elderberry habitat sites surveyed (Barr 1991). Beetle activity was distributed unevenly among elderberry shrubs, with particular trees or clumps showing more activity than others. In surveys conducted in 1997, Collinge et al. (2001) found that in the northern half of its geographic range, the beetle occurred in drainages that function as distinct, relatively isolated metapopulations.

The life history of valley elderberry longhorn beetles is not well known. Adult beetles are active from March to June, which is their assumed breeding season (USFWS 1984d). Elderberry longhorn beetles are known to lay eggs in the crevices of bark of elderberry trees (Craighead 1923), although female valley longhorn elderberry beetles have been observed ovipositing eggs at a branch approximately 2 feet long and 1/8 to 1/4 inch in diameter at its tip (Kellner 1986). The larvae hatch in a few days (ten or more) and bore into the stem of

elderberries, where they feed on the pith. Thereafter, the larvae cut an emergence/exit hole through the wood and bark of an elderberry tree. The larvae pupate inside the stem and emerge as adult beetles in the spring. The beetles may require 2 or more years to complete their life cycle (Kellner 1986; Craighead 1923). The life span of adults is unknown, but they are presumed to die after reproducing (USFWS 1999c). Adult beetles feed on the leaves of elderberry trees and possibly the flowers (Kellner 1986).

Habitat Use – The valley elderberry longhorn beetle is closely associated with blue elderberry (*Sambucus mexicana*), which is an obligate host for beetle larvae. Adult valley elderberry longhorn beetles are usually found on, or flying between, elderberry plants. The valley elderberry longhorn beetle appears to be attracted to "stressed" or unhealthy elderberry trees (Kellner 1992).

The valley elderberry longhorn beetle also prefers trees of a certain size class. Exit holes are more frequently found in trunks or branches that are 14.7 to 66.15 centimeters in circumference (5 to 20 centimeters in diameter) (Kellner 1986, 1992) or 1.0 inch or greater in diameter at ground level (USFWS 1999c), and in branches less than 1 meter off the ground (Collinge et al. 2001).

Dispersal – Since the spatial distribution of the valley elderberry longhorn beetle is often minimal (Barr 1991), the beetle is assumed to be a poor disperser (Collinge et al. 2001). This lack of dispersing capability and the beetles' presumed naturally low population densities (USFWS 1984d) results in an increased vulnerability to impacts from habitat fragmentation (USFWS 1999c). Nonfragmented stands of elderberries are essential for dispersal corridors for the species and may be necessary to maintain long-term gene-flow over large areas.

Threats to the Species – Alteration and fragmentation of riparian habitats are the main threats to the valley elderberry longhorn beetle. The construction of dams, dikes, and levees; stream and river channelization; drainage works; bypasses; and bank protection systems has altered and continues to impact the habitat of valley elderberry longhorn beetles. Other threats to the survival of the beetle include agricultural conversion, grazing, riprapping of shoreline, and urban and recreational development (USFWS 1999c). Insecticide use and vegetation control practices may also impact beetle populations (USFWS 1999c).

Critical Habitat – Critical habitat was designated for the valley elderberry longhorn beetle on August 8, 1980 (45 FR 52803 52807). Two critical habitat areas are designated along the American River in Sacramento. The primary constituent elements (PCEs) of critical habitat for the valley elderberry longhorn beetle are the habitat components that avoid the following (Federal Register 1980b):

(i) Directly eliminating the beetle's host plant, Mexican elderberry, by construction of buildings, roads, bridges, or parking lots, or by modification of riparian habitats by river channelization.
(ii) Human disturbance, such as vandalism or fire, resulting from increased recreational use, which adversely affects the beetle.

No critical habitat for this species is present within the proposed placement sites or within the dredging footprint.

Potential Areas of Occurrence within the Study Area – The valley elderberry longhorn beetle has the potential to occur in placement sites S1, S14, S19, and along the levees of the SRDWSC (USACE 2009b).

California Tiger Salamander (*Ambystoma californiense*; Federal Threatened, State Threatened, Critical Habitat Designated)

Status and Description – The California tiger salamander is an amphibian in the family Ambystomatidae. It is a large, stocky, terrestrial salamander with a broad, rounded snout. Adult males are about 20 centimeters (8 inches) long, females are a little less than 18 centimeters (7 inches) long.

The species is restricted to grasslands and low (typically below 2,000 feet/610 meters) foothill regions where lowland aquatic sites are available for breeding. They prefer natural ephemeral pools or ponds that mimic ephemeral pools (e.g., stock ponds that are allowed to go dry).

Larvae require significantly more time to transform into juvenile adults than other amphibians such as the western spadefoot toad (*Scaphiopus hammondii*) and Pacific tree frog (*Pseudacris regilla*). Compared to the western toad (*Bufo boreas*) or western spadefoot toad, California tiger salamanders are poor burrowers. They require refuges provided by ground squirrels (*Spermophilus beecheyi*) and other burrowing mammals in which to enter a dormant state, called estivation, during the dry months.

Range, Population, and Activity – This species is restricted to California and does not overlap with any other species of tiger salamander. California tiger salamanders are restricted to vernal pools and seasonal ponds, including many constructed stock ponds, in grassland and oak savannah plant communities, predominantly from sea level to 2,000 feet, in central California.

In the coastal region, populations are scattered from Sonoma County in the northern San

Francisco Bay Area to Santa Barbara County (up to elevations of 3,500 feet/1,067 meters), and in the Central Valley and Sierra Nevada foothills from Yolo to Kern counties (up to 2,000 feet/610 meters). The Sonoma population appears to have been geographically isolated from the remainder of the California tiger salamander population by distance, mountains, and major waterway barriers for more than 700,000 years.

Habitat Use – California tiger salamanders require large, contiguous areas of vernal pools (vernal pool complexes or comparable aquatic breeding habitat) containing multiple breeding ponds to ensure recolonization of individual ponds (Fisher and Shaffer 1996; USFWS 2009a). Local population in habitats without this feature are prone to extinction because typical breeding populations can drop to less than 20 breeding adults and/or recruiting juveniles in some years.

Threats to Species – The primary cause of the decline of California tiger salamander populations is the loss and fragmentation of habitat from human activities and the encroachment of nonnative predators. Federal, state, and local laws have not prevented past and ongoing losses of habitat. All of the estimated seven genetic populations of this species have been significantly reduced because of urban and agricultural development, land conversion, and other human-caused factors (Barry and Shaffer 1994; Fisher and Shaffer 1996; USFWS 2009a).

A strong negative association between bullfrogs (*Rana catesteiana*), an invasive species, and California tiger salamanders has been documented. Although bullfrogs are unable to establish permanent breeding populations in vernal pools, dispersing immature frogs from permanent waterbodies within 2 miles take up residence and prey on adult or larval salamanders in these areas during the rainy season. Louisiana swamp crayfish (*Procambarus clarkii*), mosquito fish (*Gambusia affinis*), green sunfish (*Lepomis cyanellus*), and other introduced fishes also prey on adult or larval salamanders (Barry and Shaffer 1994; USFWS 2009a).

A deformity-causing infection, possibly caused by a parasite in the presence of other factors, has affected pond-breeding amphibians at known California tiger salamander breeding sites. This same infection has become widespread among amphibian populations in Minnesota and also poses the threat of becoming widespread in California (Barry and Shaffer 1994; Fisher and Shaffer 1996; USFWS 2009a).

Reduction of ground squirrel populations to low levels through widespread rodent control programs may reduce availability of burrows and adversely affect the California tiger salamander. Poison typically used on ground squirrels is likely to have a disproportionately

adverse effect on California tiger salamanders, which are smaller than the target species and have permeable skins. Use of pesticides, such as methoprene, in mosquito abatement may have an indirect adverse effect on the California tiger salamander by reducing the availability of prey (Barry and Shaffer 1994; USFWS 2009a).

Various nonnative subspecies of the tiger salamander have been imported into California for use as fish bait. The introduced salamanders may outcompete the California tiger salamanders, or interbreed with them to create hybrids that may be less adapted to the California climate or are not reproductively viable past the first or second generations (Barry and Shaffer 1994; USFWS 2009a).

Automobiles and off-road vehicles kill a significant number of migrating California tiger salamanders, and contaminated runoff from roads, highways, and agriculture may adversely affect them (Barry and Shaffer 1994; USFWS 2009a).

Critical Habitat – Critical habitat is designated for California tiger salamander. The species requires the following PCEs:

(i) Standing bodies of freshwater, including natural and man-made (e.g., stock) ponds, vernal pools, and dune ponds, and other ephemeral or permanent waterbodies that typically become inundated during winter rains and hold water for a sufficient length of time (i.e., 12 weeks) necessary for the species to complete the aquatic (egg and larval) portion of its life cycle.

(ii) Barrier-free uplands adjacent to breeding ponds that contain small mammal burrows. Small mammals are essential in creating the underground habitat that juvenile and adult California tiger salamanders depend upon for food, shelter, and protection from the elements and predation.

(iii) Upland areas between breeding locations (PCE 1) and areas with small mammal burrows (PCE ii) that allow for dispersal among such sites (FR Vol. 69 No. 226 CTS, 68584).

No critical habitat for this species is present within the proposed placement sites or within the dredging footprint.

Potential Areas of Occurrence within the Study Area – The California tiger salamander has the potential to occur in placement site S35 (USACE 2009b).

Giant Garter Snake (*Thamnophis gigas*; Federal Threatened, State Threatened)

Status and Description – The giant garter snake is one of North America's largest native snakes, reaching up to 64 inches in length and endemic to valley floor wetlands in the

Sacramento and San Joaquin Valleys of California.

The snake is usually dark brown to olive or tan; northern snakes are often darker-colored and have bolder stripes than San Joaquin Valley snakes. The snake has three stripes that can be pale, yellow, or orange. Along its side it has rows of black dots that may appear as a checkered or blotched pattern. Snakes emerging from dormancy are often muddy and may appear to be a solid, dark color.

Range, Population, and Activity – Giant garter snakes inhabit marshes, sloughs, ponds, small lakes, low gradient streams, and other waterways and agricultural wetlands, such as irrigation and drainage canals and rice fields. They can occur in suitable habitat, as described, throughout the Sacramento and San Joaquin Valleys, including the following counties: Butte, Colusa, Contra Costa, Fresno, Glenn, Madera, Merced, Sacramento, San Joaquin, Solano, Sutter, and Yolo. There are only 13 isolated populations of the giant garter snake remaining, primarily in the Sacramento Valley (USFWS 1999b).

The breeding season for the giant garter snake extends from March through May and resumes briefly during September (USFWS 1999b). Males begin searching for females immediately after emergence from overwintering sites. Females brood young internally and typically give birth to 10 to 46 young (mean of 23) from late July through early September (Hansen and Hansen 1990). The young immediately disperse to dense cover where they absorb their yolk sac, then start feeding independently. The young will typically have doubled in size by 1 year of age (USFWS 1999b), and sexual maturity usually takes 3 years in males and 5 years in females.

Giant garter snakes feed primarily on fish and amphibians and take advantage of pools that trap and concentrate prey. Prey species include bullfrogs, Pacific chorus frogs (*Pseudacris regilla*), carp (*Cyprinus carpio*), mosquito fish, and blackfish (*Othodox microlepidotus*) (USFWS 1999b).

Habitat Use – The giant garter snake inhabits agricultural wetlands and associated waterways, including irrigation and drainage canals and rice fields; marshes; sloughs; ponds; small lakes; low-gradient streams; other aquatic habitats; and adjacent uplands (USFWS 1999b). The snake uses grasses, weeds, cattails, tules, and other vegetation for basking, foraging, and cover. It might also be seen on roads or in drains, check dams, culverts, rocks, fallen logs, debris piles, and other structures (USFWS 1999b).

Important features of these habitats include: 1) sufficient water during the snake's active season (early spring through mid–fall) to maintain an adequate prey base; 2) emergent

vegetation, such as cattails and bulrushes (*Scirpus* spp.), for escape cover and foraging habitat; 3) upland habitat with grassy banks and openings to waterside vegetation for basking; and 4) higher elevation upland areas for cover and refuge from flood waters during the snake's inactive season (Brode and Hansen 1992). Giant garter snakes are absent from the larger rivers; wetlands with sand, gravel, or rock substrates; and riparian areas lacking suitable basking sites or suitable prey populations (Brode 1988; USFWS 1999b).

Threats to Species – Threats to the species include habitat loss and fragmentation, flood-control activities, changes in agricultural and land-management practices (such as conversion of rice fields), weed abatement, rodent control, discharge of contaminants into wetlands and waterways, overgrazing in wetland or streamside habitats, predation from introduced species, pesticides, and water pollution (USFWS 1999b). Wetland destruction for agricultural, urban, and industrial development has eliminated more than 90% of suitable habitat for the species, forcing snakes to rely heavily on rice fields and managed marsh areas (Hanson and Hanson 1990).

Heavy use of toxic pesticides in the Central Valley is also a contributing factor in the decline of this once-abundant garter snake. Toxic contamination, particularly from selenium, and impaired water quality have also been identified as threats to some populations of the giant garter snake (USFWS 1993a). Preliminary studies have documented potential bioaccumulative effects of agriculturally derived contaminants on giant garter snakes or their prey species (Saiki et al. 1993). Disease and parasitism (potentially related to reduced immune response ability from contaminants) may also pose a threat to this species (USFWS 1999b).

Introduction of non-native predators, including the bullfrog, largemouth bass (*Micropterus salmoides*), and catfish (*Ictalurus* spp.), has been responsible for eliminating many species of native fishes and aquatic vertebrates in the western United States (USFWS 1999b). Invasive species probably had detrimental effects on the giant garter snake through direct predation and competition for smaller forage fish (CDFG 1992).

Critical Habitat – Critical habitat is not designated for this species.

Potential Areas of Occurrence within the Study Area – The giant garter snake has the potential to occur in placement sites S1, S4, S11, S16, S19, S20, S31, S32, and S35 (USACE 2009b). This snake is protected in Solano County, Sacramento County, the city of West Sacramento, and the city of Rio Vista.

Bank Swallow (*Riparia riparia*; State Threatened)

Status and Description – The bank swallow is a neotropical migrant found primarily in riparian and other lowland habitats in California west of the deserts during the spring-fall period.

Range, Population, and Activity – The bank swallow range in California is estimated to be reduced 50% since 1900 (CDFG 1989), and the species was formerly more common as a breeder in California. Approximately 110 to 120 colonies remain within the state. Perhaps 75% of the current breeding population in California occurs along the banks of the Sacramento and Feather rivers in the northern Central Valley. About 50 to 60 colonies remain along the middle Sacramento River (CDFG 2000).

Bank swallows are usually seen in flocks, flying low over ponds and rivers. They usually forage in flight, but in severe weather they may forage on the ground. Their quick, fluttery wing-beats are more shallow and rapid than those of other swallows. These highly social birds nest in dense colonies of 10 to 2,000 nests. Long-distance migrants, bank swallow arrive in California from South America in early March and numbers peak by early May. They begin their migration back to South America soon after the young become independent, in late July or early August. Bank swallows gather in large groups before heading south, and they migrate in mixed flocks with cliff, tree, and barn swallows (*Petrochelidon pyrrhonota*, *Tachycineta bicolor*, and *Hirundo rustica*).

Habitat Use – Usually found near water, bank swallows are closely associated with fine-textured or sandy, vertical banks along rivers and lakes or where a bank has been created by human excavation. Bank swallows forage over water or open fields, and feed primarily on flying insects such as flies, bees, and beetles. The bank swallow has a unique distinguishing characteristic in that it is the only swallow that does not build a nest. Instead, it forages holes to use as nests.

Bank swallows arrive in high numbers to the same nesting areas they occupied the previous year. If that area is no longer present, they will construct a new one. The male and female bank swallow help in the construction of the nest. Their nests are found at the top of vertical caves and sand banks and in areas that have material that is conducive to foraging, such as marshes and along river banks (Ellis 1982). The ephemeral nature of the nesting banks results in relatively low levels of nesting fidelity. Nesting colonies can be up to 1,500 pairs in size. The nesting area is defended early in the nesting period.

Bank swallows are monogamous, although extra-pair copulations are common. These swallows use their tiny, conical bills and small feet to dig burrows in sandy banks. These

banks are often not stable, and colonies move frequently because the banks collapse. The male generally digs the burrow, which can be up to 5 feet long. Deep inside the burrow, the female builds the nest of grass, rootlets, and weeds, lined with feathers. Both members of the pair incubate the 4 to 5 eggs for 14 to 16 days. Both feed the young, which leave the nest 18 to 24 days after hatching. The parents continue to feed the young for 3 to 5 days after they leave the nest.

Threats to Species – Threats to the species include habitat loss due to development or construction, human recreation in or around nesting sites, destruction of nesting sites by dogs and humans, predation, and severe weather in migratory wintering grounds.

Critical Habitat – Critical habitat is not designated for this species.

Potential Areas of Occurrence within the Study Area – The bank swallow has the potential to occur in placement sites S16, S19, and near the Port (USACE 2009b).

California Black Rail (*Laterallus jamaicensis coturniculus*; State Threatened/Fully Protected)

Status and Description – The California black rail is a small (12 to 15 cm), secretive, marsh-associated species (Eddleman et al. 1994; Richmond et al. 2008). They are black to gray in color with a small black bill, sides and back speckled with white, and a nape of deep chestnut brown. Rails are usually identified by their call because they are difficult to observe in the wild.

Range, Population, and Activity – Little information is available on seasonal patterns, timing of reproduction, dispersal, or other activities. Additionally, information is sparse on home range or territory size of black rails. The historic range of the California black rail extended from the San Francisco Bay, throughout the Delta, along the coast to northern Baja California, and included other Southern California locales such as the Salton Sea and along the lower Colorado River. Loss of tidal marsh habitat has extirpated populations from much of its coastal range, particularly in Southern California and much of the San Francisco Bay. The species persists in remaining tidal marshes in the northern San Francisco Bay estuary, Tomales Bay, Bolinas Lagoon, the Delta, Morro Bay, the Salton Sea, and the Lower Colorado River (Eddleman et al. 1994).

The breeding season begins as early as February with pair formation and extends through approximately early-to-mid June. Egg laying peaks around May 1 (Eddleman et al. 1994). The species is generally known as a medium-distance migrant that winters in Mexico and Central America; however, recently discovered inland populations in California are thought

to be year-round residents. At these locations, seasonal movements including juvenile dispersal and adult relocation to other wetland breeding sites occur each year sometime during the non-breeding season between approximately August and February (Richmond et al. 2008).

Black rails are monogamous birds. They build cup nests with a woven canopy in dead or new emergent vegetation over shallow water less than 3 cm in depth (Eddleman et al. 1994). They initiate egg-laying within a few days after nest construction is complete. Rails in California usually lay one single brood with an average clutch size of six eggs (Eddleman et al. 1994). There is limited information on the length of the brooding period, timing of fledging, parental care, or reproductive success.

Very little information is available on the foraging behavior of the black rail. The species is assumed to be an opportunistic daytime feeder that forages exclusively within the wetland habitat, presumably on or near the ground at the edges of emergent vegetation. The diet consists of insects, small mollusks, amphipods, and other invertebrates, and seeds from bulrushes and cattails (Eddleman et al. 1994).

Habitat Use – California black rails inhabit saltwater, brackish, and freshwater marshes. A highly secretive and rarely observed bird, there appears to be a preference in coastal areas for tidal salt marshes dominated by dense pickleweed (*Salicornia virginica*.) with an open structure below. This provides a dense canopy for protective cover while providing nesting habitat and accessibility below the canopy (Evens et al. 1991). Rails are susceptible to predation by herons (Ardeidae), egrets (Egretta), northern harriers (*Circus cyaneus*), short-eared owls (*Asio flammeus*), and several mammalian predators. A dense canopy that provides optimal cover is essential for survival. Factors influencing occupancy include size of wetland, cover density, wetland species composition, water levels, and food availability (Eddleman et al. 1994)

Away from coastal estuaries and salt marshes, black rails are restricted to breeding in freshwater marshes with stands of tule, cattail, bulrush, and sedge (Eddleman et al. 1994). These sites are very shallow (usually less than 3 cm) but require a perennial water source. A relatively narrow range of conditions is required for occupancy and successful breeding. Water depth is an important parameter for successful nest sites because rising water levels can prevent nesting or flood nests and reduce access to foraging habitat (Eddleman et al. 1994). Too little water will lead to abandonment of the site until the water source is reestablished. The primary factors determining black rail presence are annual fluctuation in water levels and shallow water depth (less than 3 cm; Eddleman et al. 1994).

Threats to Species – Throughout its range, the primary threat to California black rail is the loss and fragmentation of habitat from urbanization, flood control projects, agricultural practices, and hydrologic changes that affect water regimes. At inland sites, agricultural practices, livestock grazing, and urbanization may threaten individual subpopulations. Use of pesticides, including those used for mosquito control programs, may also have unintended consequences for black rails. Other potential threats include increased predation by domestic cats and by native predators as a result of hydrologic and vegetation changes that increase susceptibility of predation; pollution and its affect on freshwater marshes; and collision with automobiles and utility lines (Eddleman et al. 1994).

Critical Habitat – Critical habitat is not designated for this species.

Potential Areas of Occurrence within the Study Area – The California black rail has the potential to occur in placement sites S19, S20, and S35 (USACE 2009b).

Swainson's Hawk (*Buteo swainsoni*; State Threatened)

Status and Description – Swainson's hawk occurs as a breeding species in open habitats throughout much of the western United States and Canada, and in northern Mexico. In California, breeding populations of Swainson's hawks occur in desert, shrub-steppe, grassland, and agricultural habitats; however, the overwhelming majority of the state's breeding sites are in two disjunct populations in the Great Basin and Central Valley. Swainson's hawk is not an obligate riparian species; its relationship with riparian habitats is variable and largely dependent on the availability and distribution of suitable nesting trees in proximity to high-quality foraging habitats. In the Central Valley, nest sites are strongly associated with riparian forest vegetation. The primary habitat requisite provided by riparian systems is nesting substrate, typically large trees (Woodbridge 1998).

Range, Population, and Activity – The largest population of Swainson's hawk in the state is located in the midsection of the Central Valley in the area between Sacramento and Modesto, and in the northern San Joaquin Valley. Estimates of the size of the Central Valley population vary from 280 (Bloom 1980) to 420 (CDFG 1988), although recent estimates have placed this number higher (Woodbridge 1998). Swainson's hawks are a highly mobile, wide-ranging species with large home ranges. Home range size is highly variable, and affected by a number of factors including distribution and juxtaposition of nesting habitat and high-quality foraging habitat, amount of foraging habitat, and temporal fluctuations in availability of prey (Bechard 1982; Estep 1989; Woodbridge 1998).

With rare exceptions, Swainson's hawks are migrants, breeding in North America and wintering in southern South America, a round-trip journey of more than 20,000 km. In the

Central Valley, Swainson's hawks arrive in late February and early March. Swainson's hawks are morphologically adapted for aerial foraging, and spend a large proportion of foraging time soaring, or coursing over open habitats. During the breeding season, Swainson's hawks travel long distances (up to 29 km) in search of habitats with abundant prey (Estep 1989; Woodbridge 1998). In agricultural habitats, foraging activity is closely associated with harvest or cultivation activities that expose prey to aerial predation (Woodbridge 1998).

Habitat Use – Spatial characteristics of patches of nesting trees are relatively unimportant to Swainson's hawks. Nest sites may be located in isolated trees, natural or planted groups of trees, or riparian gallery forest. Although this species typically does not occupy large tracts of forest or woodland, they may nest at margins where woodlands meet grassland or agricultural habitat. Nesting Swainson's hawks are somewhat tolerant of human activity, particularly in areas where activity is regular and individual pairs are able to habituate to it. Nest sites are sometimes located near roads and houses, and frequently near field edges where crop cultivation activities regularly occur. However, changes in activity regimes (i.e., construction in previously open areas or human intrusion at a nest site) frequently causes nest abandonment, particularly during the pre-nesting, egg-laying, and incubation stages of the reproductive cycle (Estep 1989).

Swainson's hawks construct their nests in a wide variety of tree species, existing as riparian forest, remnant riparian trees, planted windbreaks, shade trees at residences and along roadsides, and solitary upland oaks. In the Central Valley, trees most commonly used for nesting include Fremont's cottonwood *(Populus fremonti*), willows, sycamores (*Platanus* spp.), valley oak (*Quercus lobata*), and walnut. Introduced species such as eucalyptus, pines, and redwoods also are used occasionally.

Diets of Swainson's hawks differ markedly between the breeding and nonbreeding periods. Over most of the species' range, breeding Swainson's hawks show a strong dependence on ground squirrels, voles, or other abundant small mammal prey. Territory density appears to be positively associated with the availability of specific regional prey (e.g., California vole [*Microtus californicus*] in central California; Estep 1989). Following the breeding season, this species shifts from small mammals to insects, especially grasshoppers and crickets. During nonbreeding periods, Swainson's hawks in the Central Valley of California prey on a wide variety of species, ranging from small mammals and birds to toads, crayfish, and insects. Additional prey items include California voles, pocket gophers (Geomyidae), deer mice (*Peromyscus maniculatus*), and other small mammals. Mourning doves (*Zenaida macroura*), ring-necked pheasants (Phasianidae), and meadowlarks (*Sturnella neglecta*) are also identified as prey items (Estep 1989).

Swainson's hawks are a highly mobile, opportunistic species. In central California, approximately 85% of Swainson's hawk nests are within riparian forest or remnant riparian trees (Woodbridge 1998). However, the vast majority of home ranges consist of treeless agricultural lands used for foraging. The abundance and spatial distribution of riparian forest as well as high-quality foraging habitat such as fallow fields and alfalfa fields are both critical determinants of territory suitability. Presence and quality of riparian habitat alone cannot be used as an indicator of habitat quality for this species (Woodbridge 1998).

Threats to Species – Although not an obligate riparian species, the availability of nesting habitat is strongly tied to the distribution of riparian forest or riparian trees in much of the Central Valley portion of the species' range in California (Bloom 1980; Estep 1989). Loss of small areas of remnant riparian forest within areas of highly suitable foraging habitat can result in permanent losses of Swainson's hawk territories. Similarly, loss of patches of high-quality foraging habitat to development or conversion to high-intensity crop types adjacent to riparian forest or other patches of trees may eliminate territories.

Additionally, the introduction of invasive species has equated to reductions in Swainson's hawk prey availability in habitats dominated by weedy exotic plant species.

Critical Habitat – Critical habitat is not designated for this species.

Potential Areas of Occurrence within the Study Area – Swainson's hawk has the potential to occur in placement sites S1, S11, S14, S16, S19, S31, and S32.

Salt Marsh Harvest Mouse (*Reithrodontomys raviventris*; Federal Endangered, State Endangered/Fully Protected)

Status and Description – The salt marsh harvest mouse is a small, native rodent in the Cricetidae subfamily, which includes new world mice, lemmings, voles, and hamsters. There are two subspecies: the northern (*R. r. halicoetes*) and southern (*R. r. raviventris*). The northern subspecies lives in the marshes of the San Pablo and Suisun Bays, the southern in the marshes of Corte Madera, Richmond, and South San Francisco Bay (USFWS 2010a).

Range, Population and Activity – The two subspecies are restricted to the salt and brackish marshes of San Francisco, San Pablo, and Suisun Bay areas. The southern subspecies inhabits central and south San Francisco Bay, and has suffered severe habitat loss and fragmentation. Less than 10% of its historic habitat acreage remains, nearly all of which is deficient in structural suitability. The northern subspecies, living in the marshes of San Pablo and Suisun Bays, has also sustained extensive habitat loss and degradation, but less so than the southern subspecies (USFWS 2010a).

Habitat Use – Salt marsh harvest mice are critically dependent on dense cover and their preferred habitat is pickleweed. Harvest mice are seldom found in cordgrass (*Spartina* spp.) or alkali bulrush (*Scirpus maritimus*). In marshes with an upper zone of peripheral halophytes (salt-tolerant plants), mice use this vegetation to escape the higher tides, and may spend a considerable portion of their lives there. Mice also move into the adjoining grasslands during the highest winter tides.

The mice live on leaves, seeds, and stems of plants. In winter, they seem to prefer fresh green grasses. The rest of the year, they tend toward pickleweed and saltgrass. Although salt marsh harvest mice are mainly active at night, they are sometimes active during daylight hours. They swim very well, in contrast to the western harvest mouse (*Reithrodontomys megalotis*), which is a poor swimmer.

Breeding occurs from spring through autumn. However, each female usually has only one or two litters per year. The average litter size is four young. Nests are minimal, often built over old birds' nests. Members of the southern group often do not make a nest at all.

Threats to Species – The most fundamental reason for the decline of the salt marsh harvest mouse is loss of habitat through filling, subsidence, and vegetation change. Habitat losses include areas associated primarily with historical diking and reclamation of tidal salt marshes, urban development of diked salt marshes, and adverse water management in diked brackish marshes of Suisun Marsh. Very little is known about predation impacts to the species, although predation related to flooding has been viewed as an important factor. During high winter tides, it is common to see great blue herons (*Ardea herodia*), great egrets (*Ardea alba*), snowy egrets (*Egretta thula*), ring-billed gulls (*Larus delawarensis*), California gulls (*Larus californicus*), and American kestrels (*Falco sparverius*) all taking small mammals from the upper edges and flooded areas of marshes. Protection from predators depends on the dense vegetation cover of typical salt marsh harvest mouse habitat.

Critical Habitat – Critical habitat is not designated for this species.

Potential Areas of Occurrence within the Study Area – The salt marsh harvest mouse has the potential to occur in placement site S35 and near the western terminus of the SRDWSC.

3.2.2.1.4 Utility Relocation Sites

As described in Sections 2.2.2.4 and 3.3.6, the relocation of some utility lines is a required element of the Proposed Project and the -33 Feet MLLW Alternative. Pacific Gas and Electric (PG&E) is required to undertake these realignments, and is similarly required to comply with all environmental regulations governing the discharge of dredged or fill

material into waters of the United States.

PG&E has identified three preliminary proposed utility relocation alignments, as shown on Figures 2 and 4. Based on a search of the California Natural Diversity Database, there exists a potential for three California Native Plant Society (CNPS) listed species to occur within these utility relocation areas: the Northern California black walnut (*Juglans hindsii*), Suisun marsh aster (*Symphyotrichum lentum)*, and Carquinez goldenbrush (*Isocoma arguta*). As of this Draft SEIS/SEIR, PG&E has not provided final proposed utility alignments or an assessment of the impacts of these realignments to sensitive resources. PG&E has easements around its pipelines for these purposes, and any impacts would be mitigated by PG&E. The impacts of these realignments to terrestrial habitats and plant species are not considered further in this document.

3.2.2.2 Methodology for Determining Impacts

Life history, abundance, and general ecology of terrestrial species and habitat that exist or may exist in the study area were discussed in Section 3.2.2.1. Table 45 provides an overview of the possibility for endangered, listed, and other sensitive species to be present in the placement sites. Direct and indirect impacts on these species, associated habitats, and other terrestrial species and habitats resulting from the construction and operation of the proposed alternatives are analyzed below.

Potential impacts were analyzed using professional expertise and judgment. For the analysis of threatened and endangered species, impacts are considered on the individual level, while impacts for non threatened or endangered special status species are considered on the population level. The habitat impact analysis considers the amount and quality of habitat potentially impacted under each of the alternatives.

As described in Section 1.6, the Proposed Project must comply with numerous local, state, and federal regulations. Of specific importance, the proposed discharge of dredged material into wetland or non-wetland waters of the United States must comply with the Clean Water Act (CWA) Section 404(b)(1) guidelines, and the following evaluations support the documentation of compliance with this regulation. This section also supports evaluations and determinations of compliance with the federal and California ESAs, the Migratory Bird Treaty Act (MBTA), and the California Fish and Game Code. Other laws and regulations are listed in Section 1.6.

Impacts to terrestrial species or habitat were evaluated to assess potential direct or indirect effects on species of plants or wildlife identified as endangered, threatened, rare, or candidate; or on any population of terrestrial wildlife or plants, including sensitive or special

status species. Specifically, placement of dredged material in the proposed placement sites could disturb terrestrial, wetland, or riparian species and habitats; cause a loss of designated critical habitat; or disturb associated foraging, rearing, and migration habitats.

3.2.2.3 Thresholds of Significance

For purposes of the evaluation in this section, potential impacts under thresholds 1 through 4 below were analyzed on a placement-site basis, while threshold 5 was analyzed at the alternative level. An alternative could have an impact on terrestrial species or habitats (abbreviated TSH in the thresholds and mitigation measures in this section) if it would cause any of the following:

- **TSH-1:** Disturbance to birds, amphibians, reptiles, invertebrates, plants, mammals, and their habitats, including loss of foraging habitat
- **TSH-2:** Loss of special status plant species or habitat for special status plant species
- **TSH-3:** Impacts to federally protected wetlands and sensitive habitats
- **TSH-4:** Introduction or spread of noxious weeds
- **TSH-5**: Non-compliance with local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance; the provisions of an adopted habitat conservation plan; a natural community conservation plan; or other approved local, regional, or state habitat conservation plan

3.2.2.4 Impacts and Mitigation Measures

This section discusses specific impacts, mitigation measures, and residual impacts after mitigation for each species with regard to each alternative. The impacts in this section are discussed by placement site for each alternative.

Future without Project Conditions

Placement Site S1

Placement site S1 is described in Sections 2.3.3 and 3.2.2.1. Threatened and endangered species with the potential to be present at S1 are giant garter snake, Valley elderberry longhorn beetle, and Swainson's hawk. Additional special status species with the potential to be present on S1 include tricolored blackbird (*Agelaius tricolor*; State Species of Concern [SSC]), Heckard's pepper-grass (*Lepidium latipes* var. *heckardii*; CNPS), yellow-headed blackbird (*Xanthocephalus xanthocephalus*; SSC), American badger (*Taxidea taxus*; SSC), and San Joaquin spearscale (*Atriplex joaquiniana*; CNPS). The usable portion of S1 is dominated by irrigated agriculture, with a small portion of non-native grassland in the northwestern corner of the west area. There are no wetlands, riparian areas, or other sensitive habitats within of the usable portion of S1 as summarized in Table 43.

TSH-1: Disturbance to birds, amphibians, reptiles, invertebrates, plants,

mammals, and their habitats, including loss of foraging habitat

One ESA listed species of nesting bird, the Swainson's hawk, has the potential to occur in the usable portion of S1. Swainson's hawk nests in California from March 1 through September 15. During this period, nests may potentially be present in trees within riparian or valley oak woodland occurring in placement site S1. Should site preparation or dredged material placement activities occur during the nesting season, potentially significant impacts to the Swainson's hawk may occur. This may include direct take of nests or juveniles through tree removal, loss of foraging habitat as a result of dredged material placement, and/or disturbance resulting in nest abandonment. USACE staff conducted a number of surveys between May 30 and June 30, 2000, at S1 and other placement sites with suitable nest trees where maintenance dredging was scheduled to take place. No Swainson's hawks were observed nesting in S1 or any of the surveyed areas.

Noise, vibration, visual, and proximity related disturbances associated with construction could potentially impact bird species that nest and forage on S1, including species protected under the ESA and MBTA, such as Swainson's hawk and the tricolored blackbird. Under Future without Project Conditions, ongoing use of the SRDWSC by general and bulk carriers and liquid tankers accessing the Port, and routine maintenance dredging and dredged material placement operations, would continue to result in temporary, minor impacts due to noise in the study area near current levels. In addition, it is assumed that Future without Project Conditions-induced growth at the Port would generate negligibly higher noise levels than current conditions because the number of vessels is anticipated to increase from 49 in 2009 to 231 in 2062 (USACE 2010c). Specific to dredged material placement activities, placement sites would incur noise levels at or below 60 dBA. These noise levels are within noise regulations designed to address human disturbance. Any bird species present at the placement sites would be accustomed to these noise levels. Thus, impacts to birds from noise associated with the placement of dredged material at S1 would be less than significant under Future without Project Conditions.

Although the tricolored blackbird is not listed as threatened or endangered, it is protected under the MBTA. The tricolored blackbird nests in dense marsh vegetation with cattails, bulrushes, and Himalayan blackberry (*Rubus discolor*). Its breeding period occurs from March through June. Dredged material placement within S1 is not anticipated to affect this species, because no marsh vegetation exists within the portion of S1 that has been used for dredged material placement in the past; however, significant impacts to the tricolored blackbird may occur as a result of placement and operation of the dredge pipeline if positioned near nesting sites in dense marsh vegetation during the nesting season. Potentially significant impacts may include destruction of nests and/or direct take of eggs or juveniles. Site preparation activities would occur away from suitable nesting habitat.

Placement of dredged material on S1 could result in the temporary removal of, or disturbance to, foraging habitat for potentially present ESA listed species, including Swainson's hawk and giant garter snake. Grassland and agricultural areas on the site are potential habitat for the giant garter snake. Site preparation could potentially result in individuals being run over by machinery, which would be considered a potentially significant impact. Dredged material placement may result in burial of habitat and burrow holes; these short term impacts would be more temporary in nature, and are considered less than significant given the large areas of suitable habitat within the project vicinity. Once dredged material is initially placed, there would be minimal additional impact on foraging habitat for these species with subsequent placement events. Placement would result in disturbance of a very small percentage of available foraging area; thus, the impacts due to ongoing placement of dredged material would be less than significant.

During surveys conducted in 2003, elderberry bushes were identified at placement site S1. This plant species is closely associated with the Valley elderhorn longhorn beetle. There were no emergence holes visible on any of the plants that would indicate the presence of the beetle (USACE 2004). Subsequent surveys in 2008 and 2010 did not identify any elderberry shrubs as occurring at S1 (USACE 2008c, 2010g). Project activities including dredged material placement and site preparation at S1 are therefore not anticipated to impact the Valley elderhorn longhorn beetle.

Disturbance to ESA listed amphibians, vernal pool invertebrates, mammals, and plants is unlikely since the portion of S1 that would be used for dredged material placement does not support associated habitats for these species. Additionally, it is unlikely that impacts to the above-mentioned non-listed special status amphibian, reptile, mammal, and plant species would occur at the population level. No impacts are expected for any amphibians, vernal pool invertebrates, mammals, or plants at S1.

Thus, there would be no impacts to amphibians, vernal pool invertebrates, mammals, or plants; and potentially significant impacts to Swainson's hawk, tricolored blackbird, and giant garter snake from the placement of dredged material at S1 under Future without Project Conditions. The mitigation measures below would be implemented to further reduce impacts to terrestrial species and habitats (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- TSH-MM-1: Special status species surveys and biological monitoring
- TSH-MM-2: Schedule construction outside the breeding season for protected species, or conduct special status species survey and potentially consult with USFWS to determine course of action

Residual Impact after Mitigation: After inclusion of the mitigation measures, the residual impact would be less than significant.

TSH-2: Loss of special status plant species or habitat for special status plant species

Placement site S1 may provide habitat for Heckard's pepper-grass and San Joaquin spearscale. Dredged material placement at S1 could potentially bury individuals or populations of these species, and site preparation (i.e., grubbing) could potentially result in take of these species. Placement of the dredge pipeline could also potentially damage any individuals present. These impacts would be considered potentially significant. Short term impacts associated with loss of potential habitat would be considered less than significant, given the large areas of suitable habitat within the project vicinity. The mitigation measure below would be implemented to further reduce impacts to terrestrial species and habitats (refer to Table 20 for a complete description of the mitigation measure).

Mitigation Measures:

- TSH-MM-3: Pre-construction special status plant survey during the flowering period, avoidance of individuals and populations, and potential consultation with USFWS to determine course of action

Residual Impact after Mitigation: After inclusion of the mitigation measure, the residual impact would be less than significant.

TSH-3: Impacts to federally protected wetlands and sensitive habitats

No wetlands or other sensitive habitats exist on the usable portion of S1. Thus, there would be no impacts to federally protected wetlands or other sensitive habitats from the placement of dredged material at S1 under Future without Project Conditions.

Mitigation Measures: Mitigation is not required.

Residual Impact after Mitigation: None.

TSH-4: Introduction or spread of noxious weeds

Dredged material placement has the potential to promote the spread of invasive plants currently established in S1 through transport of these species in runoff. Such species could displace native plants, potentially changing the species composition of the study area. However, non-native and invasive species are common within S1 and the project vicinity, and their establishment would be expected absent maintenance dredging operations. Thus, there would be less than significant impacts from the introduction or spread of noxious weeds from the placement of dredged material at S1 under Future without Project Conditions.

Mitigation Measures: Mitigation is not required.

Residual Impact after Mitigation: The residual impact would be less than significant.

Placement Site S14

Placement site S14 is described in Sections 2.3.3 and 3.2.2.1. Threatened and endangered species with the potential to be present on S14 are valley elderberry longhorn beetle, and Swainson's hawk (recorded nearby; Artho 2003; USACE 2009a). Additional special status species with the potential to be present on S14 include the western red bat (SSC), Heckard's peppergrass (CNPS) (Artho 2003; USACE 2009). The usable portion of S14 is primarily composed of non-native grassland and valley foothill riparian habitat designations (USACE 2010e). No wetlands exist on the usable portion of S14. Sensitive habitats occurring within the usable portion of S14 include 0.61 acres of riparian habitat as summarized in Table 43.

TSH-1: Disturbance to birds, amphibians, reptiles, invertebrates, plants, mammals, and their habitats, including loss of foraging habitat

Swainson's hawk has the potential to be present in the usable portion of S14. Swainson's hawk nests in California from March 1 through September 15. During this period, nests may potentially be present in trees within riparian or valley oak woodland occurring in placement site S14. Should site preparation or dredged material placement activities occur during the nesting season, potentially significant impacts to the Swainson's hawk may occur. This may include direct take of nests or juveniles through tree removal, loss of foraging habitat as a result of dredged material placement, and/or disturbance resulting in nest abandonment.

Noise, vibration, visual, and proximity related disturbances associated with construction could impact bird species that nest and forage on S14, including species protected under the ESA, such as Swainson's hawk. Impacts to birds from noise associated with the placement of dredged material at S14 would be less than significant as described for placement site S1 above.

Elderberry bushes, which are closely associated with the valley elderhorn longhorn beetle, were identified as occurring within the usable portion of placement site S14 during site surveys completed in 2003. Subsequent surveys in 2008 and 2010 did not identify any elderberry shrubs as occurring at S14 (USACE 2008c, 2010g). Nonetheless, there exists a potential for there to be elderberry shrubs present in S14. Disturbance to this plant species (i.e., removal, burying with dredged material, or other damage) may adversely affect the valley elderhorn longhorn beetle (if present), which could be a potentially significant impact.

Placement of dredged material on S14 could result in the temporary removal of, or disturbance to, foraging habitat for potentially present ESA listed species on site, including Swainson's hawk and valley elderberry longhorn beetle. Once dredged material is initially placed, there would be minimal additional impact on foraging habitat for these species with

subsequent placement events. Placement would result in disturbance of a very small percentage of available foraging area; thus, the impacts due to ongoing placement of dredged material would be less than significant.

Disturbance to ESA listed amphibians, vernal pool invertebrates, mammals, and plants is unlikely since S14's usable portion does not support associated habitats for these species. Additionally, it is unlikely that significant impacts to above-mentioned non-listed special status invertebrate, amphibian, reptile, mammal, and plant species would occur at the population level since any impacts to existing vegetation and habitats would be temporary.

Thus, there would be no impacts to amphibians, vernal pool invertebrates, mammals, or plants; and potentially significant incremental impacts to Swainson's hawk and valley elderberry longhorn beetle from the placement of dredged material at S14 under Future without Project Conditions. The mitigation measures below would be implemented to further reduce impacts to terrestrial species and habitats (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- TSH-MM-1: Special status species surveys and biological monitoring
- TSH-MM-2: Schedule construction outside the breeding season for protected species, or conduct special status species survey and potentially consult with USFWS to determine course of action

Residual Impact after Mitigation: After inclusion of the mitigation measures, the residual impact would be less than significant.

TSH-2: Loss of special status plant species or habitat for special status plant species

Placement site S14 may provide habitat for Heckard's pepper-grass. Dredged material placement could potentially bury individuals or populations of this species, and site preparation (i.e., grubbing) could potentially result in species take. Placement of the dredge pipeline could also potentially damage any individuals present. These potential impacts would be considered significant. Short term impacts associated with loss of potential habitat would be considered less than significant, given the large areas of suitable habitat within the project vicinity. The mitigation measure below would be implemented to further reduce impacts to terrestrial species and habitats (refer to Table 20 for a complete description of the mitigation measure).

Mitigation Measures:

- TSH-MM-3: Pre-construction special status plant survey during the flowering period, avoidance of individuals and populations, and potential consultation with USFWS to determine course of action

Residual Impact after Mitigation: After inclusion of the mitigation measure, the residual impact would be less than significant.

TSH-3: Impacts to federally protected wetlands and sensitive habitats

Dredged material placement is anticipated to result in the loss of approximately 0.6 acres of riparian habitat occurring within the usable portion of S14. There are no wetlands present in this area. The unmitigated loss of a small amount of riparian habitat would be less than significant due to the negligible amount of habitat loss at a frequently disturbed site. The mitigation measure below would be implemented to further reduce impacts to terrestrial species and habitats (refer to Table 20 for a complete description of the mitigation measure).

Mitigation Measures:

- TSH-MM-4: USACE will implement the wetland preservation project on Prospect Island as described in Section 2.2.2.3

Residual Impact after Mitigation: After inclusion of the mitigation measure, the residual impact would be less than significant.

TSH-4: Introduction or spread of noxious weeds

Dredged material placement has the potential to promote the spread of invasive plants currently established in S14 through transport of these species in runoff. Such species could displace native plants, potentially changing the species composition of the study area. However, non-native and invasive species are common within S14 and the project vicinity, and their establishment would be expected absent the dredged material placement activities. Thus, there would be less than significant impacts from the introduction or spread of noxious weeds from the placement of dredged material at S14 under Future without Project Conditions.

Mitigation Measures: Mitigation is not required.

Residual Impact after Mitigation: The residual impact would be less than significant.

Placement Site S16

Placement site S16 is described in Sections 2.3.3 and 3.2.2.1. Threatened and endangered species with the potential to be present on S16 are giant garter snake, bank swallow, and Swainson's hawk (Artho 2003; USACE 2009a). Habitat for the giant garter snake is further protected by Solano County General Plan requirement (Solano County 2008a). Additional special status species with the potential to be present on S16 include the western pond turtle (*Emys marmorata*; SSC), western red bat (*Lasiurus blossevillii*; SSC), and Heckard's peppergrass (CNPS) (Artho 2003; USACE 2009a). The usable portion of S16 is mainly composed of dryland agriculture, non-native grassland, and general urban designations (USACE 2010e). No wetlands occur within the usable portion of S20. Sensitive habitats occurring within the usable portion of S16 include 0.67 acres of riparian habitat as

summarized in Table 43.

TSH-1: Disturbance to birds, amphibians, reptiles, invertebrates, plants, mammals, and their habitats, including loss of foraging habitat

Two species of ESA listed nesting birds, the bank swallow and Swainson's hawk, could occur in the usable portion of S16. The banks along the southern edge of the site have the potential to support bank swallow nests, while trees within riparian areas could serve as Swainson's hawk nesting habitat. Little information exists regarding the precise breeding habits for the bank swallow; its breeding period is broadly identified as occurring from spring through summer. The breeding season for the Swainson's hawk occurs from March 1 through September 15. Project activities including dredged material placement and site preparation (e.g., grubbing, tree removal, and berm construction) during bird nesting periods could result in direct take of eggs or juveniles and/or nest abandonment. The bank swallow and Swainson's hawk could be significantly impacted by project activities at S16.

Noise, vibration, visual, and proximity related disturbances associated with construction could potentially impact bird species that nest and forage on S16, including special status species such as bank swallow and Swainson's hawk. Impacts to birds from noise associated with the placement of dredged material at S16 would be less than significant as described for the placement sites above.

Placement of dredged material on S16 could result in the temporary removal of, or disturbance to, foraging habitat for potentially present ESA listed species on site, including the bank swallow, Swainson's hawk, and giant garter snake. Similar to S1, grassland and agricultural areas on the site are potential habitat for the giant garter snake. Site preparation could potentially result in individuals being run over by machinery, which would be considered a potentially significant impact. Dredged material placement may result in burial of habitat and burrow holes; these short term impacts would be more temporary in nature, and are considered less than significant given the large areas of suitable habitat within the project vicinity. Once dredged material is initially placed, there would be minimal additional impact on foraging habitat for these species with subsequent placement events. Placement would result in disturbance of a very small percentage of available foraging area; thus, the impacts due to ongoing placement of dredged material would be less than significant.

Disturbance to ESA listed amphibians, vernal pool invertebrates, mammals, and plants is unlikely since the portion of S16 that would be used for dredged material placement does not support associated habitats for these species. Additionally, it is unlikely that impacts to the above-mentioned non-listed special status amphibian, reptile, mammal, and plant species

would occur at the population level. No impacts are expected for any amphibians, vernal pool invertebrates, mammals, or plants at S16.

Thus, there would be no impacts to amphibians, vernal pool invertebrates, mammals, or plants; and potentially significant impacts to the bank swallow, Swainson's hawk, and the giant garter snake from the placement of dredged material at S16 under Future without Project Conditions. The mitigation measures below would be implemented to further reduce impacts to terrestrial species and habitats (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- TSH-MM-1: Special status species surveys and biological monitoring
- TSH-MM-2: Schedule construction outside the breeding season for protected species, or conduct special status species survey and potentially consult with USFWS to determine course of action

Residual Impact after Mitigation: After inclusion of the mitigation measures, the residual impact would be less than significant.

TSH-2: Loss of special status plant species or habitat for special status plant species

Placement site S16 may provide habitat for Heckard's pepper-grass. Dredged material placement could potentially bury individuals or populations of this species, and site preparation (i.e., grubbing) could potentially result in species take. Placement of the dredge pipeline could potentially damage any individuals present. These potential impacts would be considered significant. Short term impacts associated with loss of potential habitat would be considered less than significant, given the large areas of suitable habitat within the project vicinity. The mitigation measure below would be implemented to further reduce impacts to terrestrial species and habitats (refer to Table 20 for a complete description of the mitigation measure).

Mitigation Measures:

- TSH-MM-3: Pre-construction special status plant survey during the flowering period, avoidance of individuals and populations, and potential consultation with USFWS to determine course of action

Residual Impact after Mitigation: After inclusion of the mitigation measure, the residual impact would be less than significant.

TSH-3: Impacts to federally protected wetlands and sensitive habitats

Dredged material placement is anticipated to result in the loss of approximately 0.7 acres of riparian habitat within the usable portion of S16. There are no wetlands present in this area. The unmitigated loss of a small amount of riparian habitat would be less than significant due

to the negligible amount of habitat loss at a frequently disturbed site. The mitigation measure below would be implemented to further reduce impacts to terrestrial species and habitats (refer to Table 20 for a complete description of the mitigation measure).

Mitigation Measures:

- TSH-MM-4: USACE will implement the wetland preservation project on Prospect Island as described in Section 2.2.2.3

Residual Impact after Mitigation: After inclusion of the mitigation measure, the residual impact would be less than significant.

TSH-4: Introduction or spread of noxious weeds

Dredged material placement has the potential to promote the spread of invasive plants currently established in S16 through transport of these species in runoff. Such species could displace native plants, potentially changing the species composition of the study area. However, non-native and invasive species are common within S16 and the project vicinity, and their establishment would be expected absent maintenance dredging operations. Thus, there would be less than significant impacts from the introduction or spread of noxious weeds from the placement of dredged material at S16 under Future without Project Conditions.

Mitigation Measures: Mitigation is not required.

Residual Impact after Mitigation: The residual impact would be less than significant.

Placement Site S19

Placement site S19 is described in Sections 2.3.3 and 3.2.2.1. Two areas of seasonal wetland exist on the placement site. No dredged material would be placed within the wetland areas, but decant water that carries the dredged material would drain into the wetland areas and eventually recede via a culvert to the SRDWSC, per the standard practice used by USACE during maintenance dredging events.

Threatened and endangered species with the potential to be present on S19 are Valley elderberry longhorn beetle, giant garter snake, bank swallow, California black rail, and Swainson's hawk (Artho 2003; USACE 2009a). Special status species with the potential to inhabit S19 include the western pond turtle (SSC), great blue heron (*Ardea herodia*), western red bat (SSC), and Heckard's peppergrass (CNPS) (Artho 2003; USACE 2009a). The usable portion of S19 is primarily composed of non-native grassland, irrigated agriculture, and general shrubs (USFWS 2010e). There is a large tamarisk community around the center of the northern half. No wetlands occur within the usable portion. Sensitive habitats occurring within the usable portion of S19 include 0.87 acres of riparian habitat and 0.90 acres of open water, as summarized in Table 43.

TSH-1: Disturbance to birds, amphibians, reptiles, invertebrates, plants, mammals, and their habitats, including loss of foraging habitat

Three species of ESA listed nesting birds, bank swallow, California black rail, and Swainson's hawk, could occur in the usable portion of S19. The banks along the northwestern edge of the site have the potential to support bank swallow nests, and the adjacent irrigated agriculture and grassland could support Swainson's hawk nesting area. Tidal marsh along the northwestern and southwestern edges of S19 could support California black rail. The bank swallow's breeding period is broadly identified as occurring from spring through summer. The breeding season for the Swainson's hawk occurs from March 1 through September 15, and the California black rail breeds from February through mid-June.

Project activities including dredged material placement and site preparation (e.g., grubbing, tree removal, and berm construction) during bird nesting periods could result in direct take of eggs or juveniles and/or nest abandonment. These activities would not occur within tidal marsh habitat or on banks potentially utilized by the California black rail and bank swallow. Potential impacts to these species, including species take, egg loss, or loss of nests, are therefore not anticipated. However, Swainson's hawk may nest within the placement area and could be significantly impacted by project activities.

Although the great blue heron is not listed as threatened or endangered, it is protected under the MBTA. The great blue heron nests in the top of trees within woodlands near wetlands. Its breeding period occurs from March through May. Dredged material placement is unlikely to affect this species or its habitat. If timed to occur during the nesting season, site preparation activities such as tree removal could potentially result in direct take of eggs or juveniles and/or nest abandonment. This would be considered a significant impact.

Noise, vibration, visual, and proximity related disturbances associated with construction could impact bird species that nest and forage on the portion of S19 that would be used for dredged material placement, including the bank swallow, California black rail, and Swainson's hawk. Impacts to birds from noise associated with the placement of dredged material at S19 would be less than significant as described for the placement sites above.

Placement of dredged material on S19 could result in the temporary removal of, or disturbance to, foraging habitat for potentially present ESA listed species (bank swallow, Swainson's hawk, valley elderberry longhorn beetle, and giant garter snake) with each subsequent dredging episode. Impacts to the California black rail are not anticipated, because this species forages exclusively within wetland habitat that will not be affected by the dredged material placement activities. The bank swallow and Swainson's hawk may forage in grasslands and meadows occurring at S19. Loss of foraging habitat for these species

may occur as a result of dredged material placement. Placement would result in disturbance of a very small percentage of available foraging area; thus, the impacts due to ongoing placement of dredged material would be less than significant.

Elderberry bushes, which are closely associated with the valley elderhorn longhorn beetle, were identified as occurring adjacent to placement site S19 during site surveys completed in 2003. Only one shrub was determined to be located in an area of potential pipe placement. A few elderberry shrubs were also identified in scrub-shrub habitat, though these areas would not be used for dredged material placement or otherwise disturbed. Subsequent surveys in 2008 and 2010 did not identify any elderberry shrubs as occurring at S19 (USACE 2008c, 2010g). Disturbance to elderberry plants at placement site S19 would likely be limited to plant damage during placement of the dredge pipeline, as no individuals of this species are known to occur within the dredged material placement area. Damage to elderberry plants would constitute loss of habitat for the valley elderhorn longhorn beetle (if present), which would be considered a significant impact.

Similar to the placement sites above, grassland and agricultural areas on the site are potential habitat for the giant garter snake. Site preparation could potentially result in individuals being run over by machinery, which would be considered a potentially significant impact. Dredged material placement may result in burial of habitat and burrow holes; these short term impacts would be more temporary in nature, and are considered less than significant given the large areas of suitable habitat within the project vicinity. Once dredged material is initially placed, there would be minimal additional impact on foraging habitat for these species with subsequent placement events. Placement would result in disturbance of a very small percentage of available foraging area; thus, the impacts due to ongoing placement of dredged material would be less than significant.

Disturbance to ESA listed amphibians, vernal pool invertebrates, and mammals is unlikely since the site does not support associated habitats for these species. Additionally, it is unlikely that significant impacts to the above-mentioned non-listed special status invertebrate, amphibian, reptile, mammal, and plant species would occur at the population level since any impacts to existing vegetation and habitats would be temporary. No impacts are expected for any amphibians, vernal pool invertebrates, mammals, or plants at S19.

Thus, there would be no impacts to amphibians, vernal pool invertebrates, mammals, or plants; and potentially significant impacts to bank swallow, Swainson's hawk, great blue heron, giant garter snake, and valley elderberry longhorn beetle from the placement of dredged material at S19 under Future without Project Conditions. The mitigation measures below would be implemented to further reduce impacts to terrestrial species and habitats

(refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- TSH-MM-1: Special status species surveys and biological monitoring
- TSH-MM-2: Schedule construction outside the breeding season for protected species, or conduct special status species survey and potentially consult with USFWS to determine course of action

Residual Impact after Mitigation: After inclusion of the mitigation measures, the residual impact would be less than significant.

TSH-2: Loss of special status plant species or habitat for special status plant species

Placement site S19 may provide habitat for Heckard's pepper-grass. Dredged material placement could potentially bury individuals or populations of this species, and site preparation (i.e., grubbing) could potentially result in species take. Placement of the dredge pipeline could potentially damage any individuals present. These potential impacts would be considered significant. Short term impacts associated with loss of potential habitat would be considered less than significant, given the large areas of suitable habitat within the project vicinity. The mitigation measure below would be implemented to further reduce impacts to terrestrial species and habitats (refer to Table 20 for a complete description of the mitigation measure).

Mitigation Measures:

- TSH-MM-3: Pre-construction special status plant survey during the flowering period, avoidance of individuals and populations, and potential consultation with USFWS to determine course of action

Residual Impact after Mitigation: After inclusion of the mitigation measure, the residual impact would be less than significant.

TSH-3: Impacts to federally protected wetlands and sensitive habitats

Dredged material placement is anticipated to result in the loss of approximately 0.9 acres of riparian habitat within the usable portion of S19. There are no wetland areas within the usable portion of S19. This unmitigated loss of riparian habitat would be a less than significant impact due to the negligible amount of lost habitat within a frequently disturbed site. The mitigation measure below would be implemented to further reduce impacts to terrestrial species and habitats (refer to Table 20 for a complete description of the mitigation measure).

Mitigation Measures:

- TSH-MM-4: USACE will implement the wetland preservation project on Prospect Island as described in Section 2.2.2.3

Residual Impact after Mitigation: After inclusion of the mitigation measure, the residual impact would be less than significant.

TSH-4: Introduction or spread of noxious weeds

Dredged material placement has the potential to promote the spread of invasive plants currently established in S19 through transport of these species in runoff. Such species could displace native plants, potentially changing the species composition of the study area. However, non-native and invasive species are common within S19 and the project vicinity, and their establishment would be expected absent maintenance dredging operations. Thus, there would be less than significant impacts from the introduction or spread of noxious weeds from the placement of dredged material at S19 under Future without Project Conditions.

Mitigation Measures: Mitigation is not required.

Residual Impact after Mitigation: The residual impact would be less than significant.

Placement Site S20

Placement site S20 is described in Sections 2.3.3 and 3.2.2.1. Threatened and endangered species with the potential to be present on S20 are giant garter snake and California black rail (Artho 2003; USACE 2009a). Additional special status species with the potential to be present on S20 include the Suisan song sparrow (*Melospiza melodia maxillaries*; SSC), western pond turtle (SSC), western red bat (SSC), Heckard's peppergrass (CNPS), and white-tailed kite (*Elanus leucurus*; FP) (Artho 2003; USACE 2009a). The usable portion of S20 is mainly composed of irrigated agriculture with a small area of non-native grassland. No wetlands, riparian areas, or other sensitive habitat are found within the usable portion of S20 as summarized in Table 43.

TSH-1: Disturbance to birds, amphibians, reptiles, invertebrates, plants, mammals, and their habitats, including loss of foraging habitat

One species of ESA listed nesting bird, California black rail, has the potential to occur in the portion of S20 that would be used for dredged material placement. Tidal marsh along the northern edge of the site could support California black rail. California black rail breeds from February through mid-June. Project activities including dredged material placement and site preparation (e.g., grubbing, tree removal, and berm construction) would not occur within tidal marsh habitat potentially utilized by the California black rail. Impacts to this species, including species take, loss of eggs, and/or loss of nests, are therefore not anticipated.

Although the Suisun song sparrow and white-tailed kite are not listed as threatened or endangered, they are protected under the MBTA (the Suisun song sparrow is additionally a state species of special concern and the white-tailed kite is a fully protected species). The

Suisun song sparrow nests adjacent to marsh and wetland areas composed of bulrush and cattails. The white-tailed kite nests in the top of trees 20 to 50 feet off the ground. Their breeding period is from February through July. Disturbance to these species or their nests would be considered a significant impact.

Noise, vibration, visual, and proximity related disturbances associated with construction could impact bird species that nest and forage on the site, including the ESA listed California black rail. Impacts to birds from noise associated with the placement of dredged material at S20 would be less than significant as described for the placement sites above.

Placement of dredged material on grassland and agricultural land within the usable portion of S20 could result in the temporary removal of, or disturbance to, foraging habitat for potentially present ESA listed species, including the giant garter snake. Impacts to the California black rail are not anticipated, because this species forages exclusively within wetland habitat that would not be affected by the dredged material placement activities. Site preparation could potentially result in giant garter snake individuals being run over by machinery, which would be considered a potentially significant impact. Per the 2004 USACE 10-Year Programmatic Biological Assessment, adverse effects to giant garter snake habitat would be avoided by constructing temporary berms if necessary (USACE 2004). This avoidance measure is specific to placement site S20, though it may be implemented at the other placement sites following consultation with USFWS. Dredged material placement may result in burial of habitat and burrow holes; these short term impacts would be more temporary in nature, and are considered less than significant given the large areas of suitable habitat within the project vicinity. Once dredged material is initially placed, there would be minimal additional impact on foraging habitat for this species with subsequent placement events. Placement would result in disturbance of a very small percentage of available foraging area; thus, the impacts due to ongoing placement of dredged material would be less than significant.

Disturbance to ESA listed amphibians, vernal pool invertebrates, and mammals is unlikely since the site does not support associated habitats for these species. Additionally, it is unlikely that significant impacts to the above-mentioned non-listed special status invertebrate, amphibian, reptile, mammal, and plant species would occur at the population level since any impacts to existing vegetation and habitats would be temporary.

Thus, there would be no impacts to amphibians, vernal pool invertebrates, or mammals; and potentially significant impacts to the Suisun song sparrow, white-tailed kite, and giant garter snake from the placement of dredged material at S20 under Future without Project Conditions. The mitigation measures below would be implemented to further reduce

impacts to terrestrial species and habitats (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- TSH-MM-1: Special status species surveys and biological monitoring
- TSH-MM-2: Schedule construction outside the breeding season for protected species, or conduct special status species survey and potentially consult with USFWS to determine course of action

Residual Impact after Mitigation: After inclusion of the mitigation measures, the residual impact would be less than significant.

TSH-2: Loss of special status plant species or habitat for special status plant species

Placement site S20 may provide habitat for Heckard's pepper-grass. Dredged material placement could potentially bury individuals or populations of this species, while site preparation (i.e., grubbing) could potentially result in species take. Placement of the dredge pipeline could potentially damage any individuals present. These potential impacts would be considered significant. Short term impacts associated with loss of potential habitat would be considered less than significant, given the large areas of suitable habitat within the project vicinity. The mitigation measure below would be implemented to further reduce impacts to terrestrial species and habitats (refer to Table 20 for a complete description of the mitigation measure).

Mitigation Measures:

- TSH-MM-3: Pre-construction special status plant survey during the flowering period, avoidance of individuals and populations, and potential consultation with USFWS to determine course of action

Residual Impact after Mitigation: After inclusion of the mitigation measure, the residual impact would be less than significant.

TSH-3: Impacts to federally protected wetlands and sensitive habitats

No wetlands or other sensitive habitats exist on the usable portion of S20. Thus, there would be no impacts to federally protected wetlands or other sensitive habitats from the placement of dredged material at S20 under Future without Project Conditions.

Mitigation Measures: Mitigation is not required.

Residual Impact after Mitigation: None.

TSH-4: Introduction or spread of noxious weeds

Dredged material placement has the potential to promote the spread of invasive plants currently established in S20 through transport of these species in runoff. Such species could displace native plants, potentially changing the species composition of the study area.

However, non-native and invasive species are common within S20 and the project vicinity, and their establishment would be expected absent maintenance dredging operations. Thus, there would be less than significant impacts from the introduction or spread of noxious weeds from the placement of dredged material at S20 under Future without Project Conditions.

Mitigation Measures: Mitigation is not required.

Residual Impact after Mitigation: The residual impact would be less than significant.

Placement Site S31

Placement site S31 is described in Sections 2.3.3 and 3.2.2.1. Threatened and endangered species with the potential to be present on S31 are giant garter snake, and Swainson's hawk (Artho 2003; USACE 2009a). Special status species with the potential to inhabit S31 include the purple martin (*Progne subis*; SSC), tricolored blackbird (SSC), white-tailed kite (FP), yellow-headed blackbird (SSC), American badger (SSC), and Heckard's peppergrass (CNPS) (Artho 2003; USACE 2009a). The usable portion of S31 includes unvegetated land, a thin riparian buffer, and both emergent and scrub-shrub wetlands (USACE 2008c; USACE 2010e). Sensitive habitats occurring within the usable portion of S31 include 6.79 acres of riparian habitat and 1.33 acres of wetland, as summarized in Table 43.

TSH-1: Disturbance to birds, amphibians, reptiles, invertebrates, plants, mammals, and their habitats, including loss of foraging habitat

One species of ESA listed nesting bird, Swainson's hawk, has the potential to occur in the portion of S31 that would be used for dredged material placement. Swainson's hawk nests in California from March 1 through September 15. During this period, nests may potentially be present in trees within riparian woodland occurring in placement site S31. Should site preparation or dredged material placement activities occur during the nesting season, potentially significant impacts to the Swainson's hawk may occur. This may include direct take of nests or juveniles through tree removal, loss of foraging habitat as a result of dredged material placement, and/or disturbance resulting in nest abandonment. Thus, significant impacts to Swainson's hawk could result from dredged material placement activities at S31.

Although the purple martin, tricolored blackbird, white-tailed kite, and yellow-headed blackbird are not listed as threatened or endangered, they are protected under the MBTA and may potentially occur at S31 (the white-tailed kite is also a fully protected species). The purple martin nests in cliffs, hollow trees, and abandoned woodpecker holes; its breeding season is from March through July. The tricolored blackbird nests in dense marsh vegetation such as cattails and bulrushes; its breeding season is from March through June. The white-tailed kite nests in the top of large trees approximately 20 to 50 feet off the ground; its breeding season is from February through July. The yellow-headed blackbird nests in reeds

over open water; its breeding season is from April through July. Disturbance to these species or their nests would constitute a potentially significant impact.

Noise, vibration, visual, and proximity related disturbances associated with construction could impact bird species that nest and forage on the site, including the ESA listed Swainson's hawk. Impacts to birds from noise associated with the placement of dredged material at S31 would be less than significant as described for the placement sites above.

Dredged material placement on the usable portion of S31 could result in the temporary removal of, or disturbance to, foraging habitat for the Swainson's hawk and giant garter snake. These species tend to forage across large expanses of grassland and emergent wetland. Once dredged material is initially placed, there would be minimal additional impact on foraging habitat for these species from subsequent placement events. Placement would result in disturbance of a very small percentage of available foraging area; thus, the impacts due to ongoing placement of dredged material would be less than significant. Site preparation could potentially result in giant garter snake individuals being run over by machinery, which would be considered a potentially significant impact.

Disturbance to ESA listed amphibians, vernal pool invertebrates, mammals, and plants is unlikely since the portion of S31 that would be used for dredged material placement does not support associated habitats for these species. Additionally, it is unlikely that significant impacts to the above-mentioned non-listed special status invertebrate, amphibian, reptile, mammal, and plant species would occur at the population level since any impacts to existing vegetation and habitats would be temporary.

Thus, there would be no impacts to amphibians, vernal pool invertebrates, mammals, or plants; and potentially significant impacts to Swainson's hawk, purple martin, tricolored blackbird, white-tailed kite, yellow-headed blackbird, and giant garter snake from the placement of dredged material at S31 under Future without Project Conditions. The mitigation measures below would be implemented to further reduce impacts to terrestrial species and habitats (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- TSH-MM-1: Special status species surveys and biological monitoring
- TSH-MM-2: Schedule construction outside the breeding season for protected species, or conduct special status species survey and potentially consult with USFWS to determine course of action

Residual Impact after Mitigation: After inclusion of the mitigation measures, the residual impact would be less than significant.

TSH-2: Loss of special status plant species or habitat for special status plant species

Placement site S31 may provide habitat for Heckard's pepper-grass. Dredged material placement could potentially bury individuals or populations of this species, and site preparation (i.e., grubbing) could potentially result in species take. Placement of the dredge pipeline could potentially damage any individuals present. These potential impacts would be considered significant. Short term impacts associated with loss of potential habitat would be considered less than significant, given the large areas of suitable habitat within the project vicinity. The mitigation measure below would be implemented to further reduce impacts to terrestrial species and habitats (refer to Table 20 for a complete description of the mitigation measure).

Mitigation Measures:

- TSH-MM-3: Pre-construction special status plant survey during the flowering period, avoidance of individuals and populations, and potential consultation with USFWS to determine course of action

Residual Impact after Mitigation: After inclusion of the mitigation measure, the residual impact would be less than significant.

TSH-3: Impacts to federally protected wetlands and sensitive habitats

Dredged material placement is anticipated to result in the loss of approximately 1.3 acres of wetland habitat and 6.8 acres of riparian habitat within the usable portion of S31. Any unmitigated loss of wetland or riparian habitat would be a less than significant impact due to the negligible amount of lost habitat within a frequently disturbed site. The mitigation measure below would be implemented to further reduce impacts to terrestrial species and habitats (refer to Table 20 for a complete description of the mitigation measure).

Mitigation Measures:

- TSH-MM-4: USACE will implement the wetland preservation project on Prospect Island as described in Section 2.2.2.3

Residual Impact after Mitigation: After inclusion of the mitigation measure, the residual impact would be less than significant.

TSH-4: Introduction or spread of noxious weeds

Dredged material placement has the potential to promote the spread of invasive plants currently established in S31 through transport of these species in runoff. Such species could displace native plants, potentially changing the species composition of the study area. However, non-native and invasive species are common within S31 and the project vicinity, and their establishment would be expected absent maintenance dredging operations. Thus, there would be less than significant impacts from the introduction or spread of noxious

weeds from the placement of dredged material at S31 under Future without Project Conditions.
Mitigation Measures: Mitigation is not required.
Residual Impact after Mitigation: The residual impact would be less than significant.

The following threshold applies to all sites under Future without Project Conditions.

TSH-5: Non-compliance with local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance; the provisions of an adopted habitat conservation plan; a natural community conservation plan; or other approved local, regional, or state habitat conservation plan

Use of placement sites under Future without Project Conditions would be consistent with past practices. There would be no modifications to the existing placement sites that would potentially affect compliance with local policies or ordinances, or other habitat or conservation plans protecting biological resources. Thus, there would be no impact to compliance with local policies, plans, and ordinances.
Mitigation Measures: Mitigation is not required.
Residual Impact after Mitigation: None.

Proposed Project: Channel Deepening to -35 Feet MLLW and Selective Widening

As discussed previously, the usable portions of proposed dredged material placement sites were designed to avoid wetland and other sensitive habitat impacts. Potential impacts of the Proposed Project as compared to the environmental baseline are described in the following section.

Placement Sites S1, S14, S16, S19, S20, and S31

The terrestrial species and habitat on the above-mentioned sites are described above in Future without Project Conditions. The impacts of the Proposed Project on these sites would be similar to those under Future without Project Conditions, with the following exceptions:

1. Placement site preparation and dredged material placement activities could occur for a maximum of 9 months per year, which could interfere more significantly with avian nesting seasons.
2. A placement site could be used for more than one consecutive construction year.
3. New proposed berm heights for each site are higher than under baseline conditions, resulting in incrementally greater site preparation impacts. The new proposed berm heights are shown on Table 9 in Section 2.2.2.2. Impacts to wetlands and other sensitive habitats would not be different under the Proposed Project because the usable portion of each site would not change.

The following four mitigation measures remain proposed for these six sites (refer to Table 20 for complete descriptions of mitigation measures):

- TSH-MM-1: Special status species surveys and biological monitoring
- TSH-MM-2: Schedule construction outside the breeding season for protected species, or conduct special status species survey and potentially consult with USFWS to determine course of action
- TSH-MM-3: Pre-construction special status plant survey during the flowering period, avoidance of individuals and populations, and potential consultation with USFWS to determine course of action
- TSH-MM-4: USACE will implement the wetland preservation project on Prospect Island as described in Section 2.2.2.3

After inclusion of the above mitigation measures, the residual impacts for these six sites would be the same as described under Future without Project Conditions.

The following placement sites not described under Future without Project Conditions would be used as part of the Proposed Project.

Placement Site S4

Placement site S4 is described in Sections 2.3.3 and 3.2.2.1. Threatened and endangered species with the potential to be present on S4 include the giant garter snake and Swainson's hawk. Additional special status species with the potential to be present on S4 include Western pond turtle (SSC), and Suisun song sparrow (SSC). S4 is entirely composed of an agricultural field. There are no wetlands, riparian areas, or other sensitive habitats within the usable portion of S4 as summarized in Table 43.

TSH-1: Disturbance to birds, amphibians, reptiles, invertebrates, plants, mammals, and their habitats, including loss of foraging habitat

One species of ESA listed nesting bird, the Swainson's hawk, has the potential to occur in the usable portion of S4. Swainson's hawk nests in California from March 1 through September 15. During this period, nests may potentially be present in trees within riparian scrub occurring at the margins of S4. Should site preparation or dredged material placement activities occur during the nesting season, potentially significant impacts to the Swainson's hawk may occur. This may include direct take of nests or juveniles through tree removal, loss of foraging habitat as a result of dredged material placement, and disturbance resulting in nest abandonment.

Noise, vibration, visual, and proximity related disturbances associated with construction could impact bird species that nest and forage on S4, including species protected under the

ESA, such as Swainson's hawk. Impacts to birds from noise would occur at similar levels as described under baseline conditions for other sites. While the duration of construction would be increased, the intensity of sound should remain consistent with baseline conditions. Therefore, there would be no incremental impact due to noise or vibration from construction of the Proposed Project.

Placement of dredged material on the usable portion of S4 could result in the temporary removal of, or disturbance to, foraging habitat for ESA listed species potentially present onsite, including Swainson's hawk and giant garter snake. Site preparation could potentially result in giant garter snake individuals being run over by machinery, which would be considered a significant impact. These potential impacts would be similar to other sites as described under Future without Project Conditions. Once dredged material is initially placed, there would be minimal additional impact on foraging habitat for these species from subsequent placement events. Placement would result in disturbance of a very small percentage of available foraging area; thus, the impacts due to ongoing placement of dredged material would be less than significant. Thus, as compared to the environmental baseline, despite the longer construction periods, there would be no increased incremental impacts to ESA listed species.

Disturbance to ESA listed amphibians, vernal pool invertebrates, mammals, and plants is unlikely since the site's usable portion does not support associated habitats for these species. Additionally, it is unlikely that significant impacts to the above-mentioned non-listed special status amphibian, reptile, mammal, and plant species would occur at the population level since any impacts to existing vegetation and habitats would be temporary. No impacts are expected for any amphibians, vernal pool invertebrates, mammals, or plants at S4.

Thus, as compared to the environmental baseline, there would be no impacts to amphibians, vernal pool invertebrates, mammals, or plants; and potentially significant incremental impacts to Swainson's hawk and the giant garter snake from the placement of dredged material at S4 as a result of the Proposed Project. The mitigation measures below would be implemented to further reduce impacts to terrestrial species and habitats (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- TSH-MM-1: Special status species surveys and biological monitoring
- TSH-MM-2: Schedule construction outside the breeding season for protected species, or conduct special status species survey and potentially consult with USFWS to determine course of action

Residual Impact after Mitigation: After inclusion of the mitigation measures, the residual impact would be less than significant.

TSH-2: Loss of special status plant species or habitat for special status plant species

It is unlikely that any ESA or CNPS listed plant species known to occur within the project quadrangles exist within the usable portion of S4, because no individuals of these species or their respective genera were observed during plant surveys (USACE 2008c, 2010g). Thus, as compared to the environmental baseline, there would be no impacts to special status plant species from the placement of dredged material at S4.

Mitigation Measures: Mitigation is not required.

Residual Impact after Mitigation: None.

TSH-3: Impacts to federally protected wetlands and sensitive habitats

No wetlands, riparian areas, or other sensitive habitat exist on the portion of S4 that would be used for dredged material placement. Thus, as compared to the environmental baseline, there would be no impacts to federally protected wetlands or other sensitive habitats from the placement of dredged material at S4.

Mitigation Measures: Mitigation is not required.

Residual Impact after Mitigation: None.

TSH-4: Introduction or spread of noxious weeds

Dredged material placement has the potential to promote the spread of invasive plants currently established in S4 through transport of these species in runoff. Such species could displace native plants, potentially changing the species composition of the study area. However, non-native and invasive species are common within S4 and the project vicinity, and their establishment would be expected absent the Proposed Project. Thus, as compared to baseline conditions, there would be less than significant impacts from the introduction or spread of noxious weeds from the placement of dredged material at S4.

Mitigation Measures: Mitigation is not required.

Residual Impact after Mitigation: The residual impact would be less than significant.

Placement Site S11

Placement site S11 is described in Sections 2.3.3 and 3.2.2.1. Threatened and endangered species with the potential to be present on S11 are giant garter snake and Swainson's hawk (Artho 2003; USACE 2009). One part of S11 borders the length of the SRDWSC east-levee and is dominated by mustard along the levee flank and bromes along the base. The second section of S11 is the southernmost extent and extends into an agricultural field dominated with agricultural crops. There are no wetlands within the usable portion of S11. Sensitive habitats occurring within the usable portion of S11 include 0.3 acres of riparian habitat as summarized in Table 43.

TSH-1: Disturbance to birds, amphibians, reptiles, invertebrates, plants, mammals, and their habitats, including loss of foraging habitat

One species of ESA listed nesting bird, the Swainson's hawk, has the potential to occur in the usable portion of S11. Swainson's hawk nests in California from March 1 through September 15. During this period, nests may potentially be present in trees within riparian woodland occurring in S11. Should site preparation or dredged material placement activities occur during the nesting season, potentially significant impacts to the Swainson's hawk may occur. This may include direct take of nests or juveniles through tree removal, loss of foraging habitat as a result of dredged material placement, and disturbance resulting in nest abandonment.

Noise, vibration, visual, and proximity related disturbances associated with construction could impact bird species that nest and forage on S11, including species protected under the ESA, such as Swainson's hawk. Impacts to birds from noise would occur at similar levels as described under baseline conditions for other sites. While the duration of construction would be increased, the intensity of sound should remain consistent with baseline conditions. Therefore, there would be no incremental impact due to noise or vibration due to construction of the Proposed Project.

Placement of dredged material on the usable portion of S4 could result in the temporary removal of, or disturbance to, foraging habitat for ESA listed species potentially present onsite, including Swainson's hawk and giant garter snake. Site preparation could potentially result in giant garter snake individuals being run over by machinery, which would be considered a potentially significant impact. These potential impacts would be similar to other sites as described under Future without Project Conditions. Once dredged material is initially placed, there would be minimal additional impact on foraging habitat for these species from subsequent placement events. Placement would result in disturbance of a very small percentage of available foraging area; thus, the impacts due to ongoing placement of dredged material would be less than significant. Thus, as compared to the environmental baseline, despite the longer construction periods, there would be no increased incremental impacts to ESA listed species.

Disturbance to ESA listed amphibians, vernal pool invertebrates, mammals, and plants is unlikely since the site's usable portion does not support associated habitats for these species. Additionally, it is unlikely that significant impacts to the above-mentioned non-listed special status amphibian, reptile, mammal, and plant species would occur at the population level since any impacts to existing vegetation and habitats would be temporary. No impacts are expected for any amphibians, vernal pool invertebrates, mammals, or plants at S11.

Thus, as compared to the environmental baseline, there would be no impacts to amphibians, vernal pool invertebrates, mammals, or plants; and potentially significant incremental impacts to Swainson's hawk and the giant garter snake from the placement of dredged material at S11 as a result of the Proposed Project. The mitigation measures below would be implemented to further reduce impacts to terrestrial species and habitats (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- TSH-MM-1: Special status species surveys and biological monitoring
- TSH-MM-2: Schedule construction outside the breeding season for protected species, or conduct special status species survey and potentially consult with USFWS to determine course of action

Residual Impact after Mitigation: After inclusion of the mitigation measures, the residual impact would be less than significant.

TSH-2: Loss of special status plant species or habitat for special status plant species

It is unlikely that any ESA or CNPS listed plant species known to occur within the project quadrangles exist within the usable portion of S11, because no individuals of these species or their respective genera were observed during plant surveys (USACE 2008c, 2010g). Thus, as compared to the environmental baseline, there would be no impacts to special status plant species from the placement of dredged material at S11.

Mitigation Measures: Mitigation is not required.

Residual Impact after Mitigation: None.

TSH-3: Impacts to federally protected wetlands and sensitive habitats

Dredged material placement is anticipated to result in the loss of approximately 0.3 acres of riparian habitat within the usable portion of S11. There are no wetlands present within this area. While S11 has not been used for dredged material placement, an unmitigated loss of 0.3 acres of riparian habitat would be a less than significant impact due to the negligible amount of lost habitat. The mitigation measure below would be implemented to further reduce impacts to terrestrial species and habitats (refer to Table 20 for a complete description of the mitigation measure).

Mitigation Measures:

- TSH-MM-4: USACE will implement the wetland preservation project on Prospect Island as described in Section 2.2.2.3

Residual Impact after Mitigation: After inclusion of the mitigation measure, the residual impact would be less than significant.

TSH-4: Introduction or spread of noxious weeds

Dredged material placement has the potential to promote the spread of invasive plants currently established in S11 through transport of these species in runoff. Such species could displace native plants, potentially changing the species composition of the study area. However, non-native and invasive species are common within S11 and the project vicinity, and their establishment would be expected absent the Proposed Project. Thus, as compared to baseline conditions, there would be less than significant impacts from the introduction or spread of noxious weeds from the placement of dredged material at S4.

Mitigation Measures: Mitigation is not required.

Residual Impact after Mitigation: The residual impact would be less than significant.

Placement Site S32

Placement site S32 is described in Sections 2.3.3 and 3.2.2.1. Threatened and endangered species with the potential to be present on S32 are giant garter snake and Swainson's hawk. Additional special status species with the potential to be present on S32 include yellow-headed blackbird (SSC), American badger (SSC), and Heckard's pepper grass (CNPS) (Artho 2003; USACE 2009a). The usable portion of S32 is dominated by grasses and unvegetated areas (USACE 2008c). There are no wetlands inside the usable portion of S32. Sensitive habitats occurring within the usable portion of S32 include 0.11 acres of riparian habitat and 0.07 acres of oak woodland, as summarized in Table 43.

TSH-1: Disturbance to birds, amphibians, reptiles, invertebrates, plants, mammals, and their habitats, including loss of foraging habitat

One ESA listed species of nesting bird, Swainson's hawk, has the potential to be in the usable portion of S32. Swainson's hawk nests in California from March 1 through September 15. Should site preparation or dredged material placement activities occur during the nesting season, potentially significant impacts to the Swainson's hawk may occur. This may include direct take of nests or juveniles through tree removal, loss of foraging habitat as a result of dredged material placement, and/or disturbance resulting in nest abandonment. Thus, significant impacts to Swainson's hawk could result from dredged material placement activities at S32.

Noise, vibration, visual, and proximity related disturbances associated with construction could impact bird species that nest and forage on S32, including species protected under the ESA, such as Swainson's hawk. Impacts to birds from noise would occur at similar levels as described under baseline conditions for other sites. While the duration of construction would be increased, the intensity of sound should remain consistent with baseline conditions. Therefore, there would be no incremental impact due to noise or vibration from construction of the Proposed Project.

Placement of dredged material on the usable portion of S32 could result in the temporary removal of, or disturbance to, foraging habitat for ESA listed species potentially present onsite, including Swainson's hawk and giant garter snake. Site preparation could potentially result in giant garter snake individuals being run over by machinery, which would be considered a significant impact. These potential impacts would be similar to other sites as described under Future without Project Conditions. Once dredged material is initially placed, there would be minimal additional impact on foraging habitat for these species from subsequent placement events. Placement would result in disturbance of a very small percentage of available foraging area; thus, the impacts due to ongoing placement of dredged material would be less than significant. Thus, as compared to the environmental baseline, despite the longer construction periods, there would be no increased incremental impacts to ESA listed species.

Disturbance to ESA listed amphibians, vernal pool invertebrates, mammals, and plants is unlikely since S32's usable portion does not support associated habitats for these species. Additionally, it is unlikely that significant impacts to the above-mentioned non-listed special status invertebrate, amphibian, reptile, mammal, and plant species would occur at the population level since any impacts to existing vegetation and habitats would be temporary. No impacts are expected for invertebrates, amphibians, mammals, or plants at S32.

Thus, as compared to the environmental baseline, there would be no impacts to amphibians, vernal pool invertebrates, mammals, or plants; and potentially significant incremental impacts to Swainson's hawk and giant garter snake from the placement of dredged material at S32 as a result of the Proposed Project. The mitigation measures below would be implemented to further reduce impacts to terrestrial species and habitats (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- TSH-MM-1: Special status species surveys and biological monitoring
- TSH-MM-2: Schedule construction outside the breeding season for protected species, or conduct special status species survey and potentially consult with USFWS to determine course of action

Residual Impact after Mitigation: After inclusion of the mitigation measures, the residual impact would be less than significant.

TSH-2: Loss of special status plant species or habitat for special status plant species

Placement site S32 may provide habitat for Heckard's pepper-grass and San Joaquin spearscale. Dredged material placement could potentially bury individuals or populations of these species, and site preparation (i.e., grubbing) could potentially result in take of these

species. Placement of the dredge pipeline could potentially damage any individuals present. Short term impacts associated with loss of potential habitat would be considered less than significant, given the large areas of suitable habitat within the project vicinity. The mitigation measure below would be implemented to further reduce impacts to terrestrial species and habitats (refer to Table 20 for a complete description of the mitigation measure).

Mitigation Measures:

- TSH-MM-3: Pre-construction special status plant survey during the flowering period, avoidance of individuals and populations, and potential consultation with USFWS to determine course of action

Residual Impact after Mitigation: After inclusion of the mitigation measure, the residual impact would be less than significant.

TSH-3: Impacts to federally protected wetlands and sensitive habitats

Dredged material placement is anticipated to result in the loss of approximately 0.11 acres of riparian habitat and 0.7 acres of valley oak woodland habitat occurring within the usable portion of S32. There are no wetlands present within this area. While S32 has not been used for dredged material placement, an unmitigated loss of 0.11 acres of riparian habitat and 0.7 acres of valley oak woodland habitat would be a less than significant impact due to the negligible amount of lost habitat. Solano County requires preservation of any oak tree native to California with a diameter of 10 inches above natural grade (Solano County 1999). In addition, Sacramento County administers a tree preservation ordinance requiring that no net loss of native oak canopy should occur (Sacramento County 2009), while the California Department of Fish and Game (CDFG) considers valley oak woodland to be a Habitat of Special Concern. The mitigation measures below would be implemented to further reduce impacts to terrestrial species and habitats (refer to Table 20 for complete descriptions of the mitigation measures).

Mitigation Measures:

- TSH-MM-4: USACE will implement the wetland preservation project on Prospect Island as described in Section 2.2.2.3
- TSH-MM-5: Pre-construction tree survey, avoidance of protected trees, establishment of a buffer, and potential consultation with city or county agency and CDFG

Residual Impact after Mitigation: After inclusion of the mitigation measures, the residual impact would be less than significant.

TSH-4: Introduction or spread of noxious weeds

Dredged material placement has the potential to promote the spread of invasive plants currently established in S32 through transport of these species in runoff. Such species could displace native plants, potentially changing the species composition of the study area. However, non-native and invasive species are common within S32 and the project vicinity,

and their establishment would be expected absent the Proposed Project. Thus, as compared to baseline conditions, there would be less than significant impacts from the introduction or spread of noxious weeds from the placement of dredged material at S32.
Mitigation Measures: Mitigation is not required.
Residual Impact after Mitigation: The residual impact would be less than significant.

Placement Site S35
Placement site S35 is described in Sections 2.3.3 and 3.2.2.1. A majority of the wetlands in the western area of the site contain pickleweed, which is habitat for salt marsh harvest mouse. Threatened and endangered species with the potential to be present on the site are salt marsh harvest mouse, California tiger salamander, giant garter snake, and California black rail (Artho 2003; USACE 2009a). Additional special status species with the potential to be present on this site are Western pond turtle (SSC), Suisun song sparrow (SSC), white-tailed kite (FP), and Western red bat (SSC; Artho 2003; USACE 2009a). The usable portion of S35 is comprised primarily of dryland agriculture and non-native grassland. There are no wetlands, riparian areas, or other sensitive habitats occurring within the usable portion of placement site S35, as summarized in Table 43.

TSH-1: Disturbance to birds, amphibians, reptiles, invertebrates, plants, mammals, and their habitats, including loss of foraging habitat

One species of ESA listed nesting bird, California black rail, has the potential to be in the usable portion of S35. Tidal marsh along the southern edge of the site's usable portion could support California black rail. The California black rail breeds from February through mid-June. Project activities including dredged material placement and site preparation (e.g., grubbing, tree removal, and berm construction) would not occur within tidal marsh habitat potentially utilized by the California black. Impacts, including species take, loss of eggs, and loss of nests, are therefore not anticipated.

Noise, vibration, visual, and proximity related disturbances associated with construction could impact bird species that nest and forage on S35, including species protected under the ESA. Impacts to birds from noise would occur at similar levels as described under baseline conditions for other sites. While the duration of construction would be increased, the intensity of sound should remain consistent with baseline conditions. Therefore, there would be no incremental impact due to noise or vibration from construction of the Proposed Project.

Although the Suisun song sparrow and white-tailed kite are not listed as threatened or endangered, they are protected under the MBTA (the Suisun song sparrow is additionally a state species of special concern and the white-tailed kite is a fully protected species). The

Suisun song sparrow nests adjacent to marsh and wetland areas composed of bulrush and cattails. The white-tailed kite nests in the top of trees 20 to 50 feet off the ground and their breeding period is from February through July. Disturbance to these species or their nests would constitute a significant impact.

California tiger salamander has the potential to occur in the usable portion of S35. The salamander is most commonly found in annual grassland habitat and also occurs in the grassy understory of valley-foothill hardwoods. The salamander also inhabits small ponds, lakes, or vernal pools throughout the habitat complex. Any disturbance these habitat types within the usable portion of S35 could impact California tiger salamander individuals, and is considered to be a significant impact. If present, there exists the potential for this species to be run over by construction machinery during site preparation activities. This would be considered a significant impact.

Dredged material placement in the usable portion of S35 could potentially impact salt marsh harvest mouse. This mouse thrives near saline emergent wetlands with adjacent upland habitat and requires pickleweed for forage. Since dredged material is not proposed for placement within the saline emergent wetland, it is unlikely that this species would be significantly impacted. Even so, the potential for disturbance of upland habitat or adjacent emergent wetland used by this species exists, and would remain for the subsequent maintenance dredging placement events. Significant impacts to salt marsh harvest mouse could result from dredged material placement activities at S35. If present, there exists the potential for this species to be run over by construction machinery during site preparation activities. This would be considered a potentially significant impact.

Placement of dredged material on the usable portion of S35 could result in the temporary removal of, or disturbance to, foraging habitat for species present onsite, including California black rail, giant garter snake, California tiger salamander, and salt marsh harvest mouse. These species tend to forage across large expanses of grassland and emergent wetland, and thus, any impacts to foraging habitats would be small relative to available habitat in the adjacent areas. Placement would result in disturbance of a very small percentage of available foraging area and the operation would not result in continuous disturbance at the site. Thus, as compared to the environmental baseline, there would be less than significant incremental impacts to foraging habitat for terrestrial, wetland, and riparian wildlife species from the placement of dredged material at S35 as a result of the Proposed Project. As with the California tiger salamander and salt marsh harvest mouse, site preparation could potentially result in giant garter snake individuals being run over by machinery, which would be considered a significant impact.

It is unlikely that significant impacts to the above-mentioned non-listed special status invertebrate, amphibian, reptile, mammal, and plant species would occur at the population level since any impacts to existing vegetation and habitats would be temporary. Less than significant impacts are expected for the above-mentioned non-listed special status invertebrates, amphibians, mammals, and plants.

Thus, as compared to the environmental baseline, there would be no impacts to amphibians, vernal pool invertebrates, mammals, or plants; and potentially significant incremental impacts to California black rail, Suisun song sparrow, white-tailed kite, giant garter snake, California tiger salamander, and salt marsh harvest mouse from the placement of dredged material at S35 as a result of the Proposed Project. The mitigation measures below would be implemented to further reduce impacts to terrestrial species and habitats (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- TSH-MM-1: Special status species surveys and biological monitoring
- TSH-MM-2: Schedule construction outside the breeding season for protected species, or conduct special status species survey and potentially consult with USFWS to determine course of action

Residual Impact after Mitigation: After inclusion of the mitigation measures, the residual impact would be less than significant.

TSH-2: Loss of special status plant species or habitat for special status plant species

It is unlikely that any ESA or CNPS listed plant species known to occur within the project quadrangles exist within the usable portion of S35, because no individuals of these species or their respective genera were observed during plant surveys (USACE 2008c, 2010g). Thus, as compared to the environmental baseline, there would be no impacts to special status plant species from the placement of dredged material at S35 as a result of the Proposed Project.

Mitigation Measures: Mitigation is not required.

Residual Impact after Mitigation: None

TSH-3: Impacts to federally protected wetlands and sensitive habitats

No wetlands, riparian areas, or other sensitive habitats exist on the usable portion of S35. Thus, as compared to the environmental baseline, there would be no impacts to federally protected wetlands or other sensitive habitats from the placement of dredged material at S35.

Mitigation Measures: Mitigation is not required.

Residual Impact after Mitigation: None.

TSH-4: Introduction or spread of noxious weeds

Dredged material placement has the potential to promote the spread of invasive plants currently established in S35 through transport of these species in runoff. Such species could displace native plants, potentially changing the species composition of the study area. However, non-native and invasive species are common within S35 and the project vicinity, and their establishment would be expected absent the Proposed Project. Thus, as compared to baseline conditions, there would be less than significant impacts from the introduction or spread of noxious weeds from the placement of dredged material at S35.

Mitigation Measures: Mitigation is not required.

Residual Impact after Mitigation: The residual impact would be less than significant.

The following threshold applies to all sites proposed for use under the Proposed Project.

TSH-5: Non-compliance with local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance; the provisions of an adopted habitat conservation plan; a natural community conservation plan; or other approved local, regional, or state habitat conservation plan

The study area is located within Solano, Sacramento, and Yolo counties, as well as the cities of West Sacramento and Rio Vista. Each of these counties and cities require preservation or protection of sensitive habitats and species including, but not limited to, wetlands, riparian areas, marshes, vernal pools and swales, herbaceous uplands, special status species, and fisheries. Policies and ordinances specific to each county and city are discussed in detail in Section 3.2 under the subheading "Local Regulatory Context, Wildlife Management Areas, and Preserves." The Proposed Project has the potential to affect sensitive species and their habitats, as well as wetlands, riparian areas, and other sensitive habitats as discussed in the preceding sections. Based on the 2010 vegetation survey, approximately 0.07 acres of Valley oak woodland habitat would be impacted from use of the S32 as part of the Proposed Project (USACE 2010f). This would constitute a potentially significant impact related to non-compliance with local policies or ordinances.

Solano County, Sacramento County, and the City of West Sacramento all administer a tree protection ordinance, while the Yolo County General Plan mandates the development of a tree preservation ordinance (Yolo County 2009). Solano County requires preservation of heritage trees, which include those with a diameter of 15 inches or more, measured at 54 inches above natural grade, any oak tree native to California with a diameter of 10 inches above natural grade, or any group of trees specified by Solano County (Solano County 1999). Trees are protected from removal and disturbance, including root zones. Mitigation is required for unavoidable adverse effects to heritage trees. Sacramento County also

administers a tree preservation ordinance. Non-oak native species measuring 6 inches in diameter at 4.5 feet above ground should be preserved, and no net loss of native oak canopy should occur (Sacramento County 2009). Within the City of West Sacramento, designated landmark trees and heritage trees (trees with a 75-inch trunk circumference at 4 feet 6 inches from the ground) are protected from permanent damage or removal (City of West Sacramento 2004).

Thus, as compared to the environmental baseline, there would be potentially significant incremental impacts to biological resources protected by local policies or ordinances as a result of the Proposed Project.

Sacramento County is in the process of establishing a Habitat Conservation Plan (HCP) for South Sacramento County, which would limit development in designated areas to protect sensitive habitats including wetlands, vernal pools, and upland habitat. The HCP will cover 40 species of plants and wildlife, including ten that are state or federally listed as threatened and endangered (Sacramento County 2010b). Yolo County is establishing a HCP designed to result in "no net loss" of wildlife habitat value or agricultural land (EIP Associates 1996). As described in the preceding section, the project may potentially result in loss of wetlands or habitat suitable for special status species. This may be in conflict with these future HCPs, and would be considered a significant impact.

USFWS manages two Wildlife Management Areas within the vicinity of the project site, including Antioch Dunes National Wildlife Refuge (NWR) and the Sherman Island Waterfowl Management Area. CDFG manages the YBWA, located to the east of the SRDWSC. Project activities will not encroach upon these wildlife areas, and potential impacts associated with the Proposed Project are not anticipated to significantly impact these areas.

Thus, as compared to the environmental baseline, there would be potentially significant incremental impacts to compliance with provisions of adopted HCPs; natural community conservation plans; or other approved local, regional, or state HCPs as a result of the Proposed Project. The mitigation measures below would be implemented to further reduce impacts to terrestrial species and habitats (refer to Table 20 for complete descriptions of mitigation measures).

Mitigation Measures:

- TSH-MM-1: Special status species surveys and biological monitoring
- TSH-MM-2: Schedule construction outside the breeding season for protected species, or conduct special status species survey and potentially consult with USFWS to determine course of action

- TSH-MM-3: Pre-construction special status plant survey during the flowering period, avoidance of individuals and populations, and potential consultation with USFWS to determine course of action
- TSH-MM-4: USACE will implement the wetland preservation project on Prospect Island as described in Section 2.2.2.3
- TSH-MM-5: Pre-construction tree survey, avoidance of protected trees, establishment of a buffer, and potential consultation with city or county agency and CDFG

Residual Impact after Mitigation: After inclusion of the mitigation measures, the residual impact would be less than significant.

Channel Deepening to -33 Feet MLLW and Selective Widening Alternative

Impacts to terrestrial, wetland, and riparian species in placement sites S1, S14, S16, S19, S20, S31, and S35 under the -33 Feet MLLW Alternative would be the same as those described in detail under the impacts assessed for the Proposed Project above. However, the -33 Feet MLLW Alternative would remove 50% less material than the Proposed Project, and as a result, would require less capacity at the placement sites and be completed in half the number of years. Impacts would not occur to S4, S11, or S32 under the -33 Feet MLLW Alternative. Otherwise, the same impacts and mitigation measures described above for the individual placement sites under the Proposed Project apply to the -33 Feet MLLW Alternative.

3.2.2.5 Summary of Impacts and Mitigation Measures

Table 46 summarizes impact determinations and mitigation measures, if necessary, for each alternative for the impacts to terrestrial species and habitat described above.

Table 46
Summary of Terrestrial Threatened and Endangered Species and Critical Habitat Impacts and Mitigation Measures

Alternative	Impact	Mitigation	Residual Impact After Mitigation
TSH-1: Disturbance to birds, amphibians, reptiles, invertebrates, plants, mammals, and their habitats, including loss of foraging habitat			
Future without Project Conditions (NEPA and CEQA Baseline)	Potentially significant impact: S1, S14, S16, S19, S20, S31	TSH-MM-1 and 2	Less than significant impact
Proposed Project: Channel Deepening to -35 Feet MLLW and Selective Widening	Potentially significant impact: S1, S4, S11, S14, S16, S19, S20, S31, S32, S35	TSH-MM-1 and 2	Less than significant impact
Channel Deepening to -33 Feet MLLW and Selective Widening Alternative	Potentially significant impact: S1, S14, S16, S19, S20, S31, S35	TSH-MM-1 and 2	Less than significant impact

TSH-2: Loss of special status plant species or habitat for special status plant species			
Future without Project Conditions (NEPA and CEQA Baseline)	Potentially significant impact: S1, S14, S16, S19, S20, S31	TSH-MM-3	Less than significant impact
Proposed Project: Channel Deepening to -35 Feet MLLW and Selective Widening	Potentially significant impact: S1, S14, S16, S19, S20, S31, S32	TSH-MM-3	Less than significant impact
	No impact: S4, S11, S35	None	None
Channel Deepening to -33 Feet MLLW and Selective Widening Alternative	Potentially significant impact: S1, S14, S16, S19, S20, S31	TSH-MM-3	Less than significant impact
	No impact: S35	None	None
TSH-3: Impacts to federally protected wetlands and sensitive habitats			
Future without Project Conditions (NEPA and CEQA Baseline)	Less than significant impact: S14, S16, S19, S31	TSH-MM-4	Less than significant impact
	No impact: S1, S20	None	None
Proposed Project: Channel Deepening to -35 Feet MLLW and Selective Widening	Less than significant impact: S11, S14, S16, S19, S31, S32	TSH-MM-4; and 5 (S32 only)	Less than significant impact
	No impact: S1, S4, S20, S35	None	None
Channel Deepening to -33 Feet MLLW and Selective Widening Alternative	Less than significant impact: S14, S16, S19, S31	TSH-MM-4	Less than significant impact
	No impact: S1, S20, S35	None	None
TSH-4: Introduction or spread of noxious weeds			
Future without Project Conditions (NEPA and CEQA Baseline)	Less than significant impact: S1, S14, S16, S19, S20, S31	None	Less than significant impact
Proposed Project: Channel Deepening to -35 Feet MLLW and Selective Widening	Less than significant impact: S1, S4, S11, S14, S16, S19, S20, S31, S32, S35	None	Less than significant impact
Channel Deepening to -33 Feet MLLW and Selective Widening Alternative	Less than significant impact: S1, S14, S16, S19, S20, S31, S35	None	Less than significant impact
TSH-5: Non-compliance with local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance; the provisions of an adopted habitat conservation plan; a natural community conservation plan; or other approved local, regional, or state habitat conservation plan			
Future without Project Conditions (NEPA and CEQA Baseline)	No impact	None	No impact
Proposed Project: Channel Deepening to -35 Feet MLLW and Selective Widening	Potentially significant impact	TSH-1, 2, 3, 4, and 5	Less than significant impact
Channel Deepening to -33 Feet MLLW and Selective Widening Alternative	Potentially significant impact	TSH-1, 2, 3, 4, and 5	Less than significant impact