4.5 Fisheries

4.5.1 Introduction

This section describes fisheries resources in the Russian River Estuary (Estuary) area and evaluates the potential impacts of implementing the proposed Russian River Estuary Management Project (Estuary Management Project or proposed project) management activities on these resources. The Setting section describes fisheries resources and associated aquatic habitat in the proposed project area. The primary focus of the setting information is on special-status fish species as well as the aquatic habitats capable of supporting such species. The Regulatory Framework section outlines the relevant regulatory considerations relating to the proposed action. This is followed by an assessment of the affects of implementing the proposed project in the Environmental Impact section. Both short term and long term effects to fisheries resources and aquatic habitat associated with the proposed project are analyzed in the context of applicable laws and regulations to determine their significance under CEQA. When project impacts are determined to be significant, or potentially significant, mitigation measures to avoid or reduce those impacts are identified if feasible.

Information Sources and Methodology

The evaluation and analysis of fisheries and aquatic habitat impacts are based, in part, on review of various sets of monitoring data and reports. The primary sources include available resources from National Marine Fisheries Service (NMFS), the California Department of Fish and Game (CDFG), the U.S. Fish and Wildlife Service (USFWS), and monitoring reports on water quality and fisheries survey data compiled by the Sonoma County Water Agency (Water Agency). The principal sources of information used for the setting and impact analysis presented here are as follows:

1. Russian River Estuary Sandbar Breaching 2005 Monitoring Report, SCWA 2006.
2. Russian River Estuary Sandbar Breaching 2009 Monitoring Report, SCWA 2010.
3. Preliminary Study of Russian River Estuary: Circulation and Water Quality Monitoring - 2009 Data Report, Largier and Behrens 2010.
4. Russian River Outlet Channel Adaptive Management Plan, PWA 2010.
5. Biological Opinion for Water Supply, Flood Control Operations, and Channel Maintenance conducted by the U.S. Army Corps of Engineers, the Sonoma County Water Agency, and Mendocino County Russian River Flood Control and Water Conservation District in the Russian River Watershed, NMFS 2008.
6. Russian River Biological Assessment: Prepared for U.S. Army Corps of Engineers, San Francisco District, San Francisco, California, and Sonoma County Water Agency, Santa Rosa, California. Entrix, September 29, 2004.

These technical reports, summarized here and incorporated by reference, present the methods and results of recent fisheries habitat surveys, water quality monitoring, and additional studies conducted for the proposed project and as part of long term monitoring efforts within the Estuary.

Definitions and Study Area

Estuary Study Area

The Estuary Study Area is defined as that portion of the Russian River with seawater from the Pacific Ocean or brackish water extending from the mouth of the Russian River upstream to the Duncans Mills area and below Austin Creek. As previously noted in **Chapter 2.0, Project Description,** the Estuary Study Area comprises the Estuary, which extends approximately seven miles (11 kilometers [km]) from the mouth of the Russian River upstream to just beyond the confluence of Austin Creek. Under certain closed conditions, the Estuary may backwater to Monte Rio, and as far upstream as Vacation Beach. Where appropriate, discussion of fisheries impacts within the Estuary Study Area and the larger maximum backwater area to Vacation Beach, is provided (Please refer to **Figure 2-3a** in **Section 2.0, Project Description**.

Special Status Species

Special status species, for the purpose of this document, are either (1) protected, or proposed for protection, under the federal Endangered Species Act (ESA); (2) protected, or proposed for protection, under the California Endangered Species Act (CESA); (3) managed as part of a Federal Fishery Management Plan (FMP) under the Magnuson-Stevens Fishery Conservation and Management Act (MSA); or (4) considered a species of concern by US Fish and Wildlife Service (USFWS) and/or California Department of Fish and Game (CDFG).

Critical Habitat and Essential Fish Habitat

Both Critical Habitat and Essential Fish Habitat (EFH) are designated within the project area for various special-status species. Both of these habitat types are important components in considering potential project-related impacts as part of this assessment. The federal ESA defines critical habitat as “the specific areas within the geographical area occupied by the species, at the time it is listed, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and specific areas outside the geographical area occupied by the species at the time it is listed that are determined by the Secretary to be essential for the conservation of the species.” EFH is defined in the MSA as “those waters or substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.”

4.5.2 Setting

Regional Setting

The Estuary is located about 60 miles (97 km) northwest of San Francisco in Jenner, Sonoma County, California (**Figure 2-1, Chapter 2.0, Project Description**). The Russian River is approximately 110 miles long and the watershed encompasses 1,485 square miles in Sonoma, Mendocino, and Lake counties (SCWA, 2008). Historically, streamflows in the Russian River ranged from approximately <1 to 94,900 cubic feet per second (cfs). Currently, most flows in the Russian River during the wet season (November through May) are maintained by runoff following rainfall events. During the dry season (June through October), most of the flow in the Russian River is water released from Lake Mendocino and Lake Sonoma. The Estuary is constrained by the narrow valley walls in the lower reach of the Russian River. A barrier beach occasionally forms naturally across the mouth of the river, impounding water and forming a lagoon. The barrier beach opens naturally when hydraulic conditions in the Russian River and Pacific Ocean change, or when it is artificially breached. When the barrier beach is open, the Estuary is open to full tidal mixing.

The Russian River watershed supports a diverse fish community. Aquatic habitats range from small, cool, high gradient streams to warm, low gradient riverine and estuarine habitat. The fish assemblage native to the Russian River watershed reflects this habitat diversity. The Russian River fish community is comprised of a variety of native and introduced species (discussed below). Substantial sections of the mainstem Russian River and many of the tributaries have been altered through activities such as agriculture, rural and urban development, construction of seasonal and permanent dams, channel maintenance for flood control and bank stabilization, gravel mining, agriculture, and timber harvest. These disturbances, along with changes in ocean productivity and competition from hatchery-raised fish and introduced species, have likely resulted in a decline in the distribution and abundance of various native species of fish (SCWA, 2008).

Local Setting

An extensive discussion of the NMFS' Russian River Biological Opinion (Russian River Biological Opinion) and existing conditions within the Estuary is presented in **Chapter 3.0, Project Background and Environmental Setting, Section 3.5, Historical Estuary Conditions and NMFS' Russian River Biological Opinion**. In summary, the current practice of artificial breaching during the period from late spring to early fall has created a dynamic estuarine/marine dominated environment in the Estuary in the summer. Each time the barrier beach is artificially breached, much of the freshwater lens in the Estuary that develops following formation of the barrier beach is discharged to the ocean. Near the mouth of the Estuary aquatic conditions (*e.g.*, salinity and temperature) are typical of marine conditions. Under current practices, stable freshwater aquatic habitat is currently only maintained in the upper Estuary, where freshwater inflow maintains low salinity conditions regardless of tidal action. However, summer water temperatures during summer months are sub-optimal for rearing salmonids. The high salinity in the Estuary may limit food supply for juvenile salmonids rearing in the Estuary. Additionally, the rapid changes to habitat water quality characteristics across such a broad range (e.g. 0 to

35 ppt salinity in the lower Estuary) under the current breaching practices may result in localized stress and mortality to some fish species subjected to abruptly changing habitat conditions with little time to acclimate to or behaviorally avoid unsuitable habitat conditions (NMFS, 2008).

Fish Communities in the Estuary

The Estuary provides habitat for a variety of fish species including salmonids and other important recreational fish species such as American shad and smallmouth bass. In terms of conservation, much attention is given to three ESA-listed salmonid species that are known to occur in the Russian River watershed. These are Central California Coast steelhead (*Oncorhynchus mykiss*), California Coastal Chinook salmon (*O. tshawytscha*), and Central California Coast coho salmon (*O. kisutch*; NMFS, 2010). The Estuary is important for adult and juvenile passage for the three ESA-listed salmonids (NMFS, 2008). The Estuary provides an opportunity for smolts to acclimate to ocean conditions before migrating to the ocean, as well as potentially providing rearing habitat for steelhead and Chinook salmon.

The Water Agency surveys fisheries within the Estuary to document the distribution, abundance, and condition of fish; to document salmonid residence times in the Estuary; and to assess the habitat parameters that affect salmonid presence and distribution in the Estuary. The Water Agency conducts fisheries monitoring via beach-deployed seine net stations located throughout the lower, middle, and upper Estuary, in a variety of habitat types based on substrate type (i.e., mud, sand, and gravel), depth, and tidal and creek tributary influences (**Figure 3-6**). Fish captures from seine surveys in the Estuary from 1992, 1993, 1996 to 2000, and 2003 to 2009 are summarized here to characterize existing species composition, abundance, and distribution.

Over fifty fish species have been detected during 11 years of monitoring (SCWA, 2006; SCWA, unpublished data). The distribution of fish in the Estuary is, in part, based on species' preference for, or tolerance of, salinity. In general, the influence of cold seawater from the ocean results in high salinity levels and cool temperatures in the lower reaches transitioning to warmer freshwater in the upper and middle reaches of the Estuary.

Fish commonly found in the lower Estuary are marine and estuarine species including topsmelt (*Atherinops affinis*), surf smelt (*Hypomesus pretiosus*), staghorn sculpin (*Leptocottus armatus*), and starry flounder (*Platichthys stellatus*). The middle reach Estuary has a broad range of salinities and a diversity of fish tolerant of these conditions. Common fish in the middle Estuary include those found in the lower Estuary and shiner surfperch (*Cymatogaster aggregata*), three-spine stickleback (*Gasterosteus aculeatus*), and prickly sculpin (*Cottus asper*). Freshwater dependent species, such as the Sacramento sucker (*Catostomus occidentalis*) and California roach (*Lavinia symmetricus*), are predominantly distributed in the upper reach of the Estuary. These species tend to move down into the Estuary during the summer and return upstream in the fall (Entrix, 2004). Anadromous fish that can tolerate a broad range of salinities, such as steelhead (*O. mykiss*) and American shad (*Alosa sapidissima*), occur throughout the Estuary. The upper Estuary is important for juvenile-rearing salmonids during periods of cool water temperatures. Although young steelhead typically rear in freshwater throughout the year, they have been caught in the brackish middle Estuary and may make use of other suitable portions of the Estuary. Most adult salmonids migrate up the Russian River during the period when the mouth is naturally open, usually late fall to early spring.

Typically, the highest species diversity is in the lower Estuary near Jenner Gulch. This pattern of species diversity may be due to a higher diversity of habitat features and fluctuating salinity levels that change habitat conditions from freshwater during the spring to brackish later in the season when freshwater flows decrease (SCWA, 2006). In general, fisheries monitoring demonstrates an increase in fish abundance in an upstream direction dominated by freshwater species. One possible explanation for this fish abundance pattern is the higher diversity of habitat features at these stations.

Macro-invertebrates

The Water Agency has surveyed macro-invertebrates in the Estuary annually since 2004 (SCWA, 2010a; SCWA, unpublished data). Although breaching permits do not require this monitoring, the purpose of the surveys is to determine the relative abundance and distribution of macro-invertebrates in the Estuary.

Crab and shrimp traps are deployed at six stations in the lower and middle Estuary monthly during the summer. Three marine crab species and one freshwater crayfish species have been recorded. However, nearly all of the captures have been Dungeness crab (Metacarcinus [=*Cancer*] *magister*). The Estuary is a nursery for juvenile Dungeness crabs. However, there is wide variation in the abundance of juveniles annually. This bust or boom pattern may be a result of atypical winter ocean temperatures and currents that affect larval Dungeness crab survival and migration to inshore areas and estuaries. Occasionally European green crabs (*Carcinus maenus*) are trapped and one hairy rock crab (*Cancer jordani*) has been found. In addition, fish seining surveys incidentally captured red swamp crayfish (*Procambarus clarkii*) and signal crayfish (*Pacifastacus leniusculus*). Both crayfish species are abundant in freshwater, but not native to the Russian River watershed. Bay shrimp (*Crangon stylirostris*) were detected at most fish seining stations.

Special-Status Species

The Russian River watershed provides potential habitat to a number of special-status species. Three federally-listed salmonids are found in the Russian River watershed: Central California Coast steelhead, California Coastal Chinook salmon, and Central California Coast coho salmon. Stray pink salmon (*O. gorbuscha*) are observed in the Russian River sporadically. If present, it is likely that pink salmon will use the Estuary similarly to Chinook salmon, as adult and smolt migration times and estuarine residence times are similar between the two species (NMFS, 2008). These salmonid species are sensitive to changes in streamflows and increases in water temperature, and their habitat requirements are often more limiting than for other fish species found in the watershed. For this reason, the focus of this section is on the three federally-listed salmonids. The following is a general description of the special-status fish species found in the Estuary or with the potential to occur in the project area, including life history, distribution, and habitat requirements. **Table 4.5-1** summarizes the special-status fish species that occur or have the potential to occur in the project area.

TABLE 4.5-1
SPECIAL-STATUS SPECIES OBSERVED IN THE RUSSIAN RIVER WATERSHED

Scientific Name	Common Name	Status	Anadromous/ Resident	Regulatory Status	Habitat	Potential to Occur
Spirinchus thaleichthys	Longfin smelt	Native	Anadromous	CT	Utilize freshwater rivers to spawn. Adults occur in estuaries, bays, and coastal areas	Moderate. Use of Estuary appears very low Status of smelt population in the Russian River uncertain.
Oncorhynchus mykiss	steelhead	Native	Anadromous	FT	Associated with migratory and rearing habitat in Estuary and mainstem Russian River. Utilize upper watershed and tributaries for spawning. Smolts utilize Estuary to acclimate to seawater.	High. Suitable rearing and migratory habitat present in study area; regularly observed in fisheries monitoring surveys.
Oncorhynchus kisutch	Coho salmon	Native	Anadromous	FE/CE	Associated with migratory habitat in Estuary and mainstem Russian River and with tributaries for spawning and streams with deep pools and submerged large woody cover for rearing. Some juveniles may rear in the freshwater portions of estuaries and lagoons and smolts may acclimate to seawater in estuaries.	High. Suitable rearing and migratory habitat present in study area; regularly observed in fisheries monitoring surveys.
Oncorhynchus tshawytscha	Chinook salmon	Native	Anadromous	FT	Associated with migratory and rearing habitat in Estuary and mainstem Russian River and with spawning habitat in mainstem Russian River and larger tributaries.	High. Suitable rearing and migratory habitat present in study area; regularly observed in fisheries monitoring surveys.
Oncorhynchus gorbuscha	Pink salmon	Native/Stray	Anadromous	Extinct[a]	Similar to Chinook salmon (described above).	Unlikely. There is no established run of pink salmon in the Russian River.
Lampetra tridentata	Pacific lamprey	Native	Anadromous	FSC	Associated with migratory habitat in Estuary and Russian River. Spawns in coldwater streams and young use deep pools and submerged large woody cover for rearing. Some juveniles may rear in the freshwater portions of estuaries and lagoons and smolts acclimate to seawater in estuaries.	High. Suitable rearing and migratory habitat present in study area; commonly found in the mainstem Russian River as well as in the lower and middle reaches of tributaries.
Lampetra ayresii	river lamprey	Native	Anadromous	CSC	Similar to the Pacific lamprey (described above).	Moderate. Suitable rearing and migratory habitat present in study area; reported in the Russian River but rarely observed in fisheries monitoring surveys.

**TABLE 4.5-1 (Continued)
SPECIAL-STATUS SPECIES OBSERVED IN THE RUSSIAN RIVER WATERSHED**

Scientific Name	Common Name	Status	Anadromous/ Resident	Regulatory Status	Habitat	Potential to Occur
Hysterocarpus traskii pomo	Russian River tuleperch	Native	Resident	CSC	Associated with mainstem Russian River and the lower reaches of larger tributaries with abundant cover elements such as aquatic plants, large woody debris, overhanging vegetation and riprap.	High. Suitable habitat present in study area; commonly observed in freshwater habitats of the middle and upper Estuary in fisheries monitoring surveys.
Acipenser medirostris	green sturgeon	Native/visitor	Anadromous	FT	Utilize rivers to spawn in deep fast water. Early life stage may rear in freshwater up to 2 years.	Unlikely. The Russian River is not recorded as a spawning river for the green sturgeon and none have been found during Water Agency fish studies.
Lavinia symmetricus navarroensis	Clear Lake- Russian River roach	Native	Resident	CSC	Utilize habitats ranging from cold headwater streams, to warm, low gradient rivers. Can occupy large pools as well as shallow water habitats along the shoreline in riffles.	High. Suitable habitat present in study area; Roach observed in the mainstem Russian River and in freshwater habitats in the upper Estuary and can be abundant in the lower sections of tributaries. The subspecies Navarro Roach may occur in the Russian River watershed and is listed as CSC. However, the distribution and taxonomy of each subspecies is unclear.
Mylopharodon conocephalus	hardhead	Native	Resident	CSC	Utilize low- to mid-elevation well-oxygenated streams with deep pools and low-velocity run habitat. Absent from streams where introduced species (centrarchids) predominate.	Low. Observed infrequently during fisheries monitoring surveys (last observed 1992-3; Merrit Smith, 2000).

[a] Pink salmon are thought to be extinct in the Russian River. However, small numbers of this species were observed during video monitoring conducted by the Water Agency in 2003, and are thought to be strays from other watersheds.

Regulatory Status Definitions:

FT = Federal Threatened
FE = Federal Endangered
FSC = Federal Species of Concern
CE = California Endangered
CT = California Threatened
CSC = California Species of Special Concern

Potential to Occur:

Unlikely = Habitat not present in the project area and/or species is not known to occur in the project area based on fisheries monitoring surveys or species distribution information.
Low = Habitat not present in the project area and/or few occurrences in the project area observed.
Moderate = Marginal habitat present in the project area and/or some occurrences in the project area observed.
High = Suitable habitat present in the project area and nearby occurrences observed or species is known to occur in the project area based on fisheries monitoring surveys.

SOURCES: Moyle, 2002; Cook et al. 2010; NMFS, 2008; Smith, 1990, Bond et al., 2008; SCWA, 2008, 2010; Merritt Smith, 2000.

Longfin Smelt. The California threatened longfin smelt is an anadromous species that typically ranges from 3 to 4 inches in length with a 2-year lifecycle. They spend their adult life in bays, estuaries, and nearshore coastal areas, and migrate into freshwater rivers to spawn. Most descriptions of longfin smelt life history in California focus on San Francisco Bay populations. Relatively little is known about North Coast longfin smelt or specifics about their life history (DFG, 2009). The longfin smelt is a small, planktivorous fish that can tolerate a broad range of salinity concentrations. Adult and juvenile longfin smelt occupy open waters of estuaries, mostly in the middle or at the bottom of the water column. They are found at salinities ranging from nearly pure seawater to completely fresh water, although most seem to prefer salinities in the 15-30 parts per thousand range. They can occupy water as warm as 20º C (68º F) in summer, but prefer summer temperatures around 16-18º C (61-64º F). The wide salinity and temperature preferences reflect the ability of the longfin smelt to occupy different portions of an estuary according to time of year and stage of life cycle (Moyle, 2002). Spawning occurs primarily from January through March, after which most adults die (DFG, 2009). Spawning takes place in fresh-to-brackish water over sandy-gravel substrates, rocks, or aquatic vegetation (Moyle, 2002). Overall, longfin smelt are found between Monterey Bay (southern most extreme of range) northward to Alaska. Populations in California have historically been known from the San Francisco Estuary, Humboldt Bay, the Eel River Estuary, and the Klamath River estuary (Moyle, 2002). Population declines have been defined only in the California portion of the range. Longfin smelt have also been collected within the Russian River estuary in 1996 (Moyle, 2002) and in subsequent years (observed during biological surveys from 1997 to 1999; Merrit Smith, 2000). However, longfin smelt use of the Russian River estuary appears very low and the status of the longfin smelt population in the Russian River is uncertain.

General Salmonid Life Cycle. Anadromous salmonids share similar life cycle patterns. Anadromous fish live in the oceans as adults, growing and maturing in the food-abundant environment. After reaching maturity in the ocean, salmonids immigrate[1] to their natal (place of hatching) streams to spawn. Spawning generally takes place in the tails of pools and riffles. Substrate size and quality is important for successful spawning. The suitable substrate is free of silt and size varies from small gravel to cobble (0.5 to 6 inches in diameter), depending on the fish species. Eggs are deposited in a gravel nest, called a redd, and hatch in 30 to 60 days depending on the temperature of the water and the species. In the Russian River, juvenile salmonids typically spend between two months (Chinook salmon), one and one-half years (coho salmon), and two years (steelhead) growing in the freshwater habitat before emigrating[2] to the ocean. Prior to emigration, juvenile salmonids go through a physiological process that allows them to adapt from a freshwater environment to a marine environment (smoltification). The emigrating fish, called smolts, leave the freshwater environment for the ocean during the spring. Due to this anadromous life cycle, salmonids encounter a range of distinct habitat types throughout their life history.

1 Migrate into the freshwater environment/watershed from the marine environment.
2 Migrate out of the freshwater environment/watershed to the marine environment.

During emigration, juvenile salmonids typically enter estuarine habitats, which can vary widely in their physical characteristics (as described in **Section 3.5, Historic Estuary Conditions and NMFS' Russian River Biological Opinion**). Salmonid use of estuarine habitats has been well documented, and the time spent in an estuary and the benefits received from estuarine habitat can vary widely among species and watersheds (Bond et al., 2008; Smith, 1990). Some salmonids move through estuaries in days, whereas other species remain for many months (described in more detail by species, below). Studies have demonstrated that lagoon environments, such as the likely historic conditions of the Russian River Estuary, are beneficial to the growth of juvenile steelhead in central California due to their residency time prior to emigration (NMFS, 2008; Bond et al., 2008). Fresh or brackish water lagoons at the mouths of many streams in California often provide freshwater depths, water quality, and productivity that are highly favorable to the growth and ocean survival of rearing salmon and steelhead (NMFS, 2008; Smith, 1990, Bond et al., 2008).

Steelhead. Steelhead range from Russia and Alaska to Baja, Mexico. The Russian River once supported the third most productive watershed for steelhead in California (Moyle 2002). Although steelhead have declined, wild steelhead continue to occur throughout most of the Russian River basin and spawn in the upper mainstem and numerous tributaries and are the most abundant and widespread of the ESA-listed species in the Russian River watershed. Hatchery steelhead raised at the Don Clauson Fish Hatchery are stocked in the Russian River and tributaries to mitigate for the loss of habitat upstream of Lake Sonoma and Lake Mendocino.

Steelhead/rainbow trout are adapted to a variety of habitats and show considerable flexibility in life history patterns. Fish that spend their adult life in the ocean and migrate to freshwater streams to spawn (i.e., anadromous) are called steelhead, while fish that spend their entire life cycle in freshwater streams (i.e., resident fish) are called rainbow trout. Steelhead in the ocean take advantage of the abundance of food and can grow up to 70 cm in length. Rainbow trout have limited food resources and reach maturity at much smaller sizes. Adult steelhead migrate from the ocean during winter to natal freshwater streams were they spawn. Adults may spawn up to 4 times in their life. Juvenile steelhead, called parr or smolts, spend 1 or 2 years rearing in freshwater streams or estuaries before entering the ocean where they mature. Because of the broad plasticity in this species life history, there are intermediate or differing patterns for steelhead that take advantage of local conditions.

Due to the distribution of the species and plasticity of life history, water temperature requirements for steelhead vary in the literature (SCWA, 2008). Optimal summer water temperatures for steelhead in California range from approximately 10 to 15°C. A useful criterion for determining habitat suitability based on the available literature suggests that average daily temperatures should be less than 20°C and daily maximum temperatures should be less than 24°C to allow acceptable steelhead/rainbow trout growth (Bell, 1973; Barnhardt, 1986). The 20°C criterion represents a water temperature below which reasonable growth of steelhead/rainbow trout may be expected. Data in the literature suggest that temperatures above 21.5°C result in no net growth or a loss of condition in rainbow trout and a reduced capacity for respiration (Barnhardt, 1986). The upper incipient lethal temperature for steelhead/rainbow trout is approximately 24°C (75°F; Bell, 1973;

Barnhardt, 1986). In general, salmonids in warmer waters require more food and oxygen because their metabolism increases with temperature (Moyle, 2002).

In the absence of more definitive data on the thermal tolerance of steelhead, the thermal tolerance criteria (frequency of average daily temperatures greater than 20°C, and frequency of maximum daily temperatures greater than 24°C) should not be used as absolute thermal thresholds, but rather represent general guidelines for assessing the biological significance of water temperature conditions. However, steelhead have been documented in habitat with temperatures ranging from 0°C in winter to as high as 26-27°C in summer (Moyle, 2002). Temperatures greater then 23°C can become lethal if acclimation is not gradual. Even with acclimation, temperatures between 24-27°C are typically lethal other than for short exposures (Moyle, 2002).

The seasonal abundance of steelhead captured in the Estuary varies annually, but is usually highest in May and decreases in succeeding summer months. The spatial distribution of steelhead in the Estuary varies greatly. Most age 0+ steelhead are typically captured in the upper and middle Estuary (fresh and brackish water) during May and June (SCWA, 2010b). Few steelhead are captured in the lower Estuary during this period. Conversely, from July to September most steelhead are captured in the middle and lower Estuary (brackish and marine salinity conditions). Steelhead have rarely been captured at the two lower sample stations (River Mouth and Penny Island) during all survey years (SCWA, 2010b).

Recent research by Bond et al. (2008) has specifically attributed the importance of estuarine lagoon rearing to the survival of returning adult steelhead. Steelhead reared in a lagoon were shown to be significantly larger for all years studied than juveniles migrating directly to the ocean in spring (Bond et al., 2008). Lagoon residents were consistently larger than downstream migrants who spent little time rearing in lagoons. Size-selective survival is the largest determinant in driving which individuals contribute to the adult population. Steelhead smolts experience a strong size-selective mortality in the marine environment (that is, smaller individuals have a lower probability of survival). Bond et al. (2008) demonstrate a survival advantage for larger lagoon-reared individuals and over 95% of returning adults were lagoon-reared. These patterns of growth and ocean survival are driven by the difference in growth rates between productive estuary/lagoon waters and the relatively oligotrophic[3] upstream habitat (Bond et al., 2008). There is strong evidence of the importance of lagoon habitat as a nursery to coastal California steelhead populations (Bond et al., 2008; Smith, 1990, NMFS, 2008) demonstrating the importance of lagoons in producing larger smolts that contribute to the majority of the adult population.

Coho salmon. Coho salmon range from Asia and Alaska to Central California as far south as Santa Cruz County. This salmon is state and federally listed as endangered due to a 90-95% decline in abundance (Moyle, 2002). There is little historical documentation regarding the distribution and abundance of coho salmon in the Russian River (SCWA, 2010b). However, an early estimate put the coho salmon population at 5,000 fish, which utilized the tributaries near Duncans Mills (SCWA, 2008). Although there are no current estimates of coho salmon in the Russian River, recent juvenile surveys indicate that the wild coho population has been reduced to very low levels and are only

3 A deficiency of plant nutrients accompanied by an abundance of dissolved oxygen.

known to persist in a few creeks. In an attempt to recover the Russian River run, the Coho Salmon Broodstock Program was initiated. The program propagates local coho at the Don Clauson Fish Hatchery located adjacent to Warm Springs Dam and releases young into several Russian River tributaries with historic occurrences of coho.

Coho salmon is an anadromous species with a three-year life cycle. Adults spend approximately two years at sea before migrating in late-fall and winter to their natal stream to spawn. Once spawning is completed adults die within a few days or weeks. Young spend their first year rearing in streams with deep pools and submerged large woody cover. Emigration occurs in spring usually before June to avoid warmer summer temperatures. Smolts may acclimate to seawater in estuaries before entering the ocean. Coho salmon are the most temperature sensitive of the three salmonids in the Russian River watershed and require permanent cool clean water for spawning and rearing young. Optimal juvenile habitat for growth is characterized by temperatures of 12-14°C. Coho do not persist in streams where summer temperatures reach 22-25°C for extended periods of time or where there are high fluctuations in temperature at the upper end of their tolerance range (Moyle, 2002). Additionally, although coho typically rear in clear streams, some juveniles rear in the freshwater portions of estuaries and lagoons rather than streams (Moyle, 2002), but summer lagoon rearing appears to be rare among coho salmon along the central California coast, probably due to the lower tolerance of the species to high water temperatures compared to steelhead.

Very few coho salmon smolts have been captured in the Estuary during fish monitoring surveys (SCWA 2006, 2010a). A total of 77 smolts have been captured since 2004. Low coho captures in the Estuary are related to their low numbers in the Russian River watershed, but also the timing of Water Agency fish surveys that begin in late-May or June when most smolts have already migrated to the ocean. Nearly all smolts are captured during May or early June (SCWA, 2010a). Most smolts seined in the Estuary had a clipped adipose fin indicating a hatchery origin from the Coho Salmon Captive Broodstock Program (SCWA, 2010b).

Chinook salmon. Russian River Chinook salmon follow the life history pattern of fall-run Chinook salmon, which is an adaptation to avoid summer high water temperatures. Fall-run adult salmon migrate from the ocean to spawn in the main channels of rivers and large tributaries in late summer and fall, and die soon after spawning. Fry[4] emerge in spring and move downstream within a few months. Young Chinook salmon may rear in the mainstem of rivers or estuaries during spring before water temperatures increase in the summer. Estuary-reared juvenile Chinook salmon may grow to a larger size than river-reared fish, which is likely to improve their chances for ocean survival and return (McKeon, 1985; cited in Entrix, 2004). Once accustomed to saltwater, smolts emigrate out to sea where they spend between 1 and 5 years maturing before returning to their natal stream to spawn and complete their lifecycle. Upstream migration from the ocean to spawn in the mainstem of the Russian River and tributaries occurs from the last week in August through December (primarily October through November). Spawning begins in November and likely continues through early January, when the salmon die after spawning.

4 Life stage of trout and salmon between hatching and full absorption of the yolk-sac.

A major limiting factor for juvenile Chinook salmon is temperature, which strongly affects growth and survival (Moyle, 2002). Typically, optimal temperatures are from 13-18ºC and few Chinook salmon can survive temperatures greater then 24°C, even for short periods with mortality experienced in wild populations at around 22-23°C (Moyle, 2002). At sublethal temperatures, growth is reduced. There are likely slight differences (1-2 ºC) in optimal and lethal temperatures of Chinook salmon of different runs and stocks (Moyle, 2002).

Chinook salmon smolts are typically most abundant in May or June during Water Agency fish surveys and then by July are rarely captured in the Estuary. Chinook salmon smolts are well distributed throughout the Estuary with captures at most sample stations annually (SCWA, 2006, 2010). Chinook salmon primarily utilize the Estuary as migratory habitat.

Pacific Lamprey. Pacific lamprey, a federally listed species of concern, are anadromous with a generalized life cycle similar to steelhead. In California, Pacific lampreys spend approximately 18 months in the marine environment before returning to freshwater to spawn during the winter and spring and are known to spend up to a year in freshwater prior to spawning. Pacific lamprey spawn in riffles with gravel/cobble substrates. Adult Pacific lampreys migrate upstream during the spring from April through mid-June. The young, worm-like Pacific lamprey, called ammocoetes, emerge from the buried nest after approximately three weeks and drift downstream to suitable rearing habitat consisting of backwater areas with soft mud/sand substrates. Ammocoetes burrow tail first into the soft substrate, where they feed on detritus and are commonly found in the mainstem Russian River as well as in the lower and middle reaches of tributaries. Ammocoetes pass through a transformation process similar to the smolting phase in salmonids. The newly transformed ammocoetes, called marcopthalmia, develop eyes and functioning mouthparts and migrated to the ocean where they take up a predaceous feeding lifestyle.

River Lamprey. River lamprey are a California species of special concern. Although the lifecycle of river lampreys has not been studied in California, it is known to be similar to the Pacific lamprey (described above). The major difference is that river lampreys are smaller and spend less time in the marine environment (approximately three to four months) before returning to freshwater to spawn. Although river lampreys have been documented in the Russian River, they are rarely seen, and little is known about their status in the river. However, the uncertainty regarding the abundance and distribution of the species may be the result of the difficulty inherent in distinguishing between lamprey species.

Russian River Tule Perch. This subspecies of tule perch, a California listed species of concern, inhabit the mainstem Russian River and the lower reaches of the larger tributaries. Tule perch are often found in pools, although they can forage in relatively fast water habitats. They are often associated with heavy cover elements such as aquatic plants, large woody debris, overhanging vegetation and riprap (Moyle, 2002). Tule perch feed on small invertebrates picked off the substrate or off of plants. Important food items in the Russian River include the larvae of mayflies and midges. Tule perch are viviparous, meaning that they give birth to live young (as opposed to laying eggs) in May and June. Russian River tule perch are common in freshwater habitats of the middle and upper Estuary (Cook et al. 2010).

Green Sturgeon. There has been little study of the lifecycle of the federally threatened green sturgeon because of its generally low abundance and limited spawning distribution. Green sturgeon is the most marine species of sturgeon and comes into rivers mainly to spawn, although the early life stage is in freshwater and may last as long as two years. Juveniles and adults are bottom feeders feeding on shrimp, amphipods, and small fish. Green sturgeon typically spawn between March and July with a peak from mid-April to mid-June in water temperatures from 8-14ºC. Spawning takes place in deep, fast water. In California the abundance of green sturgeon gradually increases north of Point Conception. The southern-most spawning population is in the Sacramento River. The Russian River is not recorded as a spawning river for the green sturgeon and none have been found during Water Agency fish studies. However, green sturgeon are occasionally captured in ocean waters, estuaries, and bays.

California Roach. California roach, as a whole, are not considered a special-status species. However, the Navarro Roach subspecies, which may occur in the Russian River watershed, is a California species of concern (Moyle et al., 1995). The distribution and taxonomy of each subspecies is unclear, including in the Russian River. California roach are a small, relatively short-lived species, seldom living longer than three years. Roach inhabit environments ranging from cold headwater streams, to warm, low gradient rivers. Roach are seldom abundant in the presence of large numbers of other fish species. When found alone, they occupy waters of large pools. In the presence of predatory fish, such as pikeminnow, roach occupy shallow water habitats along the shoreline in riffles. Roach appear to be particularly vulnerable to competition with green sunfish (*Lepomis cyanellus*). Roach are omnivores, feeding primarily on algae, aquatic insects, and small crustaceans. Roach are found in the mainstem Russian River and can be very abundant in the lower sections of tributaries such as Santa Rosa Creek. Roach are also found in freshwater habitats in the upper Estuary.

Hardhead. Hardhead are widely distributed in low- to mid-elevation streams in the main Sacramento-San Joaquin drainage and are also present in the Russian River (Moyle, 2002). This freshwater native minnow is a California species of special concern. They are typically found in undisturbed areas of streams with summer temperatures in excess of 20°C with optimal temperature in the range of 24-28°C (Moyle, 2002).Hardhead are intolerant of low oxygen levels, limiting distribution to well oxygenated streams and surface waters of reservoirs, preferring clear deep pools (>80cm) and runs with a sand-gravel-boulder substrate and low water velocities (Moyle, 2002). Hardhead are often found in association with Sacramento pikeminnow and Sacramento sucker, but are typically absent from streams dominated by introduced species, especially centrarchids (Moyle, 2002). Hardhead are commonly observed in the Russian River, but rarely have been found in the brackish Estuary (Merritt Smith, 2000).

Federally Managed Marine Species

Marine species are primarily distributed in the lower and middle Estuary with some limited distribution into upper portions of the Estuary as salinity levels change based on the condition of the barrier beach (open/closed) and based on tidal influence. As described in **Section 3.5, Historic Estuary Conditions and NMFS' Russian River Biological Opinion**, when the mouth closes, marine fish distribution shifts towards the lower portion of the Estuary and concentrates around the river mouth where the highest salinities are sustained for longer periods as the Estuary undergoes limited transition to fresh or brackish water habitat. After the Estuary is opened, fewer marine species are typically detected in the project area and estuarine species are typically redistributed into the lower and middle Estuary as tidal influence resumes. Following breaching (natural or artificial) it is typical for marine species to once more enter the lower Estuary as habitat conditions once again become suitable.

The Estuary occurs within Essential Fish Habitat (EFH) for various federally-managed marine fish species within the Pacific Salmon Fishery Management Plan (FMP), the Coastal Pelagics FMP, and the Pacific Groundfish FMP. **Table 4.5-2** lists the FMP-managed species that have been observed in the project area. As described in detail above, the Russian River basin contains habitat necessary to Pacific salmon and other anadromous species for spawning, breeding, and feeding or growth while rearing. Species managed under the Coastal Pelagics and Pacific Groundfish FMPs use the Estuary primarily for juvenile rearing, though some species may use the area for spawning as well.

TABLE 4.5-2
FEDERALLY-MANAGED MARINE FISH SPECIES WITH DESIGNATED ESSENTIAL FISH HABITAT IN THE RUSSIAN RIVER ESTUARY

Scientific Name	**Common Name**	**Fisheries Management Plan**
Clupeidae		
Sardinops sagax	Pacific sardine	Coastal Pelagic
Engraulidae		
Engraulis mordax	northern anchovy	Coastal Pelagic
Salmonidae		
Oncorhynchus gorbuscaha	pink salmon	Pacific Salmon
Oncorhynchus kisutch	coho salmon	Pacific Salmon
Oncorhynchus tshawytscha	Chinook salmon	Pacific Salmon
Sebastidae		
Sebastes paucispinis	bocaccio	Pacific Groundfish
Sebastes melanops	black rockfish	Pacific Groundfish
Sebastes spp.	copper blackfish complex	Pacific Groundfish
Hexagrammidae		
Hexagrammos decagrammus	kelp greenling	Pacific Groundfish
Ophiodon elongates	lingcod	Pacific Groundfish
Cottidae		
Scorpaenichthys marmoratus	cabezon	Pacific Groundfish
Carangidae		
Trachurus symmetricus	jack mackerel	Coastal Pelagic
Bothidae		
Citharischthys sordidus	Pacific sanddab	Pacific Groundfish
Plueronectidae		
Platichthys stellatus	starry flounder	Pacific Groundfish

SOURCE: NMFS, 2010.

4.5.3 Regulatory Framework

Please refer to **Section 4.4, Biological Resources** for a detailed discussion of federal and State regulations and local policies germane to the Estuary Management Project, including the Federal and State Endangered Species Acts, Federal and State Clean Water Act, Section 1600 of the California Fish and Game Code, California Coastal policies. Local policies established in the *Sonoma County General Plan 2020* and Local Coastal Program that govern fisheries resources in the project area are summarized in Section 4.5 in **Appendix 4.0, Local Regulatory Framework Governing Environmental Resources**.

In addition to the above mentioned regulations, the following apply to the Estuary Management Project.

Magnuson-Stevens Fishery Conservation and Management Act – Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-297), requires that all federal agencies consult with NMFS on activities or proposed activities authorized, funded, or undertaken by that agency that may adversely affect EFH of commercially-managed marine and anadromous fish species. EFH is defined in the Magnuson-Stevens Act as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The components of this definition are interpreted as follows: "Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle. In addition, the Estuary Management Project area occurs within areas designated as Habitat Areas of Particular Concern (HAPC) for species managed under the Pacific Groundfish FMP. HAPC are described in the regulations as subsets of EFH which are rare, particularly susceptible to human induced degradation, especially ecologically important, or located in an environmentally stressed area. Designated HAPC are not afforded any additional regulatory protection under Magnuson- Stevens Act; however, Federal projects with potential adverse impacts to HAPC will be more carefully scrutinized during the consultation process.

The Sustainable Fisheries Act of 1996 amended the Magnuson-Stevens Act to establish new requirements for EFH descriptions in federal FMPs and to require federal agencies to consult with NMFS on activities that may adversely affect EFH. The Magnuson-Stevens Act requires all fishery management councils to amend their FMPs to describe and identify EFH for each managed fishery. The EFH provisions of the Magnuson-Stevens Act are designated to protect fishery habitat from being lost due to disturbance and degradation. The Act requires that EFH must be identified for all species federally managed by the Pacific Fishery Management Council (PFMC), which is responsible for managing commercial fishery resources along the coasts of Washington, Oregon, and California.

The PFMC has designated the Russian River Estuary as EFH to protect and enhance habitat for coastal marine fish and macroinvertebrate species that support commercial fisheries. The EFH provisions of the Sustainable Fisheries Act are designated to protect fishery habitat from being lost due to disturbance and degradation. The Act requires that EFH must be identified for all species federally managed by the PFMC, which is responsible for managing commercial fishery resources along the coasts of Washington, Oregon, and California. Three fishery management plans cover species that occur in the project area, and designate EFH within the entire Estuary:

1. Pacific Groundfish Fishery Management Plan: bocaccio, black rockfish, copper rockfish complex, other unidentified juvenile rockfish, kelp greenling, lingcod, cabezon, Pacific sanddab, starry flounder, green sturgeon

2. Coastal Pelagic Fishery Management Plan: northern anchovy and Pacific sardine, jack mackerel

3. Pacific Salmon Fishery Management Plan: pink salmon, coho salmon, Chinook salmon

4.5.4 Environmental Impacts and Mitigation Measures

Significance Criteria

Implementation of the Estuary Management Plan would have a significant impact on fisheries resources if it were to:

1. Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the CDFG, U.S. Fish and Wildlife Service (USFWS), or NMFS;

2. Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the CDFG or USFWS[5];

3. Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, coastal, etc.) through direct removal, filling, hydrologic interruption, or other means;

4. Interfere substantially with the movement of any native resident or migratory fish, or impede the use of native fish nursery (rearing) sites;

5. Have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish species, cause a fish population to drop below self-sustaining levels, threaten to eliminate a fish community, or substantially reduce the number or restrict the range of an endangered, rare, or threatened species;

6. Conflict with any local policies or ordinances protecting biological resources; or

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5 Addressed in Section 4.4, Biological Resources.

7. Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan.

For the purpose of this EIR, the word "substantial", as used in the significance criteria (above), has three principal components, each of which contributes to the determination of impacts on fisheries resources and their significance:

1. Magnitude and duration of the impact (e.g., substantial/not substantial);
2. Uniqueness of the affected resource (rarity);
3. Susceptibility of the affected resource to disturbance.

The evaluation of significance must also consider the interrelationship of these three components. For example, a relatively small-magnitude impact on a state or federally listed fish species could be considered significant because the species is rare and is believed to be very susceptible to disturbance. Conversely, a natural fish population such as prickly sculpin is not necessarily rare or sensitive to disturbance, and thus, a much larger magnitude of impact would be required to result in a significant impact. Impacts on fisheries resources are considered *significant* when project-related habitat modifications (e.g., development, introduction of non-native species, increased human intrusion, barriers to movement, or landscape management) could reduce fish species populations to the extent that they become locally less numerous; impacts on habitats are considered *significant* when the habitats could not continue to support viable populations of associated fish species as a result of project implementation.

Approach to Analysis

As noted in **Chapter 2.0, Project Description**, the Water Agency would continue its current practice of artificial breaching outside of the lagoon management period of May 15 through October 15. Timing, implementation, access, sensitivity to pinniped haulout, personnel, equipment and general procedures would be equivalent to current practices, as described in **Section 2.2.2**. No change to artificial breaching outside of the lagoon management period would occur under the Estuary Management Project.

The Estuary Management Project is to reduce the current frequency of artificial breaching in the Estuary during the lagoon management period, and thereby allow the Estuary to function more naturally and in a manner likely more consistent with historic conditions. The proposed management actions are intended to limit tidal exchange between the ocean and the Estuary from May 15 to October 15, when a freshwater lagoon would be expected to form. Instead of the existing tidal Estuary, the proposed project will manage the Estuary as a perched lagoon with water levels above tidal elevations during the lagoon management period. With tidal inflows limited, the proposed project aims to enhance the extent of freshwater habitat for the benefit of salmonid rearing and to reduce the frequent and abrupt transitioning between states from marine to freshwater habitat that occurs under current practices. As discussed in **Section 3.6.2, Current Estuary Management and Fish Habitat**, the current practice results in artificial breaching of the barrier beach during the proposed lagoon management period resulting in potentially degraded habitat conditions throughout the summer for both freshwater and marine species. Under the proposed project, management would allow the Estuary to transition to freshwater/brackish habitat for a longer duration, thereby benefitting salmonid rearing.

The Russian River Biological Opinion (NMFS, 2008) requires the Water Agency to collaborate with NMFS and CDFG and to modify Estuary management in order to reduce marine influence (high salinity and tidal inflow) and promote a higher water level in the Estuary (formation of a fresh or brackish water lagoon) from May 15 to October 15. The Estuary Management Project would involve three primary actions (described in detail below): lagoon adaptive management including monitoring and response to physical conditions, construction of a lagoon outlet channel to control water surface elevation, and artificial breaching consistent with current practices and as allowed under the Russian River Biological Opinion.

The Water Agency will continue the historical practice of artificially breaching the barrier beach outside the lagoon management period (October 16 to May 14) to minimize the potential for flooding of low-lying properties. Additionally, the techniques used to manage the outlet channel or to undertake breaching of the barrier beach during the proposed management period are identical in nature to the current practices in terms of use of heavy equipment to on the barrier beach. The frequency of equipment use may be increased during the lagoon management period in order to maintain the outlet channel. However, the increased use of equipment would not be expected to result in direct impacts to fish or aquatic habitat from construction-related breaching practices or lagoon outlet channel management. For this reason, construction related impacts to fisheries from management of the outlet channel are unlikely and are not assessed further in this section.

As described in the Setting section, above, three federally-listed salmonids are found in the Russian River watershed: Central California Coast steelhead, California Coastal Chinook salmon, and Central California Coast coho salmon. There is no established run of pink salmon in the Russian River and is not expected to be affected by the proposed project. Green sturgeon (*Acipenser medirostris*) is considered unlikely to occur in the project area based on monitoring data (SCWA, 2006) and known occurrences, and is not expected to be affected by the proposed project. Longfin smelt (*Spirinchus thaleichthys)* use of the Estuary appears to be very low based on historic monitoring data and the status of a longfin smelt population in the Russian River is uncertain. Longfin smelt are tolerant of a broad range of salinities and typically spawn January through March (outside of the proposed estuary management period). Therefore, longfin smelt are not expected to be affected by the proposed project. The special-status freshwater species listed in Table 4.5-1 (Russian River tuleperch, Clear Lake-Russian River roach, and hardhead), are typically restricted to freshwater areas in the upper Estuary that would remain fresh under lagoon conditions resulting from the proposed project and formation of a freshwater lagoon would likely benefit these species. Therefore, Russian River tuleperch, Clear Lake-Russian River roach, and hardhead are not expected to be affected by the proposed project. Adult lamprey return to freshwater habitats from the ocean during the winter and spring (outside of the proposed management period) and typically migrate upstream to spawn from April to June and spend up to a year in freshwater prior to spawning. Juvenile lamprey can rear in the freshwater portions of estuaries and lagoons acclimate to seawater in estuaries in a process similar to the smolting phase in salmonids. Therefore, lamprey are not expected to be affected by the proposed project.

The salmonid species occurring in the Estuary Management Project area are sensitive to changes in habitat conditions, and their habitat requirements are often more limiting than for other fish species found in the watershed. For this reason, the following impact assessment focuses on these salmonid species in terms of potential impacts to fisheries resources. Potential impacts are assessed for salmonid species under **Impact 4.5.1** and **4.5.2** and are applicable to potential impacts to other freshwater and estuarine fish species resident in the Estuary. Federally managed marine species and associated Essential Fish Habitat impacts are assessed under **Impact 4.5.3**.

Impact Analysis

The following impact analysis focuses on potential impacts of the proposed Estuary Management Project related to fisheries. The evaluation considered project plans, current conditions at the project site, and applicable regulations and guidelines. Impacts are summarized and categorized as either "no impact," "less than significant," "less than significant with mitigation," or "significant and unavoidable."

Impact 4.5.1: Habitat Availability. Estuary management to promote freshwater lagoon conditions would increase the frequency, duration and volume of freshwater storage within the Estuary during the lagoon management period, thereby increasing potential habitat availability for juvenile salmonids. (Beneficial)

Table 4.5-3 summarizes the anticipated surface area and volume of storage that would be provided by average water surface elevations under existing conditions (2 feet) versus those provided by the proposed project (7 feet average, 9 feet maximum). The volume of storage within the Estuary Study Area was estimated based upon bathymetric survey data available between the mouth and Austin Creek (EDS, 2009). The volume of storage within the reach between Austin Creek and Vacation Beach was estimated using two storage curves developed for the Estuary by Behrens (2010): one extending from the Estuary mouth up to Austin Creek and one extending up to Monte Rio.[6] The volumetric difference between the two curves was extended, through linear interpolation, upstream to Vacation Beach. Under existing conditions, the average water surface elevation of 2 feet provides approximately 345 acres of surface area within the Estuary Study Area, with a corresponding storage volume of 1,750 acre-feet. Upstream of Austin Creek, an additional storage volume of 36 acre-feet is provided, for a total storage volume of 1,786 acre-feet at 2 feet.

6 Behrens (2010) developed a storage curve for the Estuary, up to Austin Creek, based upon recent bathymetric survey data. The storage curve was extended upstream to Monte Rio using unpublished notes and data related to an earlier study of the Estuary (Goodwin et al., 1993).

TABLE 4.5-3
STORAGE VOLUME PROVIDED BY PROPOSED PROJECT

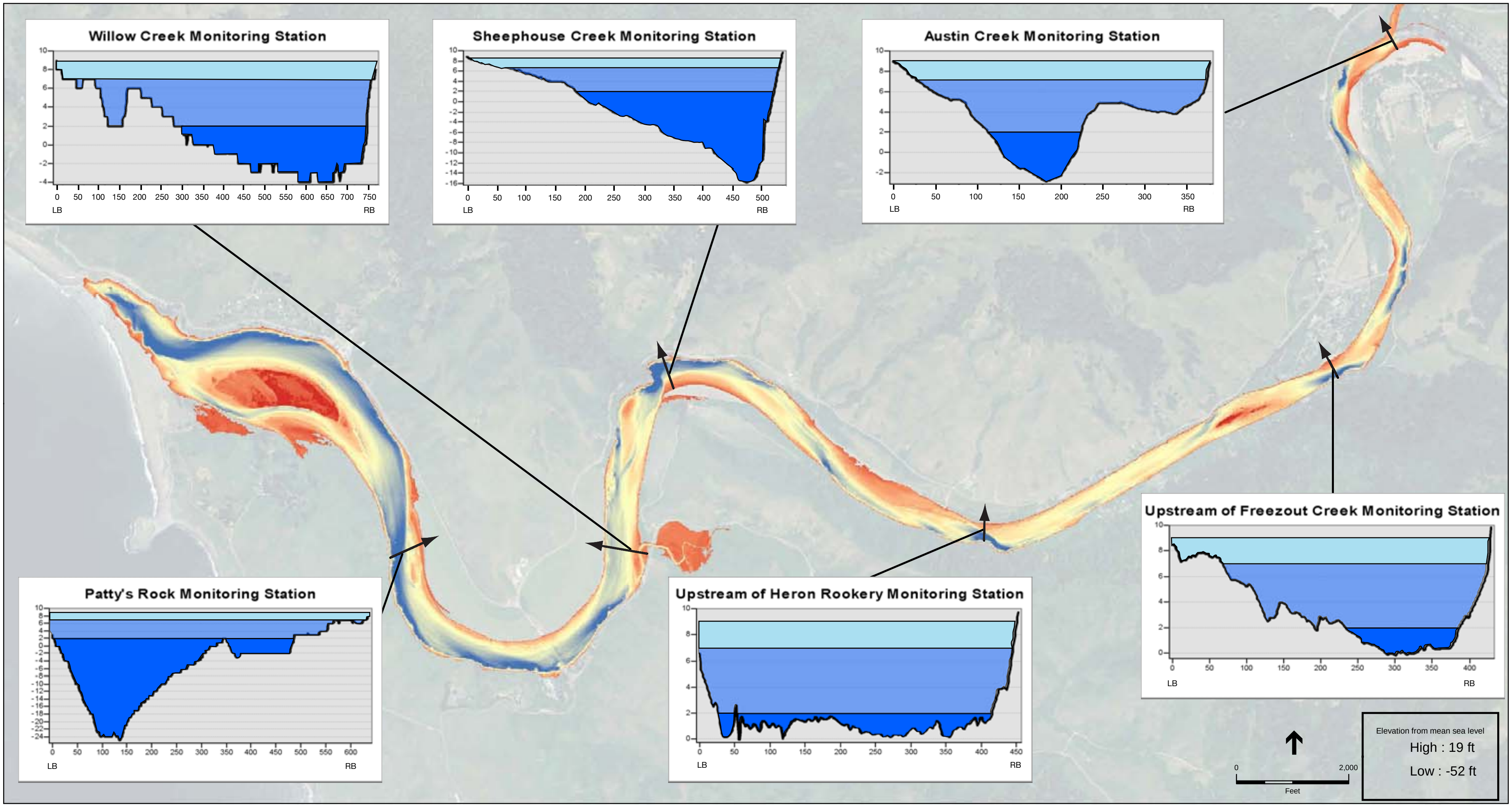
	Estuary Study Area[a]			Austin Creek to Vacation Beach[b]			Project Total	
WSE	**Area (acres)**	**Storage Volume (AF)**	**Storage Increase from Existing**	**Area (acres)**	**Storage Volume (AF)**	**Storage Increase from Existing**	**Storage Volume (AF)**	**Storage Increase (AF)**
2 feet (Existing Average)	345	1,750	--	NA	36	--	1,786	--
7 feet (Project Average)	421	3,832	2,082	NA	725	689	4,557	2,771
9 feet (Project Maximum)	524	4,838	3,088	NA	1,513	1,477	6,351	4,565

a Calculated based upon SCWA bathemetric mapping of Estuary Study Area, 2009.
b Estimated using storage curves provided by Behrens (2010).

Figure 4.5-1 presents bathymetric data for the Estuary Study Area and cross sections at typical locations within the Estuary Study Area to illustrate how increased water surface elevations associated with the proposed project would increase storage volumes within the Estuary Study Area. Under the proposed project maximum water surface elevation of 9 feet, the Estuary Study Area is estimated to provide an additional 3,088 acre-feet of storage. Upstream of Austin Creek, an additional storage volume of approximately 1,477 acre-feet is provided at the maximum water surface elevation of 9 feet. Therefore, under the proposed project, it is anticipated that up to 4,565 acre-feet of additional storage, or the difference in storage between 2 feet and 9 feet, could be provided within the project area between the river mouth and Vacation Beach.

The amount of actual habitat provided by this additional storage volume would be dependant upon several factors, including water quality (salinity, temperature and dissolved oxygen levels), food source production, and cover and habitat structure conditions. However, when compared to existing conditions, this amount of additional storage volume would substantially increase the volume of water available for freshwater habitat conditions favorable to juvenile salmonids to develop and be present during the lagoon management period.

The proposed project would either result in a full transition from tidally influenced marine habitat to productive freshwater estuarine lagoon habitat or maintain stratified conditions with increased stable freshwater habitat in the upper portion of the water column. Based on currently available research of lagoon productivity and benefits to juvenile salmonid rearing, management of the Estuary under the proposed project is expected to result in greater estuarine habitat productivity, increased juvenile steelhead growth and increased subsequent adult recruitment to the population (Bond et al., 2008; Smith, 1990; NMFS, 2008; McKeon, 1985 as cited in Entrix, 2004). Additionally, the proposed project would result in a reduction in the frequency of abrupt and prolonged changes to habitat conditions and water quality parameters that may result in stress or mortality to resident fish. No adverse impacts to the abundance and distribution of other, non-salmonid, species have been observed to date from prolonged closure of the barrier beach.



Estuary Study Area

Existing Average WSE – 2 feet	Proposed Project – 7 feet	Proposed Project – 9 feet
Area: 345 Acres	Area: 421 Acres	Area: 524 Acres
Volume: 1,750 AF	Volume: 3,832 AF	Volume: 4,838 AF
	Project Increment: 2,082 AF	Project Increment: 3,088 AF

Austin Creek to Vacation Beach

Existing Average WSE – 2 feet	Proposed Project – 7 feet	Proposed Project – 9 feet
Area: NA	Area: NA	Area: NA
Volume: 36 AF	Volume: 725 AF	Volume: 1,513 AF
	Project Increment: 689 AF	Project Increment: 1,477 AF

Total Estimated Volume: Mouth to Vacation Beach

Proposed Project – 7 feet	Proposed Project – 9 feet
Area: NA	Area: NA
Volume: 4,557 AF	Volume: 6,357 AF
Project Increment: 2,771 AF	Project Increment: 4,565 AF

SOURCE: EDR, 2009; SCWA, 2008; ESA, 2010

Note: Elevations show for display purposes only

Figure 4.5-1
Estuary Study Area: Typical River Profiles and Estimated Volume Summary

Standardized fish surveys conducted before and during a prolonged river mouth closure, lasting 29 days (described in detail in **Section 3.4, 2009 Data Report**) from September 6 through October 5, 2009, showed that other estuarine and freshwater fish groups maintained distributions throughout the Estuary during barrier beach closure (SCWA, 2010b). However, marine fish, especially demersal fish, were restricted to near the mouth and did not quickly redistribute after reopening. Implementation of the proposed project and establishment of freshwater lagoon conditions would reduce the abundance and distribution of most marine and estuarine fish species. Please refer to **Impact 4.5.2** for additional discussion.

Impact 4.5.2: Habitat quality. Management of the Estuary could result in changes in water quality conditions (water temperature, dissolved oxygen, and salinity) becoming stressful for rearing salmonids, special status, and other native fish species inhabiting the Estuary, resulting in reduced quantity and quality of habitat. (Less than Significant)

Under the proposed project, the Estuary would be managed to create a lagoon in the summer as a restoration and enhancement action. The lagoon will be managed to remain closed for a longer period (described in **Section 3.5, Historic Estuary Conditions and NMFS' Russian River Biological Opinion**). The ecological benefits of naturally functioning lagoons have been documented extensively (e.g., Smith, 1990; Bond et al., 2008; NMFS, 2008). However, implementation of the Estuary Management may not fully transition the Estuary to freshwater conditions, resulting in stratified conditions that may reduce habitat function and productivity. Therefore, it remains unclear whether the proposed project would result in a highly productive freshwater lagoon system during the lagoon management period, or whether the less productive and potentially adverse conditions characteristic of a partially converted stratified lagoon would predominantly occur.

A partially converted lagoon could potentially impact resident fish species, especially rearing steelhead, due to a reduction of water quality and habitat function, leading to increased stress or mortality as a result of increased water temperatures, reduced dissolved oxygen levels, or reduced foraging potential due to loss of estuarine productivity. A reduction in productivity or habitat function within the Estuary could result in a further potential indirect impact related to increased competition in unaffected areas where suitable habitat persists. Additionally, stratification could result in a reduction in the total area of available suitable habitat for a range of fish species due to adverse water quality conditions in the lower water column. Also, as the smaller juvenile stages of steelhead and other freshwater species are concentrated in the shallow freshwater lens of a temporarily stratified Estuary, they are more susceptible to significant amounts of avian predation (NMFS, 2008). Failure to fully transition the lagoon to freshwater habitat could result in an increased potential for such predation. Thus, the potential impact to aquatic species and habitat from implementing the proposed project stems from uncertainty regarding the potential success of the proposed management regime to more closely emulate natural lagoon functions and the possibility that the proposed action may result in persistent adverse habitat conditions and stress to resident fish species.

Salmonid spawning habitat is not present within the Estuary Management Project area for the listed salmonids in the Russian River. The Estuary serves as migratory habitat for adult and juvenile passage from and to the ocean, as transition habitat for salmonids smolts, and has the potential to serve as important rearing habitat for juvenile salmonids, particularly steelhead. Adult salmonids typically immigrate upstream following winter storms outside the proposed management period, when the Estuary would be open due to natural or artificial breaching. Chinook salmon can begin immigrating as early as August (a few individuals), but peak migration into the Estuary is typically in November and December, after the proposed management period. Delaying entry into the Estuary for a few early individuals during the summer when water temperatures can be high (and therefore stressful) is unlikely to significantly impede Chinook salmon adult immigration into the Russian River for spawning.

With respect to outmigration of Chinook and coho smolts, SCWA monitoring data in 2009 and 2010 indicate the timing of outmigration varies year to year, but that in most years the peak of the run may be expected between mid-April and mid-May, generally before the beginning of the lagoon management period. However, in certain years, it is likely that smolts will still be outmigrating at the beginning of the lagoon management period, and Chinook smolts may outmigrate well into the lagoon management period. Under these conditions, smolts would have to swim the lagoon outlet channel to enter the ocean (or spend time in the estuary). The confines of the outlet channel may make the smolts more suspectible to predation by birds and seals. The Russian River Biological Opinion indicates that Chinook salmon migrants will be able to enter and exit the outlet channel and that most coho salmon are expected to move into the ocean prior to the summer, and are therefore not likely to be adversely affected by lagoon management. Therefore, potential impacts to either the spawning or migratory life stages for the three ESA-listed salmonids are anticipated to be less than significant.

In other estuary/lagoon systems, the repeated turnover from salt to freshwater from breaching of barrier beaches has been observed to reduce food productivity and the presence of saltwater also likely impedes the successful rearing of steelhead (NMFS, 2008).[7] Other natural lagoon systems in California studied by Smith (1990) converted to unstratified freshwater lagoons when sufficient freshwater inflow was available to displace impounded high salinity sea water. Once the lagoons studied by Smith (1990) converted, water quality was characterized by relatively low temperature with high dissolved oxygen levels, so long as adequate freshwater inflow was maintained. Smith's (1990) research in the Pescadero, San Gregorio, and Wadell estuary/lagoons showed that juvenile steelhead survival and growth is excellent when lagoons remain open to full tidal mixing or when the closed lagoons are converted to freshwater. Smith (1990) documented that lagoon productivity and steelhead growth tends to be reduced during the marine to freshwater transition period, but then resumes and increases once freshwater conversion has been completed. Growth and habitat function is poor during long, stratified transition periods between barrier beach closure and conversion of the lagoons to freshwater (Smith, 1990), such as occurs under the current management practice due to the short durations of the barrier beach typically persisting for only five to 14 days.

7 This is a conservative assumption that assumes that the Russian River system functions similar to other studied systems.

In some years, with low freshwater inflow, natural lagoons have been documented to remain stratified throughout the summer and fall, with denser saltwater on the bottom forming high temperature, low dissolved oxygen saltwater lenses and reduced invertebrate abundance (Smith, 1990). Similarly, the Navarro River Estuary, which is more similar in size and configuration to the Russian River Estuary than the smaller estuary/lagoons studied by Smith (1990) and Bond et al. (2008), did not always fully convert to freshwater after it closed, but remained stratified in some years (NMFS, 2008). Steelhead productivity in the Navarro remained high despite prolonged stratification due to abundant food (potentially a result of the freshwater lens flooding streamside fringe habitat) and a stable surface freshwater layer (NMFS, 2008).

Additionally, freshwater conditions and enhanced steelhead rearing habitat have been documented to result from artificially managed perched lagoons, a condition where an estuary is closed to ocean tides but freshwater flows out over the sandbar, as is proposed for the Russian River Estuary. The freshwater outflow through the discharge channel can entrain a portion of the saltwater at the boundary between fresh and salt layers, steadily removing saltwater from the lagoon, as has been documented in the managed Carmel Lagoon (NMFS, 2008). The City of Capitola has managed the Soquel Creek Lagoon since approximately 1990 as a perched lagoon during the summer months to enhance fisheries habitat (Habitat Restoration Group, 1990; D.W. Alley & Associates, 2004). The primary fish species of interest in the managed lagoon is steelhead (D.W. Alley & Associates, 2004). The lagoon is managed as a perched, rather then closed, lagoon to ensure flood protection of low lying properties; thus maintaining a stable lagoon water surface elevation during the management period (Habitat Restoration Group, 1990; D.W. Alley & Associates, 2004, 2010). The managed lagoon provides valuable nursery habitat for juvenile steelhead (D.W. Alley & Associates, 2004). Juveniles grow rapidly in the productive lagoon environment there and have maintained a stable summer density since management of the lagoon for enhanced steelhead habitat began in the 1990s (D.W. Alley & Associates, 2004, 2010). Water temperature and oxygen levels have been maintained within the physiological tolerance of steelhead (D.W. Alley & Associates, 2004, 2010). Annual water quality monitoring of the Soquel Creek Lagoon in the deepest sections (7-8 feet depth) has demonstrated that typically no lagoon stratification or thermocline[8] occurs (D.W. Alley & Associates, 2010). The Soquel Creek Lagoon is subject to daily inland breezes that circulate the water, surface to bottom, resulting in complete, diurnal (daily) mixing of the water column in the lower and middle estuary, except in deeper pockets where a temporary, dense anoxic saline layer can develop (D.W. Alley & Associates, 2010). Although the lagoon is generally shallow (two to eight feet deep) and temperatures become elevated in summer (>21 °C), the abundance of food and lagoon productivity allows juvenile steelhead to grow rapidly and in relatively high numbers compared to steelhead production in the mainstem Soquel Creek. In most years, the lagoon produces a significant proportion (10–35%) of the smolt sized juveniles in the Soquel Creek system (D.W. Alley & Associates, 2004, 2010).

Therefore, when compared to other managed and natural lagoon systems, it is likely that the current practice of breaching the Russian River Estuary for flood control reduces the value of the Estuary for salmonid rearing in summer months (Smith, 1990; Bond et al., 2008; NMFS, 2008). Breaching causes repeated abrupt changes in habitat conditions (depth of freshwater, salinity, temperature, and

8 Zone of rapid temperature change between warm surface waters (epilimnion) and cooler deep waters (hypolimnion)

DO) in the Estuary that reduce habitat function and likely results in stress and/or mortality to various resident fish species as well as reducing the beneficial effects of lagoon formation for salmonids (Smith, 1990; Bond et al., 2008). Current practices during the lagoon management period do not allow for a full transition to a freshwater lagoon due to frequency of breaching and the short durations of the barrier beach persisting (typically five to 14 days) due to the need to artificially breach the barrier beach.

While salmonids are highly mobile and can move away from unsuitable areas following breaching of the barrier beach, most of their foodbase is not as mobile and may experience population fluctuations during repeated breachings. The reduction of this foodbase may thereby reduce the suitability of the Estuary for juvenile salmonids and other resident freshwater and estuarine species under the current breaching regime (Entrix, 2004; NMFS, 2008). Therefore, under the current breaching regime, lagoon habitat function and productivity is reduced because the Estuary does not remain closed for a long enough period to fully transition to a freshwater lagoon during the summer season in most years. This degradation of habitat likely contributes to reduced survival of juvenile salmonids that emigrate to the Estuary (Bond et al., 2008; Smith, 1990) as well as reduced adult recruitment of returning steelhead (Bond et al., 2008). The Russian River Biological Opinion concluded that the combination of high inflows into the Estuary and current breaching practices likely impact rearing habitat by interfering with natural processes that would otherwise potentially allow a freshwater lagoon to form behind the barrier beach for a longer duration.

The proposed project includes an adaptive management element designed to reduce the likelihood of additional impacts to fish species through a range of monitoring, assessment, agency consultation, and management actions. The adaptive management plan developed for the proposed project requires monitoring of biological productivity, water quality, and physical processes in the Estuary in response to changes in water surface elevations in the estuary-lagoon system; and refinement of management actions to achieve desired water levels to support biological productivity, while simultaneously providing flood control for properties adjacent to the Estuary. The adaptive management of future conditions in the Estuary will be closely coordinated with NMFS and CDFG staff. Therefore, unexpected impacts potentially resulting from the proposed management of the Estuary relating to habitat critical water quality conditions becoming stressful for rearing listed juvenile salmonids, special status, and other native fish species inhabiting the Estuary are considered less than significant.

Impact Significance: Less than Significant.

Impact 4.5.3: Essential Fish Habitat. Management of the Russian River Estuary could affect essential fish habitat (EFH) for various federally managed marine species within the Pacific Salmon FMP, the Coastal Pelagics FMP, and the Pacific Groundfish FMP. (Less than Significant)

The proposed project occurs within EFH for various federally-managed marine fish species within the Pacific Salmon FMP, the Coastal Pelagics FMP, and the Pacific Groundfish FMP. Table 4.5-2 lists the FMP-managed species with designated EFH in the Russian River Estuary. The Russian

River basin contains habitat necessary to Pacific salmon for spawning, breeding, and rearing. The Pacific Salmon FMP includes Coho and Chinook salmon species and the potential project-related impacts to these salmon species are discussed under **Impact 4.5.1** and **4.5.2**, above. Marine species managed under the Coastal Pelagics FMP with designated EFH in the Russian River Estuary include northern anchovy, Pacific sardine, and jack mackerel. Marine species managed under the Pacific Groundfish FMP with designated EFH in the Russian River Estuary include starry flounder, Pacific sanddab, cabezon, lingcod, kelp greenling, rockfish, and bocaccio. Potential impacts to these marine species from the proposed project are assessed here.

Many marine species utilize estuaries, primarily for juvenile rearing, though some species may use estuaries for spawning as well (NMFS, 2008). As defined in the Pacific Groundfish FMP, the Russian River watershed contains Estuary habitat – a habitat designated as a HAPC. Estuaries are important elements of Pacific Groundfish EFH, as estuaries provide prey items, foraging areas, habitat complexity, nursery areas, and refugia. Estuaries provide the same vital elements for species managed under the Coastal Pelagic FMP, as well as many other fish species and macroinvertebrates, such as Dungeness crab.

Under current practices, artificial breaching of the barrier beach at the mouth of the Russian River is required to minimize potential flooding of low-lying properties adjacent to the Estuary. The barrier beach typically persists for approximately five to 14 days. Water quality surveys monitoring showed that the Estuary remains stratified following formation of the barrier beach, and conversion to a freshwater lagoon has not yet been observed; possibly due to the barrier beach persisting only for short durations. Typically, when a closed estuary stratifies, and especially during the conversion period to a freshwater lagoon, lower portions of the water column (highly saline water) are not mixed and develop very low dissolved oxygen conditions which can create temporary adverse habitat conditions for most fish species.

The current management regime causes the Estuary to open, through artificial breaching, with a frequency and duration that is inconsistent with other natural lagoons in California (discussed in detail under **Impact 4.5.1**, above). Following breaching events, the abundance and diversity of marine and estuarine fish increases in the project area as marine fish move into the open estuary. Following re-creation of the barrier beach the abundance and diversity of marine and estuarine fish decreases over time (SCWA, 2006) due to rapidly changing habitat conditions (salinity, temperature, dissolved oxygen). Additionally, when the barrier beach forms, marine fish become less dispersed in the Estuary and are concentrated near the river mouth where the highest salinities occur (SCWA, 2010b).

The abundance of most marine species in the Estuary is low as these species are dependent on marine conditions (i.e., cabezone, ling cod, rockfish). Also, pelagic fish (northern anchovy, pacific sardine, and jack mackerel) are rarely caught in the Estuary (SCWA, 2010a). However, Dungeness crab and starry flounder prefer brackish to freshwater. These two species use the Estuary for rearing and can be very abundant during summer. The proposed project would manage the Estuary so that the naturally formed barrier beach persists for a longer duration during the lagoon management period to either enable a full transition from tidally influenced marine habitat to productive freshwater estuarine lagoon habitat, or maintained stratified conditions with increased stable freshwater habitat in the upper portion of the water column. Managing the Estuary as proposed, to allow formation of a freshwater lagoon that persists through the lagoon management period, would reduce the number of times (between May and October) that species managed under the Coastal Pelagics, Pacific Groundfish FMPs, and other marine species have opportunity to access the Estuary and utilize suitable habitat that is present under tidally-influenced conditions. Additionally, prolonged closure and conversion to freshwater lagoon conditions may locally affect the distribution of marine species within the Estuary during the management period. However, from a population and habitat area standpoint, the numbers of marine fishes in the relatively small Estuary are minima compared to the inshore coastal waters and the San Francisco Bay. Therefore, these localized effects from the Estuary Management Plan to fish managed under the Coastal Pelagic, and Pacific Groundfish FMPs, as well as other marine fish species and macroinvertebrates that use portions of the Estuary are unlikely to represent a substantial adverse affect and impacts are considered less than significant.

As part of the proposed project, the Water Agency has developed, in consultation with NMFS, an adaptive management plan to better understand the potential impacts associated with the proposed project. The adaptive management plan incorporates monitoring and adaptive management to better understand, minimize, or otherwise mitigate (within the context of the overall goals) any adverse effects Estuary management may have regarding estuary water surface elevation, water transport through the barrier beach, estuarine water quality, and habitat quantity and quality.

Impact Significance: Less than Significant.

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