4.3 BIOLOGICAL RESOURCES

4.3.1 Introduction and Methodology

This analysis examines the potential effects of the project on both terrestrial and marine biological resources. Impacts on terrestrial resources are primarily associated with construction of the desalination plant, as well as the different alignments for the offsite water delivery pipelines and the pump station. Impacts are assessed in terms of short-term, construction-related impacts, and long-term operational impacts.

With regard to terrestrial biological resources, the majority of potential impacts would occur as a result of construction of portions of the offsite water delivery pipelines traversing undeveloped areas. Most of the water delivery pipeline alignments generally follow existing and future planned roadways, including Cannon Road, Faraday Avenue, Melrose Avenue, and Palomar Airport Road within the cities of Carlsbad, Oceanside, and Vista. In addition, a number of alignments in undeveloped areas have already been analyzed under CEQA as part of the review for various development projects, or future roadways. Those studies have been incorporated by reference as noted in *Section 2.4*. The remaining areas that are the focus of this analysis, are those areas that are not within existing developed roadways and have not been previously analyzed and approved for development. For the portions of the alignments that are shown within future roadways (*Figure 3-5*), that may be ultimately selected for construction, the pipelines would be constructed in conjunction with or subsequent to roadway construction that has already undergone CEQA review. Pipeline construction would not precede roadway construction. Therefore, the analysis of biological effects associated with future roadway construction is considered to provide adequate coverage under CEQA for the effects associated with the proposed pipelines.

Marine resources are evaluated in terms of impacts on both source water intake (impacts on organisms drawn through the water intake system) and by-product water discharge (primarily related to increased salt content of discharge from the reverse osmosis process). Evaluation of potential impacts on marine biological resources is based on available published literature, as well as studies conducted for the proposed project, including a Hydrodynamic Modeling Study (Jenkins and Wasyl, 2001 and 2005), a report entitled "Marine Biological Considerations Related to the Reverse Osmosis Desalination Project" (Graham, 2005) and results of Salinity Tolerance Investigations (Le Page, 2005), and Carlsbad Desalination Facility Intake Effects Assessment (Tenera Environmental, 2005). The methodology and results of the Hydrodynamic Modeling Study are more fully discussed in *Section 4.7, Hydrology and Water Quality*.

4.3.2 Existing Conditions

Terrestrial Environment

Botany - Plant Communities and Floral Diversity

Based on species composition and general physiognomy, 11 native plant communities were identified within the project study area: chamise chaparral, coastal sage scrub (disturbed and undisturbed), coyote brush scrub, herbaceous wetland (disturbed and undisturbed), disturbed mule fat scrub, open channel, scrub oak chaparral, and southern willow scrub. In addition to these native communities, there are six non-native, non-natural or unvegetated land covers within the project study area: non-native grassland, agriculture, developed, disturbed habitat, ornamental and ruderal habitat. *Table 4.3-1* provides acreages for each community.

TABLE 4.3-1
Acreages of Plant Communities

Habitat Type	Acreage
Native Habitats	
Chamise Chaparral	0.27
Coastal Sage Scrub	5.27
Disturbed Coastal Sage Scrub	1.12
Coyote Brush Scrub	0.03
Herbaceous Wetland	0.01
Disturbed Herbaceous Wetland	0.05
Disturbed Mule Fat Scrub	0.14
Open Channel	0.07
Scrub Oak Chaparral	0.13
Southern Willow Scrub	0.55
Non-Native Habitats	
Annual (non-native) Grassland	10.71
Agriculture	6.85
Developed	23.67
Disturbed Habitat	8.48
Ornamental	7.88
Ruderal	1.24
TOTAL	**66.46**

Open Channel/Jurisdictional Waters of the U.S.

Open channel typically refers to unvegetated portions of drainage channels. Within the Tri-Agency Pipeline easement in the City of Oceanside between Shadowridge Drive and Cannon Road, open channel is comprised of ungrouted riprap bound by one 36-inch culvert to the north and two 24 inch culverts to the south. Approximately 0.07 acre of open channel was identified within the study area.

Zoology - Wildlife Diversity

Birds

Thirty-nine bird species were observed during the survey visits. A complete list of bird species observed is contained in APPENDIX E. The diversity of birds is limited due to the high levels of urbanization and relatively low habitat quality throughout the study area. The habitats and land covers within the study area provide habitat for a variety of birds, including house finch (*Carpodacus mexicanus*), Anna's hummingbird (*Calypte anna*), California towhee (*Pipilo crissalis*), bushtit (*Psaltriparus minimus*), American crow (*Corvus brachyrhynchos*) and the federally-listed threatened coastal California gnatcatcher. All species were observed within the offsite pipeline study area with the exception of a brown pelican (*Pelecanus occidentalis californicus*), state- and federally-listed as endangered, which was observed west of the Encina Power Station over open water. Although not observed during surveys, there is moderate potential for the California least tern (*Sterna antillarum browni*) to occur in association with the Pacific Ocean and Agua Hedionda Lagoon. However, there is not breeding habitat present for the least tern within the study area.

Reptiles and Amphibians

Two reptile species were observed onsite: side-blotched lizard (*Uta stansburiana*) and western fence lizard (*Sceloporus occidentalis*). However, reptiles common in the area and likely to occur in the study area include gopher snake (*Pituophis melanoleucus*), red-diamond rattlesnake (*Crotalus ruber*), coachwhip (*Masticophis flagellum*) and common kingsnake (*Lampropeltis getulus*), among others.

No amphibian species were observed during the survey; however, one or more of the following species may occur within the study area: garden slender salamander (*Batrachoseps attenuatus*), western toad (*Bufo boreas*) and Pacific treefrog (*Hyla regilla*).

Habitat quality for reptiles and amphibians is low and the diversity of these species is expected to be low because of the small amount of habitat available and the likely negative effects of the adjacent urban environment in all of the areas analyzed.

Mammals

Ten mammal species, or their signs, were observed within the study area during the survey including: brush rabbit (*Sylvilagus bachmani*), Botta's pocket gopher (*Thomomys bottae*), California ground squirrel (*Spermophilus beecheyi*), deer mouse (*Peromyscus maniculatus*), woodrat (*Neotoma* sp.), striped skunk (*Mephitis mephitis*), bobcat (*Lynx rufus*), coyote (*Canis latrans*), common raccoon (*Procyon lotor*) and domestic dog (*Canis familiaris*). Mammals not observed onsite but likely to be present include California pocket mouse (*Chaetodipus californicus*),California mouse (*Peromyscus californicus*), Dulzura California pocket mouse (*Chaetodipus californicus femoralis*), cactus mouse (*Peromyscus eremicus*) and Virginia opossum (*Didelphis virginiana*).

Invertebrates

Ten (10) species of butterfly and one (1) skipper were recorded during surveys including: morning cloak (*Nymphalis antiopa*), cabbage butterfly (*Pieris rapae*), common white (*Pontia protodice*), west coast lady (*Vanessa annabella*), buckeye (*Junonia coenia*), Behr's metalmark (*Apodemia mormo virgulti*), marine blue (*Leptotes marina*), acmon blue (*Plebejus acmon*), California ringlet (*Coenonympha tullia*), tiger swallowtail (*Papilio rutulus*) and fiery skipper *(Hylephila phyleus)*. The moderate plant species richness within most of the project corridor is undoubtedly accompanied by a fairly diverse number of phytophagous (plant-feeding) insect species. In particular, a variety of species of Lepidoptera (butterflies and moths) and a comparable number of Coleoptera (beetles), Hymenoptera (bees, ants and wasps), and Diptera (flies) are expected to be present within the local area.

Sensitive Biological Resources

The following resources are discussed in this section: **(1)** plant and animal species present in the project vicinity that are given special recognition by federal, state, or local conservation agencies and organizations owing to declining, limited, or threatened populations, that are the results, in most cases, of habitat reduction; and **(2)** habitat areas that are unique, are of relatively limited distribution, or are of particular value to wildlife.

Sensitive Plants

The suitability of the project area, based on geographic location, soils and habitats present, to support sensitive plant species was evaluated during the surveys. No plant species listed as rare, threatened, or endangered by the USFWS or the CDFG were detected in the study area. Two plant species designated as sensitive by the California Native Plant Society (CNPS) were detected in the project area in the City of Carlsbad: Nuttall's scrub oak, a CNPS List 1B species; and San Diego County viguiera (*Viguiera laciniata*), a CNPS List 4 species.

Sensitive Wildlife Species

Focused surveys resulted in observation of one federally-listed threatened wildlife species: coastal California gnatcatcher. Three pairs and one individual were detected within the study area near the McClellan Palomar Airport and the Maerkle Reservoir in the City of Carlsbad. The California gnatcatcher is a Carlsbad Habitat Management Plan (HMP) covered species. Two non-listed wildlife species considered California State Species of Special Concern, the northern harrier and Cooper's hawk, also were observed near the Maerkle Reservoir.

Sensitive Habitats

Sensitive habitats are those that are considered rare within the region, support sensitive plant or wildlife species, or function as corridors for wildlife movement. Habitat types found within the study area that are considered sensitive include coastal sage scrub (including disturbed forms), scrub oak chaparral, herbaceous wetland (including disturbed forms), disturbed mule fat scrub, open channel, southern willow scrub (including disturbed forms), and vernal pools.

Wildlife Corridors and Habitat Linkages

Wildlife corridors are linear features that connect large patches of natural open space and provide avenues for the immigration and emigration of animals. Habitat linkages are patches of native habitat that function to join larger patches of habitat. They serve as connections between habitat patches and help reduce the adverse effects of habitat fragmentation. Although individual animals may not move through a habitat linkage, the linkage does represent a potential route for gene flow and long-term dispersal. Habitat linkages may serve as both live-in habitat and avenues of gene flow for small animals such as reptiles and amphibians. No wildlife corridors or habitat linkages have been identified within the project study area in the Oceanside Subarea Plan. One segment of pipeline crosses a habitat linkage in Carlsbad as identified in the HMP (further described below).

Regional Resource Planning Context

The study area analyzed in this report is situated within the Cities of Carlsbad and Oceanside, California. It is within the boundary of the Carlsbad HMP, the City of Oceanside Habitat Conservation Plan/Natural Communities Conservation Plan (hereafter, Oceanside Subarea Plan) and partially within the City of Carlsbad Local Coastal Program (LCP). Both the HMP and the Oceanside Subarea Plan provide local implementation for the Multiple Habitat Conservation Program (MHCP), which is a comprehensive, long-term habitat conservation program and provides permit issuance authority for take of covered species to the local agencies. Conservation provided for in the MHCP in general and the HMP and Subarea Plan specifically, addresses cumulative and growth inducing impacts on covered species and their habitats. The MHCP is incorporated by reference in the HMP. As the project does not impact habitat in the City of Vista, the EIR contains no discussion regarding habitat planning and issues in this City.

Based on existing distribution of vegetation communities and sensitive species, the HMP identifies Focus Planning Areas (FPAs). These FPAs are broken down into habitat cores, connecting linkages and wildlife corridors, and, Special Resource Areas. These areas focus habitat preserve assembly and establish a basis for biological planning . Based on proposed development and the biological resources identified by the FPAs, the HMP strategy is to establish a preserve system that consists of existing hard-line preserve areas (which are areas of already dedicated open space), proposed hardline preserve areas, and standards areas (planned open space) . Hardline areas generally require 100% conservation and standards areas generally require specific conservation standards to be implemented during development review.

Some of the pipeline segments fall within the general boundaries of the FPAs. Part of the pipeline proposed in College Boulevard north of Cannon Road crosses Core 3. Impacts to existing and proposed hard line conservation areas are avoided through the planned location of pipelines and construction areas within existing road rights of way. This segment, as well as the proposed pipeline that would be located in the future College Boulevard south of Cannon Road, also cross proposed standards areas, or areas where open space is planned but not yet determined. However, the project is not expected to have any impacts to such future open space areas because the pipelines would be located within road rights of way.

In addition, the portion of pipeline segment along Cannon Road, east of Legoland Drive to El Camino Real, and a portion of the segment along Faraday Avenue, west of College Boulevard, is in Core 4. In these areas, impacts to existing or proposed hard line conservation areas are avoided through trenchless construction methods and the planned location of pipelines and construction areas within existing road rights of way.

Linkage Area F, a wildlife and habitat "stepping stone" linkage between Core 4 and other cores in the southern part of the City, extends west and north of McClelland Palomar Airport and east of College Boulevard. The portion of pipeline planned from College Boulevard east to the airport would cross this linkage and proposed hardline conservation areas within it. However, through trenchless construction and location of the pipeline in future planned roadways and developed areas, impacts to conservation areas are avoided.

The portion of the pipeline segment at McClellan Palomar Airport located east of El Camino Real and the entire segment located on the Maerkle Reservoir Property are located within Core 5 of the Carlsbad HMP. However, these segment portions are in areas that do not fall within any existing or proposed Hard Line Conservation Areas. Construction of the pipeline segment in future Faraday Avenue, east of El Camino Real, would also occur within Core 5. While this future street crosses a proposed hardline conservation area, pipeline impacts to the hardline area would be avoided as the pipeline would be located within the road right of way.

The project would not impact any Special Resource Areas identified in the HMP.

The project study area contains several habitat types considered sensitive by the HMP: coastal sage scrub, scrub oak chaparral, herbaceous wetland, disturbed mule fat scrub, southern willow scrub and open channel. Sensitive species detected within the study area which are covered under the HMP include California gnatcatcher and Cooper's hawk. The California brown pelican (*Pelecanus occidentalis*), another HMP-covered species, also was detected in association with the Pacific Ocean and Agua Hedionda Lagoon. The HMP allows for impacts on covered habitats and species but also requires mitigation.

The Oceanside Subarea Plan guides biological resource planning, protection and development within the City in accordance with the MHCP. An approximately 2,800 foot segment of pipeline is situated within the boundaries of this Plan. This segment is located outside of all Preserve Planning Zones identified by the Subarea Plan. However, this area supports habitats identified as sensitive by the Plan: coastal sage scrub, herbaceous wetland, southern willow scrub and open channel. The Plan allows for impacts on covered habitats but also requires mitigation.

Marine Environment

The offshore area adjacent to the plant site is located within the larger biogeographic zone known as the Southern California Bight (SCB), which encompasses approximately 22,000 square miles, with boundaries that span from Point Conception, California in the north to Cabo Colnett, Baja California in the south. The SCB also extends 125 miles to the west and encompasses the Channel Islands. The primary water current within the SCB is the Southern California Countercurrent that flows generally counter-clockwise with a northerly flow at most coastal locations. Ocean current flow is induced by eddies from the Southerly flowing California Current, topography, and by the north-flowing undercurrent called the Davidson Current. Water movement along the immediate shoreline is called the Long Shore Current and is a local effect driven by winds, tides, and the predominate swell direction. In San Diego County the long shore current generally flows southerly. This current is responsible for the longshore transport of sediment. The SCB has a high upwelling index, (upward flowing current) between April and August, but geostrophic or wind-driven flows may occur year round. Seasonal surface water temperatures are coolest in December – March and warmest in July –

September, with an annual range of 12-19 degrees Celsius (°C). Salinity variations recorded in the 20.5 years of data collected for the Hydrodynamic Modeling Study (Jenkins and Wasyl, 2001, 2005) included in APPENDIX E, range from a low of 31.26 part per thousand (ppt) to a high of 34.44 ppt, with an~~d~~ average salinity of 33.5 ppt. The distribution of species within the SCB is related to the complex hydrography and geology of the region. The SCB marine biota is defined as a transitional zone (ecotone) between organisms living in cooler-water habitat to the north and warmer-water habitat to the south. As such, temperature fluctuations, particularly those associated with El Niño conditions, have a major influence on the distribution of marine organisms within the SCB (Graham, 2005).

Seasonal changes in water temperature, as well as the warming associated with an El Niño will affect relative organism abundances and species composition throughout the SCB. El Niño warming can eliminate the cool-water elements of the biota within the SCB and permit warm-water adapted organisms to expand their geographic distributions north into the coastal waters of Central California. In addition to seasonal and El Niño induced changes, the relative abundances of species of kelp, invertebrates, and fishes, living within the SCB and along the coastline in the area in the vicinity of the EPS, are also determined by a number of factors affecting recruitment success (Graham, 2000, 2002, 2005). Recruitment is defined as the arrival of young-of-the-year organisms to an area in which they can live to adulthood. While it is essential for sustaining ecosystem diversity, recruitment is affected by factors such as temperature, sedimentation, primary production, drift mortality, substrate availability, and pollution. Regarding drift mortality, the young of most invertebrates and fishes have a drifting or planktonic phase during early development and they must metamorphose from this into a juvenile stage that is able to find an appropriate place to take up its life. Kelp reproduction also involves a drifting (zoospore) stage. Most of the fishes inhabiting the SCB and the area around the project site spent their early development as larvae that drifted in the currents. Exceptions include live bearing sharks and rays and a few bony fish families, surfperch and rockfish.

Monitoring studies prepared for the power plant are performed regularly to meet power plant permit requirements. Recent studies performed by MEC Analytical Systems have included dive-transect censusing of kelp, macroinvertebrates and fishes at fixed locations within the area of potential effect of the desalination plant discharge. The inventories compiled as a result of these studies do not indicate the presence of listed species or areas of Special Biological Significance, such as eelgrass, surfgrass, or kelp beds within the "Zone of Initial Dilution" (ZID), which is the area within a 1,000-foot radius of the discharge point (MEC 2004).

As further discussed in the impacts section below, and in *Section 4.7 Hydrology and Water Quality*, elevation of salinity resulting from the project that would be beyond ambient fluctuations, will be restricted to receiving waters in inshore areas adjacent to the discharge channel. No elevation in salinity resulting from the project beyond ambient levels would be experienced in Agua Hedionda

Lagoon under all but the rarest circumstances, in which case the salinity change at the inlet of the lagoon would be limited to less than~~t~~ a 1% increase. Consequently, this analysis of the marine environment will generally be limited to inshore and nearshore waters and habitats within and immediately outside of the ZID and will not include an analysis of the biological assemblages in Agua Hedionda Lagoon.

The coastline has 50-70 m (162.5-227.5 ft) wide beaches backed by 12-24 m (39-78 ft) remnant marine terrace bluffs. Within 100 m (325 ft) of the usually sandy shore, and over depths ranging from 1-2 m (3.3-6.6 ft), the Power Plant's warm (cooling water) discharge is well mixed by wave action and longshore transport. Immediately offshore, the ocean bottom is sandy with scattered low-lying rocky outcroppings, some of which extend out to deeper water. Seasonal storms, waves, and different rates of longshore sediment transfer affect the thickness of sand in the shallow littoral and sublittoral areas. This ranges from exposed cobble consisting of 2-12 cm (1-5 inch) diameter stones in winter to a 0.3-1.0 m (0.9-3.3 ft) thick sand layer in the summer (EA Engineering, Science, and Technology, 1997).

Intertidal Soft-Bottom Habitats

The beach habitat in the project vicinity consists mainly of wave-swept sandy shores. Sand cover on the beaches and in shallow depths varies naturally on a seasonal basis. In the winter, sand on the beach and the included animals are exported offshore and the underlying cobble is exposed. The grinding of the cobble and remaining sand associated with winter storm activity is inimical to its infauna. During spring and summer, sand moves from offshore bars onto the beach. The sand beach assemblage consequently is patchily distributed both in time and space. Abundance and biomass can vary from sparse to abundant in summer (especially sand crabs and bean clams) to virtually nonexistent during the winter when cobble and gravel are the predominant sediment type.

Species common to the sandy beach include: Air-breathing pill bugs (*A1loniscus perconvexus*), an isopod (*Tylos punctatus*), the amphipod beach hopper (*Orchestoidea californiana*), the mole crab (*Emerita analoga*), the opossum (mysid) shrimp (*Archaeomysis maculata*), the polychaete worm (*Euzonus mucronata*), the bean clam (*Donax gouldi*), and the pismo clam (*Tivela stultorum*). EA Engineering, Science, and Technology (1997) indicated a lower number of species and biomass in an area about 150 m (488 ft) down coast from the discharge where water temperature varies considerably and can be as much as 5˚C warmer than ambient.

Fishes in the sandy beach habitat include California grunion [*Leuresthes tenuis*, which spawns seasonally (March-July) in the sand beneath the highest series of waves at the crest of nocturnal spring tides], the northern anchovy (*Engraulis mordax*), topsmelt (*Atherinops affinis*), barred surfperch (*Amphisticus argenteus*), walleye surfperch (*Hyperprosopon argenteum*), queenfish (*Seriphus politus*), and California corbina (*Menticirrhus undulatus*).

About 1,000 m (3,250 ft) down coast of the discharge channel, just beyond the open sandy beach (and in the vicinity of where Cannon Road intersects Carlsbad Boulevard) is the rocky intertidal habitat, known locally as Terra Mar. This area is subject to continued physical disturbance, periodic air exposure, and a wide range of temperatures. Organisms living in this habitat are tolerant of a range of physical conditions. Comparative surveys of the rocky intertidal species at Terra Mar and other locations indicate that the overall species composition has remained the same over the years, even with the addition of the Encina Power Station (EPS) Units 4 (1973) and 5 (1978). As reported by EA Engineering, Science, and Technology (1997), about 10-15 species account for 95% of the organisms inventoried and the bulk of the biomass present each year. This report also stated that organism distribution and abundance are largely independent of the power plant's thermal discharge.

Subtidal Sand Habitats

Sand areas beyond the surf zone are subjected to seasonal stripping and sand replenishment, however, the frequency and intensity of this action declines with depth. Nevertheless, and similar to shallower sand habitats, the unstable nature of this habitat leads to a spatially and temporarily heterogeneous assemblage of organisms.

Species listed by EA Engineering, Science, and Technology (1997) as associated with the subtidal sand habitat within the project vicinity include: a polychaete (*Prionospio pygmaeus*), a proboscis worm (*Carinoma mutabilis*), a sea spider (pycnogonid) (*Callipallene californiensis*), two crustaceans (*Megaluropus* sp. and *Leptocuma forsmani*), and the sand dollar (*Dendraster excentricus*). Polychaetes are the most abundant followed by arthropods. Fishes found in this habitat include: the speckled sanddab (*Citharichthys stigmaeus*), northern anchovy (*Engraulis mordax*), queenfish (*Seriphus politus*), sand bass (*Paralabrax nebulifer*), white croaker (*Genyonemus lineatus*), horneyhead turbot (*Pleuronichthys verticalis*), and California halibut (*Paralichthys californicus*). Pelagic fishes occurring slightly further offshore include: northern anchovy (*Engraulis mordax*), deepbody anchovy (*Anchoa compressa*), queenfish (*Seriphus politus*), topsmelt (*Atherinops affinis*), and walleye surfperch (*Hyperprosopon argenteum*). The calanoid copepod (*Arcartia tonsa*) is also abundant in this area.

EA Engineering, Science, and Technology (1997) reports a total of 234 taxa occurring in this habitat and indicates most were uncommon, not present throughout the year, and when present were patchily distributed. There were also no spatial patterns or distribution trends indicating any effect of Power Plant's warm discharge on the benthic community.

Subtital Hard Bottom Habitat

The rocky outcroppings at Terra Mar extend offshore to form the hard-bottom substrate for a large kelp stand. There are three kelp beds in the project vicinity. These are named the Southern Kelp

Stand (SKS), North Kelp Stand (NKS) and Control Kelp Stand (CKS) (EA Engineering, Science, and Technology, 1997). SKS, located approximately 2,000 feet southwest of the discharge channel, is the only kelp bed in the vicinity of the EPS that is regularly, but only partially contacted by its heated seawater discharge. Regions of the rocky outcropping supporting the SKS are also subject to seasonal burying and exposure by sand, which can affect kelp abundance and the numbers and diversity of animals living in the kelp understory and on the rocky reefs.

NKS occurs approximately 1000 m (3,250 ft) north of the EPS discharge channel and is rarely contacted by the discharge. Even with a very low incidence of contact with the heated seawater return, recent observations of the NKS by Le Page and Ware (2001) indicate that this kelp bed undergoes periodic changes in area, including variations in the size of the surface canopy in early 1997, and absence of kelp at this site in March and September 2000. The control kelp stand (CKS) is located 4 km south of the discharge channel and entirely beyond the range of the outfall's thermal plume. MEC (2004), which conducts semi-annual surveys at NKS, SKS, and CKS, has also documented the recurrent history of kelp bed expansion and contraction in relation to ocean conditions, pointing out that these occur independently of power plant activities.

The most common kelp species within the project vicinity is the giant kelp *Macrocystis pyrifera*. This plant can reach a length of 150 ft and grows to the water surface and then along it, held there by gas-filled bladders at the base of each blade. Dense clusters of giant and other kelp species, with thick fronds extending upward from the rocks give rise to the "kelp forest" appearance. On the surface, fronds (stipes and blades) of many plants become entangled into a surface canopy or mat that shades the underlying seafloor. Other macroalgae grow up under the canopy to occupy mid-depths of the kelp forest. EA Engineering, Science, and Technology (1997) list the following kelp species within the project vicinity: *Eisenia arborea* (southern sea palm), *Egregia laevigata* (feather boa kelp), *Laminaria farlowii* (oar weed), *Cystoseira osmundacea* (bladder chain), all of which are brown algae. Also, present are "turf algae" growing within a short distance of the seafloor. Among genera found at the kelp beds within the project vicinity are *Dictyota flabellata*, a brown alga and *Rhodymenia californica*, a red alga. All of these plants are included in the MEC (2004) algal list of 16 varieties occurring at their study sites. Since the mid 1950s, kelp beds along the southern California coastline have been monitored for their area extent and relative health.

The kelp beds fluctuate in size mainly in response to episodic oceanographic conditions of El Niño and La Niña. El Niño, which brings warm, nutrient-poor water up from the south, adversely affects kelp beds. Additional El Niño effects on kelp come from larger than normal freshwater runoff associated with increased rains and a greater number of storms (EA Engineering 1997; MBC 2002). Other factors influencing kelp abundance include turbidity, large waves, and changes in the available substrate. Turbidity effects are largely attributable to anthropogenic factors (dredging, runoff from coastal construction sites, and damaged watershed). Changes in substrate, such as the seasonal burial of rocky areas by sand, also affect kelp abundance. However, a greater effect is exerted by weather-related factors such as wave strength and direction and coastal currents and the deleterious effect of the warmer, nutrient-poor water on kelp condition and vigor, which reduces the ability of kelp plants to remain attached to rocky substrate during storm events.

Kelp reproduces by alternation of generations. In the case of *Macrocystis*, mature kelp plants, called sporophytes, release zoospores (flagellated spores that swim), which attach to the bottom and germinate. Germination involves formation of a tube through which the spore contents move into a new cell. These attached microscopic growths are termed male and female gametophytes. Sperm released by the male gametophyte finds its way to and fertilizes the egg produced by a female gametophyte. The sporophyte grows from this site, often over the female gametophyte. Full development of the sporophyte can require 1-2 years. All of these reproductive steps are temperature dependent and also affected by environmental factors that include sunlight, sedimentation, ocean conditions, and the presence of animals that will eat the young plant stages.

Kelp beds are ecologically important because they provide refuge for many species. Biological surveys of the coast within the project vicinity (EA Engineering, Science, and Technology, 1997; Le Page and Ware, 2001) list the following animals associated with the kelp forest and its rocky substrate: Invertebrates; the dominant species is the polychaete (*Dioptra ornata*), also present are sea fans (*Muricea californica*, and *M. fructicosa*), a sea anemone (*Anthopleura elegantissima*), the tunicate (*Styela montereyensis*), the dog or Kellets whelky (*Kelletia kelletii*) and the sea urchins (*Stronglyocentrotrus franciscanus* and *S. purpuratus*). Also abundant are encrusting species (bryozoans, other tunicates, sponges and hydrozoans). The MEC (2004) kelp surveys include all of these taxa and list the regular occurrence of 32 macroinvertebrate species.

EA Engineering, Science, and Technology (1997) reports no changes in the major constituents of the kelp bed fauna over the extended period of monitoring the EPS heated seawater outflow, including the 20 years since Unit 5 went on line.

Fishes associated with kelp include: kelp bass (*Paralabrax clathratus*), sand bass (*P. nebulifer*), black surfperch (*Embiotica jacksoni*), kelp surfperch (*Brachyistius frenatus*), white surfperch (*Phaenerodon furcatus*), black surfperch (*Embiotica jacksoni*), California sheephead (*Semicossyphus pulcher*), rock wrasse (*Halichoeres semicinctus*), senorita (*Oxyjulis californica*), topsmelt (*Atherinops affinis*), and many others (Tumer et al., 1964; Quast, 1968; Allen and DeMartini, 1983; Larson and DeMartini, 1984; DeMartini and Roberts, 1990; Graham, 2000). MEC (2004) includes 7 of these same species among its listing of the 11 species most common in the kelp beds. Among these, the kelp bass occurs in most survey areas while the senorita is most abundant.

Nearshore Water Column

Pelagic fish (fish inhabiting the water column) that also occur farther offshore include: northern anchovy (*Engraulis mordax*), deepbody anchovy (*Anchoa compressa*), queenfish (*Seriphus politus*), topsmelt (*Atherinops affinis*), and walleye surfperch (*Hyperprosopon argenteum*). The northern anchovy has been reported from all of the subtidal habitats.

The pelagic fishes commonly reported in the nearshore water-column habitat also include some species important to the commercial and sportfishing industries. Species of fish that occur in kelp beds or adjacent waters and that are targeted by sportfishers include: chub mackerel (*Scomber japonicus*), jack mackerel (*Trachurus symmetricus*), sand bass (*Paralabrax nebulifer*), kelp bass (*Paralabrax clathratus*), yellowtail (*Seriola dorsalis*), barracuda (*Sphyraena argentea*), ocean whitefish (*Caulolatilus princeps*), and halibut (*Paralichthys californicus)* (EA Engineering 1997).

Both phyto- and zooplankton frequent the open coast area offshore of the Power Plant. Phytoplankton are very small and usually single celled plants that live suspended in the water column and are thus affected by ocean currents and turbulence. Phytoplankton are the open ocean's principal primary producers, meaning that, by means of photosynthesis, they covert solar energy into energy containing organic molecules that sustain life and form the basis for pelagic food chains. Phytoplankton and kelp are the main energy production sources in coastal waters. The most common forms of phytoplankton in local waters include diatoms, dinoflagellates, and the reproductive stages of the kelp.

Zooplankton are small animals that also drift with ocean currents. They range in size from single celled animals (most common are protozoans), to fairly large shrimp. Phytoplankton are the main food supply of zooplankton. There are two zooplankton categories, holo- and meroplankton. Holoplankton are the zooplankton that spend their entire lives in the plankton. Copepods are holoplankton, and one species, *Acartia tonsa*, is the most abundant zooplankton species in waters within the project vicinity. Meroplankton are animals that spend part of their early life as plankton but then settle out into the juvenile or sub-adult body form. Principal among the meroplankton are the larvae of crustaceans (crabs, barnacles), mollusks (whelks, clams), and echinoderms (urchins, sand dollars), and fishes. The relative abundance of these groups varies seasonally. As a group, zooplankton are the main food supply for benthic filter and particulate feeding invertebrates (e.g., barnacles, clams, polychaetes, anemones) and planktivorous fishes (northern and deep body anchovy).

Potentially Sensitive Species

No endangered or at-risk species occur in waters in the project vicinity and the coastline has not been designated as an area of Special Biological Significance. The United States Environmental Protection Agency (EPA) developed the concept of Representative Important Species (RIS) for the purpose of focusing impact assessments on selected species that could be assumed to reflect the status of species within a "balanced indigenous community." As part of analyses for the EPS, EA Engineering, Science, and Technology (1997) identified one kelp species, six macroinvertebrate species, and seven fish species living on the coastline in the vicinity of the power plant as qualifying for RIS status and evaluated them in relation to the plant's thermal discharge. The RIS designated for the EPS are:

Giant kelp	*Macrocystis pyrifera*
Mysid shrimps	*Archaeomysis maculata, Metamysidopsis elongata*
Polychaete worms	*Euzonus mucronata, Scolelepis acuta, Prionospio pygmaeus*
Mole crabs	*Emerita analoga*
California halibut	*Paralichthys californicus*
Cheekspot goby	*Ilypnus gilberti*
Walleye surfperch	*Hyperprosopon argenteum*
Queenfish	*Seriphus politus*
Kelp bass	*Paralabrax clathratus*
California grunion	*Leuresthes tenuis*
Northern anchovy	*Engraulis mordax*

With respect to benthic invertebrates, the EA Engineering, Science, and Technology report categorically states:

"The mix of species and trophic structure of the nearshore benthic invertebrate community is similar to that observed at other locations along the southern coast of California. No biologically significant changes have occurred in the nearshore benthic community over time since Unit 5 began commercial operation and no significant spatial differences associated with the thermal plume have been observed except in a very small area in the immediate vicinity of the end of the discharge channel. Any such localized effects would have no impact on the overall benthic community and the utilization of components of that community by higher trophic levels along the southern coast of California."

4.3.3 Significance Criteria

Significance thresholds for biological resources are based on the applicable measures of significance identified in Appendix G of the CEQA Guidelines. However, these thresholds are generally more applicable to terrestrial biological resources. As further explained below, additional criteria have been considered for marine biological resources.

Terrestrial Biological Resources

The project may have a significant effect on the environment if it would:

- 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 California Department of Fish and Game or U.S. Fish and Wildlife Service;
- Have a substantial adverse effect on any riparian, aquatic or wetland habitat or other sensitive natural community identified in local or regional plans, policies, or regulations or by California Department of Fish and Game or U.S. Fish and Wildlife Service;
- 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, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means;
- Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites;
- Have a conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance; or
- Have a conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan

Marine Biological Resources

With respect to marine biological resources, guidance in developing appropriate significance thresholds has been taken from the California Coastal Commission (CCC). In a recent report, (Anon. 2004) the CCC identified potential impacts on the marine environment resulting from seawater desalination. These include :

- Potential detrimental effects from chemicals added to the seawater during the desalination process.
- Potential for impingement and entrainment in the intake system to degrade the quality of

assemblages in the local or regional marine environment.
- Increased salinity of the effluent.

These generalized concerns encompass the range of potential effects of the desalination plant on marine organisms, and therefore are the primary focus for determination of significant effects of the project.

Chemical Discharge

Significant impacts related to chemical discharge would occur if the project would discharge any chemical wastes that would have a substantial adverse effect on marine biota.

Impingement and Entrainment

Effects related to impingement and entrainment would be considered significant if the desalination plant operations result in impingement effects (trapping of larger organisms on intake screens) or entrainment effects (loss of small planktonic organisms passing through cooling water system) that constitute substantial ecological losses to source populations.

Elevated Salinity

Specific regulatory guidance related to dissolved solids (salinity) and their effect on aquatic life is limited. The California Ocean Plan (SWRCB 2001) does not specify requirements or water quality objectives concerning RO concentrate discharge. On the other hand, the Ocean Plan does set forth limits on levels of water quality characteristics for ocean waters to ensure reasonable protection of beneficial uses and prevention of nuisance. The discharge from the proposed project shall not cause a violation of these objectives. Specifically relevant to the proposed project are the following Ocean Plan objectives that are applicable to the areas outside the ZID:

- Marine communities, including vertebrate, invertebrate, and plant species shall not be degraded.
- Waste management systems that discharge to the ocean must be designed and operated in a manner that will maintain the indigenous marine life and a healthy and diverse marine community.
- Waste discharged to the ocean must be essentially free of substances which will accumulate to toxic levels in marine waters, sediments or biota.

EPA (1986) policy on discharge effects related to salinity acknowledges that fishes and other aquatic organisms are naturally tolerant of a range of dissolved solids concentrations (in this case salinity) and must be able to do this in order to survive under natural conditions. Also, marine species do exhibit variation in their ability to tolerate salinity changes. EPA (1986) recommendations state that, in order to protect wildlife habitats, salinity variation from natural levels should not exceed 4 parts per thousand (ppt) from natural variation in areas permanently occupied by food and habitat forming plants when natural salinity is between 13.5 and 35 ppt. The food and habitat forming plants located in the vicinity of the proposed project are found in the subtidal hard bottom habitat located to the north and to the south of the discharge channel. As applied to the proposed project, operational conditions that do not elevate salinities above 38.4 ppt (34.4 ppt upper limit of the natural variation in salinity plus EPA recommended variation of 4 ppt) in the subtidal hard bottom habitat would appear to be fully protective of the food and habitat forming plants living in the discharge field.

To specifically address effects on local marine organisms, the project applicant conducted studies to determine the threshold salinity levels at which adverse effects to local marine species would occur. The purpose of the studies was also to determine whether the historic EPS flow would provide an acceptable dilution rate in consideration of the proposed operational characteristics of the desalination plant. The Salinity Tolerance Investigations study (Le Page, 2005) examined the effects of the predicted salinity levels for the desalination operating parameters. This study examined the effects of long-term exposure on organism behavior and vitality to predicted salinity levels ranging from 36 ppt to 40 ppt.

The results of those studies are discussed in further detail in *Section 4.3.4*. Important to the determination of appropriate threshold, the conclusions of the studies are that no substantial effects were identified on local marine organisms with salinity levels ranging from 36 ppt to 40 ppt.

Therefore, based on existing available guidelines, as well as site-specific studies to determine significance threshold levels, the following numerical thresholds for significance of impacts on marine organisms resulting from elevated salinity were established:

- Significant impacts related to elevated salinity would occur if the project would discharge salinity levels that would have a substantial adverse effect on marine biota.
- Extended exposure to salinity levels above 40 ppt would be significant.
- Permanent elevation of salinity levels to 38.4 ppt or greater on the hard bottom habitat would be significant.

It should be noted that these thresholds do not represent the absolute tolerance level of local species that could be affected, and that the actual maximum exposure thresholds may be higher. The selected maximum salinity level of 40 ppt is conservatively estimated threshold for extended exposure established for the site-specific conditions of the proposed project and is consistent with the Ocean Plan criteria summarized above.

4.3.4 Impacts

Terrestrial Environment

Direct impacts were quantified by overlaying the limits of project grading, trenching and construction staging on the biological resources map of the study area. For the purposes of this assessment, all biological resources within the limits of the proposed trenching, and drilling and receiving pits are considered temporary impacts, because no permanent improvements, such as access roads are proposed. For lengths of the pipeline not utilizing trenchless construction (the majority of the pipeline), open trench construction techniques would be utilized. A 40-foot impact corridor has been used to assess direct impacts for trench construction.

Portions of the pipeline alignments will utilize three different methods of trenchless construction: Horizontal Directional Drilling (HDD), micro-tunneling, and auger boring. Trenchless construction will occur in areas of sensitive environmental resources, railroad tracks, or at busy roads and freeway crossings. HDD involves the drilling of a pilot hole at a prescribed angle from one end of the area to be crossed to the other utilizing a pilot drill string. Once the pilot hole is complete, the hole must be enlarged to a suitable diameter for the pipeline. This is accomplished by "pre-reaming" the hole to an appropriate diameter. A reamer is attached to the drill string and is pulled through the pilot hole by a drilling rig. Large quantities of slurry are pumped into the hole to maintain the integrity of the hole and to flush out cuttings. Once the drilled hole is enlarged, a reamer is once again attached to the drill string, and the prefabricated pipeline is connected behind the reamer via a swivel. The drilling rig then pulls the reamer and pipeline through the tunnel until surfacing at the opposite end, once again circulating high volumes of drilling slurry.

Microtunneling is a process that uses a remotely controlled microtunnel boring machine combined with the pipe jacking technique to directly install product pipelines underground in a single pass. The microtunneling technique removes spoils in a hydraulic slurry. Although these two drilling technique are minimally invasive to biological resources because they eliminate the need for trenching, potential impacts on biological resources could occur as a result of hydro-fracturing. Hydro-fracturing occurs when the drilling slurry leaves the drill bore and ruptures to the surface, usually at locations where the depth of cover over the pilot drill approaches the surface, near the end of the bore. If hydro-fracturing occurs in areas of sensitive biological resources, significant impacts could result. To avoid potential adverse effects of hydro-fracturing on sensitive biological resources, design considerations for the drilling operation are required (See *Section 4.3.5*).

Auger boring is a trenchless technique that forms a bore hole between shafts by means of a rotating cutting head. Spoil is transported back to the drive shaft by helical-wound auger flights rotating inside a steel pipe casing that is being jacked in place simultaneously. The cutting head completely removes the spoil and does not compress the surrounding soil. Therefore, soil heave is not an issue of concern and roadways are not damaged during the drive. In addition, unlike HDD, the spoils are not mixed with water to facilitate removal, and therefore, there in no risk of hydro-fracturing with this technique. However, this method has limited capabilities of achieving accurate lines and grades and is not suitable in places with high ground water and cannot be installed in soils with large boulders.

Indirect Impacts are very difficult to identify and quantify but are presumed to occur. They primarily result from adverse "edge effects:" either short-term indirect impacts related to construction or long-term, chronic indirect impacts associated with the location of urban development in proximity to biological resources within natural open space. During construction of the project, short-term indirect impacts may include dust and noise and construction related soil erosion and runoff , which could disrupt habitat and species vitality temporarily. However, all project grading will be subject to the typical restrictions and requirements that address erosion and runoff, including the federal Clean Water Act, National Pollution Discharge Elimination System (NPDES), and preparation of a Stormwater Pollution Prevention Plan. Long-term indirect impacts may include intrusions by humans and domestic pets, noise, lighting, invasion by exotic plant and wildlife species, effects of toxic chemicals (*e.g.*, fertilizers, pesticides, herbicides, and other hazardous materials), urban runoff from developed areas, soil erosion, litter, fire, and hydrological changes (*e.g.*, groundwater level and quality).

Cumulative Impacts refer to incremental individual environmental effects of two or more projects when considered together. These impacts taken individually may be minor, but collectively significant as they occur over a period of time.

Direct Impacts

Vegetation Communities

Implementation of the proposed project would result in the direct loss of the vegetation community acreages intersecting the proposed 40-foot construction corridor associated with open trench construction techniques (*Figures 4.3-1* through *4.3-11*). All impacts are considered temporary. Losses would occur as the result of trench construction and trenchless construction techniques. Acreages representing temporary impacts are presented in *Table 4.3-2*. Impacts were calculated by overlaying the 40-foot impact corridor over the vegetation map and all work will be contained within this impact corridor.

Figure 4.3-1

Figure 4.3-2

Figure 4.3-3

Figure 4.3-4

Figure 4.3-5

Figure 4.3-6

Figure 4.3-7

Figure 4.3-8

Figure 4.3-9

Figure 4.3-10

Figure 4.3-11

TABLE 4.3-2
Temporary Impacts On Plant Communities And Land Cover Types *

Habitat Type	Impacts (acres)
Native Habitats	
Coastal Sage Scrub	3.84
Disturbed Coastal Sage Scrub	0.66
Coyote Brush Scrub	0.03
Herbaceous Wetland	0.01
Disturbed Herbaceous Wetland	0.05
Open Channel	0.07
Southern Willow Scrub	0.44
TOTAL NATIVE IMPACTS	**5.1**
Non-native Habitats	
Annual (non-native) Grassland	4.39
Agriculture	2.12
Developed	7.95
Disturbed Habitat	4.71
Ornamental	3.03
Ruderal	0.82
TOTAL NON-NATIVE IMPACTS	**23.02**
TOTAL IMPACT	**28.12**

* Unvegetated ephemeral stream channel is an overlay on the vegetation layer and therefore is not included in the total calculations. Numbers may not total precisely due to rounding.

Direct impacts on sensitive vegetation communities, including chamise chaparral, coastal sage scrub (undisturbed and disturbed), coyote brush scrub, scrub oak chaparral, non-native grassland, herbaceous wetland (undisturbed and disturbed) open channel (jurisdictional waters of the U.S.), and southern willow scrub are considered to be significant.

In addition, impacts on the open channel in the vicinity of the Tri-Agency Pipeline (see *Figure 4.3-11)* are subject to review under Sections 401 and 404 of the federal Clean Water Act and/or Section 1602 of the California Fish and Game Code. Implementation of the project would temporarily impact ~~0.08~~ 0.57 acre of jurisdictional waters. These impacts are subject to review under Sections 401 and 404 of the federal Clean Water Act and/or Section 1602 of the California Fish and Game Code. Impacts on agricultural land, ruderal habitat, and developed land are regarded as less than significant, because of the lack of sensitivity of these land cover types.

Sensitive Plants

Implementation of the proposed project would result in direct impacts on a portion of a population of San Diego County viguiera (75 to 100 individuals) located within the City of Carlsbad as indicated on *Figure4.3-7*. San Diego County viguiera is designated as a CNPS List 4 species. No sensitive plants occur within the portion of the study area situated in Oceanside. Furthermore, no plant species listed as rare, threatened, or endangered by the USFWS or the CDFG were detected in the overall study area.

Impacts to San Diego County viguiera are not considered significant because the CNPS RED code (1-2-1) is so low that the project's impacts to this species do not represent a substantial reduction to the population of this species. Further, areas impacted do not include any of the major populations for this species. Additionally, the project impacts are not within any hard line preserve or standards areas of the HMP.

A population of Nutall's scrub oak (*Quercus dumosa nuttallii*) occurs adjacent to the limits of work northeast of the intersection of El Camino Real and Palomar Airport Road. As part of a critical population, the MHCP states impacts to the Nutall's scrub oak are to be maximally avoided to the degree practicable. Impacts to this species are avoided with the pipe alignment in this area, however, because of the close proximity of the habitat to the area of work, mitigation will include installation of a construction fence around the existing habitat and maintenance of the fence during construction.

Sensitive Animals

Implementation of the proposed project would result in the temporary loss of suitable habitat for three pairs and one individual coastal California gnatcatcher. This is considered a significant impact. No other sensitive animals would be substantially impacted by the project.

Habitat Linkages/Movement Corridors

Because of the temporary nature of project impacts, no direct impacts are anticipated to habitat linkages or wildlife movement corridors.

Indirect Impacts

Indirect impacts on vegetation communities primarily would result from adverse "edge effects." During construction of the project, edge effects may include dust from soil disruption which could affect plant vitality, or construction related soil erosion and run-off. Impacts associated with dust are potentially significant and require mitigation. Long-term indirect impacts on vegetation communities most likely would not increase as a result of this project because all impacts are considered temporary and resources will be revegetated to their pre-construction conditions.

Most of the indirect impacts on vegetation communities and sensitive plants cited above can also affect sensitive wildlife. In addition, short-term noise has the potential to affect wildlife activity including bird breeding behavior. Long-term maintenance-related noise is expected to be limited in volume and frequency and therefore not expected to result in indirect impacts on wildlife including coastal California gnatcatcher. In regard to the potential indirect impacts on California least tern (*Sterna antillarum browni*) prey species, a study by Atwood and Kelly (1984) indicates that northern anchovy, topsmelt, jacksmelt, and deepbody or slough anchovies were the primary food sources for least terns in California. Based on the tern's mobility, diversity of diet and lack of significant impacts on fish species (as further discussed below), California least terns and other birds that utilize this area for foraging are not expected to be impacted by implementation of the project. Further, the lighting from the desalination plant would be directed away from the lagoon and beach and is not expected to have a significant effect on terns or their prey species.

Because of the temporary nature of project impacts and absence of above ground project features that could preclude linkages or movements, no indirect impacts are anticipated on habitat linkages or wildlife movement corridors.

Regional Resource Planning Context and Cumulative Effects

The HMP and Oceanside Subarea Plan were developed primarily to address cumulative impacts on biological resources within the Multiple Habitat Conservation Program plan area. The project is not within hardline preserve areas or standards areas of the Oceanside Subarea Plan. While portions of the different pipeline alignments under study cross hardline preserve areas and standards areas in Carlsbad, the alignments will not disturb these existing and future habitat areas as all construction will be located within existing or future road rights of way or will be placed underground using trenchless construction methods. Project implementation will be consistent with regional and local conservation goals, particularly the successful completion of habitat linkage or wildlife movement corridors and protection of critical populations of sensitive species. The City of Carlsbad will need to issue a take permit for impacts to species and habitats covered by the HMP.

Marine Environment

Potential Effects of Chemical Additives

Potential effects from chemical additives during the desalination process will be negligible for the proposed operations at the Carlsbad desalination plant. Chemicals that will be added or impurities that will need to be dealt with include:

Source	Parameter	Fate
Source Seawater	Silt, sand, plankton residue & organics	Removed by sand filtration
	Ferric Sulfate and Polymer	Removed by sand filtration
	Sodium Hypochlorite (Chlorine)	Dechlorination with sodium bisulfite
	Sulfuric Acid	Neutralized by seawater
Sand Filter Backwash Water	Plankton residue & organics	Solids removed for futher processing and disposal
	Ferric Sulfate and Polymers	Clarified backwash water returned to effluent discharge channel Solids removed for further processing and disposal
Spent Membrane Cleaning Fluid	Citric Acid Sodium Hydroxide Sodium Tripolyphosphate Sodium Dodecylbenzene Sulfuric Acid	Neutralized prior to discharge into local sewer system for treatment and disposal

Examination of the fate of the various chemicals added to the source water and its included “impurities” indicates that none of these except the clarified backwash water are returned to the power plant’s discharge channel. Consequently, chemical additives are not an issue of concern, and would not result in any of the identified thresholds of significance being exceeded. Therefore, impacts would be less than significant.

Potential Effects Related to Impingement and Entrainment

Impingement impacts upon marine organisms occur as a result of organisms being trapped against screens, filters or other mechanisms associated with a seawater intake system and suffer damage or mortality as a result of pressure exerted from the flow of water. Entrainment effects occur when small planktonic organisms are drawn through the intake system, and suffer damage or mortality as a result of pressure changes, mechanical damage, temperature increases, or turbulence in the water flow.

To determine the potential effects resulting from seawater intake, a study was conducted to characterize the type and concentration of organisms within the source water for the cooling water intake structure and the incremental effects of the proposed desalination plant operations on these organisms. The following discussion is based on the findings of that study, entitled: *Carlsbad Desalination Facility Intake Effects Assessment*, prepared by Tenera Environmental, dated March, 2005 which is included as APPENDIX E to this EIR.

The study was designed to specifically address the following issues:

- What species and in what numbers of fish larvae and what numbers of *Cancer* spp. crabs, and spiny lobster are entrained through the EPS cooling water intake structure and what proportion of these organisms would be susceptible to further entrainment by the desalination plant feedwater withdrawal?
- How might any additional losses of organisms due to desalination plant feedwater entrainment affect the source populations of the entrained species in Aqua Hedionda Lagoon and the southern reaches of the Southern California Bight?
- Are these losses ecologically or economically significant?

The study concluded the following:

Impingement Effect

- The desalination plant operation does not require the power plant to increase the quantity of water withdrawn nor does it increase the velocity of the water withdrawn.
- The Carlsbad Desalination Plant will not have a separate direct lagoon or ocean intake and screening facilities, and will only use cooling water that is already screened by the EPS intake.
- Therefore, the Carlsbad Desalination Plant will not cause any additional impingement losses to the marine organisms impinged by the EPS.

Entrainment Losses

- Based on in-plant testing, the average observed entrainment mortality of the power plant was 97.6 percent (2.4 percent survival). Living fish larvae entrained by the Carlsbad desalination plant would represent an incremental loss of approximately 0.01 to 0.28 percent of the larvae present in the power plant source water.

The cooling water intake structure is part of the EPS existing operations and is presently regulated under Section 316(b). The desalination plant feedwater withdrawal does not include a cooling water intake structure. Therefore, it is not subject to intake regulation under the Federal Clean Water Act (CWA) Section 316(b). However, since the desalination plant will withdraw intake seawater from the EPS discharge flow, the study was conducted consistent with the intent of Section 316(b), which requires that baseline conditions be established. The desalination plant feedwater intake will not increase the volume, nor the velocity of the EPS cooling water intake nor will it increase the number of organisms entrained or impinged by the EPS cooling water intake structure. Therefore, the project would not result in any additional impingement effects of the EPS and therefore, impingement effects are not considered as significant impacts attributable to desalination plant operations.

Study Methodology: The study required an assessment of both the source water for the EPS (lagoon and ocean) and the discharge from the EPS (the desalination plant's feedwater supply). The source water was analyzed to establish population characteristics (relative abundance) for species potentially impacted by the desalination plant. The desalination plant feedwater was characterized to determine the baseline conditions for potential impacts associated with the desalination facility. Specifically, the feedwater characterization examined the type and quantity of organisms that survive entrainment through the EPS cooling water intake structure that could subsequently be impacted by the desalination plant operations.

The EPS source water was partitioned into lagoon and nearshore ocean areas for modeling purposes; ten sampling stations were chosen so that all source water community types would be represented, including five lagoon stations and five nearshore stations. Samples were also collected from EPS's discharge (desalination plant feedwater supply) just before the water flows into the power station's discharge pond.

Laboratory processing for both the feedwater and source water consisted of sorting (removing), identifying, and enumerating all larval fishes, pre-adult larval stages of *Cancer* spp. crabs, and California spiny lobster larvae from the samples. Identification of larval fishes was done to the lowest taxonomic level practicable.

Source Water Larval Abundance Estimates: Data collected from three source water surveys conducted on June 10, June 24, and July 6, 2004, included a total of 27,029 larval fishes, with 4,750 specimens collected from the five nearshore stations and the remaining 22,279 specimens from the lagoon stations. Two taxa comprised 84 percent of the total number of larval fishes collected from all surveys and source water stations combined: three species from the goby family (*Clevelandia ios, Ilypnus gilberti, Quietula y-cauda*) hereinafter referred to as CIQ gobies comprised 65 percent and combtooth blennies (*Hypsoblennius* spp.) comprised 19 percent. In addition, four species of target invertebrates were collected in the samples from both the lagoon and nearshore sampling stations: California spiny lobster (*Panulirus interruptus*, 93 specimens), yellow rock crab (*Cancer anthonyi*, 31 specimens), brown rock crab (*Cancer antennarius*, 4 specimens), and slender crab (*Cancer gracilis*, 2 specimens).

The mean concentration of CIQ goby larvae from all source water stations and surveys combined was approximately 4,900/1,000 m^3 and the mean concentration of combtooth blennies was approximately 1,200/1,000 m^3.

Feedwater (EPS Discharge) Larval Abundance Estimates: A total of 1,648 fish larvae was collected during two surveys of the EPS discharge water conducted on June 16 and July 6, 2004 (*Table 4.3-3*). Four taxa comprised 95 percent of all of fish larvae in the EPS discharge flows from which the proposed desalination plant would withdraw its feedwater supply. They were combtooth blennies, CIQ gobies, labrisomid kelpfishes (*Labrisomidae unid*.), and garibaldi (*Hypsypops rubicundus)*. Gobies and blennies combined accounted for nearly 72 percent of the larvae identified in the feedwater. No target invertebrate larvae were found in any of the samples from the EPS discharge.

TABLE 4.3-3
Total Counts and Mean Concentrations of Larval Fishes from EPS Discharge

Taxon	Common Name	Total Count	Percent	Cum. Percent	Mean Concentration (#/1,000 m^3)
Hypsoblennius spp.	combtooth blennies	766	46.48%	46.48%	1,119.89
CIQ gobies	CIQ goby complex	426	25.85%	72.33%	630.94
Labrisomidae unid.	labrisomid kelpfishes	205	12.44%	84.77%	291.66
Hypsypops rubicundus	garibaldi	174	10.56%	95.33%	230.14
Rimicola spp.	kelp clingfishes	13	0.79%	96.12%	17.54
Gibbonsia spp.	clinid kelpfishes	12	0.73%	96.84%	16.38
Engraulidae	anchovies	12	0.73%	97.57%	15.83
Gobiesocidae unid.	clingfishes	8	0.49%	98.06%	10.15
Sciaenidae	croakers	8	0.49%	98.54%	11.38
Blennioidei	Blennies	7	0.42%	98.97%	9.21
Atherinopsidae	Silversides	6	0.36%	99.33%	7.36
larval/post-larval fish unid.		3	0.18%	99.51%	3.50
Heterostichus rostratus	giant kelpfish	1	0.06%	99.58%	1.14

TABLE 4.3-3
Total Counts and Mean Concentrations of Larval Fishes from EPS Discharge

Taxon	Common Name	Total Count	Percent	Cum. Percent	Mean Concentration (#/1,000 m^3)
Syngnathus spp.	Pipefishes	1	0.06%	99.64%	0.92
Paralichthys californicus	California halibut	1	0.06%	99.70%	1.28
Chaenopsidae unid.	Clinids	1	0.06%	99.76%	0.92
Labridae	Wrasses	1	0.06%	99.82%	1.28
larvae, unidentified yolksac		1	0.06%	99.88%	2.45
Typhlogobius californiensis	blind goby	1	0.06%	99.94%	1.96
Agonidae unid.	Poachers	1	0.06%	100.00%	2.19
Total		1,648			

Feedwater Larval Survival Results: Eleven surveys to estimate the survival of larval fishes in the EPS discharge flow were conducted from June through November 2004. A total of 1,989 fishes was collected from the eleven surveys (*Table 4.3-4*). Larvae that were alive immediately after collection were placed in separate containers and observed for up to three hours after collection. Approximately half of the larvae continued swimming for up to two hours after collection while the others died between 0.5–1.5 hours after collection. The species of larvae that survived entrainment and sampling were CIQ gobies, combtooth blennies, and unidentified clingfishes. The highest concentration of larval fishes (2,444/1,000 m^3) was collected July 6, 2004, and the lowest concentration (93/1,000 m^3) was collected on October 21, 2004.

The average survey percent survival ranged from 0 percent (November 2 survey) to 9.2 percent (November 30 survey) (*Table 4.3-4*). The overall average percent survival based on an average of survival data from each sample containing fish (n=223 out of a 291 total surveys) is 2.40 percent with a standard deviation of 11.22. The average percent survival based on each survey's (n=11) average survival data is 2.71 with a standard deviation of 11.24 among survival averages for the 11 surveys. The surviving larvae that enter the desalination plant will be retained on the pretreatment filters, which could be either granular media facilities or membrane filters. The retained organisms will be removed from the pretreatment filters with the filter media backwash.

TABLE 4.3-4
Summary Of Larval Fish Data Collected During In-Plant Survival Studies From EPS Discharge Flows During June Through November 2004.

Date Collected	Number of Samples[1]	Total Volume Filtered (m^3)	Average Larval Fish Concentration (#/1,000 m^3) per Survey[2] (s.d. in parenthesis)	Total # Larvae Collected	Total # Alive upon Collection	Average % Survival per Survey[3] (s.d. in parenthesis)
6/16/2004	8	117	1,289.4 (754.2)	140	2	1.8 (4.7)
7/06/2004	9	112	2,443.8 (875.0)	276	13	4.3 (4.1)
7/20/2004	30	301	1,053.3 (674.6)	315	7	1.6 (4.0)
8/13/2004	30	339	564.4 (632.9)	192	2	0.005 (0.02)
8/26/2004	32	284	415.4 (350.9)	112	1	0.6 (3.2)
9/09/2004	31	342	2,027.5 (2,246.4)	590	4	0.5 (1.8)
9/23/2004	30	344	668.8 (1,134.6)	200	2	1.2 (5.5)
10/21/2004	31	347	93.0 (123.9)	31	1	5.9 (24.3)
11/02/2004	30	257	182.3 (161.9)	47	0	0
11/18/2004	30	271	132.9 (166.7)	34	2	4.6 (13.8)
11/30/2004	30	216	264.5 (291.6)	52	4	9.2 (24.2)

1. The number of samples per survey increased beginning July 20, 2004 when the duration of sampling increased to cover 24-hour periods.
2. The average larval fish concentration per survey was calculated by summing the individual sample concentrations and dividing by the number of samples in each survey.
3. The average percent survival per survey was calculated by summing the individual sample survival percentages and dividing by the number of samples containing fish larvae in each survey.

In order to assess any potential effects of the desalination facility feedwater withdrawal on local fishery resources, three taxa were selected: CIQ goby complex, combtooth blennies, and northern anchovy. These taxa were some of the most commonly entrained species in the EPS cooling water intake structure or were species (northern anchovy) that may be of interest to fishery managers. Larvae of species with high value to sport and commercial fisheries such as California halibut were entrained in such low numbers (approximately 0.06 percent of the total number of EPS-entrained larvae) that any effects on source water populations of these species could not be modeled.

Entrainment Effects Model: The Empirical Transport Model (*ETM*) used in the analysis is based on principles used in fishery management. To determine the effects of fishing on a population, a fishery manager needs an estimate of the number of fishes in the population and the number of fishes being *removed* by the fishery. ETM is recommended and approved by the California Energy Commission (CEC), California Coastal Commission (CCC), Regional Water Quality Control Boards and other regulatory and resources agencies for analyzing impacts to fisheries. This assessment assumes 100 percent mortality of all organisms surviving the EPS upon withdrawal into the desalination facility.

The *ETM* first takes the estimate of daily mortality (also known as Proportional Entrainment (*PE*)), and expands the estimate over the number of days the larvae from a single cohort, or batch of larvae, would be exposed to entrainment. The ETM thereby predicts regional effects on appropriate adult populations. Finally, the effects of entrainment are examined in the context of survival data collected from the EPS discharge.

The estimate of daily incremental mortality, or proportional entrainment (*PE*), was computed as the ratio of the number of larvae in the water withdrawn by the proposed facility to the number of larvae in the surrounding source water. The average concentration of larvae in the feedwater, as noted in Table 4.3-4, was multiplied by desalination facility's maximum feedwater withdrawal volume of 401,254 m^3/day (106 mgd). A total maximum withdrawal volume of 106 mgd (as compared to average withdrawal of 104 mgd) was used as a worst case volume, under a scenario where maximum backwash water volumes would be used during a period of maximum RO production.

Average concentrations of larval fishes from the source water survey data were multiplied by the volume estimates for each of the water body segments (total of three lagoon and nine nearshore areas) and then combined to estimate the average source water population.

The estimated effects of withdrawal for desalination operations on a single cohort of larvae were calculated using the *ETM* as: $P_M = 1 - (1 - PE)^{duration}$, where P_m is the proportional level of mortality resulting from the water withdrawals by the proposed desalination facility. A larval duration of 23 days from hatching to entrainment was calculated from growth rates using the length representing the upper 99th percentile of the length measurements from larval CIQ gobies collected from entrainment samples during 316(b) studies (Tenera 2004).

The results of the analysis are contained in *Table 4.3-5.* Estimates of *PE* ranged from 0.01 percent for northern anchovy to 0.55 percent for CIQ gobies.

TABLE 4.3-5
Estimates of Average Daily Mortality (*PE*)
(Standard Error in parentheses)

Fish Group	Feedwater Volume – Maximum Flow 401,254 m^3/day (106 MGD)
CIQ gobies	0.55% (2.08)
Combtooth blennies	0.36% (0.87)
Northern anchovy	0.01% (0.05)

Fish larvae entrained by desalination plant represent an incremental loss of the EPS source water supply of larvae. The average observed entrainment mortality of the EPS was 97.6 percent (2.4 percent survival). Since 97.6 percent of the larvae are dead at the point of the desalination plant intake, the incremental entrainment loss on source water populations is the 2.4 percent survival rate times the desalination plant proportional entrainment for each specific species in the EPS discharge. These incremental effects range from 0.01 percent for northern anchovy to 0.28 percent for CIQ gobies (*Table 4.3-6*). The incremental mortality assumes 100 percent mortality of all organisms surviving the EPS upon withdrawal into the desalination facility.

TABLE 4.3-6
Estimates of Proportional Mortality (P_m)

Fish Group	P_m based on Maximum Length at Entrainment	Estimate When Applying The Overall Average Survival Estimate Of 2.4 Percent[1]
	Desalination Plant Entrainment from EPS Discharge Flow Maximum flow - 106 MGD (401,254 m^3/day)	Incremental Entrainment Loss Due to Desalination Plant Operations Maximum flow - 106 MGD (401,254 m^3/day)
CIQ gobies	11.8%	0.28%
Combtooth blennies	5.7%	0.14%
Northern anchovy	0.6%	0.01%

1. The overall average percent survival (2.4 percent with a standard deviation of 11.22) was based on an average of each sample that contained fish (n=223).

The role of turbulence and temperature and how larvae are affected were not evaluated at the EPS. It is noted that mortality from entrainment through the cooling water intake structure may be primarily due to pressure and turbulence in the water flow, rather than temperature increases resulting from the cooling operation. Since the desalination plant feedwater will be subject to the same turbulence whether or not the EPS is operating, it is reasonable to estimate incremental mortality for the heated and unheated desalination scenarios using the survival data presented in Table 4.3-4 Using those data, and based on typical operation of the EPS, the entrainment loss rate ranges from 0.01 percent to 0.28 percent.

Although combtooth blennies had higher *PE* estimates, CIQ gobies had higher estimates of P_m because their larvae were exposed to entrainment for a longer period of time (either from multiple spawnings of one species or from different species spawning at different times). Adult CIQ gobies and combtooth blennies are very common in Agua Hedionda Lagoon habitats and these levels of mortality would not be expected to result in any population-level effects because these fishes are adapted to estuarine environments where large percentages of their larvae are exported into nearshore areas during tidal flushing. Gobies are abundant in the shallow mudflat and eelgrass habitats that are common in Agua Hedionda middle and inner lagoons. A significant proportion of the CIQ goby larvae in the outer lagoon at the point of entrainment likely originated in the inner and middle lagoon segments and would be exported from the lagoon system on the following tidal cycle. Adult combtooth blennies are common in outer lagoon habitats including rock jetties, docks, pilings, and aquaculture floats, as well as some sandy areas in the lagoon, which explains the large numbers of the larvae found in the EPS discharge flows. The estimates for northern anchovy are much lower than the other two taxa because they are more common in the nearshore areas than the lagoon. In fact, the estimates for northern anchovy are very conservative because these fish are distributed over a large area and therefore the estimate of their source water population would be much larger than the estimate used in the calculation of *PE*.

Significance of Entrainment Losses: The small proportion of marine organisms lost to entrainment as a result of the desalination plant would not have a substantial effect on the species' ability to sustain their populations because of their widespread distribution and high reproductive potential. The most frequently entrained species are very abundant in the area of EPS intake, Agua Hedionda Lagoon, and the Southern California Bight, and therefore, the actual ecological effects due to any additional entrainment from the desalination plant are less than significant. California Department of Fish and Game (2002) in their Nearshore Fishery Management Plan provides for sustainable populations with harvests of up to 60 percent of unfished adult stocks. The incremental entrainment (or "harvest") effect of larval fishes from the desalination plant operations between 0.01 and 0.28 percent. Species of direct recreational and commercial value constitute less than 1 percent of the entrained organisms, and considering the fact that in general, less than one percent of all fish larvae become reproductive adults, the operation of the desalination plant would not result in significant impacts on those species.

Potential Effects from Elevated Salinity

Dispersion and Dilution Modeling of Discharge

Jenkins and Wasyl (2001, 2005) applied the U.S. Navy Coastal Water Clarity Model to analyze the dispersal and dilution of the combined Power Plant and RO discharge for the project (APPENDIX E). The objective was to predict how differences in discharge characteristics (salinity-density, temperature, and volume) interact with variations in ocean mixing processes. Maps showing these effects on the discharge plume's salinity and temperature profiles in the nearshore environment enable estimates of the magnitude of the changes and duration of the exposure periods that the organisms might experience. The accuracy of these models has been verified by independent analysis (Grant, 2003) and by findings in agreement with previous works: 1) indicating a less than 1% probability that any of the EPS discharge would drift north and enter the Aqua Hedionda lagoon (EA Engineering, Science, and Technology, 1997) and, 2) suggesting that, because of a greater density, the saltier combined RO and seawater discharge would sink (CA Coastal Commission, 1993). Additional detail regarding the methodology and results of the study is provided in *Section 4.7, Hydrology and Water Quality*.

Jenkins and Wasyl (2001) used time-series data for five coastal oceanographic conditions [most from a continuous 20.5 year (1980-2000) record] to estimate "historical average day" and "month" coastal oceanographic conditions affecting discharge seawater dispersal. The five conditions are, average ocean mixed layer temperature (˚C) and salinity (parts per thousand - “ppt”), average wave height (meters), average wind speed (knots) and maximum tidal current velocity (cm/second). These factors influence discharge dispersal by affecting vertical mixing and longshore flow. Not only do the factors interact with one another, they are further affected by wind and by ocean temperature and salinity (Jenkins and Wasyl, 2001). The combined data were also used to designate periods when the ocean's dispersal capacity would be low: both an actual "historical extreme day" and "month" were identified in the time series and modeled together with the corresponding EPS flow rate for that time.

As detailed in Jenkins and Wasyl (2001, 2005) these oceanographic and weather-related controlling factors were combined using a joint probability analysis based on their separate occurrence frequencies over the 20.5-year period. The corresponding values for flow and for the temperature difference between the discharge and the ocean (the delta T value = 5.5˚C and the delta T value = 0˚C) were also factored in, as was the assumption of a Reverse Osmosis (RO) discharge of 50 mgd with a total dissolved solids (TDS) concentration (salt) that is twice that of ambient seawater for the entire period.

Jenkins and Wasyl (2001, 2005) modeled a diversity of power plant operations and coastal oceanographic variables in order to encompass the range of potential discharge scenarios for the combined RO and heated EPS discharge. This ranges from "historical average day" and "month" conditions to the relatively rare "historical extreme day" and "month," conditions resulting from either or both low flow rates and no increase in temperature.

The models display the thermal and salinity contours that will develop by adding the 50 mgd RO concentrate to the EPS discharge under different EPS flow and receiving-water conditions. They also reveal the central importance of total EPS discharge flow on the discharge dispersal and assimilation; primarily through its effect on the "in-pipe-dilution" of the RO concentrate, but also through its effect on delta T. The model analyses also permit comparisons of the discharge at different points along its route, from "end-of-pipe" to 1,000 feet offshore of the discharge channel, an area identified as the "Zone of Initial Dilution" (ZID).

As noted, modeling examined a range of historical conditions (Jenkins and Wasyl, 2004). Historical scenarios included: 1) worst-case day; 2) average day; 3) worst-case month; and 4) average month. The EPS can run with an "unheated" discharge (i.e., no power plant operation). To account for these variables, two "historical extreme" conditions were modeled, each reflective of a pump configuration that could be used during low-flow operations. Also, to examine the potentially severest case, unheated and heated discharges were assumed along with "historical extreme" receiving water conditions in all flow scenarios. The following summarizes the extreme cases:

PLANT FLOW (mgd)		DELTA T	COOLING: RO OUTFLOW "IN PIPE DILUTION RATIO"	RECEIVING WATER CONDITIONS
Total	Net (-50 mgd)			
304	254	unheated	5.08	"historical extreme"
304	254	heated	5.08	"historical extreme"

Note: Net flow reflects the removal of 50 mgd freshwater.

In addition to matching the "historical extreme" operating conditions and "historical extreme" receiving water conditions to define the potentially most extreme scenario, the analyses focused on defining conditions from the discharge channel out to the edge of the ZID.

Historical Average Scenarios: The highest salinities under the average day and month scenarios occurred in the average day conditions. Therefore, for purposes of evaluating the effects of permanent increases in salinity that would represent typical operating conditions, the average day scenario is used. This scenario provides a reasonable representation of the typical operating conditions for the proposed project from which elevated salinity effects are measured. Salinity levels under the average day scenario are identified in *Table 4.3-7*.

TABLE 4.3-7
Salinities for Average Day Operating Scenario

Scenario: 50 MGD/RO Process	Average Day
Net EPS Discharge Rate (MGD)	526
Bottom Salinity (end of pipe)	36.2 ppt
Bottom Salinity (1,000 ft from discharge jetties)	34.4 ppt
Bottom Salinity Hard Bottom Habitat	<34.6 ppt
Salinity at the Inlet to Agua Hedionda Lagoon	33.5 ppt
Mid-Water Column Salinity (end of pipe)	34.4 ppt
Mid-Water Column Salinity (1,000 ft from discharge jetties)	34.0 ppt

Historical Extreme Scenarios: The "historical extreme" cases evolve from lower power plant flow rates and have a lower "in-pipe dilution ratio" than the "historical average" scenarios described above. The outflow water can also be either "heated" or "unheated," which differentially affects density and sinking rate and thus ocean mixing. Highest bottom salinities were noted with the "unheated" condition due to its reduced buoyancy. Therefore, to determine worst-case conditions, the unheated conditions are examined. Relative to "historical average" conditions, the bottom salinity contours resulting from the 254 mgd net flow, "unheated" discharge will have a higher bottom salinity and establish larger salinity contours than the "heated" discharge. By slightly lessening the density difference with ambient water, the "heated" discharge mixes better with the receiving water, resulting in a smaller bottom area that is contacted by the elevated salinity.

A summary of the salinity calculations for the unheated historical extreme operating scenario is provided in *Table 4.3-8.* As shown in Table 4.3-8, the salinity levels for the hard bottom habitat are below the significance criteria established for this habitat (EPA Guidelines indicating 38.4 ppt), and extended exposure to salinity levels above 40 ppt would be avoided.

TABLE 4.3-8
Historical Extreme (2 pumps, unheated) Operating Scenario

Scenario: 50 MGD/RO Process	Unit 4 historical extreme (2 pumps, unheated)
Net EPS Discharge Rate (MGD)	254
Bottom Maximum Salinity (end of pipe)	40.1 ppt
Bottom Maximum Salinity (1,000 ft from discharge jetties)	38.2 ppt
Bottom Maximum Salinity Hard Bottom Habitat	<38.4 ppt
Maximum Salinity at the Inlet to Agua Hedionda Lagoon	33.7
Mid-Water Column Maximum Salinity (end of pipe)	36.0 ppt
Mid-Water Column Maximum Salinity (1,000 ft from discharge jetties)	35.2 ppt
Modeled Probability of Occurrence	Less than 1%

The "historical extreme day" condition (i.e., the simultaneous occurrence of low power plant flow and minimal natural mixing conditions in the vicinity of the discharge channel) has less than a 1% probability of occurrence (i.e., less than 1 day in 20 years; Jenkins and Wasyl, 2001). In addition to being unlikely, these extremes, if they occurred, would be unlikely to persist for the time (about 24 hours) required for them to markedly affect the salinity and temperature contours established under the more prevalent "historical average" conditions. Moreover, the "historical extreme" scenario would be associated with periods of low rates of power generation or times when the water pumps are undergoing maintenance. These conditions are less likely to occur during summer months (when power demand is high) and are thus unlikely to co-occur with ocean conditions that are less favorable for vertical mixing (also more common in summer).

Typical Operating Conditions: When the historical flow rate and the historical ocean mixing conditions are combined over the entire 20.5 year historical record, the modeling results shows that 95% of the time the salinity level at the ZID will be at or below 36.2.

Salinity Tolerance Investigations

Based on the results of the Hydrodynamic Modeling Study, studies were conducted to determine salinity tolerance for species that are found within the area that would be affected by the elevated salinity levels. The purpose of the Salinity Tolerance Investigations (Le Page, 2005 – APPENDIX E) was to examine the effects of the predicted salinity levels from the Hydrodynamic Modeling Study under historic operating conditions ranging from 36 ppt to 40 ppt.

The salinity tolerance investigations (Le Page 2005) consisted of examining the effects of exposure to elevated salinity produced by the historical average model (36 ppt at end-of-pipe)salinity levels on organism behavior and vitality. The salinity toxicity study (Le Page 2005) consisted of exposing salinity sensitive species to a range of salinities from 37-40 ppt).

Comparative Salinity Study: A collection of 18 marine species was held in an aquarium that contained a blend of desalination plant concentrate and power plant effluent to obtain salinity equal to the typical salinity that would occur within the ZID. The marine aquarium contained several local fishes and invertebrates that are known to exist within the ZID, including the following: California halibut (*Paralichthys californicus);* Kelp bass *(Paralabrax clathratus);* Barred sand bass *(Paralabrax nebulifer);* Bay blenny *(Hypsoblennius gentilis);* Red sea urchin *(Strongylocentrotus franciscanus);* Purple sea urchin *(Strongylocentrotus purpuratus);* Ochre sea star *(Pisaster ochraceus);* Bat star *(Asterina miniata);* Sea cucumber *(Parastichopus californicus);* Red rock crab *(Cancer productus);* Giant rock scallop *(Crassadoma gigantea);* Green abalone *(Haliotis fulgens);* Giant keyhole limpet *(Megathura crenulata);* Wavy turban snail *(Lithopoma undosum);* Chestnut cowrie *(Cypraea spadicea);* Sand castle worm *(Phragmatopoma californica);* Aggregating anemone *(Anthropleura elegantissima);* and Brown gorgonian *(Muricea fruticosa).*

These organisms were monitored and compared to a second set of organisms held in a control tank at ambient conditions (salinity of 33.5 ppt) to evaluate overall health based on the following qualitative parameters: 1) appearance (coloration, tissue marks or legions); 2) willingness to feed; 3) activity, and 4) gonad production in the urchins. The quantitative parameters measured were percent weight gain/loss and fertilization success of the Purple sea urchin (*Strongylocentrotus purpuratus*). This species was chosen for the fertilization test, since it is the only species contained in the test tank that has an approved protocol as a bioassay species.

Data were collected over a 5-½ month period. No mortality was encountered and all species showed normal activity and feeding behavior. The appearance of the individuals remained good with no changes in coloration or development of marks or lesions. Gonad production in the Purple sea urchin and the Red sea urchin was evident in both the test tank and the control tank by the observation of successful induced spawning. Fertilization of the Purple sea urchin was also successful. During the test period, there was no significant difference in the weight gain of the individuals of all species compared to the individuals in the control tank.

Salinity Toxicity Study: For this study, the following species were evaluated and checked for survivability: Purple sea urchin (*Stronglyocentrotus purpuratus*); Sand dollar (*Dendraster excentricus*), and Red Abalone (*Haliotis rufescens*). These species were chosen due to their known susceptibility to environmental stress. Four separate re-circulating saltwater tanks with salinity levels of 37, 38, 39 and 40 ppt were assembled in the laboratory. After 19 days, there were no adverse effects to the Purple sea urchins (*Stronglyocentrotus purpuratus*), Sand dollars (*Dendraster excentricus*) or the Red abalones (*Haliotis rufescens*) at any of the salinities levels tested (37-40 ppt). Both Sand dollars and Red abalones had 100% survival at all salinity ranges and 100% survival in the control tank. One individual in the Purple sea urchin group died in each of the tested levels including one mortality in the control group. Therefore, the adjusted survival rate was also 100% for this species.

General observations during the test run showed that all individuals of the species tested were behaving normally. Feeding was active in the Purple sea urchin and Red abalone groups. Dissection of the gut at the end of the test run for the Sand dollars indicated that feeding was also occurring. Although these species are not known to move actively, movement was noted and compared well with that of the control group.

The experiments provided in the salinity tolerance investigations (Le Page 2005) indicate that species exposed to the predicted salinity levels will not be substantially affected by the typical range of proposed operating conditions (salinity levels of 36 ppt in the ZID). Similarly, the experiments provided in the salinity toxicity study (Le Page 2005) indicate that species exposed to historical extreme conditions (40 ppt) would not be substantially affected. Collectively, these studies demonstrate that the test species would not experience substantial adverse effects in terms of overall health and vitality when exposed to the full range of proposed operating conditions (salinity levels of 36 ppt to 40 ppt).

Toxicity Testing of Reverse Osmosis Concentrate

In addition to the salinity tolerance investigations described above, a toxicity testing study was performed pursuant to the requirements of the California Ocean Plan. Tests were performed by MEC Analytical Systems using RO concentrate diluted with seawater to a salinity of 36 ppt in standard bioassays on the following three species:

1) *Macrocystis pyrifera*, giant kelp, germination and growth (48 hours).
2) *Atherinops affinis*, topsmelt, 7 day survival using 10-day old larva.
3) *Haliotis rufescens*, red abalone, embryonic development over 48 hours post fertilization.

The bioassay results indicate no effect of RO concentrated seawater in cases where it had been diluted to 36 ppt using local seawater.

These findings largely agree with earlier bioassays done by Bay and Greenstein (1992/1993) who studied the toxicity of mixes of concentrate (obtained from a variety of sources) and seawater and other waters including secondary effluent wastewater. These studies included standard bioassays using giant kelp, amphipods, and fertilized sea urchin eggs. These bioassays revealed:

- Their 48 hour test of spore germination and germ tube length using *Macrocystis pyrifera* indicated no effect of salinities ranging from 34.5 to 43 ppt.
- Hypersalinity tests with the amphipod *Rhepoxynius abronius* showed no effect on survival of 10 day exposure to salinities ranging from 34.5 to 38.5 ppt.
- Tests of sea urchin (*Strongylocentrotus purpuratus*) fertilization also showed no effect over 48 hours exposure to various levels of concentrate (from the RO facility at Diablo Canyon) and diluted with seawater.

It is important to emphasize the latter finding on sea urchins and contrast it with other data presented in the same report. While Bay and Greenstein did not find an elevated salinity effect on sea urchin development when they used concentrate that had been diluted with seawater, they did find that concentrate diluted with treated secondary municipal wastewater (El Estero treatment plant, Santa Barbara, CA) negatively affected fertilized sea urchin egg development. This concentrate plus treated municipal wastewater result has received considerable notoriety. It is cited with an expression of concern in California Coastal Commission (1993) report on desalination. The results of the concentrate plus treated wastewater are not applicable to the proposed project because the discharge from the proposed project would be mixed with the seawater leaving the EPS, not treated municipal wastewater.

Additional Considerations Related to Analysis of Elevated Salinity Effects on Marine Organisms

Relative Sensitivity of Habitats and Species Affected

The area that would experience elevated salinity levels consists mainly of the sandy bottom habitat beyond the surf zone, just offshore from the jetties. This area has a uniform, sandy bottom and lacks the habitat complexity and biodiversity of the nearby kelp beds. The Southern Kelp Stand (SKS) is the closest subtidal hard bottom habitat to the discharge channel. The SKS is located approximately 2000 feet southwest of the discharge channel and1000 ft beyond the ZID. The SKS will be exposed to a modest increase in salinity on the order of 1.1 ppt under average conditions and less than 4 ppt under historical extreme conditions.

No endangered or at risk species occur in the waters around the project site and none of the coastline has been designated as an area of Special Biological Significance. Surveys have been made of the diverse habitats near the EPS (kelp beds, the intertidal area, sandy beaches in and deeper than the surf zone). The organisms surveyed over the years include macroinvertebrates, the benthic interstitial fauna, and fishes.

Salinity Tolerance

Most of the organisms living near the EPS also occur in areas of the SCB where salinity can be greater than will occur in the combined discharge receiving water (e.g., in San Pedro Bay). Also, the natural geographic distributions of most of the species within the project area, including the Representative Important Species, extend south to near the tip of Baja California where both coastal temperatures and salinities are as high or higher than those for the combined discharge. In addition, some of these species, or ones very closely related to them, live in the upper part of the Gulf of California where salinities are 36-38 ppt and can be as high as 40 ppt. Thus, many of the species living within the project vicinity naturally experience a salinity range comparable to or greater than what is predicted for the combined discharge. Fishes, plankton, and other pelagic animals that encounter elevated salinity in the discharge region will have very low exposure times (on the order of several hours).

Analysis of Significance –Elevated Salinity Exposure Effects

The "historical extreme" cases that have been modeled all involve combinations of relatively low flow with either a heated or unheated discharge and further assume "historical extreme" conditions for the receiving water. The models demonstrate the prominent effect that the Plant cooling-seawater flow will have on discharge salinity (i.e., the "in-pipe-dilution ratio" affects the salinity and temperature of the discharge and thus its behavior in the receiving water). While the "historical extreme" cases also have a very low probability of occurrence and a relatively short persistence, the model results show the importance of "in-the-pipe" dilution and natural mixing conditions as a means of diluting and dispersing the RO plant discharge. The models suggest that a combined unheated EPS and RO discharge at of about 254 mgd results in an end-of-pipe salinity of about 40.1 ppt under historical extreme natural mixing conditions, which is diluted across the ZID to about 38.2 ppt on the bottom and 35.2 ppt in the water column. The salinity levels for the subtidal hard bottom habitat, which is outside of the ZID, will always be below the significance criteria of 38.4 established for this habitat. Extended exposure to salinity levels above 40 ppt would be avoided under all proposed operating conditions.

The “historical extreme” scenarios are considered to be short-term and episodic. As previously described, plant-specific tests, as well as relevant literature suggest that salinity levels at or below 40 ppt would not have substantial effects on species within the study area. Since the “historical extreme” scenarios under all operating conditions would not result in salinity levels exceeding this threshold for an extended period of time, impacts related to elevated salinities would not be significant.

In addition, the experiments provided in the Salinity Tolerance Investigations indicate that species exposed to the predicted salinity levels (salinity levels of 36 ppt to 40 ppt) will not be substantially affected by the project's operating conditions. Operation of the desalination plant under "typical" conditions (modeled as the "average day" scenario) would not result in salinity levels in excess of 36.2 ppt within the ZID. Therefore, operation of the desalination plant would not result in significant impacts related to elevated salinity levels. However, a mitigation measure has been included for purposes of requiring monitoring of the combined operations of the desalination plant and the EPS to ensure that salinity levels remain within the parameters that have been analyzed.

Combined Effect of Elevated Salinities and Temperatures

The temperature increases modeled for the combined discharge flow field are in the range of those that occur presently in the heated-only EPS discharge. Presently the EPS only discharges warm water and this forms a lens along the ocean surface that drifts down the coast with the prevailing coastal flow (Jenkins and Wasyl, 2001, figure 3.23, MEC, 2004, figures 4-6). The 30-year monitoring history at EPS (SDGE, 1972; EA Engineering, Science, and Technology. 1997; MEC, 2004) documents the absence of a significant biological effect of this magnitude of a thermal increase on local organisms. When the RO concentrate is added, the discharge will submerge. Under "historical average day" conditions the plume will drift down coast as it sinks. This will cause a greater extent of bottom warming than occurs within the water column and expand the thermal contours along the bottom. The warmest temperatures will occur in waters near the discharge channel. However, whether along the bottom or in the water column, the "historical average day" temperature increase would only be about 1.1˚ C above ambient temperature. No significant effects associated with combining concentrate discharge with the existing thermal discharge are anticipated.

4.3.5 MITIGATION MEASURES

Terrestrial Environment

4.3-1 Proposed mitigation for temporary impacts to sensitive habitats shall be based on the ratios listed below in *Table 4.3-9*. With the exception of temporary impacts on habitats designated as Groups E and F by the HMP (*i.e.*, disturbed lands, eucalyptus and agricultural lands) mitigation shall consist of, at a minimum, 1:1 revegetation of in-kind habitats at the location of impact, and, for the portion of ratios greater than 1:1, off-site purchase or acquisition as described in mitigation measure 4.3-2. Temporary impacts on non-native habitats designated as Groups E and F by the HMP are expected to recover on their own and therefore are not included in revegetation efforts; however, impacts to these habitat groups are subject to payment of a fee pursuant to the Habitat Management Plan Mitigation Fee Program. Mitigation acreages for disturbed and undisturbed habitats have been added together. It should be noted that acreage figures are based on estimated "worst case" impacts. Actual impacts may be less and would be subject to the same mitigation ratios, but the mitigation acreages could change as a result.

TABLE 4.3-9
Mitigation Ratios

Habitat Type	Impacts (acres)			Mitigation Ratio	Mitigation (acres) @ ratio		
	In Coastal Zone	Outside Coastal Zone	Total		In Coastal Zone	Outside Coastal Zone	Total
Coastal Sage Scrub	0.90	3.6	4.5	2:1	1.80	7.20	9.00
Coyote Bush Scrub	0.00	0.03	0.03	2:1	0.00	0.06	0.06
Herbaceous Wetland	0.00	0.06	0.06	3:1	0.00	0.18	0.18
Open Channel	0.00	0.07	0.07	1:1	0.00	0.07	0.07
Southern Willow Scrub	0.00	0.44	0.44	3:1	0.00	1.32	1.32
Annual (non-native) grassland	0.68	3.71	4.39	Fee	0.00	0.00	0.00
Agriculture/ disturbed/ ruderal	3.12	4.53	7.65	Fee	0.00	0.00	0.00

Sensitive vegetation communities shall be restored to the pre-existing vegetation type. Restoration of wetlands shall be discussed in a Conceptual Wetlands Mitigation and Monitoring Plan which shall, at a minimum, include discussion of impact assessment, recording of pre-construction site conditions, post-construction site preparation, planting, irrigation, five-year maintenance and monitoring, and long-term preservation. Restoration of uplands shall be discussed in an Uplands Mitigation and Monitoring Plan which shall, at a minimum, include discussion of impact assessment, recording of pre-construction site conditions, post-construction site preparation, planting, irrigation, five-year maintenance and monitoring, and long-term preservation. These measures will reduce significant direct effects identified in *Section 4.3-4* to a level less than significant.

4.3-2 Mitigation ratios identified in *Table 4.3-9* that require more than 1:1 mitigation (e.g., 2:1) shall satisfy the mitigation that is in addition to the 1:1 in one or both of the following ways and in a manner acceptable to local, state, and federal agencies:

- Through purchase of mitigation bank credits.
- Through acquisition and preservation of suitable habitat in the vicinity of the project.

4.3-3 Indirect impacts including dust, soil erosion, pollution, siltation, and runoff shall be reduced through implementation of construction best management practices (BMPs) and implementation of an approved SWPPP. At a minimum, implementation of these practices shall include the following.

- Placement of stockpiles of soils and materials such that they cause minimal interference with onsite drainage patterns.
- Hay bale barriers or gravel bags shall be placed along areas of exposed soil to help reduce sedimentation during grading operations.
- Placement of a silt curtain or other drainage control device around construction areas shall be required to protect natural drainage channels from sedimentation.
- Any dewatering that is needed shall be conducted in accordance with the standard regulations of the RWQCB. A permit to discharge water from dewatering activities will be required.
- Use of paved roadways or designated staging areas (existing developed areas) for all equipment and vehicle refueling and maintenance.
- Implementation of dust control measures such as watering.
- Temporary fencing of the limits of the construction area with clearly visible orange construction fencing.
- Temporary fencing of the Nuttall's scrub oak population located adjacent to the work area and northeast of the intersection of El Camino Real and Palomar Airport Road to avoid impacts.

In order to assure that these measures are adequately protecting adjacent biological resources, construction activity shall be monitored by a qualified biologist familiar with the sensitive flora and fauna of the area. Biological monitoring shall be of a frequency and duration necessary to reasonably assure that indirect impacts are minimized. This shall include implementation of a contractor education program, verification of proper construction and maintenance of staking/fencing, full-time monitoring of vegetation removal, periodic monitoring of construction activity adjacent to sensitive resource areas, and reporting of contractor compliance and impact minimization measures on a monthly basis. These measures shall ensure that indirect impacts on vegetation communities, including dust, erosion, sedimentation, pollution, siltation, and runoff are reduced to level below significant.

4.3-3 The potential for direct impacts on coastal California gnatcatcher individuals shall be mitigated by restricting the clearing of coastal sage scrub within the project alignment to outside of the gnatcatcher breeding season (August 16 through February 14).

4.3-4 The potential short-term increase in noise related to construction shall be mitigated through avoidance of construction during the gnatcatcher breeding season or maintenance of noise levels below 60 dBA Leq at occupied nest locations if construction takes place during the breeding season (*i.e.*, February 15 through August 15). The maintenance of appropriate noise levels shall be confirmed through protocol gnatcatcher surveys to determine presence of all gnatcatcher within 500 feet of project construction and noise measurements at nest locations during peak construction activity by a qualified acoustician.

4.3-5 To avoid potential adverse effects from hydro-fracturing that could occur as a result of horizontal directional drilling or micro-tunneling, the applicant shall provide evidence to the local jurisdiction that demonstrates that the design of the drilling operation provides sufficient horizontal distance and depth from sensitive habitat areas. Information provided shall provide appropriate engineering calculations to demonstrate to the local jurisdiction's satisfaction that surface rupture will not occur within sensitive habitat areas.

Marine Environment

4.3-6 The operator of the desalination plant shall continuously monitor the desalination plant and EPS discharge flow rates and salinity levels~~.~~. The operator of the desalination plant shall on at least a semi-annual frequency monitor and conduct testing to measure and evaluate the combined EPS/desalination plant discharge for compliance with Ocean Plan acute and chronic toxicity requirements. The operator of the desalination plant shall ~~and~~ maintain records of the monitoring results to ensure compliance with Ocean Plan criteria and EPA guidelines. All semi-annual monitoring and testing required by this mitigation measure shall be summarized in a report and submitted to the RWQCB within 45 days of completion, and any noncompliance with Ocean Plan acute and chronic toxicity requirements shall be reported to the RWQCB. Such monitoring results shall be available for inspection by the City of Carlsbad and the RWQCB. Should the RWQCB adopt a permit requirement that is intended to provide equal or greater protection to the marine environment, the Planning Director is authorized to amend this mitigation measure to conform to the RWQCB order.

4.3.6 Unavoidable Significant Impacts

No unavoidable significant impacts would result with implementation of the mitigation measures provided above.